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As of July 2021

APPLE

Fernández-Cancelo, P., Teixidó, N., Echeverría, G., Torres, R., Larrigaudière, C., & Giné-Bordonaba, J. (2021). Dissecting the influence of the orchard location and the maturity at harvest on apple quality, physiology and susceptibility to major postharvest pathogens. *Scientia Horticulturae*, *285*, 110159. https://doi.org/10.1016/j.scienta.2021.110159

Abstract

'Golden Reinders' apple quality parameters, fruit physiology, biochemical composition and susceptibility to *Penicillium expansum* and *Rhizopus stolonifer* were analysed in fruit harvested from four different locations (two valley and two mountain orchards) and from the same valley orchard at six different maturity stages. Growing location strongly influenced the taste- and health-related fruit composition whereas the fruit maturity at harvest mainly affected the ethylene biosynthetic pathway and ethylene-dependant quality traits such as the fruit firmness and starch index. The fruit maturity at harvest, but not the growing location, also affected the severity of the infection caused by *P. expansum* and *R. stolonifer*, with mature fruit showing higher susceptibility to pathogen infection. Besides, by employing a Partial Least Square (PLS) regression model, our data showed that the severity of the lesions caused by *R. stolonifer* were intimately related to the fruit ethylene production. Overall, the results from this study demonstrate that differences in environmental conditions between orchards (mountain vs valley) strongly influenced the composition of 'Golden Reinders' apples without affecting the susceptibility of the fruit to two major postharvest pathogens.

Keywords: /Antioxidants/ /Ethylene metabolism/ /*Penicillium expansum*/ /*Rhizopus stolonifer*/ /Sugars/

Gong, Y.F., Cao, Y., & Zhang, X.-R. (2021). Forced-air precooling of apples: airflow distribution and precooling effectiveness in relation to the gap width between tray edge and box wall. *Postharvest Biology & Technology, 177*, 111523. https://doi.org/10.1016/j.postharvbio.2021.111523

Abstract

Forced-air precooling is a widely-used precooling technique in the food cold chain. Optimizing ventilation design of packaging systems to improve cooling uniformity and reduce energy consumption has been a hot research topic. Inner tray is an important factor contributing to cooling heterogeneity. However, the study about the design optimization of inner tray is rather limited. The present study focused on the influence of inner tray on the precooling process of apples and explored the impact of widening the gap between the tray edge and box wall on airflow distribution and precooling effectiveness. A three-dimensional model was established on the basis of an existing container being widely used in China's agricultural cold-chain-logistics industry, and the direct computational fluid dynamics (CFD) simulation method was adopted to study the precooling process. The examined gap width increments were between 0 and 0.015 m. Results indicated that properly widening the gap was an effective way to achieve the goal of enhancing precooling effectiveness, without changing the design configuration parameters of the box. For the selected two-layer package, the optimal increment of the gap width was about 0.010 m, with which the cooling time could be reduced by 18.8 %, the cooling uniformity could be increased by 16.0 %, and the energy consumption could be reduced by 21.6 % simultaneously.

Keywords: /Direct computational fluid dynamics (CFD) simulation/ /Tray design/ /Flow heterogeneity/ /Cooling rate/ /Cooling uniformity/ /Energy consumption/

McCormick, R. J., Biegert, K., & Streif, J. (2021). Occurrence of physiological browning disorders in stored "Braeburn" apples as influenced by orchard and weather conditions. *Postharvest Biology & Technology*, *177*, 111534. https://doi.org/10.1016/j.postharvbio.2021.111534

Abstract

Physiological storage disorders continue to cause sizable economic losses in a range of commercially important pome fruit cultivars. Given similar storage regimes, the incidence and severity of browning disorders in the apple cultivar 'Braeburn' can vary in different years in a way that can be explained by the interaction of preharvest seasonal and orchard factors. Over a three-year period (2016–2019) at the Kompetenzzentrum Obstbau Bodensee (KOB) in Southwest Germany a range of orchard and storage treatments were conducted for: air temperature during cell division for three weeks post petalfall or during four weeks preharvest, and crop load. Following controlled atmosphere (CA) storage, the disorder incidence for internal browning and cavity formation varied markedly over the three different growing seasons. Crop load treatments strongly influenced the expression of browning disorders in all years. Differences in air temperatures (△ +/- 2 °C compared to ambient) during the cell division period showed little effect on browning incidence. Warm night temperatures (>10 °C) prior to harvest can reduce internal browning in 'Braeburn' apples during CA storage and shelf-life.

Keywords: /Controlled atmosphere (CA) storage/ /Crop load/ /Internal browning disorders/ /Receiver operating characteristic (ROC)/

APRICOT

Batool, M., Bashir, O., Amin, T., Wani, S. M., Masoodi, F. A., Jan, N., Bhat, S. A., & Gul, A. (2021). Investigating the effect of oxalic acid and salicylic acid treatments on the post-harvest life of temperate grown apricot varieties (Prunus armeniaca) during controlled atmosphere storage. *Food Science and Technology International, July 2021*. https://doi.org/10.1177/10820132211032074

Abstract

This study aimed at investigating the influence of different postharvest treatments with oxalic acid (OA) and salicylic acid (SA) on quality attributes and postharvest shelf life of temperate grown apricot varieties stored under controlled atmosphere (CA) storage conditions. After each treatment was given, the samples were stored in CA store maintained at a temperature of 0 °C, 90 ± 5% relative humidity, 5% oxygen and 15% carbon dioxide for 30 days. Results indicated that both OA and SA treatments significantly ($p \leq 0.05$) retained total soluble solids, titratable acidity, color profile, ascorbic acid content and total phenolic content of apricot varieties and had a positive effect on antioxidant activity and texture of samples compared to control. However, carotenoid content was found to be higher in control. Both the treatments reduced chilling injury index, weight loss and decay percentage of samples. Moreover, it was found that SA treatment was the most effective treatment in maintaining visual color of apricots while OA maintained fruit firmness and effectively decreased the decay percentage and chilling injury index of apricot varieties. In conclusion, it was found that both OA and SA have the potential to extend storage life of apricots and maintain quality attributes of the crop during CA storage.

