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As of November 2021

APPLE

Algul, B., Shoffe, Y., Park, D., Miller, W., & Watkins, C. (2021). Preharvest 1-methylcyclopropene treatment enhances 'stress-associated watercore' dissipation in 'Jonagold' apples, *Postharvest Biology and Technology, 181*, 111689. https://doi.org/10.1016/j.postharvbio.2021.111689

Abstract

The objective of this study was to evaluate the effect of the preharvest application of 1-methylcyclopropene (1-MCP) on postharvest dissipation of stress watercore incidence and severity rating over 30 d at 20 °C. 'Jonagold' trees were untreated or sprayed with 1-MCP one week before harvest. Harvest indices and quality factors at 20 °C, were assessed on days 2, 5, 9,15, 20, and 30. Fruit treated with preharvest 1-MCP treatment had lower internal ethylene concentrations and lower starch pattern indices (higher starch concentration) at harvest compared with untreated fruit, but no effects on flesh firmness, soluble solids concentration, titratable acidity, watercore incidence and severity rating, and soluble sugars were detected. At 20 °C, however, preharvest 1-MCP treated fruit had a faster decrease of stress water core incidence and severity than untreated fruit, and delayed development of senescent breakdown and skin shriveling. Sorbitol concentrations were lower in preharvest 1-MCP treated fruit than untreated fruit, but effects on glucose, fructose, sucrose, and starch concentrations were not consistent. More rapid loss of stress-associated water core in preharvest 1-MCP treated fruit was consistent with lower sorbitol concentrations in the cortical tissues.

Keywords: /*Malus domestica* Borkh./ /Harvista/ /Fruit quality/ /Storage/ /Physiological disorder/

Ekramirad, N., Khaled, A., Parrish, C., Donohue, K., Villanueva, R., & Adedeji, A. (2021). Development of pattern recognition and classification models for the detection of vibro-acoustic emissions from codling moth infested apples. *Postharvest Biology and Technology*,*181*, 111633. https://doi.org/10.1016/j.postharvbio.2021.111633

Abstract

Codling moth (CM) is the most devastating global pest of apples with a huge potential impact on the post-harvest quality and yield of the product. Due to the small size of its larvae and potentially hidden behavior, simple visual inspection is ill-suited for accurate infestation detection. The characteristic vibro-acoustic signals of multiple behaviors of CM larvae such as chewing and boring were identified in a previous study. In this study, two different approaches were proposed to build on this previous work: multi-domain feature extraction with machine learning to show basic classification potential, and matched filter-aided classification to show the effects of preprocessing using the larval behavior templates. Additionally, low-intensity heat stimulation was applied to improve classification results by increasing the larvae's hidden activity rate. The results indicated that the first approach led to accuracies as high as 97.47 % for an acoustic signal duration of 10 s, with heat stimulation improving classification rates to 98.96 % for the same interval. Finally, the matched filter-aided classification approach improved upon the heat stimulated results even further to obtain a 100 % accuracy on classifying the test set for a signal duration of 5 s. These findings suggest that the vibro-acoustic technique can be an adaptable tool for detecting CM infestation in apples and improve post-harvest classification quality in fruit.

Keywords: /Apples/ /Codling moth/ /Vibro-acoustic/ /Matched filter/ /Machine learning/

Rees, D., Bishop, D., Schaefer, J., Colgan, R., Thurston, K., Fisher, R. & Duff, A. (2021). SafePod: A respiration chamber to characterise apple fruit response to storage atmospheres, *Postharvest Biology and Technology, 181*, 111674. https://doi.org/10.1016/j.postharvbio.2021.111674

Abstract

During long-term storage of apples, detection of low O2 stress is used to optimise low O2 storage regimes for dynamic controlled atmosphere (DCA) storage. Monitoring respiratory characteristics, specifically the respiratory quotient (RQ), provides a tool to achieve this. The objectives of this study were to evaluate protocols to monitor response of apple consignments to low O2 using a respiration chamber, the SafePod, designed for use in commercial stores and research laboratories, and to compare the RQ response to changes in chlorophyll fluorescence (CF) yield from the fruit skin as used in DCA-CF. Protocols to identify the lowest oxygen limit (LOL), the O2 concentration below which RQ rises, were tested using 'Braeburn' (sensitive to low O2) and 'Gala' (less sensitive to low O2). A protocol that allows fruit to acclimatise at each O2 concentration takes several weeks and is therefore not practical for commercial use. A rapid profile without fruit acclimatisation can be completed in 2–3 days. Although this underestimates RQ values, and results in an increase in RQ at a higher O2 concentration than observed for acclimatised fruit, the rapid RQ protocol provides a practical method to compare response of apple consignments between cultivars, orchards and seasons. By the rapid protocol, the LOL of 'Braeburn' consignments was near 0.6 kPa and of 'Gala' consignments was near 0.2 kPa, consistent with detection of alcoholic taints below the LOL in each case. The RQ response using the SafePod was consistent with increase in CF yield using HarvestWatch™. Fruit respiration rates change through the storage season, including a substantial decrease over the first 2 months after harvest. As RQ response is affected by respiration rate, accurate comparison of consignments depends on profiles being measured at the same stage in the storage season. It is more difficult to determine the LOL by RQ profiling later in the season when respiration rates are lower.

Keywords: /Dynamic controlled atmosphere/ /Apple (*Malus domestica*)Respiratory quotient/ /Respiration rate/ /SafePod/

AVOCADO

Melado-Herreros, A., Nieto-Ortega, S., Olabarrieta, I., Gutierrez, M., Villar, A., Zuffia, J., Gorretta, N. & Roger, J. (2021). Postharvest ripeness assessment of 'Hass' avocado based on development of a new ripening index and Vis-NIR spectroscopy. *Postharvest Biology and Technology, 181*, 111683. https://doi.org/10.1016/j.postharvbio.2021.111683

Abstract

A classification model using Vis-NIR spectroscopy (380–2000 nm) coupled with partial least square discriminant analysis (PLS-DA) was developed to segregate avocados in three classes, predefined by a warehouse using destructive FF tests performed on a small number of samples. This classification showed a satisfactory general accuracy of 62 %, with 100 % well-classified samples in Class 1, 20 % in Class 2 and 65 % in Class 3. To improve classification, a ripening index (RI) was developed, which combines FF and DMC. The discrimination ability in the three classes was tested using Wilk's lambda, calculated as between-class variance to the total variance ratio. Results showed values of 0.648 for RI, 0.516 for FF and 0.038 for DMC. A regression model was subsequently developed using Partial Least Squares (PLS) regression to predict RI using Vis-NIR spectroscopy in an independent dataset. The PLS results were satisfactory with the whole spectrum wavelength range (380–2000 nm), with R2 of 0.62, SEP of 0.69 (), but presented a large bias value of 1.22 (). The same occurs in models developed in the wavelength range from 400 to 1100 nm, with R2 of 0.63, SEP of 0.68 () and bias of 1.03 (). This could be corrected using a bias and slope correction algorithm. Study of the correlation coefficients of the PLS regression models showed that the region 400–1100 nm has a huge influence in the model, which indicates the potential of using cost-effective short Vis-NIR spectrophotometers for RI prediction.

Keywords: /Dry matter content/ /Flesh firmness/ /Classification/ /Chemometrics/ /PLS regression/ /Non-destructive/

BANANA

Zhu, L., Shan, W., Wu, C., Wei, W., Xu, H., Lu, W., Chen, J., Su, X., & Kuang, J. (2021). Ethylene-induced banana starch degradation mediated by an ethylene signaling component MaEIL2. *Postharvest Biology and Technology, 181*, 111648. https://doi.org/10.1016/j.postharvbio.2021.111648

Abstract

Starch is the major reserve carbohydrate in nature, which possesses nutritional property and industrial applications. Starch degradation is an important contributor to softening and sweetening of banana fruit, but more details in this process are not fully understood. In this study, the contents of total starch, amylose and amylopectin were gradually decreased during banana fruit ripening, which is in parallel with the increased levels of total soluble sugars. Particularly, reduced sizes and elongated shapes of starch granules, as well as decreased crystallinity were observed as ripening proceeds, which is largely due to the digestion of starch degradation enzymes such as amylase and isoamylase. Importantly, an ethylene signaling component MaEIL2 bound to the promoters of amylase and isoamylase encoding genes *MaAMY3*, *MaISA2* and *MaISA3*, stimulated their transcription. Overall, these findings reveal that starch-sugar transformation during banana ripening is mediated by enzymatic hydrolysis, and that ethylene signaling component MaEIL2 positively modulates starch breakdown via trans-activation of *MaAMY3*, *MaISA2* and *MaISA3*.

Keywords: /Banana fruit/ /Postharvest quality/ /Ripening/ /Starch-sugar transformation/ /Ethylene/

BLUEBERRY

Arteaga, H., Robleto-Martinez, E., Carolina de Sousa Silva, A., Souto, S., Batista, J., & Xavier Costa, E. J. (2021). Postharvest freezing process assessment of the blueberry structure in three acts: Bioimpedance, color, and granulometry analysis. *LWT - Food Science & Technology*, *151*, 112237. https://doi.org/10.1016/j.lwt.2021.112237

Abstract

The bioelectrical impedance, cell granulometry and the color of the freeze-thawed blueberries were investigated. The blueberries were subjected to freezing at −18 °C for 135 min, during this process, groups were removed every 9 min, and stored at 4 °C until further analysis. Bioelectrical impedance, color, pH, total soluble solids and cell granulometry were measured. The characteristics of bioelectrical impedance, cell granulometry and color were analyzed by computational algorithms, which allowed extracting characteristics of blueberries during the freezing process. The results showed progressive loss of the cellular structure during freezing, this behavior was associated with the bioimpedance parameters. The cells damage also influenced color parameters, and cell granulometry. The color followed the direction toward darkness and more intense red-blue tones, which suggest the migration of pigments from the blueberry's skin towards the flesh. In conclusion, evaluation of the color and cell granulometry by computational algorithms with bioelectrical impedance provides a powerful tool for evaluating cell damage in blueberries during the freezing process. Track the blueberry structure during the freezing process by computational methods. Details of impedance and image processing to evaluate blueberry-freezing process. Provide a low cost way to evaluate fruit freezing. Bioelectrical impedance is able to monitor the postharvest fruit freezing process. Combining three technologies to evaluate cell damage in fruits during freezing.

Keywords: /Blueberry properties/ /Computational vision/ /Electrical impedance spectroscopy/ /Freezing process/ /Modeling and fit/

BROCCOLI

Kim, M. & Park, E. (2021). Postharvest-induced microbiota remodeling increases fungal diversity in the phyllosphere mycobiota of broccoli florets. *Postharvest Biology and Technology, Volume 181*, 111693. https://doi.org/10.1016/j.postharvbio.2021.111693

Abstract

Fresh vegetables harbor numerous microbial populations in their phyllosphere. The phyllosphere microbiota is important not only for enhancing crop production, but also maintaining the quality and safety of fresh vegetables. However, studies of fungal communities on fresh vegetables are lacking, and very little is known about changes to fungal communities after harvest. This study explored the phyllosphere mycobiota of broccoli florets collected from 14 farms (n = 42, preharvest) and 10 retail stores (n = 40, postharvest) by culturing and amplicon sequencing of an internal transcribed spacer region. Core genera were identified that were specific to the broccoli phyllosphere. Fungal populations exceeded bacterial populations in both total abundance and biodiversity, and fungal communities differed much more between preharvest and postharvest samples than bacterial communities. The fungal variance explained by postharvest (25.4 %) was larger than the variance by farming region (10.9 %) or practice (10.9 %), but the bacterial variance by postharvest (3.5 %) was lower than that by farming region (19.5 %) or practice (9.5 %). Both species richness and evenness were significantly higher in postharvest samples, and the *Ascomycota*-to-*Basidiomycota* ratio was significantly lower in postharvest samples than in preharvest samples. Microbial association network analysis illustrated that preharvest interspecies interactions involving *Purpureocillium* and *Cystofilobasidium* were replaced with interactions involving *Sporobolomyces*, *Papiliotrema*, and *Bulleromyces* in postharvest samples, resulting in a decrease of network robustness, as corroborated by functional changes and enrichment of a postharvest pathogen. Overall, the fungal community is an important component of the postharvest microbiome in the phyllosphere of fresh vegetables that has large potential impacts on fresh produce storage and spoilage.

Keywords: /Postharvest microbiome/ /Phyllosphere mycobiota/ /Broccoli/ /Microbial diversity/ /Metagenomics/

CABBAGE

Wang, C., Zeng, Z., Su, X., Lakshmanan, P., Shan, W., Kuang, J., Lu, W., Chen, J., & Zhao, Y. (2021). A transcriptional repressor BrDof2.4 regulates protease genes involved in postharvest leaf senescence in Chinese flowering cabbage. *Postharvest Biology and Technology, 181*, 111680. https://doi.org/10.1016/j.postharvbio.2021.111680

Abstract

Protein degradation is an integral process of leaf senescence, and this catabolism is strongly associated with proteases in diverse plant species. However, the characterization of proteases as well as their upstream regulators during postharvest senescence, especially in economically important leafy vegetables such as Chinese flowering cabbage, remains to be determined. In this study, temporal and spatial gene expression patterns of eight proteases showed that three of them, namely, *BrAPM1*, *BrASPG2* and *BrSAG12*, were most up-regulated during postharvest leaf senescence. Their expressions were also significantly induced by senescence-accelerating phytohormones abscisic acid (ABA) and methyl jasmonate (MeJA), but were inhibited by senescence-delaying hormones gibberellin (GA3) and cytokinin (6-BA). Importantly, using yeast one-hybrid screening, we identified a Dof (DNA-binding with one finger) transcription factor, BrDof2.4, as the putative binding protein of *BrAPM1*, *BrASPG2* and *BrSAG12* promoters. Nucleus-localized *BrDof2.4* was senescence-, ABA- and MeJA-repressible, but was GA3- and 6-BA-inducible. Furthermore, gel mobility shift and transient dual luciferase reporter assays revealed that

BrDof2.4 suppressed the transcription of *BrAPM1*, *BrASPG2* and *BrSAG12*, through binding to their promoters. Taken together, our findings demonstrate that BrDof2.4 acts as a potential repressor of postharvest leaf senescence in Chinese flowering cabbage by the direct suppression of protease expression. Our work contributes towards improving the technology for increasing the shelf-life and commercial value of this important leafy vegetable.

Keywords: /Chinese flowering cabbage/ /Protease/ /Dof/ /Transcriptional repressor/ /Leaf senescence/

CITRUS

Ma, G., Zhang, L., Kudaka, R., Inaba, H., Murakami, K., Yamamoto, M., Kojima, N., Yahata, M., Matsumoto, H., & Kato, M. (2021). Auxin induced carotenoid accumulation in GA and PDJ-treated citrus fruit after harvest. Postharvest Biology and Technology, 181, 111676. https://doi.org/10.1016/j.postharvbio.2021.111676

Abstract

Combined spraying of gibberellin (GA) and prohydrojasmon (PDJ) was an effective method to prevent the physiological disorder of peel puffing in citrus fruit. However, the GA and PDJ combined treatment inhibited carotenoid biosynthesis during the fruit ripening process, which led to the mature fruit with poor color. In the present study, to improve the coloration of the GA and PDJ-treated fruit, the effects of postharvest treatments of two auxins, indole-3-acetic acid (IAA) and 1-naphthaleneacetic acid (NAA), on carotenoid accumulation were investigated in Satsuma mandarin 'Aoshima unshiu' (*Citrus unshiu* Marc.). The results showed that IAA and NAA treatments induced carotenoid biosynthesis in the GA and PDJ-treated fruit after harvest. With the treatments of IAA and NAA, the contents of β-carotene, β-cryptoxanthin, all-*trans*-violaxanthin, and 9-*cis*-violaxanthin were enhanced in both flavedos and juice sacs. The increase in the carotenoid accumulation was accompanied with the up-regulation of carotenoid biosynthetic genes and down-regulation of carotenoid catabolic genes in the IAA and NAA treatments. In addition, ethylene production was induced after the IAA and NAA treatments, and the increase of the endogenous ethylene might stimulate carotenoid biosynthesis in citrus fruit. The results presented in this study suggested that the postharvest treatment of auxin was an effective method for improving the coloration of the GA and PDJ-treated fruit.

Keywords: /Flavedo/ /Juice sacs/ /Gene expression/ /Carotenoid/ /IAANAA/

Moosa, A., Farzand, A., Sahi, S.T., Khan, S.A., Aslam., M.N., & Zubair, M. (2021). Salicylic acid and Cinnamomum verum confer resistance against Penicillium rot by modulating the expression of defense linked genes in Citrus reticulata Blanco. *Postharvest Biology and Technology, 181*, 111649. https://doi.org/10.1016/j.postharvbio.2021.111649

Abstract

Penicillium digitatum and *Penicillium italicum* are potentially important post-harvest pathogens of citrus fruit causing huge economic loss. In this study salicylic acid (SA) and *Cinnamomum verum* were tested to control the infection of *P. digitatum* (green mold) and *P. italicum* (blue mold) as an alternative to chemical control. In an *in vitro* assay methanolic extracts of five plants were tested for antifungal activity where *C. verum* exhibited the highest colony growth inhibition 74.6 and 76.4 % of green and blue mold respectively. Moreover, during *In Planta* assay the combination of *C. verum* and SA produced the lowest disease incidence (20 and 33.3%) and severity (13.1 and 6.1%) of green and blue mold respectively compared to stand-alone treatments without affecting the fruit quality considerably. Furthermore, an upsurge in the activity of polyphenol oxidase (*PPO*), peroxidase (*POD*), and phenylalanine ammonia lyase (*PAL*) encoding genes of citrus fruit was recorded during transcriptional profiling. The highest gene expression was recorded in fruit treated with *C. verum* and SA in combination compared to healthy control. Similar results were observed during quantification of corresponding gene products. This unveils the fact that the

enhanced expression of defense-linked genes might be associated with disease suppression. Conclusively, our findings indicate that *C. verum* and SA in combination can suppress green and blue mold of Citrus by modulating the expression of defense-linked genes. The combined use of plant extracts and resistance inducers is a safer alternative to chemicals to suppress green and blue mold during storage.

Keywords: /*Penicillium italicum/ /Penicillium digitatum/ /*defense-linked genes/ /induced resistance/ /peroxidase/ /phenylalanine lyase/ /polyphenol oxidase/

CHERRY TOMATO

Álvarez, A., Manjarres, J. J., Ramírez, C., & Bolívar, G. (2021). Use of an exopolysaccharide-based edible coating and lactic acid bacteria with antifungal activity to preserve the postharvest quality of cherry tomato. *LWT - Food Science & Technology*, *151*, 112225. https://doi.org/10.1016/j.lwt.2021.112225

Abstract

One of the main causes of cherry tomato postharvest loss is diseases caused by food-contaminating fungi. Edible coatings (ECs) can preserve the quality of this crop and can serve as carriers of lactic acid bacteria (LAB), which have demonstrated inhibitory potential against phytopathogenic fungi. In the present study, the effectiveness of the LAB strain Lactiplantibacillus plantarum A6 incorporated into an EC based on exopolysaccharide from Weissella confusa JCA4 on the physicochemical and microbiological quality of cherry tomatoes was evaluated. The fruit were artificially inoculated with the fungi Aspergillus niger , Fusarium sp., and Rhizopus stolonifer to test the antifungal potential of the coating. The physicochemical and microbiological quality of cherry tomato was studied at two storage temperatures to calculate its shelf life. L. plantarum A6 remained viable both in the solution and on the surface of the fruit after coating, protecting the fruit against two of the three evaluated fungi (Fusarium sp. and Rhizopus stolonifer). The EC controlled weight loss, maintained firmness, and slowed the respiration rate of cherry tomato; the other physicochemical properties and the appearance of the fruit were not negatively affected. Based on these results, prolongation of shelf life was achieved by the application of the exopolysaccharide coating. Exopolysaccharide (EPS) and the bacteria L. plantarum A6 were used to coat cherry tomatoes. The bacteria L. plantarum A6 survived on the surface of the fruit during storage. The coating reduced the growth of Fusarium sp. and R. stolonifer in cherry tomatoes. The physicochemical and microbiological quality of cherry tomatoes was preserved. The edible coating increased the cherry tomato shelf life.

Keywords: /Antifungal activity/ /Cherry tomato/ /Edible coating/ /Exopolysaccharide/ /Lactic acid bacteria/

CUT FLOWERS

Fanourakis, D., Papadopoulou, E., Valla, A., Tzanakakis, V.A., & Nektarios, P.A. (2021). Partitioning of transpiration to cut flower organs and its mediating role on vase life response to dry handling: A case study in chrysanthemum. *Postharvest Biology and Technology, 181*, 111636. https://doi.org/10.1016/j.postharvbio.2021.111636.

Abstract

The mediating role of water relations on vase life response to prior desiccation (dry handling) was addressed in cut chrysanthemum. In the first part of the study, the contribution of different organs to whole-cut flower transpiration was determined in 12 cultivars. During desiccation, leaf transpiration decreased owing to stomatal closure. Instead, no active regulation was apparent in either stem or flower. Cultivar differences in leaf transpiration were related to the weight loss required to induce stomatal closure ($R^2 = 0.919$). A small portion of cut flower transpiration was through the flower (12.3 ± 0.3 %), with

the major contributor being either leaves or stem, depending on the water status and the cultivar. Leaf transpiration was positively correlated with whole-cut flower transpiration (R^2 = 0.879). In the second part of the study, the postharvest longevity upon arrival and following desiccation (5 or 10 % weight loss) was determined on six cultivars with contrasting whole-cut flower transpiration rates. In these cultivars, the rehydration ability following a dehydration event, petal carbohydrate and soluble protein contents, as well as leaf carbohydrate, soluble protein and mineral contents were also assessed. Impaired water transport, as a result of prior desiccation, was not associated with the vase life response to dry handling. A strong correlation between whole-cut flower transpiration in the desiccation experiment and the vase life response to prior desiccation was found. Low vase life decrease in response to prior desiccation was associated with decreased whole-cut flower transpiration during the postharvest period. In conclusion, cultivar differences in vase life response to prior desiccation were attributed to variation in leaf stomatal characteristics.

Keywords: /Carbohydrate status/ /Dry storage/ /Keeping quality/ /Rehydration/ /Stomatal closing ability/ /Transpiration/ /Mass allocation/

FRUITS AND VEGETABLES

Ali, A., Xia, C., Ouattara, N., Mahmood, I., & Faisal, M. (2021). Economic and environmental consequences' of postharvest loss across food supply Chain in the developing countries. *Journal of Cleaner Production*, *323*, 129146. https://doi.org/10.1016/j.jclepro.2021.129146

Abstract

Reducing Food losses and waste (FLW) is a key global challenge to ensure sufficient food for the future and to use available natural resources more efficiently. This study is based on the primary data collected from 343 tomato supply chain actors' in Egypt. We adopted the life cycle assessment approach and the category method (C-Method) to estimate the percentage of postharvest losses (PHL) and their economic and environmental impacts. The result revealed the average percentage of PHL is ,8.6% ,7.5% ,13.36% 8.8% and 11.63% for the farmers, processors, village traders', wholesalers and retailers respectively. The total land and water used to produce this lost food is estimated around 80 thousand hectares and 306 million cubic meters, besides the other production inputs. Which costs the Egyptian economy about 449$ million annually and emits 4.5 million tons of CO 2 eq. The study highlights the importance of prevention strategies is better than recovering ones to mitigate the economic and environmental impacts of FLW. Additionally, diversity of the marketing channels for perishables could contribute to lessen the percentage of PHL through reducing unsold share, meet the consumers' preferences and providing greater marketing opportunities for small farmers. This study suggests the intervention of mitigation PHL should include the different actors from the farmers to retailers. Adopting a short supply chain, collective marketing, access to cold transportation and storage services, that could maintain product quality and extend its shelf-life. Agricultural education is essential for disseminating the best agricultural practices including the postharvest operations for perishable products. Therefore, designing sustainable intervention strategies requires intensive public-private partnership and it should include incentives for small stakeholders. That could raise their knowledge, improve their skills and practices, and change their attitudes to be more sustainable users for the limited natural resources. [Display omitted] • Egyptian economy lost 449$ million annually as a food losses for tomatoes. Egypt lost water estimated at 500 Mm3 annual which could reduce the water gap by 2.3%. GHG emission associated with PHL for tomatoes in Egypt estimated at 4.53 Mt CO 2 eq. A diverse supply chain could reduce food losses in developing countries. Incentives policy could motivate small stakeholders to reduce food losses.