Keywords: Apricot; antioxidant activity; chilling injury; controlled atmosphere storage; phenolic content

Fan, X., Du, Z., Cui, X., Ji, W., Ma, J., Li, X., Wang, X., Zhao, H., Liu, B., Guo, F., & Gong, H. (2021). Preharvest methyl salicylate treatment enhance the chilling tolerance and improve the postharvest quality of apricot during low temperature storage. *Postharvest Biology & Technology*, *177*, 111535. https://doi.org/10.1016/j.postharvbio.2021.111535

Abstract

Apricot is highly susceptible to chilling injury during low temperature storage, while methyl salicylate (MeSA) can alleviate chilling injury and enhance the postharvest quality of fruit. The apricots were preharvest sprayed twice with 0.05 mmol L^{-1}, 0.1 mmol L^{-1} and 0.2 mmol L^{-1} of MeSA solution, and then were harvested and stored at 2 °C (humidity of 70 %). After cold storage for every 4 d, apricots were transferred to 20 °C for 2 d to determine the fruit quality. Our results indicated that 0.2 mmol L^{-1} MeSA treatment exhibited the best efficacy. Preharvest MeSA treatment could reduce decay rate and chilling injury (CI) index, and maintain firmness, soluble solid content (SSC), organic acids and antioxidant capacities at a relative higher level. Preharvest MeSA treatment inhibited the increase of electrolyte leakage, malondialdehyde (MDA) and H_2O_2 content in apricot. The chilling temperature of 2 °C could lead to the degradation of sucrose to fructose and glucose in apricot. At the same time, preharvest MeSA treatment effectively alleviated CI symptoms of apricot by reducing the degradation rate. The enhanced chilling tolerance of apricot treated with MeSA could be affected by the increased sucrose content, which was regulated by the higher activities of sucrose phosphate synthase (SPS) and sucrose synthase-synthesis (SS-S), and the lower activities of acid invertase (AI), neutral invertase (NI) and sucrose synthase-cleavage (SS-C). We proposed that preharvest MeSA treatment could enhance the chilling tolerance by regulating sugar metabolism and further improve the postharvest quality of apricot during low temperature storage.

Keywords: /Apricot/ /Methyl salicylate/ /Chilling tolerance/ /Sugar metabolism/ /Postharvest quality/

BLUEBERRY

Ji, Y., Hu, W., Liao, J., Xiu, Z., Jiang, A., Guan, Y., Yang, X., & Feng, K. (2021). Ethanol vapor delays softening of postharvest blueberry by retarding cell wall degradation during cold storage and shelf life. *Postharvest Biology & Technology*, *177*, 111538. https://doi.org/10.1016/j.postharvbio.2021.111538

Abstract

Blueberry fruits were treated with 500 μL L^{-1} ethanol for 18 h and then stored at 0 ± 0.5 °C with 90 % relative humidity (RH) for 40 d. The firmness, contents of cell wall polysaccharides, activities of cell wall-degrading enzymes (CWDEs), and cell wall ultrastructure in the blueberry fruit were determined during storage. The results showed that the decline in firmness of blueberries was delayed by ethanol vapor treatment during cold storage and shelf life, compared to the control. The contents of water-soluble pectin (WSP) and 4 % KOH-soluble fraction (4KSF) in ethanol-treated blueberries were reduced compared to those in the control. The contents of EDTA-soluble pectin (ESP), Na_2CO_3-soluble pectin (SCSP), 24 % KOH-soluble fraction (24KSF), and cellulose in ethanol-treated blueberries were higher than the control. The activities of pectin methylesterase (PME), polygalacturonase (PG), carboxymethyl cellulase (CMCase), *β*-glucosidase (*β*-Glu), *β*-galactosidase (*β*-Gal), *α*-galactosidase (*α*-Gal), and *α*-mannosidase (*α*-Man) in blueberries were suppressed by ethanol vapor treatment. However, there was no significant difference in the activity of *α*-arabinofuranosidase (*α*-Af) between ethanol-treated blueberries and the control. Moreover, ethanol vapor treatment delayed the destruction of the cell wall structure of the blueberry fruit via ultrastructural observations. Ethanol vapor treatment can retard the disassembly of cell wall polysaccharides by inhibiting CWDEs activities, thereby delaying blueberry softening.

Keywords: /Blueberry/ /Ethanol vapor/ /Cell wall polysaccharides/ /Cell wall degrading enzymes/ /Softening/

Xu, F., Liu, S., Liu, Y., & Wang, S. (2021). Effect of mechanical vibration on postharvest quality and volatile compounds of blueberry fruit. *Food Chemistry*, *349*, 129216. https://doi.org/10.1016/j.foodchem.2021.129216

Abstract

The objective of the study was to investigate the effect of mechanical vibration on postharvest quality and volatile compounds in blueberries (*Vaccinium* spp. Berkeley). Ethylene production, respiratory rate, firmness, decay incidence, soluble solids content (SSC), titratable acid content (TAC), flavonoid content, total phenols content (TPC), enzyme activity and volatile compounds of blueberry fruit were determined. Results showed that mechanical vibration resulted in the increase of ethylene production, respiratory rate, decay incidence and the decrease of firmness, enzyme activity, SSC, TAC, flavonoid content, TPC in blueberries comparing with the control. Moreover, mechanical vibration improved the relative content of alcohols and decreased the relative content of esters in comparison with the control group. In conclusion, the effect of transport vibration on blueberry quality was conspicuous. The quality of blueberry fruit gradually decreased with the extension of vibration time during the transportation, which seriously reduced storage life and commodity value of blueberries.