Keywords: /Environmental impacts./ /Postharvest losses/ /Reducing food losses/ /Short supply chain/ /Sustainable resources management/ /Water footprint/

I. S. Mahlangu, R., M. Maboko, M., Mudau, F. N., & Amoo, S. O. (2021). Nitrogen levels, plant density and postharvest storage duration affect phytochemical and antioxidant properties of field-grown basil and rocket crops. *International Journal of Vegetable Science*, *27*(6), 515–525. https://doi.org/10.1080/19315260.2021.1876198

Abstract

Growers usually apply elevated nitrogen levels when plants are established at high densities to obtain improved yields. It is not known how this practice affects phytochemical and antioxidant properties of basil (Ocimum basilicum L.) and rocket [Diplotaxis tenuifolia (L.) DC]) during postharvest storage, which are important quality aspects of these crops for human health. This study investigated effects of N application (60, 90, 120, 150, or 180 kg.ha−1), plant density (40,000; 62,500 and 93,750 plants.ha−1 for basil; 40,000; 80,000 and 133,333 plants.ha−1 for rocket), and postharvest storage duration (0, 5, 10 or 15 days) on phytochemical and antioxidant properties of basil and rocket. After harvest, leaves were packaged in biaxially oriented polypropylene (anti-mist) bags and kept at 12°C and 85% relative humidity in a cold temperature room. Nitrogen application of 120 kg.ha−1 at day 0 of storage, caused the highest accumulation of total phenolic content (TPC), flavonoid content (FC), strong free radical scavenging activity, and % antioxidant with limited effect due to plant density on basil. In rocket, application of 60 to 120 kg.ha−1 N at day 0 of storage had high TPC; FC was high at 90 to 180 kg.ha−1 N and 10 days of storage. Rocket had strong scavenging activity, as a result of 120 to 180 kg.ha−1 N, at 15 days of storage, and for 60 and 90 kg.ha−1 N at 0 and 10 days of storage. Postharvest quality of basil was affected by storage time and N application; TPC, FC, and free radical scavenging activity (FRS) were reduced as storage time lengthened. Rocket had improved postharvest quality at 10 days of storage. Spacing had limited effect on all parameters in basil and rocket. The most economical treatment in basil was 60 kg.ha−1 N for TPC, FC, FRS, and antioxidant activity; in rocket, it was 120 kg.ha−1 with a longer shelf-life of 10 days of storage with regard to antioxidant activity. Optimization of agronomic practises for improved production should consider phytochemical quality assurance to ensure crop health benefits to consumers are not compromised.

Keywords: /Antioxidant/ /Diplotaxis tenuifolia/ /Ocimum basilicum/ /Plant spacing/ /Total flavonoids/ /Total phenols/

GRAPES

Zhong, T., Wang, Z., Zhang, M., Wei, X., Kan, J., Zalán, Z., Wang, K., & Du, M. (2021). Volatile organic compounds produced by Pseudomonas fluorescens ZX as potential biological fumigants against gray mold on postharvest grapes. *Biological Control*, *163*, 104754. https://doi.org/10.1016/j.biocontrol.2021.104754

Abstract

Biofumigation by VOCs from P. fluorescens ZX managed gray mold on postharvest grapes. Biofumigation by VOCs resulted in damage on the morphology of hyphae. VOCs and sulphur containing compounds showed inhibitory effect. VOCs from P. fluorescens ZX colonized on healthy grapes could inhibit gray mold on grapes. Pre-fumigation by VOCs could control the development of gray mold. Volatile organic compounds (VOCs) produced by antagonistic microorganisms have the potential for controlling postharvest diseases on fruit and vegetables. In this study, the biocontrol efficacy of VOCs emitted by Pseudomonas fluorescens ZX was determined in vitro and in vivo against gray mold, caused by Botrytis cinerea , on grapes. In vitro , application of VOCs produced by bacterial suspension of P. fluorescens ZX at initial inoculum concentration of 1 × 109 colony-forming units (CFU)/mL inhibited B. cinerea mycelial growth from 52 to 23 mm and spore germination from 88.56 to 39.67%. In vivo tests indicated that, for grapes, disease incidence and disease index were markedly reduced by VOCs from P. fluorescens ZX incubated on NA plates, in NB, and on healthy grapes. Pre-fumigation with VOCs could inhibit development of gray mold on grapes. Furthermore, P. fluorescens ZX-producing VOCs exhibited favorable effects on postharvest natural decay of grapes. In vitro testing of selected pure chemicals

demonstrated that dimethyl trisulfide (20 μL/L), dimethyl disulfide (40 μL/L), geranyl formate (640 μL/L), acetic acid (160 μL/L), butyric acid (320 μL/L), 2-methylbutyric acid (160 μL/L), isobutyric acid (160 μL/L) and isovaleric acid (320 μL/L) could completely inhibit mycelial growth of B. cinerea on PDA plates. These eight substances also exerted a strong inhibitory effect on gray mold on grapes. Additionally, SEM analysis showed that VOCs could affect the morphological and structural characteristics of B. cinerea both in vitro and in vivo. Collectively, VOCs produced by P. fluorescens ZX are promising for biocontrol of gray mold on grapes through fumigant action.

Keywords: /Biological control/ /Botrytis cinerea/ /Gray mold disease/ /Pseudomonas fluorescens ZX/ /Volatile Organic Compounds (VOCs)/

GREEN BEAN

Ustun, H., Ali, Q., Kurubas, M. S., Dogan, A., Balkhi, M., Peker, B., & Erkan, M. (2021). Influence of postharvest UV-C illumination on biochemical properties of green beans. *Scientia Horticulturae*, *289*, 110499. https://doi.org/10.1016/j.scienta.2021.110499

Abstract

0.3 kJ m −2 and 0.5 kJ m −2 UV-C doses damaged the green beans surface in shelf life. kJ m −2 UV-C dose reduce decay rate without damaging the surface of green beans. UV-C illumination doses decreased respiration rates of green beans. Non-reducing sugars enhance when intensity of UV-C illumination is increased. In this study, harvested green beans (Phaseolus vulgaris cv. Bourgondia) were subjected to different doses of UV-C illuminations (0.1, 0.3, 0.5 kJ m −2; low, medium, and high dose, respectively) and stored under modified atmosphere packages (MAP) at 8°C for 25 days. The extension in storage time resulted in an increase in weight loss, fluctuations in TSS content, and respiration rate. Medium and high doses resulted in higher total phenolic contents compared to control and low dose treatments. No UV-C damage or deterioration was detected during the entire cold storage period, however medium and high doses caused damages to the surface at the beginning 15 days cold storage plus 3 days shelf life (15 d CS plus 3 d SL) period. All doses also resulted in lower respiration rates and higher total sugar content than control. The effects of illumination on reducing sugar and total chlorophyll contents were non-significant. There were no significant effects on antioxidant activity in cold storage, however during shelf-life the high UV-C dose had highest antioxidant activity compared to control and other doses. Low dose had positive effects on the edible quality and maintained the postharvest quality of green beans for 25 days. Our findings showed that low UV-C dose can be recommended commercially to maintain quality of green beans with no surface damage among the UV-C illumination doses tested.

Keywords: /MAP/ /Phaseolus vulgaris/ /Postharvest quality/ /Respiration rate/ /UV-C illuminations/

GUAVA

Chaiwong, A., Yoythaisong, P., Arwatchananukul, S., Aunsri, N., Tontiwattanakul, K., Trongsatikul, T., Kitazawa, H., & Saengrayap, R. (2021). Vibration damage in guava during simulated transportation assessed by digital image analysis using response surface methodology. *Postharvest Biology and Technology, 181*, 111641. https://doi.org/10.1016/j.postharvbio.2021.111641

Abstract

Vibration damage on guava peel is an important criterion for fruit grading classification and consumer perception. Response surface methodology (RSM) using central composite design (CCD) with three independent variables as frequency (7, 13.5 and 20 Hz), vibration duration (15, 30 and 45 min), and acceleration (2.942, 5.884 and 8.826 m s^{-2}) were employed for vibration testing of ‘Glom Sali’ guava. Twenty simulated vibration treatments were conducted at 20 °C for 48 h to assess and analyze browning

index (BI), total color difference (TCD), digital image analysis of bruise area (BA) and normalized fractal dimension difference ($\Delta FD/FD_0$) for vibration bruising damage on guava peel. Results showed that acceleration was an important factor in vibration bruising, particularly combined at 8.826 m s^{-2}. For a fixed target value of $\Delta FD/FD_0$ at 1.088 and BA at 10 % of the total area, the optimized treatment condition was frequency level 13.5 Hz, vibration duration 30 min and acceleration level 6.570 m s^{-2}. The correlation coefficient (*r*) between TCD and either BA (0.7724) or $\Delta FD/FD_0$ (0.7484) showed a higher relationship than BI (0.4605), while $\Delta FD/FD_0$ value had greater reliability and repeatability than BA to predict vibration bruising in guava. Results demonstrated that fractal dimension difference assessed by image analysis was a potential methodology to determine the severity of vibration bruising in guava fruit.

Keywords: /Acceleration/ /Browning incidence/ /Bruise area/ /Central composite design/ /Fractal dimension/

HONEYSUCKLE

Wu, X., Zhang, S., Li, X., Zhang, F., Fan, Y., Liu, Q., Wan, X., & Lin, T. (2021). Postharvest UV-B radiation increases enzyme activity, polysaccharide and secondary metabolites in honeysuckle (Lonicera japonica Thunb.). *Industrial Crops & Products*, *171*, 113907. https://doi.org/10.1016/j.indcrop.2021.113907

Abstract

Bioactive compounds in leaves, stems and flowers of honeysuckle increasd under a short-term ultraviolet-B radiation. Antioxidant enzymes and osmolytes protect the honeysuckle from ultraviolet-B radiation. Metabolites in honeysuckle under ultraviolet-B radiation are beneficial for the value of the plant. The study may provide a simple way to enhance the bioactive compounds of plants. Postharvest ultraviolet-B (UV-B) radiation can modulate the accumulation of bioactive compounds with many pharmacological effects in plants. Honeysuckle (Lonicera japonica Thunb.) is a UV-B tolerant crop which has a high medical value. The effects of UV-B on bioactive compounds in its flowers have been reported, while very few studies focused on the leaves and stems. Therefore, the effects of postharvest UV-B radiation on basic physiological traits and bioactive compounds (polysaccharides and secondary metabolites) in the leaves, stems and flowers of honeysuckle were investigated in this study. In this study, the leaves, stems and flowers of honeysuckle were exposed to UV-B radiation (0, 8.4 and 22.4 μW cm−2) for different times (2, 4, 6 and 8 h), and variables were detected after 24 h after they were able to get a repair time. The results showed that the contents of chlorophyll, carotenoid, soluble sugar, and the activities of catalase (CAT) and superoxide dismutase (SOD) in postharvest leaves were increased after UV-B treatment. But the malonaldehyde (MDA) content in leaves decreased when the duration of UV-B treatment lasted for 4 h. Besides, the contents of polysaccharide, total polyphenols, total flavonoid, and chlorogenic acid in different organs all increased significantly and reached a peak under the UV-B 1 (8.4μW cm−2) treatment for 2 h, whereas they reached the lowest point under the 6 h of UV-B 2 (22.4μW cm−2) exposure according to the heat map analysis. Interestingly, the Pearson correlation analysis revealed that the total flavonoid content was positively correlated with the chlorogenic acid content in the flowers of honeysuckle, and the total flavonoid content was negatively correlated with the contents of chlorophyll, CAT and carotenoid in plant leaves. In a word, the secondary metabolites and polysaccharide of honeysuckle can be increased by postharvest UV-B, and the quality can be improved by adjusting its physiological traits. In addition, the content of bioactive substances is correlated with the physiological traits. The results will provide a basis for improving the medicinal values of honeysuckle by postharvest UV-B treatment.

Keywords: /Antioxidant enzyme/ /Honeysuckle/ /Polysaccharide/ /Postharvest UV-B radiation/ /Secondary metabolites/

HOT PEPPER

Magalhães, H. C. R., Filho, E. G. A., Garruti, D. dos S., Massaretto, I. L., & Purgatto, E. (2021). Effect of postharvest methyl jasmonate and ethylene treatments on the biosynthesis of volatile compounds of hot pepper fruits. *Scientia Horticulturae*, *289*, 110477. https://doi.org/10.1016/j.scienta.2021.110477

Abstract

The ripening process had more influence on the biosynthesis of hot pepper volatile compounds than the treatments applied, due to the peculiar climacteric character of the fruit. The ethylene perception seems to be important for the aroma formation in the beginning of the hot pepper ripening. MeJA delayed the production of volatile compounds in pepper and increased levels of hexanal at the end of fruit ripening, independently of ethylene. Hot pepper (Capsicum frutescens L.) can show climacteric behavior at the beginning of ripening and the role of ethylene in the aroma formation of these fruits is not very clear. Methyl jasmonate (MeJA) is known to play an important role in regulating metabolic changes that promote aroma formation in fruits. This study investigated the correlation between ethylene and MeJA on the biosynthesis of volatile hot pepper compounds. Hot peppers were randomly separated and distributed in five groups, corresponding to the four treatments, MeJA, Ethylene, 1-MCP (1-methylcyclopropene), MeJA+1-MCP and control. Analyses of volatile compounds and gene transcripts for the enzymes lipoxygenase (LOX), alcohol dehydrogenase (ADH) and hydroperoxide lyase (HPL) were carried out during the fruit ripening. Results revealed that ripening influenced the aroma biosynthesis more than treatments applied to hot pepper, probably due to the intermediate climatic character of the fruit. Despite this, the perception of ethylene seems to be important at the beginning of the formation of volatile hot pepper compounds. This effect was observed in monitoring with C6 volatiles, in which treatment with ethylene was highlighted on day 1, including a corresponding increase in HPL. In the ripe fruit, there was a small delay in the volatile composition caused by MeJA, MeJA+1-MCP and 1-MCP. In C6 volatiles, MeJA caused an evident increase in hexanal on days 01, 06 and 12, and there was also a correspondent increase in HPL for day 1.

Keywords: /C6 volatile/ /Lipoxygenase pathway/ /MeJA/ /Plant hormone/ /Ripening/ /Volatile compound/

Obayelu, O. A., Adegboyega, O. M., Sowunmi, F. A., & Idiaye, C. O. (2021). Factors explaining postharvest loss of hot pepper under tropical conditions. *International Journal of Vegetable Science*, *27*(6), 526–535. https://doi.org/10.1080/19315260.2021.1879342

Abstract

Major loss of hot pepper (Capsicum chinense Jacquin) in the humid tropics is due to disease and spoilage during postharvest storage following harvest occurring when conditions are cool and damp. The study assessed socio-economic drivers of postharvest loss of hot pepper in the tropics in order to provide empirical information on the underlying causes of postharvest losses of hot pepper for efficient and sustainable hot pepper value chain policies under tropical conditions. Data were analyzed with descriptive statistics, gross margin analysis and binary logistic regression. Although Capsicum chinense had a low yield in the sub-humid region, it was profitable. Being a male, primarily engaged in farming, reduced the likelihood of high postharvest loss, while long distances and high transportation costs increased it. Technical and marketing support for smallholder farmers, especially females, could reduce postharvest loss of hot pepper.

Keywords: /Capsicum chinense/ /Gross margin/ /Nigeria/ / On-farm/ /socio-economic determinants/

LEMON

Oztekin, S., & Karbancioglu-Guler, F. (2021). Bioprospection of *Metschnikowia* sp. isolates as biocontrol agents against postharvest fungal decays on lemons with their potential modes of action. *Postharvest Biology and Technology, 181,* 111634. https://doi.org/10.1016/j.postharvbio.2021.111634

Abstract

In this study, various fruits were employed as biocontrol yeast reservoirs, and eleven distinct yeast cultures of *Metschnikowia* sp. belonging to 6 different species were identified with sequence-based analysis of the D1/D2 domain of 26S rDNA. For initial screening, *Metschnikowia* isolates were tested on *Fusarium oxysporum, Botrytis cinerea, Penicillium digitatum, Penicillium expansum,* and *Alternaria alternata*. The highest antagonism was obtained on green and blue *Penicillium* (83.63–100 %). All tested yeasts showed chitinase activity, while some had protease, pectinase, cellulase, β-1−3 glucanase, and gelatinase activities. Since lemons have high pectin content, three pectinase-free cultures at tested conditions with high *in vitro* antagonism on *Penicillium* were selected and used on lemons. The activities of the *in vitro* antifungal studies were found to be compatible with those of the *in vivo*, and *P. digitatum*'s incidence was found to be higher than that of *P. expansum* on lemons. All tested pectinase-free *Metschnikowia* sp. lead to a significant reduction in the disease incidences and lesions at varying levels. The combined effect of lytic enzyme secretion, iron depletion, and volatile organic compounds (VOCs) production determined the antifungal mechanism of action. *M.* aff. *fructicola* demonstrated the highest biocontrol efficacy against *Penicillium* on lemons with an increasing shelf-life. The use of tentatively pectinase-negative *Metschnikowia* sp. as an antifungal biocontrol agent on lemons was considered for the first time. The findings will shed light on the effective use of *Metschnikowia* sp. as a potential biofungicide against the growth of postharvest fungal pathogens.

Keywords: /Biocontrol yeast/ /*Metschnikowia* sp./ /Biofungicide/ /*Penicillium/ /*Postharvest disease/ /Pulcherrimin/

LETTUCE

Peng, H., Lou, Y., Teng, Z., Zhou, B., Bornhorst, E.R., Fonseca, J.M., & Simko, I. (2021). Phenotypic characterization and inheritance of enzymatic browning on cut surfaces of stems and leaf ribs of romaine lettuce. *Postharvest Biology and Technology, 181*, 111653. https://doi.org/10.1016/j.postharvbio.2021.111653

Abstract

Enzymatic browning is a major postharvest quality defect of romaine lettuce (*Lactuca sativa* L.). This study provides the first analysis of the relationship between the browning of leaf ribs and stems across twelve lettuce genotypes (ten cultivars, a breeding line, and a plant introduction). While all samples showed a progressive increase in browning index (BI) and decline in lightness (*L**) and hue (*h*°) during 5 °C storage, differences in the rate of browning development were observed among genotypes. The most intensive browning was observed mainly around the vascular bundles dispersed along the rim area of the stems. Browning on the cut surfaces of the stems was correlated with browning on the cut leaf ribs, with Pearson correlation coefficients of 0.886 for BI, 0.891 for *L** and 0.866 for *h*°. These results showed that the degree of browning in leaf ribs can be predicted by the browning degree of the stems. High genetic similarity was found among four cultivars with limited browning (Darkland, Parris Island Cos, Green Towers, and Hearts Delight) and also between cultivars with severe browning (King Henry and Tall Guzmaine). The highest broad-sense heritability (*H2*) in both trials (July and November 2018) was 0.88 and 0.92 for stem and rib browning, respectively. The method based on stem browning can be used to simplify postharvest phenotypic evaluation of lettuce and to decipher the genetics of browning to accelerate the breeding of browning-resistant cultivars.

Keywords: /Broad-sense heritability/ /Browning/ /Lettuce stem/ /Romaine lettuce/

LITCHI

Qu, S., Li, M., Wang, G. & Zhu, S. (2021). Application of ABA and GA3 alleviated browning of litchi (Litchi chinensis Sonn.) via different strategies. *Postharvest Biology and Technology, 181*, 111672. https://doi.org/10.1016/j.postharvbio.2021.111672

Abstract

Browning of harvested litchi causes fast quality losses that are closely associated with anthocyanin degradation. Abscisic acid (ABA) and gibberellins (GA) are antagonistic in regulating plant growth and development, but it is unclear whether and how they affect anthocyanin metabolism in harvested litchi fruit. Here, application of ABA and GA3 to harvested litchi reduced browning and maintained higher anthocyanin content relative to the untreated control during storage at 20 °C. Transcriptome profiling showed 2362 and 6304 differentially expressed genes (DEGs) were induced in response to ABA and GA3 treatment, respectively, implying the metabolism pathways regulated by ABA and GA are quite different. The flavonoid and phenylpropanoid biosynthesis are two of the 30 most enriched KEGG pathways for ABA-treated fruit compared with the control, but not for GA3-treated fruit. ABA upregulated key DEGs involved in phenylpropanoid biosynthesis and anthocyanin synthesis pathways, *phenylalanine ammonia-lyase (PAL), cinnamic acid 4-hydroxylase (C4H), chalcone synthase* (*CHS*) and *UDP-flavonoid glucosyl transferase* (*UFGT*), but GA3 downregulated them. ABA upregulated DEGs related to anthocyanin degradation and transport, *laccase* (*LAC*), *peroxidase* (*POD*), and *glutathione S-transferase* (*GST*), whereas GA3 downregulated them. Of the 29 different anthocyanin-related metabolites identified by LC–MS, ABA and GA3 caused an increase of four and two, respectively. Taken together, ABA alleviated browning mainly by promoting anthocyanin synthesis, whereas GA3 inhibited anthocyanin degradation. These findings add to understanding of the roles of ABA and GA in regulating anthocyanin metabolism of plants in senescent stages and provide new approaches to pericarp browning prevention in litchi.

Keywords: /*Litchi chinensis* Sonn./ /Anthocyanins/ /Browning/ /Abscisic acid/ /Gibberellic acid/

Xu, D., Xi, P., Lin, Z., Huang, J., Lu, S., Jiang, Z., & Qiao, F. (2021). Efficacy and potential mechanisms of benzothiadiazole inhibition on postharvest litchi downy blight.*Postharvest Biology and Technology, 181,* 111660. https://doi.org/10.1016/j.postharvbio.2021.111660

Abstract

Benzothiadiazole (BTH) is a functional analog of salicylic acid (SA), and has been applied to delay postharvest decay in several fruits. However, the efficacy of BTH on delaying postharvest decay of litchi fruit and involved regulatory mechanisms remained unknown. Physiological, microbiological, and metabolomic analyses were applied in this study to reveal efficacy and potential mechanism of BTH on the control of postharvest litchi downy blight. Our results showed that BTH enhanced the disease resistance of litchi fruit against downy blight *in vivo*. The *in vitro* test indicated that BTH treatment markedly inhibited the mycelial growth and sporangia germination of *Peronophythora litchii*. Enzyme activity assay revealed that BTH treatment enhanced the activities of CAT, SOD, PPO and PAL in litchi fruit. Moreover, the expression levels of senescence-related genes were down-regulated by BTH treatment. A comparative metabonomic analysis showed that metabolite accumulation significantly affected by BTH treatment, especially amino acids contents of arginine, phenylalanine and glutamic acid increased in comparison with the control group. In all, the inhibitory effect on pathogen, the blocked transcription of senescence-related genes, and the activation of defense enzymes and amino acid metabolism induced by BTH treatment might be attributed to the alleviation effect of BTH on postharvest litchi downy blight. These findings indicated that BTH might be a potential agrochemical to control postharvest litchi downy blight and extend shelf life of litchi fruit.