Keywords: /Mechanical vibration/ /Postharvest quality/ /Volatile compounds/ /Blueberry/

CABBAGE

Tan, X., Fan, Z., Zeng, Z., Shan, W., Kuang, J., Lu, W., Su, X., Tao, N., Lakshmanan, P., Chen, J., & Zhao, Y. (2021). Exogenous melatonin maintains leaf quality of postharvest Chinese flowering cabbage by modulating respiratory metabolism and energy status. *Postharvest Biology & Technology*, *177*, 111524. https://doi.org/10.1016/j.postharvbio.2021.111524

Abstract

The efficacy of melatonin on postharvest quality of Chinese flowering cabbage was investigated in this study. Treatment of Chinese cabbage with melatonin significantly delayed leaf yellowing and maintained higher contents of nutrients such as soluble sugars, protein, vitamin C, total flavonoids and phenols during a 7-day storage. Also, melatonin enhanced the activities and expression level of glucose-6-phosphate dehydrogenase (G6PDH) and 6-phosphogluconate dehydrogenase (6-PGDH). Melatonin treatment decreased tissue weight loss, respiration rate, activities of phosphohexose isomerase (PHI), succinate dehydrogenase (SDH), cytochrome C oxidase (CCO), and ascorbic acid oxidase (AAO) and the expression of their corresponding genes. Additionally, melatonin-treated leaves maintained high energy status, as evidenced by higher total ATPase and nicotinamide adenine dinucleotide kinase (NADK) activities, higher energy charge level, adenosine triphosphate (ATP) and adenosine diphosphate (ADP) contents, lower level of adenosine monophosphate (AMP) and transcript abundance of respiratory enzymes. These findings collectively suggest that melatonin maintains leaf quality of postharvest Chinese flowering cabbage might be, at least in part, due to the reduced ratio of Embden-Meyerhof-Parnas pathway (EMP), tricarboxylic acid (TCA) cycle, and cytochrome pathway (CCP), a relatively higher level of pentose phosphate pathway (PPP) and energy status.

Keywords: Chinese flowering cabbage/ /Melatonin/ /Quality/ /Respiratory metabolism/ /Energy status/

CITRUS

Khumalo, G., Goedhals-Gerber, L. L., Cronje, P., & Berry, T. (2021). The non-conformance of in-transit citrus container shipments to cold protocol markets: A systematic literature review. *Food Control*, *125*, 107947. https://doi.org/10.1016/j.foodcont.2021.107947

Abstract

The cold chain is vital in the reduction of physiological developments in citrus fruit to prolong the shelf-life and influence market rates. It is also important for some niche export markets that have specified time-temperature cold treatment protocols as phytosanitary risk mitigation measures for pests that they deem to be of phytosanitary concern. The review covers 44 publications that relate to the non-conformance of in-transit citrus shipments with cold-chain specifications. The findings indicate that the literature can be categorised into different themes, namely technological trends, temperature control, and cold-chain modelling and refrigeration. In addition, the key findings from the literature reviewed show that most non-conformances that occur are due to temperature deviations in the cold chain. In addition, the study suggests a framework for successful engagement with the cold-treatment process. The framework adapted from a citrus industry assessment conducted in 2016 provides a detailed explanation of the different phases and processes that need to be followed to help minimise the occurrence of non-conformances, while also detailing some of the disadvantages of the three components that the framework is comprised of. The three components are: the pre-cooling phase, the container-packing phase and the pulp/probe-stabilisation phase. The results of the study serve as a basis to further develop the research area by presenting recommendations and proposing future research.

Keywords: /Citrus fruit/ /Cold chain/ /Cold-sterilisation protocol(s)/ /Non-conformance/ /Phytosanitary requirements/

Xu, F., An, H., Zhang, J., Xu, Z., and Jiang F. (2021). Effects of Fruit Load on Sugar/Acid Quality and Puffiness of Delayed-Harvest Citrus. *Horticulturae*, *7*(7), 189; https://doi.org/10.3390/horticulturae7070189

Abstract

Delayed harvesting technology is believed to improve the citrus fruit flavor, but improper tree fruit load under delayed harvest might cause puffiness and reduce fruit quality. In order to find out an optimum tree fruit load level to obtain better flavor quality as well as reduce puffiness in delayed-harvest citrus under protected cultivation, experiments were conducted in the present study between 2019 and 2020 to determine the effect of different fruit loads and fruit-bearing per single branch on the soluble sugars and organic acids metabolism in the peel and flesh, the anatomical structure of the matured fruit peel, and fruit texture-related indexes. The results suggested significant negative correlations between leaf N level and flesh sucrose and glucose contents, and between branch P level and flesh citric acid contents; no significant correlation between NPK levels and flesh texture; relatively lower leaf N and branch P under relatively higher load can increase flesh sucrose and glucose accumulation and slow down citric acid degradation to the greater extent, thus optimizing the sugar/acid ratio of fruits during delayed harvest. The lignification of parenchyma cells closely around peel secretory cavities due to ascorbic acid deficiency might be the primary cause for puffiness under low-load treatments.

Keywords: /Satsuma Mandarin/ /Tree fruit load/ /Sugar/ /Acid quality/ /Puffiness/ /Fruit texture analysis/ /Delayed harvest/

CUT FLOWERS

Mohammadi, M., Aelaei, M., & Saidi, M. (2021). Pre-harvest spray of GABA and spermine delays postharvest senescence and alleviates chilling injury of gerbera cut flowers during cold storage. *Scientific Reports*, *11*(1), 1–14. https://doi.org/10.1038/s41598-021-93377-4

Abstract

Short vase life, capitulum wilting, neck bending, and postharvest chilling injury (CI) are major disorders that have negative impact on quality and marketing of gerbera cut flowers. Low storage temperatures prolong the vase life, but on the other hand leads to serious CI which decreases the quality and consumer preferences. Spermine (SPER) and γ-aminobutyric acid (GABA) were identified as anti-aging factors that delay the senescence and elevate the chilling tolerance in many species. Greenhouse-grown gerbera cv. 'Stanza' is sprayed with 2 mM SPER and 1 mM GABA twice (2 T) or thrice (3 T). Cut flowers were stored at 1.5 °C and 8 °C postharvest to study the effects of GABA and SPER on senescence and CI. Vase life, CI and quality of cut flowers were improved by GABA and SPER treatments. No CI was observed in GABA-treated flowers at 1.5 °C; while, flowers sprayed with water showed severe CI. GABA treatments efficiently prolonged the vase life for 6–7 days more than the control (15 days). GABA and SPER increased the fresh weight, solution uptake, protein and proline contents, catalase, peroxidase, and superoxide dismutase activities, while decreased the electrolyte leakage, H2O2, and malondialdehyde contents, polyphenol oxidase, lipoxygenase, and phospholipase D activities. GABA and SPER significantly prolonged the vase life and prevented degradation of proteins and chilling damage and increased capacity of detoxifying and scavenging of H2O2 and reactive oxygen species (ROS), led to alleviate the negative consequences of the senescence and CI.