Keywords: /BTH/ /Disease resistance/ /Inhibitory activity/ /Arginine/ //*Peronophythora litchii/*

Zhang, J., Zhu, F., Gu, M., Ye, H., Gu, L., Zhan, L., Liu, C., Yan, C., & Feng, G. (2021). Inhibitory activity and action mechanism of coumoxystrobin against Phytophthora litchii, which causes litchi fruit downy blight. *Postharvest Biology and Technology, 181*, 111675. ttps://doi.org/10.1016/j.postharvbio.2021.111675

Abstract

Phytophthora litchii is the causative agent of litchi downy blight, one of the most destructive pre- and postharvest diseases of litchi, which has caused severe economic losses. Coumoxystrobin is a novel fungicide developed by incorporating two active moieties from coumarin and methoxyacrylate into a single molecule. In the current study, coumoxystrobin showed high activity against different developmental stages of *P. litchii* tested in our research. The inhibitory activity on cystospore germination (mean EC50 = 0.034 mg L−1) was the highest, then followed by zoosporangia germination (mean EC50 = 0.193 mg L−1), mycelial growth on plates (mean EC50 = 0.269 mg L−1), zoosporangia production (mean EC50 = 2.019 mg L−1), mycelial growth in broth (mean EC50 = 3.722 mg L−1) and zoospore discharge (mean EC50 = 4.451 mg L−1). In the protective activity test in detached litchi fruit, coumoxystrobin exhibited excellent activity against *P. litchii*, though this compound was slightly less potent than azoxystrobin. After treatment with coumoxystrobin, the respiration rate and complex III activity of mycelia decreased significantly. These findings indicate that coumoxystrobin could have the potential to control litchi downy blight.

Keywords: /Coumoxystrobin/ /*Phytophthora litchii/ /*Inhibitory activity/ /Action mechanism/ /Complex III/ /QoI/

MANGO

Khan, S., Ullah, R., Ali, H., Waheed, A., & Abbas, Q. (2021). Elemental analysis of mango ripened by different postharvest treatments using laser induced breakdown spectroscopic. *Optik - International Journal for Light & Electron Optics*, *246*, 167770. https://doi.org/10.1016/j.ijleo.2021.167770

Abstract

Laser induced breakdown spectroscopy (LIBS) provides sample information on elemental scale. Current result depicts both qualitative and quantitative detection of most prominent organic elements like hydrogen (H), nitrogen (N), oxygen (O) and carbon (C) from mango pulp ripened under different post-harvest treatments. Similarly, it also indicates variable concentration of minerals such as calcium (Ca), magnesium (Mg) and potassium (K) under these treatments. The concentration of Ca, Mg and K detected under different postharvest ripening techniques are 0.163−0.257 mg\100 gm, 0.212−0.431 mg\100 gm and 0.675−1.802 mg\100 gm respectively. Moreover, the respective concentration H, N, O and C are 41.56−46.51 gm/100 gm, 41.28−44.91 gm\100 gm, 12.11−14.49 gm\100 gm and 53.1−100.1 mg\100 gm. Traces of arsenic (As) or phosphorous (P) were not found in samples treated with calcium carbide. Further studies on commercial grade fruits ripened with these agents are required to differentiate among nutritional elements of mango fruits treated under different ripening agents as well as to confirm the presence/absence of health hazardous elements.

Keywords: /Compositional analysis/ /Laser induced breakdown spectroscopy/ /Mango fruit/ /Ripening treatments/

MELON

Gao, G., Duan, X., Jiang, H., Yang, F., & Qi, H., (2021). CmMYB113 regulates ethylene-dependent sucrose accumulation in postharvest climacteric melon fruit.*Postharvest Biology and Technology, 181,* 111682. https://doi.org/10.1016/j.postharvbio.2021.111682

Abstract

Sucrose is mainly accumulated in mature oriental melon fruit, and it is generally regulated by ethylene. However, the molecular mechanism of sucrose accumulation induced by ethylene remains largely unknown. Here, high sucrose melon cultivar 'HS' and low sucrose melon cultivar 'LW' fruit were treated with ethylene and 1-MCP at ethylene release initial stage (27 d after anthesis, DAA), we found that the exogenous ethylene treatment promoted the sucrose accumulation, and enhanced the activity of sucrose phosphate synthase (SPS), as well as the transcript of *CmSPS1* in postharvest climacteric melon fruit 'HS'. However, both treatments had no effect on sucrose accumulation, SPS activity and its transcription in 'LW' fruit. In addition, exogenous ethylene increased endogenous ethylene production in 'HS' fruit, and had no effect in 'LW' fruit, except 5 d after treatment. Also, a strong positive correlation between ethylene and the *CmACO1* expression level was observed in 'HS'. The expression of transcription factor CmMYB113, screened from yeast one hybrid library, was induced by exogenous ethylene treatment in 'HS' rather than 'LW'. Moreover, the yeast one hybrid and GUS activity assays indicated that CmMYB113 could activate the transcription of *CmACO1* and *CmSPS1* by binding directly to their promoters, respectively. From the findings, it was revealed that the targeted up-regulation of *CmACO1* and *CmSPS1* by CmMYB113 could be involved in ethylene-dependent sucrose accumulation, which enhanced flavor quality in climacteric melon fruit.

Keywords: /Ethylene/ /*CmSPS1*/ /CmMYB113/ /Sucrose accumulation/ /Oriental melon fruit/

MUSHROOM

Tang, J., Ren, H., Chen, X., Ma, F., Jiang, F., Sun, B. (2021). Effects of short-term N2 anaerobic treatment on respiratory metabolism and oxidation status of Agaricus bisporus, *Postharvest Biology and Technology, 181*, 111692. https://doi.org/10.1016/j.postharvbio.2021.111692

Abstract

In this study, the effects of N2 anaerobic treatment for 6 h, 12 h, and 24 h on respiratory metabolism and the oxidation status of mushroom (*Agaricus bisporus*) were evaluated for a storage period of fifteen days including key enzyme activity of respiratory pathway, antioxidant enzyme activity, brightness, browning index, anaerobic metabolites, and cell ultrastructure. The results showed that 6 h anaerobic treatment inhibited key enzyme activities of glycolysis (EMP), tricarboxylic acid (TCA) cycle and pentose phosphate pathway (HMP), increased the activity of superoxide dismutase (SOD) and catalase (CAT) as well as maintained the cell integrity and functionality compared to other treatments. The intensity of anaerobic treatment was proportional to ethanol production, while the senescence of mushrooms seemed to be closely related to acetaldehyde content. The 24 h treatment showed the highest browning index, which may be related to the cytotoxicity produced by acetaldehyde. Therefore, appropriate anaerobic treatment of 6 h in the condition of this study can reduce the oxidative damage of cells and delay mushroom senescence by regulating the fermentation metabolism at a beneficial level.

Keywords: /*Agaricus bisporus*/ /Anaerobic treatment/ /Respiratory pathway/ /Cell oxidation/

ORANGE

Lin, Y., Fan, L., He, J., Wang, Z., Yin, Y., Cheng, Y., & Li, Z. (2021). Anthocyanins contribute to fruit defense against postharvest green mold. *Postharvest Biology and Technology, 181*, 111661. https://doi.org/10.1016/j.postharvbio.2021.111661

Abstract

Anthocyanins, an important class of pigmented and health-promoting plant secondary metabolites, are involved in protecting plants from stresses. However, the contribution of anthocyanins in plant resistance to biotic stresses is poorly understood compared with that in plant resistance to abiotic stresses. Here, we characterized the function of anthocyanins in protecting fruit from green mold, the major postharvest disease of citrus fruit. Compared with other oranges, 'Tarocco' orange, one of the most important blood oranges enriched in anthocyanins, showed reduced susceptibility to the necrotrophic fungus *Penicillium digitatum* (*Pd*) which causes citrus postharvest green mold. *Pd* infection induced the accumulation of anthocyanins in 'Tarocco' orange and exogenous treatment of anthocyanins significantly reduced the susceptibility of citrus fruit to *Pd*. The accumulation of reactive oxygen species (ROS), which was shown to contribute to plant infection of necrotrophic fungal pathogens, in 'Tarocco' oranges was less than that in other oranges upon *Pd* infection. ROS content and associated gene expression in citrus fruit upon *Pd* infection were reduced after exogenous treatment of anthocyanins. Moreover, transcriptome analysis showed that a lot of genes probably participating in plant–pathogen interaction and anthocyanin biosynthesis were noticeably up-regulated in 'Tarocco' orange upon *Pd* infection. These findings highlight the contribution of anthocyanins to fruit disease resistance and provide significant insights into the control of citrus postharvest green mold.

Keywords: /Fruit resistance/ /Anthocyanins/ /Blood orange/ /*Penicillium digitatum*/ /ROS/

PAPAYA

Singh, A., Rahman, M., Sharma, R., & Yemmireddy, V., (2021). Papaya ripeness and post-harvest storage conditions affect growth, survival and death kinetics of Salmonella and spoilage organisms. *Postharvest Biology and Technology, 181,* 111659. https://doi.org/10.1016/j.postharvbio.2021.111659

Abstract

The purpose of this study was to determine the effect of papaya ripeness level (0, 25, 50, 75 and/or 100 %) and post-harvest storage conditions (i.e., Temperature: 4, 12 and 21 °C, and RH: 55 and 90 %) on the survival kinetics of *Salmonella* spp., and spoilage organisms. In addition, the effect of test conditions on the physico-chemical properties of fresh-cut papayas was also determined. Maradol papayas of different commercial ripeness levels were cut into 3 cm2 cubes either with or without a peel. The samples were spot inoculated with 25 μL of nalidixic acid adopted *Salmonella* spp (4-strain) to achieve 4–5 log CFU g−1. The inoculated samples and uninoculated controls were stored in an environmental chamber for up to 14 d. Papaya ripeness level in combination with storage temperature and RH have shown to affect *Salmonella* survival on both fresh-cut papaya and papaya peel. Increasing the fruit ripeness level from 0 to 100 %, storage temperature from 4 to 21 °C and RH from 55 to 90 % increased the log survival. Samples at low ripeness levels showed slower growth of yeast and molds compared to samples at higher ripeness levels. Ripeness levels also showed an effect on the total soluble solids content of fresh-cut papaya during the storage. Based on these findings, papaya ripeness level in combination with post-harvest storage conditions need to be considered to maximize the microbiological safety while maintaining the quality.

Keywords: /Papaya/ /Storage/ /Quality/ /*Salmonella*/ /Ripeness/ /Modeling/

PEACH

Cao, K., Wei, Y., Chen, Y., Jiang, S., Chen, X., Wang, X., & Shao, X. (2021). PpCBF6 is a low-temperature-sensitive transcription factor that binds the PpVIN2 promoter in peach fruit and regulates sucrose metabolism and chilling injury. *Postharvest Biology and Technology, 181*, 111681.https://doi.org/10.1016/j.postharvbio.2021.111681

Abstract

PpVIN2 is the only vacuolar invertase (VIN) gene in peaches that is sensitive to cold. *PpVIN2* functions in sucrose decomposition and chilling injury (CI), but it is unknown how low temperatures induce *PpVIN2*. Here, we confirmed low-temperature activation of *PpVIN2* transcription from a *PpVIN2* promoter using a transgenic tobacco model. C-repeat binding factor (CBF) is a conserved cold-responsive gene in plants, and *PpCBF6* expression increases rapidly when peaches suffer from cold stress. We studied the interaction between PpCBF6 and *PpVIN2* both *in vivo* and *in vitro*. Using yeast one-hybrid assay and electrophoretic mobility shift assay, we confirmed that PpCBF6 binds to the promoter of *PpVIN2*, and results from a dual luciferase assay indicate that PpCBF6 inhibits the promoter activity of *PpVIN2*. *In vivo*, transient overexpression of *PpCBF6* decreases *PpVIN2* expression and VIN activity, and increases sucrose levels. In addition, when *PpCBF6* is targeted using virus-induced gene silencing (VIGS), *PpVIN2* expression and activity increase, accompanied by a decrease in sucrose content. Compared to the control group, exogenous methyl jasmonate (MeJA) treatment caused a higher expression of *PpCBF6*, and reduced the rapid rise of *PpVIN2* expression level. This resulted in the lower VIN activity and higher sucrose content in MeJA-treated peach fruit, thereby reducing the CI. In general, we proved that PpCBF6 retarded the degradation of sucrose by inhibiting the increased expression of *PpVIN2*, which improves the chilling resistance of peach fruit.

Keywords: /C-repeat binding factor/ /Transcriptional regulation/ /*Prunus persica*/ /Chilling stress/ /Sucrose metabolism/ /Methyl jasmonate/

Diezma, B., BarreiroP., Baltazar, P. & Correa, E.C. (2021) A general procedure for predicting the remaining shelf life of nectarines and peaches for virtualization of the value chain. *Postharvest Biology and Technology, 181*, 111677. https://doi.org/10.1016/j.postharvbio.2021.111677

Abstract

Decision-making along the supply chain requires accurate estimates of the remaining shelf life (RSHL) depending upon not only the initial storage conditions and duration but also aspects such as the variety or condition of the fruit at harvest. Offering ready-to-eat fruit on at the retail level, is a frequent marketing strategy in which management of shelf life is mandatory. The most widespread models, so-called generic shelf life models for estimating the RSHL, gather the actual temperature series and the optimal storage temperature while assuming standard values for other parameters such Q10 or the reference shelf life. In this work, a general mathematical procedure, and corresponding algorithm are proposed to adjust the parameters of the generic RSHL model referring to several varieties of peaches and nectarines. Postharvest protocols are simulated to obtain ready-to-eat fruit for recently bred varieties. To this aim, temperature was recorded continuously throughout the postharvest protocol, while instrumental and sensory evaluations were taken at the end of each stage of the protocol. Outputs of a principal component analysis based on instrumental data allowed to i) identify the instrumental variables most relevant to sensory evaluation and corresponding evolution under shelf life conditions and ii) define a multidimensional estimator of shelf life. The particular values of this multidimensional estimator together with the temperature series are the basis to solve the equation that lead to specific values of Q10 and reference shelf life for each variety in the study. The average reference shelf life of peaches is bounded to 24 d, 30 % shorter (10 d less) than the average shelf life of nectarines. The Q10 values are bounded between 1.5 and 2.8, highlighting the varietal effects. Generally, Q10 values for peaches are indicative of a higher susceptibility to the breakage of the cold chain compared to nectarines.

Keywords: /Stone fruit/ /Ready-to-eatq10/ /Supply chain/ /Shelf life model/

Garcia-Pastor, M., Falagan, N., Gine-Bordonaba, J., Wojcik, D., Terry, L., & Alamar, M. (2021). Cultivar and tissue-specific changes of abscisic acid, its catabolites and individual sugars during postharvest handling of flat peaches (Prunus persica cv. platycarpa). *Postharvest Biology and Technology, 181*, 111688. https://doi.org/10.1016/j.postharvbio.2021.111688

Abstract

The role of abscisic acid (ABA) during postharvest ripening of peaches remains unclear. This study aimed to investigate the temporal and tissue-specific changes in ABA, and ABA catabolites, of two flat peach cultivars, 'Plane Sun' and 'Platibell', during the stone fruit supply chain. The relationship between ABA catabolism, ethylene production, individual sugar changes and fruit firmness was also studied. We found that flat peaches can produce and metabolise ABA during postharvest ripening, and that this is cultivar and tissue dependent. Our results demonstrated that a burst in ABA concentration preceded that of ethylene production in 'Plane Sun' fruit, suggesting cross-talk between the two hormones. ABA and ethylene were both negatively correlated with fruit firmness, whilst sugar content, especially glucose, was only correlated with ABA. In conclusion, ABA may trigger ethylene production changes while also affecting sugar metabolism leading to fruit softening and over-ripening associated processes during stone fruit postharvest handling.

Keywords: /Ethylene/ /Non-structural carbohydrates/ /Ripening control / /Senescence/

Tatsuki, I., Sawamura, Y., Yaegaki, H., Suesada, Y., Nakajima, N. (2021). The storage temperature affects flesh firmness and gene expression patterns of cell wall-modifying enzymes in stony hard peaches. *Postharvest Biology and Technology, 181,* 111658. https://doi.org/10.1016/j.postharvbio.2021

Abstract

Stony hard (SH) peaches undergo minimal softening on the tree or after harvest in air at room temperature. Instead, the firmness of SH peach fruit is reduced by treatments with ethylene or auxin or storage at 10 °C. In this study, the SH peach cultivar 'Manami' was stored at 0 °C, 5 °C, 8 °C, 10 °C, 15 °C, 18 °C, and 20 °C to characterize fruit softening with storage temperature. Fruit firmness was effectively reduced with storage at 8 °C, 10 °C, and 15 °C, with softening occurring, even in fruit with lower ethylene production, at 15 °C. In these fruit tissues, expression of a cell wall-modifying enzyme gene coding for polygalacturonase (*PG*) was identified (*PpPGM*), which is related to fruit firmness. The duration and sequence of different softening treatments were also examined. Fruit stored at 10 °C for 6 d prior to cold storage (0 °C) continued to soften after storage, and *PpPGM* was expressed in these tissues during cold storage. However, fruit stored at 0 °C or 20 °C for longer than 2 w did not soften during subsequent treatment at 10 °C. These results indicate that temperature-induced fruit softening, for example, within 7 d of treatment and during storage at 15 °C, occurred under conditions of lower ethylene production and may be partly attributed to ethylene-independent *PG* induction. Thus, *PG* expression might be an important factor for SH peach fruit softening during or after storage.

Keywords: /*Prunus persica* (L)./ /Batsch/ /Stony hard peach/ /Temperature/ /Softening/ /Endo-polygalacturonase/ /Pectinmethylesterase/

Xie, B., Ling, C., Hu, S., Hou, Y., Zheng, Y., Jin, P. (2021). CaM enhances chilling tolerance of peach fruit by regulating energy and GABA metabolism. Postharvest Biology and Technology, 181, 111691. https://doi.org/10.1016/j.postharvbio.2021.111691

Abstract

The effects of calcium chloride (CaCl2), calmodulin antagonist trifluoperazine (TFP) and different storage temperatures on chilling injury (CI) of peach fruit during postharvest storage were studied. The results showed that 0 ℃ storage and CaCl2 treatment reduced the CI index, reduced the ion leakage and maintained the integrity of the cell membrane. Storage at 0 ℃ and CaCl2 treatment increased calmodulin (CaM) expression and protein content, energy charge (EC), adenosine triphosphate (ATP) content and adenosine diphosphate (ADP) content. At the same time, it also promoted the expression and activity of Ca2+-ATPase and other enzymes related to energy metabolism. In addition, storage at 0 ℃ and CaCl2 treatment promoted the expression and activity of glutamic acid decarboxylase (GAD), and increased the content of γ-aminobutyric acid (GABA) and the expression of GABA transaminase (GABA-T*)*. On the contrary, TFP treatment significantly increased CI index and ion leakage, significantly inhibited *PpCaM* expression and protein content, and decreased EC and GABA content. Moreover, the molecular properties of PpCaM were studied. The results showed that PpCaM was a highly conserved hydrophilic protein, located on the nucleus and plasma membrane. PpCaM could induce the expression of *PpCa2+-ATPase*, increase the activity of Ca2+-ATPase, and participate in the regulation of energy metabolism. In addition, PpCaM could activate the activity of PpGAD, promote the synthesis of GABA, and participate in the regulation of GABA metabolism. These results suggested that 0 ℃ storage and CaCl2 treatment promoted the expression of *PpCaM* and increased the protein content of PpCaM, suggesting PpCaM enhanced the cold resistance and reduced the occurrence of CI by participating in the regulation of energy metabolism and GABA metabolism.

Keywords: /Cold stress/ /Ca2+CaM/ /Energy metabolism/ /Peach fruit/

Zhu, Y., Wang, K., Wu, C., Hao, Y., Zhang, B., Grierson, D., Chen, K., & Xu, C. (2021). DNA hypermethylation associated with the development of temperature-dependent postharvest chilling injury in peach fruit. *Postharvest Biology and Technology, 181,* 111645. https://doi.org/10.1016/j.postharvbio.2021.111645

Abstract

Peach fruit is often subjected to postharvest chilling injury (CI) during long-term cold storage and the degree of CI is related to the storage temperature. Analysis of the data on softening, ethylene production and internal browning (IB) showed that CI occurred in fruit stored at or below 12 °C. Impairment of ethylene production and softening was greater in fruit stored at 0 and 5 °C and was consistent with lower expression of related critical genes. Lower malondialdehyde and hydrogen peroxide contents and enhanced hydroxyl radical contents were observed in fruit stored at 0 and 5 °C. These changes were associated with higher transcript levels of *polyphenol oxidases* and *peroxidase*, but lower expression levels of *lipoxygenase*, *superoxide dismutase* and *catalase*. To investigate whether DNA methylation is involved in the CI development in peach fruit, single-base resolution DNA methylome and transcriptome analysis was carried out. The DNA methylation level was higher in CI fruit and a close positive correlation was observed between the methylation level and IB index. Furthermore, for most genes involved in softening, ethylene biosynthesis and signal transduction, IB and reactive oxygen species metabolism, the expression level was found to be well correlated with low temperature-induced DNA hyper- or hypo-methylation in promoter, genebody or downstream regions. It was concluded that changes in DNA methylation in different genomic regions regulate CI associated gene expression and contribute to the development of temperature-dependent CI in postharvest peach fruit.

Keywords: /Chilling injury/ /DNA methylation/ /Internal browning/ /Low temperature/ /Peach (*Prunus persica*)/ /Softening/

PEAR

Qian, M., Wang, L., Zhang, S., Sun, L., Luo, W., Posny, D., Xu., S., Tang, C., Ma, Min, Zhang, C., Lin, S., Wang, J., Hui, W., & Zhang, S. (2021). Investigation of proline in superficial scald development during low temperature storage of 'Dangshansuli' pear fruit. Postharvest Biology and Technology, 181, 111643. https://doi.org/10.1016/j.postharvbio.2021.111643

Abstract

The role of proline in superficial scald development in pear fruit was investigated in this study. During low temperature storage of 'Dangshansuli' pear fruit, superficial scald incidence and index accumulated in association with the alternation of α-farnesene and conjugated trienols (CTols). 14 out of 17 free amino acids were identified; proline content gradually decreased, which was consistent with the up-regulation of PbrP5CS activity and down-regulation of PbrProDH activity in its metabolic pathway. A total of 14 genes involved in proline metabolism were identified based on transcriptome annotation with diverse expression profiles. Results from correlation analysis among proline content further indicate that enzyme activity and gene expression profile, *PbrProDH2*, *PbrProDH4*, *PbrProDH5* & *PbrP5CS5* might play a critical role in proline metabolism during low temperature storage of 'Dangshansuli' fruit; thus, influencing superficial scald development which was then functionally validated using the transgenic pear fruit. Postharvest 1-MCP and diphenylamine (DPA) treatment inhibited the accumulation of CTols, and thus, mitigated superficial scald development and maintained higher proline content, in association with the up-regulated PbrP5CS activity, *PbrP5CS4* & *PbrP5CS5* mRNAs as well as the down-regulated PbrProDH activity & *PbrProDH4* transcripts. In a further study, we found that exogenous application of proline alleviated superficial scald incidence and index. To that end, the results of our study confirmed that proline was involved in superficial scald development during pear storage.