Keywords: /Gaba/ /Spermine/ /Gerbera/ /Cut flowers/ /Cold storage

EDIBLE FLOWERS

Dermasi, S., Mellano, M., Falla, N., Caser, M., & Scariot, V. (2021). Sensory Profile, Shelf Life, and Dynamics of Bioactive Compounds during Cold Storage of 17 Edible Flowers. *Horticulturae*, *7*(7), 166. https://doi.org/10.3390/horticulturae7070166

Abstract

In this study, 17 edible flowers (*Allium ursinum* L., *Borago officinalis* L., *Calendula officinalis* L., *Centaurea cyanus* L., *Cichorium intybus* L., *Dianthus carthusianorum* L., *Lavandula angustifolia* Mill., *Leucanthemum vulgare* (Vaill.) Lam., *Paeonia officinalis* L., *Primula veris* L., *Robinia pseudoacacia* L., *Rosa canina* L., *Rosa pendulina* L., *Salvia pratensis* L., *Sambucus nigra* L., *Taraxacum officinale* Weber, and *Tropaeolum majus* L.) were investigated to assess their sensory profile at harvest and their shelf life and bioactive compounds dynamics during cold storage. The emerging market of edible flowers lacks this information; thus, the characteristics and requirements of different flower species were provided. In detail, a quantitative descriptive analysis was performed by trained panelists at flower harvest, evaluating 10 sensory descriptors (intensity of sweet, sour, bitter, salt, smell, specific flower aroma, and herbaceous aroma; spiciness, chewiness, and astringency). Flower visual quality, biologically active compound content (total polyphenols and anthocyanins), and antioxidant activity (FRAP, DPPH, and ABTS assays) were evaluated both at harvest and during storage at 4 °C for 14 days to assess their shelf life. Generally, species had a wide range of peculiar sensory and phytochemical characteristics at harvest, as well as shelf life and bioactive compounds dynamics during postharvest. A strong aroma was indicated for *A. ursinum, D. carthusianorum, L. angustifolia*, and *L. vulgare*, while *B. officinalis* and *C. officinalis* had very low values for all aroma and taste descriptors, resulting in poor sensory profiles. At harvest, *P. officinalis, R. canina*, and *R. pendulina* exhibited the highest values of polyphenols (884–1271 mg of gallic acid equivalents per 100 g) and antioxidant activity (204–274 mmol Fe^{2+}/kg for FRAP, 132–232 and 43–58 µmol of Trolox equivalent per g for DPPH and ABTS). The species with the longest shelf life in terms of acceptable visual quality was *R. pendulina* (14 days), followed by *R. canina* (10 days). All the other species lasted seven days, except for *C. intybus* and *T. officinale* that did not reach day 3. During cold storage, the content of bioactive compounds differed, as total phenolics followed a different trend according to the species and anthocyanins remained almost unaltered for 14 days. Considering antioxidant activity, ABTS values were the least variable, varying in only four species (*A. ursinum, D. carthusianorum, L. angustifolia*, and *P. officinalis*), while both DPPH and FRAP values varied in eight species. Taken together, the knowledge of sensory profiles, phytochemical characteristics

and shelf life can provide information to select suitable species for the emerging edible flower market.

Keywords: /Anthocyanins/ /Aroma/ /Flavor/ /Polyphenols/ /Sensory Analysis/ /Postharvest/ /Shelf life/

FOOD PACKAGING

Yadav, A., Kumar, N., Upadhyay, A., Pratibha, & Anurag, R. K. (2021). Edible Packaging from Fruit Processing Waste: A Comprehensive Review. *Food Reviews International*, 1–32. https://doi.org/10.1080/87559129.2021.1940198

Abstract

Fruit by-products are considered as a potent natural source for value-added compounds such as starch, pectin as well as bioactive compounds. These are also rich sources for carbohydrate, minerals, vitamins, fibers, phenolic compounds, flavonoid compounds, anthocyanin, hydrolysable and condensed tannins. The starch and pectin are natural-based polysaccharide produced also after fruit processing; has unique properties to develop biodegradable packaging and can expand the possible range of uses in food industries. Recently, the consumer and industry demand for biodegradable and edible packaging has increased. Edible packaging is considered alternatives of the synthetic polymer and helps to enhance the shelf life of the food products while retaining their nutritional, biological and sensory quality. It helps in minimizing lipid oxidation; reducing weight loss, retarded respiration and enzymatic browning of the food products, that is, fruits & vegetables and others. The present review explores the edible packaging, physiochemical properties and edible film forming ability of fruit wastes of apple, banana peel, citrus, grapes, jackfruit, mango, pomegranate, pineapple, and tamarind. Therefore, the by-products of the fruit processing can be utilized to develop edible coating and film to enhance the shelf life of food products at commercial scale.

Keywords: /Bioactive compounds/ /Biopolymers/ /Edible packaging/ /Fruit processing/ /Fruit waste/ /Pectin/ /Starch/

FRUITS AND VEGETABLES

Araujo-Rodrigues, H., Santos, D., Campos, D., Ratinho, M., Rodrigues, I., Pintado, M. (2021). Development of Frozen Pulps and Powders from Carrot and Tomato by-Products: Impact of Processing and Storage Time on Bioactive and Biological Properties. *Horticulturae*, *7*(7), 185. https://doi.org/10.3390/horticulturae7070185

Abstract

Vegetables and fruits have an interesting nutritional profile, rich in bioactive metabolites, holding a high antioxidant potential and health associated benefits. However, their functional properties, the shorter shelf-life due to their high-water content, and their seasonality nature lead to extensive food losses and waste. The valorization of vegetables and fruits by-products through the development of value-added products and the application of preservation methods is of utmost importance to prevent food losses and waste. In this study, based on a circular economy approach, pulps and powders of baby carrot and cherry tomato by-products were prepared. Freezing, hot air drying and storage time impact on antioxidant activity and bioactive compounds were studied. Microbiological quality and pulps viscosity were also monitored for 6 months. During the freezing storage, TPC and antioxidant capacity by ABTS and ORAC assays decreased. The antioxidant capacity by DPPH method and carotenoid content increased during the first months of freezing, but then decreased. The drying process negatively affected the antioxidant capacity as well as carotenoid and polyphenolic content compared with the fresh vegetables. Both processing methodologies positively impacted the vitamin E content. During drying storage, there were no key variations in antioxidant capacity and bioactive content.