Keywords: /*Pyrus bretschneideri*/ /Superficial scald/ /Proline/ /1-MCP/ /DPA/

Zhai, R., Xiang, F., Song, J., Wang, Z., Yang, C., & Xu, L. (2021). Roles of laccase and cultivar-specific phenolic composition in scald-like disorder development in pears. *Postharvest Biology and Technology, 181,* 111651. https://doi.org/10.1016/j.postharvbio.2021.111651

Abstract

'Starkrimson' pears are prone to develop scald-like disorders after cold storage. In contrast, 'Conference' pears are less susceptible to scald-like disorders. In the present study, the scald morphology and underlying mechanism related to scald formation in 'Starkrimson' fruit and 'Conference' fruit were investigated. The scald-like symptoms in the two pear varieties were different from typical superficial scald in pears. In 'Starkrimson' fruit, the scald morphology was similar to soft scald symptoms, and the scald disorder could be inhibited by 1-MCP treatment but not triggered by oxidation of α-farnesene. In 'Conference' fruit, the occurrence of scald-like symptoms was accompanied by fruit senescence. To elucidate the scald formation mechanism in the two cultivars, scald incidence, membrane integrity, PPO activities, laccase activities and phenolic compositions were evaluated in peel tissue of 'Starkrimson' and 'Conference'. The cell membrane integrity related parameters including malondialdehyde (MDA) contents and relative leakage rates (RLR) gradually increased accompanying scald development in both cultivars. However, higher levels of MDA contents and RLR but less scald symptom was observed in 'Conference' than those in 'Starkrimson'. The enzymatic browning during scald development was further confirmed to be catalyzed by laccases but not PPO. Laccase activity and the expression pattern of *PcTT10* (the typical enzymatic browning related laccase) were highly associated with scald development. Moreover, the native phenolic compounds in 'Starkrimson' could cause more severe enzymatic browning than that in 'Conference'. Taken together, our results indicated although cell membrane integrity and laccase participated in scald formation in pear fruit, variable phenolic composition in different pear cultivars may contribute to their different susceptibility to scald.

Keywords: /Scald-like disorder/ /Laccase/ /*PcTT10*/ /Phenolic/ /Pear/

PITAYA

Li, X., Li, B., Min, D., Ji, N., Zhang, X., Li, F. & Zheng, Y. (2021). Transcriptomic analysis reveals key genes associated with the biosynthesis regulation of phenolics in fresh-cut pitaya fruit (Hylocereus undatus). *Postharvest Biology and Technology, 181,* 111684. https://doi.org/10.1016/j.postharvbio.2021.111684

Abstract

Wounding stress induces phenolic accumulation in pitaya fruit (*Hylocereus undatus*). This study aimed to elucidate the possible molecular mechanism underlying the wound-induced phenolic biosynthesis in fresh-cut pitaya fruit based on transcriptomic and bioinformatic analysis. Wounding stress induced the activation of metabolic pathways associated with phenolic biosynthesis, including secondary metabolism such as phenylpropanoid pathway and flavonoid pathway, signaling molecules metabolism such as ethylene, reactive oxygen species and jasmonic acid, and primary metabolism such as glycolysis, pentose phosphate pathway and shikimate pathway. Moreover, weighted gene coexpression network analysis and evolutionary relationship analysis revealed that 1 HuMYB, 3 HubHLHs, 7 HuAP2-EREBPs could be identified as putative transcription factors participating in the regulation of wound-induced phenolic biosynthesis in pitaya fruit. These findings validated previous study that wounding stress induces the conversion of hexose pool to supply essential carbon skeletons for the phenolic accumulation in fresh-cut pitaya fruit in transcriptional level and provide important and useful genetic information for further studies on the functions of transcription factors in wounding response in pitaya fruit.

Keywords: /Pitaya fruit/ /Wounding stress/ /Phenolics/ /RNA-Seq/ /Transcription factors/

POSTHARVEST TECHNOLOGY

Zhang, H. & Tikekar, R. (2021). Air microbubble assisted washing of fresh produce: Effect on microbial detachment and inactivation. *Postharvest Biology and Technology, 181*, 111687. https://doi.org/10.1016/j.postharvbio.2021.111687

Abstract

Chlorine based sanitizers are used during fresh produce washing to reduce microbial cross-contamination. However, the antimicrobial effectiveness of these sanitizers on pathogens attached to produce surface is limited. Therefore, we evaluated the ability of air microbubbles to detach and inactivate bacteria from fresh produce and generate sub-lethal stress within bacteria to increase their susceptibility to sodium hypochlorite, thus improving the latter's efficacy. At tested levels, air microbubbles did not cause damage to *E. coli* O157:H7 cell membrane or intracellular oxidation. Compared to water, microbubble-assisted washing had no improvement on bacterial detachment from grape tomatoes, blueberries, and baby spinach. Microbubble-assisted washing resulted in 3.3 ± 0.1, 0.8 ± 0.5, and 1.0 ± 0.4 log CFU/g reduction from grape tomatoes, blueberries, and baby spinach surface when used together with 100 mg/L sodium hypochlorite, indicating the role of produce surface properties on bacterial inactivation. However, these reductions were not significantly different from that obtained by washing these samples with 100 mg/L sodium hypochlorite in the absence of microbubbles ($P > 0.05$), indicating that air microbubbles did not increase the efficacy of sodium hypochlorite. Interestingly, microbubble assisted washing significantly increased ($P < 0.05$) soil removal from baby spinach, with the turbidity of sonicated water, which represented the soil content remaining on produce following washing (with or without microbubbles) process, reduced from 52.9 ± 11.5 (control) to 14.3 ± 2.4 NTU, compared to 31.0 ± 7.7 NTU for water washed samples. At tested conditions, air microbubbles may have limited effect on detachment and inactivation of bacteria in the presence of sanitizers, but they can improve cleaning efficacy of washing processes.

Keywords: /Air microbubbles/ /Disinfection/ /Detachment/ /*E. coli* O157:H7/ /Sodium hypochlorite/

Martinez-Zamora, L., Castillejo, N., & Artes-Hernandez, F. (2021). Postharvest UV-B and UV-C radiation enhanced the biosynthesis of glucosinolates and isothiocyanates in Brassicaceae sprouts. *Postharvest Biology and Technology, 181,* 111650. https://doi.org/10.1016/j.postharvbio.2021.111650

Abstract

The objective of this study was to evaluate the effect of UV lighting (UV-B, UV-C and UV-C + UV-B) as a postharvest abiotic stress in the quality changes of minimally processed *Brassicaceae* sprouts (broccoli and radish) during a shelf-life period of 10 d at 4 °C. No UV illumination was used as control (CTRL). The total UV-C doses received were 9 kJ m−2 (UVC) and 15 kJ m−2 UV-B (UVB) by applying the 50 % of such doses after harvest and on the first day of the shelf-life. Results showed that when UVC was applied, the epiphytic microbial load was reduced up to 1 log CFU g-1 fw. The UVB treatment reported the highest total phenolic content (TPC) and total antioxidant capacity (TAC) after 10 d at 4 °C. In general, both species showed an amelioration effect in the TPC and TAC after UV treatments, which also enhanced the glucosinolate (GL) and the main isothiocyanates (ITC) content. In fact, UVB increased by ~30 % the GL content compared to CTRL samples, which were mostly aliphatic GLs in radish and indolyl GLs in broccoli. As main ITC, sulforaphane content was enhanced by 37.5 % in UVB-treated broccoli sprouts while the sulforaphene content was highly increased by 72 % in radish sprouts. In conclusion, UVB radish sprouts reported 5-fold higher GL content and 60-fold higher biologically ITC content than broccoli sprouts. Therefore, its inclusion in the daily intake is recommended to increase the prevention of chronic inflammatory diseases.

Keywords: /Broccoli/ /Radish/ /*Crucifereae*/ /Fresh-cut/ /Glucoraphanin/ /Sulforaphane/

POTATO

Barrera-Gavira, J., Pont, S., Morris, J., Hedley, P., Stewart, D., Taylor, M. & Hancock, R. (2021). Senescent sweetening in potato (Solanum tuberosum) tubers is associated with a reduction in plastidial glucose-6-phosphate/phosphate translocator transcripts, *Postharvest Biology and Technology, 181,* 111637. https://doi.org/10.1016/j.postharvbio.2021.111637

Abstract

Senescent sweetening results in the accumulation of reducing sugars in potato tubers following extended periods of storage at moderate temperatures used to avoid the separate condition of cold-induced sweetening. It represents a significant problem for the potato processing industry due to the development of dark fry colour and the accumulation of acrylamide in processed products. Previous studies have implicated oxidative stress in the accumulation of reducing sugars in potato tubers over long term storage. However, in the present analysis we found no evidence for a correlation between oxidative stress as estimated from quantification of hydrogen peroxide, lipid peroxidation or activity of redox enzymes and the accumulation of reducing sugars. On the contrary, transcriptional profiling indicated changes in carbohydrate metabolism were associated with the onset of senescent sweetening and qRT-PCR indicated that reduced abundance of transcripts encoding a plastidial glucose-6-phosphate/phosphate translocator was widely observed during sweetening onset in multiple genotypes. Our data suggest that reduction in the capacity of plastids to import glucose-6-phosphate reduces the capacity for starch resynthesis in the stored tuber thereby shifting the metabolic balance towards starch turnover resulting in reducing sugar accumulation.

Keywords: /Carbohydrate metabolism/ /Starch/ /Reducing sugars/ /Acrylamide/ /*Solanum tuberosum*/ /Storage/

Kothawade, G., Chandel, A.K., Khot, L.R., Sankaran, S., Bates, A., & Schroeder, B. (2021). Field asymmetric ion mobility spectrometry for pre-symptomatic rot detection in stored Ranger Russet and Russet Burbank potatoes. *Postharvest Biology and Technology, 181*, 111679. https://doi.org/10.1016/j.postharvbio.2021.111679

Abstract

This study was aimed at early detection and rot progression monitoring in stored potatoes using a portable field asymmetric ion mobility spectrometry (FAIMS) system. Tuber samples of Ranger Russet (RR) and Russet Burbank (RB) cultivars were inoculated with *Pectobacterium carotovorum*subsp.*carotovorum* (causes soft rot) and sterile water (control). The samples were stored in jars either at room temperature (25 °C with 30 % relative humidity [RH]) or reduced temperature (4 °C with 95 % RH). Volatile headspace from samples was scanned with FAIMS at regular intervals up to 14 days for room temperature and 31 days for reduced temperature storages. Infection symptoms were detected for higher ion current pertinent to headspace of inoculated samples compared to the controls of both the cultivars. Such discrimination was evident at FAIMS compensation voltage (CV)-dispersion field (DF) ranges of −1.70–1.31 V and 38–90 % for room temperature and −1.58–1.31 V and 36–92 % for reduced temperature storages. The rot was detected as early as one day after inoculation (DAI) under room temperature and five DAI under reduced temperature storages. The ion currents were affected by the storage temperature and humidity, and associated interaction with the DAI and cultivar ($F_{7,712}$ = 21.6–31.4, $p < 0.001$). The FAIMS responses of control and inoculated tubers were also classified by the Naïve Bayes and Random Forest algorithms at accuracies in the ranges of 70–90 % and 75–100 %, respectively. Overall, a portable and tunable FAIMS system was found suitable for high throughput early detection of soft rot in potato tubers. Future studies need to revalidate the FAIMS system in commercial storage facilities for timely rot detection and initiation of potential remedial measures.

Keywords: /Potato postharvest losses/ /Soft rot/ /*Pectobacterium carotovorum* subsp. *carotovorum*/ /Volatile organic compounds/ /FAIMS/

Tiwari, R.K., Bashyal, B.M., Shanmugam, V., Lal, M.K., Kumar, R., Sharma, S., Gaikwad, V.K., Singh, B., & Aggarwal, R. (2021). Impact of Fusarium dry rot on physicochemical attributes of potato tubers during postharvest storage. *Postharvest Biology and Technology, 181*, 111638. https://doi.org/10.1016/j.postharvbio.2021.111638

Abstract

Fusarium is a major spoilage fungus of potato tubers during post-harvest storage. The dry rot disease caused by *Fusarium* species severely affects the harvested potatoes and impose a critical loss to processing industries and consumers. In our experiment, we investigated the occurrence of *Fusarium sambucinum* (FS) and *Fusarium oxysporum* (FO) as major storage fungus causing *Fusarium* dry rot in potato tubers. Further, we performed morpho-molecular identification of both the fungi and confirmed their pathogenicity on potato tuber during storage. We evaluated the susceptibility parameters and quality attributes during infection in two popular cultivars namely ‘Kufri Pukhraj’ (table purpose) and ‘Kufri Chipsona 3’ (processing purpose). Out of two cultivars, ‘Kufri Pukhraj’ was shown to have greater susceptibility as compared to ‘Kufri Chipsona 3’ in terms of lesion diameter, fungus penetration and rot volume during periodic observation of 20, 40 and 60 d of storage. FS was highly aggressive as compared to FO. However, a mixed inoculum of *Fusarium* species caused higher damage irrespective of cultivars. The physicochemical analysis revealed that fungus infection (individual or mixed inoculum) leads to a reduction in starch and amylose content in both the cultivars after 60 d of storage. Moreover, amylopectin, reducing sugars, sucrose and total soluble sugar content were increased in response to fungal infection in both cultivars. Pearson correlation analysis indicated that lesion diameter and rot volume was negatively correlated ($R < -0.80$) with starch and amylose content. However, amylopectin, reducing sugar, sucrose and total soluble sugar was positively correlated with susceptibility parameters. This study highlights the impact of storage fungus infection on the nutritional quality parameters of potato tubers which is a critical concern for consumers and processing industries.