Keywords: /Tomato and carrot by-products/ /Freezing and drying impact/ /Antioxidant capacity/ /Polyphenolics/ /Carotenoids/ /Vitamin E/

Becerra-Sanchez, F & Taylor, G. (2021). Characterising the sweet corn postharvest supply chain: travel from Senegal to the UK. *International Journal of Postharvest Technology and Innovation*, *8 (1)*, 1 - 18. DOI: 10.1504/IJPTI.2021.116076.

Abstract

Sweet corn (*Zea mays* L.) is a grain harvested before maturity and consumed as a vegetable. An optimal supply chain, to preserve sugars and antioxidant (AO) capacity is essential to maintain the quality of sweet corn. The choice of packaging film plays an essential role, especially in products with a high respiration rate such as sweet corn. Sweet corn grown on a commercial farm in Senegal was sampled at the harvest day, at the UK arrival date following 12-14 d of shipping (packaging date), at the best before date (BBD) and five days after the best before date. The results showed that high quality preservation of sweet corn is possible along a complex supply chain from harvest in Senegal through transport to the UK. Results suggested that lower perforation films have a beneficial role in preserving antioxidant capacity. Furthermore, damaged kernels in the cut-ends of the cobs were shown to be the main factor reducing the overall quality of the product.

Keywords: /Sweet corn/ /Maize/ /Postharvest/ /Shelf life/; /Packaging/ /Films/ /Sugars/ /Starch/ /Antioxidant/ /Peroxidase/ /Pod/ /Polyphenol Oxidase/ /Ppo/ /Damage/ /Senegal/ /UK/

Mulaosmanovic, E., Lindblom, T. U. T., Windstam, S. T., Bengtsson, M., Rosberg, A. K., Mogren, L., & Alsanius, B. W. (2021). Processing of leafy vegetables matters: Damage and microbial community structure from field to bag. *Food Control*, *125*, 107894. https://doi.org/10.1016/j.foodcont.2021.107894

Abstract

Leafy vegetables undergo abiotic and biotic stresses, and a series of processing steps that cause mechanical injury. Breaching the epidermis alters phyllosphere structural and nutrient conditions, resulting in successional shifts in leaf microbiota and entry of human pathogens. This study examined damage during processing of baby leaves (Swiss chard, spinach) and concomitant microbial successional events. Machine-harvesting, washing, and packaging caused major phyllosphere perturbations, with increasing levels of leaf damage. Older leaves showed most damage, but plant species was influential. Diversity estimates of bacterial and fungal communities revealed shifts in microbiota post-harvest, particularly after the washing step. Relative abundance of *Pseudomonadaceae* and *Enterobacteriaceae* increased from field to bag. Bacterial species specific to different harvesting and processing steps replaced core microbiota species. While processing is unavoidable, procedures that mitigate leaf damage can enhance shelf-life and food safety.

Keywords: /Damage/ /*Escherichia coli* O157:H7/ /Microbiota/ /Post-harvest/ /Spinach/ /Swiss chard/

Vázquez-Fuentes, S., Pelagio-Flores, R., López-Bucio, J., Torres-Gavilán, A., Campos-García, J., de la Cruz, H. R., & López-Bucio, J. S. (2021). N-vanillyl-octanamide represses growth of fungal phytopathogens in vitro and confers postharvest protection in tomato and avocado fruits against fungal-induced decay. *Protoplasma*, *258*(4), 729–741. https://doi.org/10.1007/s00709-020-01586-x

Abstract

Plant diseases caused by pathogenic fungi result in considerable losses in agriculture. The use of fungicides is an important alternative to combat these pathogens, but may affect both the environment

and human health. Plants produce many bioactive compounds to defend themselves from biotic challenges and an increasing number of secondary metabolites have been identified, which may be used to control fungal infections. Here, the bioactivity of a synthetic capsaicinoid, N-vanillyl-octanamide, also termed ABX-I, in the growth of five phytopathogenic fungi was assessed in vitro. The compound inhibited growth of Colletotrichum gloeosporioides, Botrytis cinerea, Colletotrichum acutatum, Fusarium sp., and Rhizoctonia solani AG2, while the magnitude of this effect differed from capsaicin. To investigate if ABX-I could effectively protect crops against phytopathogens, fungal challenges were performed in tomato leaves and fruits, as well as avocado fruits co-infiltrated with Botrytis cinerea or Colletotrichum gloeosporioides, respectively. In both tomato leaves and fruits and avocado fruits, ABX-I decreased the fungal damage not only in vegetative but also in edible tissues, and diminished decay symptoms compared with untreated fruits, which were highly sensitive to the pathogens. Furthermore, ABX-I spray application to tomato or avocado plants did not compromise growth and development, whereas it repressed spore germination and growth of C. gloeosporioides, which suggests its potential as an affordable and promising resource to control fungal diseases in the agronomic sector.

Keywords: /Antifungal compounds/ /Capsaicinoids/ /Fruit decay/ /Leaf protection/

GARLIC

Ludlow, R. A., Pacenza, M., Chiappetta, A., Christofides, S. R., Evans, G., Graz, M., Marti, G., Rogers, H. J., & Müller, C. T. (2021). Storage time and temperature affects volatile organic compound profile, alliinase activity and postharvest quality of garlic. *Postharvest Biology & Technology*, *177*, 111533. https://doi.org/10.1016/j.postharvbio.2021.111533

Abstract

Garlic (*Allium sativum* L.) has a long history of use as a culinary seasoning and source of health-promoting compounds. In particular organosulphur compounds derived from the action of alliinase on alliin are of interest for their antimicrobial action. Due to the seasonal nature of the garlic harvest, long-term storage is required to ensure year-round supply of high-quality bulbs. However, quality is known to deteriorate throughout storage, and storage regimes are aimed at maintaining culinary, not biochemical quality, posing challenges for biotech firms extracting high value products, such as alliinase, from garlic. Storage typically involves extended periods of up to 9 months at -1.5 °C. Here, quality parameters (disease incidence and moisture content) as well as biotechnological quality parameters (alliinase yield and activity) were measured, and correlated with gene expression and volatile organic compound (VOC) profiles comparing storage at -1.5 °C and 22 °C. The aim is to develop potential molecular markers for garlic quality assessment. Alliinase activity fell in the first 6 months of storage, with garlic stored at -1.5 °C losing more activity, however 22 °C stored garlic suffered higher spoilage after 12 months storage. Alliinase activity loss was not proportional to gene transcript levels, suggesting post-translational control. A total of 150 VOCs were detected across all samples using thermal desorption gas chromatography, time of flight mass spectrometry of intact garlic bulbs, the most abundant of which were organosulphur compounds. Storage temperature significantly affected the whole VOC profile and discrete profiles were detected from garlic cold-stored for different time periods. Using weighted correlation network analysis 17 VOCs were identified that correlated with storage time, six VOCs that were indicative for storage temperature and four VOCs (azulene, octanal, o-Xylene and 4-methylhexadecane) were significantly associated with alliinase activity.

Keywords: /*Allium sativum*/ /VOC/ /GC–M/ /SAlliinase/ /Storage/

GINGER

Lv, J., Bai, L., Han, X., Xu, D., Ding, S., Li, C., Ge, Y., & Li, J. (2021). Effects of 1-MCP treatment on sprouting and preservation of ginger rhizomes during storage at room temperature. *Food Chemistry*, *349*, 129004. https://doi.org/10.1016/j.foodchem.2021.129004

Abstract

The purpose of this study was to explore the effects of 1-MCP on the sprouting and preservation of ginger rhizomes during storage at room temperature. Ginger rhizomes were treated with 1 μL L^{-1} 1-methylcyclopropene (1-MCP) and stored at 23 ± 0.2 °C. Our data showed that application of 1-MCP reduced the rate of sprouting during storage compared with the control rhizome. Respiration rate and the reducing sugar content were also reduced following 1-MCP treatment, while the starch content increased. 1-MCP treatment increased the total phenol content and inhibited polyphenol oxidase (PPO) activity. 1-MCP treatment was also associated with a higher ascorbic acid content but a reduced crude fiber content. The generation of superoxide anion free radicals ($O_2 \cdot^-$), hydrogen peroxide (H_2O_2) and malondialdehyde (MDA) was lower following 1-MCP treatment, while the activities of catalase (CAT), peroxidase (POD) and superoxide dismutase (SOD) were higher compared with the controls. These results suggested that application of 1-MCP could reduce sprouting rates, decrease the accumulation of ROS, and maintain the quality of ginger rhizomes during storage at room temperature. It would be useful to further explore the role and mechanisms of action of ethylene in regulating the sprouting of ginger rhizomes.

Keywords: /Ginger rhizomes/ /1-MCP/ /Sprouting rate/ /Storage quality/

GUAVA

Madhav, J. V., Sethi, S., Sharma, R. R., Nagaraja, A., Arora, A., & Varghese, E. (2021). Influence of bilayer coating of salicylic acid and edible wax on chilling injury and functional attributes of guava. *Journal of Food Processing & Preservation*, *45*(7), 1–8. https://doi.org/10.1111/jfpp.15601

Abstract

In the present investigation, the effect of bilayer coating was evaluated on the chilling injury and quality of guava fruits. The fruits of white fleshed guava cv. Allahabad Safeda and pink fleshed cv. Lalit were subjected to treatment with 5-sulfosalicylic acid (2 mM) followed by vegetable wax (1:4 v/v). The treated fruits were stored under two temperatures, namely, 5 and 10°C for 15 days. Post cold storage, fruits were transferred to supermarket conditions (20 ± 2°C) for a 2-day shelf life simulation period. The results revealed that treated fruits showed significantly lower weight loss and chilling injury compared to control fruits. The bilayer coating was effective in delaying yellowing of fruit skin and respiration peak with greater retention of total antioxidant capacity compared to control fruits. The treated fruits maintained the shelf life up to 12 + 2 days and 9 + 2°days under 5 and 10°C, respectively. Practical applications: We recommend that bilayer application of salicylic acid and edible wax can efficiently suppress chilling injury, extend shelf life, and maintain quality of guava under low temperature storage.

Keywords: /Guava/ /Salicylic acid/ /Fruit skins/ /Oxidant status/ /Waxes/ /Fruit

KALE

Reda, T., Thavarajah, P., Polomski, R., Bridges, W., Shipe, E., & Thavarajah, D. (2021). Reaching the highest shelf: A review of organic production, nutritional quality, and shelf life of kale (Brassica oleracea var. acephala). *Plants, People, Planet*, *3*(4), 308–318. https://doi.org/10.1002/ppp3.10183

Abstract

Societal Impact Statement: Since its inception in the early 20th century, organic agriculture has grown increasingly popular due to its focus on a holistic, environmentally friendly approach to crop production. However, it is comparatively limited in biomass production, disease management, nutritional quality, and postharvest treatment compared to conventional agriculture. These challenges carry over into kale production, the majority of which is certified organic. This article reviews organic kale production, morphology, and shelf life, focusing on nutrition and plant breeding. It explores the shortcomings of organic output and potential areas of study to enhance shelf life in organic kale while maintaining nutritional quality. Summary Organic production has grown exponentially over the past few decades in both acreage and popularity worldwide. This review focuses specifically on kale produced in the USA. However, regulations limiting synthetic inputs leave organic produce at a disadvantage compared to conventional agriculture in terms of biomass, nutritional quality, disease management, and postharvest treatment. Organic agriculture requires significant improvements to be a viable means of production for a growing population. Kale (Brassica oleracea var. acephala) is a "nutritional powerhouse" leafy green vegetable. The high concentration of vitamins, minerals, and prebiotic carbohydrates in a low-calorie food makes kale an important crop for combating obesity-related non-communicable diseases. However, the short shelf life of organic kale and inevitable fresh food waste make developing new kale cultivars with increased shelf life essential. This review article aims to (a) review kale morphology, consumer preference, and production, and (b) review nutritional quality, its effect on shelf life, and current breeding efforts of kale. Future research could focus on developing a kale breeding pipeline following suitable kale germplasm selection adapted to organic agriculture with both superior shelf life and improved nutritional quality.