Keywords: /*Fusarium*/ /Pathogenicity/ /Lesion diameter/ /Starch/ /Post-harvest storage/

Zhou, F., Xu, D., Liu, C., Chen, C., Tian, M., &Jiang, A. (2021). Ascorbic acid treatment inhibits wound healing of fresh-cut potato strips by controlling phenylpropanoid metabolism. *Postharvest Biology and Technology, 181,* 111644. https://doi.org/10.1016/j.postharvbio.2021.111644

Abstract

In this study, we investigated the ability of ascorbic acid (AA) to regulate the wound-healing response in fresh-cut potato strips during storage. The results demonstrated that treatments of AA could delay browning, decrease hardening, improve taste, as well as reduce weight loss and respiration rate. Furthermore, AA treatment inhibited wound healing by modulating the activity of phenylalanine ammonia-lyase (PAL), cinnamate-4-hydroxylase (C4H), 4-coumarate-CoA ligase (4CL), chalcone synthase (CHS) and coumarate-3-hydroxylase (C3H), increasing total phenolics and flavonoid content, and decreasing monomeric phenolic acid content, including caffeic acid, *p*-coumaric acid, and ferulic acid. The accumulation of lignin and the polyphenolic component of suberin was also reduced. Overall, our results provided information on wound healing and revealed the potential benefits of AA in regulating the process of suberization in potato strips.

Keywords: /Ascorbic acid/ /Fresh-cut potato strips/ /Wound healing/ /Phenylpropanoid metabolism/

ROSE

Fang, H., Wang, C., Wang, S. & Liao, W. (2021). Hydrogen gas increases the vase life of cut rose 'Movie star' by regulating bacterial community in the stem ends. *Postharvest Biology and Technology, 181,* 111685. https://doi.org/10.1016/j.postharvbio.2021.111685

Abstract

Hydrogen gas (H2), as a signal molecule, is involved in plant growth, development and stress response. However, there are no reports about the effects of H2 on the bacteria at the stem ends of cut flowers. The study investigated whether hydrogen-rich water (HRW, as a H2 donor) might regulate the postharvest preservation of cut rose (*Rosa hybrida* 'Movie star') by regulating the bacteria community of the stem ends. The results showed that HRW significantly improved the vase life of cut roses. HRW inhibited bacterial colonization and biofilm formation in the xylem vessels. Thus, HRW decreased the bacterial blockages and rot in the xylem vessels, thereby promoting water uptake of cut flowers and prolonging their vase life. While, by high-throughput sequencing of the 16S rRNA gene sequence, we found that HRW significantly increased the richness index of bacteria on the stem-end cut surface, suggesting that the beneficial bacteria abundances on the stem-end cut surface were increased by HRW. The results from the individual beneficial bacteria inoculations also verified the results. Consequently, HRW increased the vase life and ornamental quality of cut roses by decreasing bacterial blockages in the xylem vessels and increasing the beneficial bacteria abundances on the stem-end cut surface.

Keywords: /Cut rose (*Rosa hybrida*)/ /Hydrogen-rich water (HRW)/ /Bacteria community/ /Beneficial bacteriaWater relations/ /Vase life/

SWEET CHERRY

Zhang, Y.-L., Cui, Q.-L., Wang, Y., Shi, F., Liu, Y.-P., Liu, J.-L., & Nie, G.-W. (2021). Effect of carboxymethyl chitosan-gelatin-based edible coatings on the quality and antioxidant properties of sweet cherry during postharvest storage. *Scientia Horticulturae*, *289*, 110462. https://doi.org/10.1016/j.scienta.2021.110462

Abstract

The effects of various carboxymethyl chitosan (CMCS)-gelatin (GL) based edible coating combinations with CaCl 2 and/or ascorbic acid (AA) on the quality and antioxidant properties of sweet cherry were investigated. The fruits treated with AA-CaCl 2 -CMCS-GL showed the lowest fruit decay ratio, weight loss, and pedicel browning incidence at the end of storage. AA-CaCl 2 -CMCS-GL treatment significantly slowed down the decrease process of fruit firmness throughout storage. Total phenolic, total anthocyanin content, and antioxidant activity were higher in AA-CaCl 2 -CMCS-GL fruit during storage. The effects of various carboxymethyl chitosan (CMCS)-gelatin (GL) based edible coating combinations with calcium chloride (CaCl 2) and/or ascorbic acid (AA) on the quality and antioxidant properties of sweet cherry (Prunus avium L. cv. "Red Agate") were investigated. Sweet cherries were treated with tap water (control), 2 % CaCl 2 , CMCS-GL, CaCl 2 + CMCS-GL, CaCl 2 -CMCS-GL, or AA-CaCl 2 -CMCS-GL for 2 min and dried at ambient temperature. All fruit were stored at 0 ± 0.5 °C under Relative Humidity (RH) of 85–90 % for 30 d, and 23 ± 1 °C, RH 40-50 %, for a further 3 d. Weight loss, fruit firmness, soluble solids content (SSC), titratable acidity (TA), SSC/TA, AA, skin color characteristics (L_*, chroma, and hue angle), total phenolics compounds (TPC), total anthocyanins concentration (TAC), and antioxidant activity (DPPH and ABTS+ radical scavenging capacity) were measured, in addition to fruit decay ratio, pedicel browning incidence, and pedicel moisture content. AA-CaCl 2 -CMCS-GL treatment decreased fruit decay ratio, weight loss, respiration rate, and pedicel browning incidence; slowed the increase of SSC and SSC/TA; maintained high fruit firmness, pedicel moisture content, TA, AA, TPC, TAC, and antioxidant activity. Fruit coated with AA-CaCl 2 -CMCS-GL exhibited better skin color with higher L_*, chroma, and hue angle values throughout the storage period. AA-CaCl 2 -CMCS-GL treatment is a promising management strategy to control the quality of sweet cherries during postharvest storage.

Keywords: /Ascorbic acid/ /Carboxymethyl chitosan/ /Edbile coating/ /Gelatin/ /Postharvest storage/ /Sweet cherry/

TOMATO

Tao, X., Wu, Q., Li, J., Cai, L., Mao, L., Luo, Z., Li, L., & Ying, T. (2021). Exogenous methyl jasmonate regulates sucrose metabolism in tomato during postharvest ripening. *Postharvest Biology and Technology, 181*, 111639. https://doi.org/10.1016/j.postharvbio.2021.111639

Abstract

Sucrose metabolism is a fundamental process during tomato ripening. Studies have shown the role of the phytohormone methyl jasmonate (MeJA) in tomato fruit ripening. However, the role of MeJA in regulating sucrose metabolism in tomatoes is still unclear. In this study, mature green cherry tomato fruits were infiltrated with MeJA (0.5 mM) or sterile deionized water (control). The changes in color, firmness, and ethylene production in fruit, the contents of sucrose, glucose and fructose, and the enzymatic activities and the expression levels of key genes associated with sucrose metabolism were determined periodically during a storage period of 16 d. MeJA-treated fruit showed a significant acceleration in ripening, with higher a* value and ethylene production and lower firmness. MeJA treatment enhanced sucrose phosphate synthase (SPS) activity, whereas it inhibited acid invertase (AI) and neutral invertase (NI) activities. These changes in enzyme activities together resulted in a significantly higher sucrose content and lower glucose and fructose contents. Furthermore, exogenous MeJA upregulated the gene expression levels of sucrose-phosphate synthase1–4 (*SPS1-4*) and sucrose-phosphate phosphatase2 (*SPP2*), which were associated with sucrose biosynthesis, and downregulated those related to sucrose degradation, except for sucrose synthase2 (*SUS2*) and *SUS3*. The findings indicated that exogenous MeJA might alter sucrose metabolism during tomato ripening by regulating the enzymatic activities and gene expression levels. This research provides valuable information to elucidate the mechanisms via which MeJA regulates tomato sucrose metabolism.

Keywords: /Tomato/ /Methyl jasmonate/ /Ripening/ /Sucrose/ /metabolism/ Enzymatic activity/ /Gene expression/

Zhu, G.Y., Sha, P.F., Zhu, X.X., Shi, X., Shahriar, M., Zhou, Y., Wang, S., & Laborga, P. (2021). Application of melatonin for the control of food-borne Bacillus species in cherry tomatoes. *Postharvest Biology and Technology, 181,* 111656. https://doi.org/10.1016/j.postharvbio.2021.111656

Abstract

Food-borne *Bacillus* species are often associated with postharvest fruit and vegetables, and are a common cause of food poisoning. In this work, melatonin was found to inhibit the growth of food-borne *Bacillus* species, including *B. cereus*, *B. licheniformis* and *B. subtilis*, on cherry tomatoes. This result was attributed to two complementary effects. On one side, melatonin showed antibacterial activity to *B. subtilis*, inhibiting cell division and oxidative phosphorylation, and reducing swimming motility and biofilm formation. On the other side, melatonin enhanced the antioxidant capacity of cherry tomatoes, and induced the biosynthesis of phenolics and ethylene, and the overexpression of pathogenesis-related genes *PT16* and *PR1b1*. The defence response was only observed in the presence of both *B. subtilis* and melatonin, but not in the single treatments. Although melatonin was known to induce disease resistance in fruit in the presence of necrotrophic pathogens, this is the first report of melatonin inducing fruit defence after treatment with a non-necrotrophic bacterium. Collectively, the application of melatonin for the control of food-borne *Bacillus* pathogens was explored for the first time, revealing a new potential application of melatonin in postharvest products.

Keywords: /Melatonin/ /Food-borne pathogens/ /Fruit preservation/ /Postharvest biology/ /*Bacillus* species/

YAM

Guo, S., Zhao, X., Ma, Y., Zhang, Y., & Wang, D. (2021). Ethanol treatment suppresses the yellowing of fresh-cut yam by repressing the phenylpropanoid pathway and bisdemethoxycurcumin biosynthesis *Postharvest Biology and Technology, 181,* 111642. https://doi.org/10.1016/j.postharvbio.2021.111642

Abstract

An ethanol treatment (10 % v/v) inhibited the yellowing of fresh-cut yam during storage. The ethanol treatment also prevented bisdemethoxycurcumin formation, and reduced the contents of metabolites in fresh-cut yam during storage at 25 °C. Ethanol treatment also inhibited the activities of key enzymes in the phenylpropanoid pathway, including phenylalanine ammonia lyase (PAL), cinnamic acid-4-hydroxylase (C4H), and 4-coumarate-CoA ligase (4CL), and decreased the transcription level expressions of PAL, C4H, and 4CL compared to the control. The expressions of diketide-CoA synthase, curcumin synthase 3, and curcumin synthase were also reduced by ethanol treatment compared to the control, in agreement with the absence of bisdemethoxycurcumin in fresh-cut yam treated with ethanol. These findings suggest that ethanol can be used to attenuate the yellowing of fresh-cut yam stored at 25 °C, which may be related to ethanol inhibition of the phenylpropanoid pathway and bisdemethoxycurcumin biosynthesis.

Keywords: /Yam/ /Ethanol/ /Yellowing/ /Bisdemethoxycurcumin/ /Enzyme/