Keywords: /Kale/ /Minerals/ /Nutritional breeding/ /Nutritional quality/ /Organic production/ /Prebiotic carbohydrates/ /shelf life/

KIWI

Di Francesco, A., Di Foggia, M., Vittoria, A., & Baraldi, E. (2021). Post-Harvest Non-Conventional and Traditional Methods to Control Cadophora luteo-olivacea: Skin Pitting Agent of Actinidia chinensis var. deliciosa (A. Chev.). *Horticulturae,* *7*(7), 169. https://doi.org/10.3390/horticulturae7070169

Abstract

Cadophora luteo-olivacea represents a critical problem for kiwifruit in the post-harvest phase, mainly for its little note epidemiology. The study presented some results about the possibility of preserving kiwifruit from skin pitting symptoms using alternative methods to fungicides. By in vitro assays, antagonist mechanisms of action against pathogen isolates were tested. Trichoderma harzianum (Th1) showed the highest inhibitory activity against C. luteo-olivacea isolates by volatile, non-volatile, and by dual culture assay, displaying an inhibition respectively by 90%, 70.6%, and 78.8%, and with respect to Aureobasidium pullulans (L1 and L8) by 23.3% and 25.8%, 50% and 34.7%, and 22.5% and 23.6%, respectively. Further, the sensitivity on CFU and mycelial growth of C. luteo-olivacea isolates to fludioxonil, and $CaCl_2$ was tested, displaying interesting EC50 values (0.36 and 0.92 g L^{-1}, 22.5 g L^{-1}, respectively). The effect of Brassica nigra defatted meal was tested as biofumigation assays and through FT-IR (Fourier-Transform Infrared) spectroscopy. The above-mentioned treatments were applied in vivo to evaluate their efficacy on kiwifruits. Our data demonstrated that alternative solutions could be considered to control postharvest pathogens such as C. luteo-olivacea.

Keywords: /Yeasts/ /Kiwifruit/ /VOCs/ /Fungicides/ /Trichoderma/

LANZHOU LILY

Li, C., Chen, G., Huang, D., Wang, N., & Liao, W. (2021). The Antioxidant Defense System during Lanzhou Lily Scales Storage Is Modulated by Hydrogen Sulfide. *Horticulturae*, *7*(7), 183. https://doi.org/10.3390/horticulturae7070183

Abstract

As an important gaseous regulator, hydrogen sulfide (H_2S) is involved in various aspects of plant processes, including seed germination, stomatal movement, and postharvest senescence. The preservation capacity of Lanzhou lily (*Lilium davidii* var. *unicolor* Salisb) scales fumigated with or without exogenously applied sodium hydrosulfide (NaHS, a H_2S donor) was investigated in the current study. Results indicate that NaHS fumigation was able to extend storage life and elicit endogenous H_2S production of postharvest Lanzhou lily scales with an optimal concentration at 0.8 mM. Moreover, exogenously applied NaHS (0.8 mM) led to higher soluble sugar, soluble protein, and ascorbic acid levels and lower total phenolic and flavonoid contents compared with those of the control. The application of 0.8 mM NaHS also reduced the lipid peroxidation level and reactive oxygen species (ROS) accumulation in scales, as indicated by the lower malondialdehyde (MDA) content, relative conductivity, lipoxygenase (LOX) activity, O_2^- production rate, and hydrogen per-oxide (H_2O_2) content. Further, scales treated with 0.8 mM NaHS exhibited significantly higher activities of superoxide dismutase (SOD), catalase (CAT), peroxidase (POD), and ascorbic acid peroxidase (APX). Collectively, our data provide new insight into how the postharvest senescence of Lanzhou lily scales might be alleviated by H_2S by enhancing antioxidant defense systems.

Keywords: /Fumigation/ /Hydrogen sulfide (H_2S)/ /Lily bulbs/ /Lipid peroxidation/ /Postharvest senescence/ /Quality/ /Reactive oxygen species (ROS)/ /Storage life/

LEMON

Olmedo, G. M., Baigorria, C. G., Ramallo, A. C., Sepulveda, M., Ramallo, J., Volentini, S. I., Rapisarda, V. A., & Cerioni, L. (2021). Inhibition of the lemon brown rot causal agent Phytophthora citrophthora by low-toxicity compounds. *Journal of the Science of Food & Agriculture*, *101*(9), 3613–3619. https://doi.org/10.1002/jsfa.10990

Abstract

Phytophthora spp., soil-borne oomycetes, cause brown rot (BR) on postharvest lemons. The management of this disease is based on cultural practices and chemical control using inorganic salts of limited efficacy. In the search for new alternatives, the aim of this work was to evaluate the effect of low-toxicity compounds to inhibit the growth of P. citrophthora and to control BR disease on lemons. Sodium bicarbonate, potassium sorbate, polyhexamethylene guanidine, Ascophyllum nodosum extract and a formulation containing phosphite salts plus A. nodosum (P+An) were evaluated. RESULTS: All tested products inhibited mycelial growth, sporangia formation and zoospore germination of P. citrophthora in vitro. In postharvest applications on artificially inoculated lemons, only P+An exhibited a BR curative effect, with incidence reduction of around 60%. When this formulation was applied in field treatments, BR incidence was reduced by 40% on lemons harvested and inoculated up to 30 days post application. CONCLUSION: Our results demonstrate the in vitro direct anti-oomycete effect of low-toxicity compounds and the in vivo efficacy of P+An formulation to control BR, encouraging the incorporation of the latter in the management of citrus BR.

Keywords: /Ascophyllum nodosum/ /Citrus/ /GRAS salts/ /Oomycete/ /PHMG/

Soto-Muñoz, L., Martínez-Blay, V., Pérez-Gago, M. B., Fernández-Catalán, A., Argente-Sanchis, M., & Palou, L. (2021). Starch-based antifungal edible coatings to control sour rot caused by Geotrichum citri-aurantii and maintain postharvest quality of "Fino" lemon. *Journal of the Science of Food and Agriculture*, *101*(9), 3613-3619. https://doi.org/10.1002/jsfa.11414

Abstract

Two edible coating (EC) emulsions based on potato starch (F6 and F10) alone or formulated with sodium benzoate (SB, 2% w/w) (F6/SB and F10/SB) were evaluated to maintain postharvest quality of cold-stored 'Fino' lemons and control sour rot on lemons artificially inoculated with Geotrichum citri-aurantii. Previous research showed the potential of these ECs to improve the storability of 'Orri' mandarins and reduce citrus green and blue molds caused by Penicillium digitatum and Penicillium italicum, respectively. The coatings F6/SB and F10/SB significantly reduced sour rot incidence and severity compared to uncoated control samples on lemons incubated at 28 °C for 4 and 7 days. The F6/SB coating reduced weight loss and gas exchange in comparison with uncoated fruit after 2 and 4 weeks of storage at 12 °C plus shelf life of 1 week at 20 °C, without adversely affecting the lemon physicochemical quality. Overall, the F6/SB coating formulation, composed of pregelatinized potato starch, glyceryl monostearate, glycerol, emulsifiers and SB, with a total solid content of 5.5%, showed the best results in reducing citrus sour rot and maintaining the postharvest quality of cold-stored 'Fino' lemons. Therefore, it showed potential as a new cost-effective postharvest treatment suitable to be included in integrated disease management programs for citrus international markets with zero tolerance to chemical residues.

Keywords: /Citrus limon/ /GRAS salts/ /Food additives/ /Postharvest quality/ /Sour rot control/

LITCHI

Ali, S., Sattar Khan, A., Ullah Malik, A., Anwar, R., Akbar Anjum, M., Nawaz, A., Shafique, M., & Naz, S. (2021). Combined application of ascorbic and oxalic acids delays postharvest browning of litchi fruits under controlled atmosphere conditions. *Food Chemistry*, *350*, 129277. https://doi.org/10.1016/j.foodchem.2021.129277

Abstract

The effect of ascorbic acid [AA (40 mmol L^{-1})] and oxalic acid [OA (2 mmol L^{-1})] on browning of litchi fruit was investigated under 5% CO_2 + 1% O_2 controlled atmosphere (CA) and compared with air at 5 ± 1 °C for 28 days. The combined application of AA and OA suppressed browning index, soluble quinones, and activities of polyphenol oxidase and peroxidase under CA compared with control. The combination of CA along with AA + OA reduced weight loss and maintained higher anthocyanins, total phenolics, membrane integrity, ascorbate peroxidase, catalase, glutathione reductase and superoxide dismutase activities compared with control. In addition, AA + OA + CA combination showed markedly lower malondialdehyde, superoxide anion and hydrogen peroxide with substantially higher soluble solids content, ascorbic acid, titratable acidity and sensory quality compared with control. In conclusion, AA + OA combination could be considered appropriate to delay browning and to conserve litchi fruit visual appearance under CA storage conditions.

Keywords: /Ascorbic acid/ /Electrolyte leakage/ /Litchi fruit/ /Oxalic acid/ /Polyphenol oxidase/ /Peroxidase/ /Surface browning/

LONGAN

Chen, Y., Zhang, S., Lin, H., Lu, W., Wang, H., Chen, Y., Lin, Y., & Fan, Z. (2021). The role of cell wall polysaccharides disassembly in Lasiodiplodia theobromae-induced disease occurrence and softening of fresh longan fruit. *Food Chemistry*, *351*, 129294. https://doi.org/10.1016/j.foodchem.2021.129294

Abstract

Cell wall polysaccharides in fruits act a pivotal role in their resistance to fungal invasion. *Lasiodiplodia theobromae* (Pat.) Griff. & Maubl. is a primary pathogenic fungus causing the spoilage of fresh longan fruit. In this study, the influences of *L. theobromae* inoculation on the disassembly of cell wall polysaccharides in pericarp of fresh longans and its association with *L. theobromae*-induced disease and softening development were investigated. In contrast to the control, samples with *L. theobromae* infection showed more severe disease development, lower firmness, lower amounts of cell wall materials, covalent-soluble pectin, ionic-soluble pectin, cellulose and hemicellulose, whereas higher value of water-soluble pectin, higher activities of cell wall polysaccharide-disassembling enzymes (cellulase, *β*-galactosidase, polygalacturonase and pectinesterase). These findings revealed that cell wall polysaccharides disassembly induced by enzymatic manipulation was an essential pathway for *L. theobromae* to infect harvested longans, and thus led to the disease occurrence and fruit softening.

Keywords: /Cell wall-disassembling enzymes/ /Cell wall polysaccharides/ /Disease development/ /Longan fruit/ /*Lasiodiplodia theobromae* (Pat.) Griff. & Maubl/ /Firmness/

Luo, T., Yin, F., Liao, L., Liu, Y., Guan, B., Wang, M., Lai, T., Wu, Z., & Shuai, L. (2021). Postharvest melatonin treatment inhibited longan (Dimocarpuslongan Lour.) pericarp browning by increasing ROS scavenging ability and protecting cytomembrane integrity. *Food Science & Nutrition*, 00: 1-11. https://doi.org/10.1002/fsn3.2448

Abstract

Postharvest melatonin treatments have been reported to improve the quality and storability, especially to inhibit browning in many fruits, but the effect had not been systematically investigated on longan fruit. In this study, the effect of 0.4 mM melatonin (MLT) dipping on the quality and pericarp browning of longan fruits stored at low temperature was investigated. The MLT treatment did not influence the TSS content of longan fruits but lead to increased lightness and h° value while decreased a* value of pericarp. More importantly, the treatment significantly delayed the increase in electrolyte leakage and malonaldehyde accumulation, inhibited the activities of polyphenol oxidase and peroxidase, and thus retarded pericarp browning. In addition, the treatment significantly inhibited the production of $O_2^{\bullet-}$ and H_2O_2 while promoting the accumulation of glutathione, flavonoids, and phenolics at earlier storage stages in longan pericarp. Interestingly, the activities of ascorbate peroxidase (APX) and superoxide dismutase (SOD) were significantly upregulated but activities of catalase were downregulated in the MLT-treated longan pericarp. MLT treatment effectively enhanced APX and SOD activities, increased flavonoid, phenolics, and glutathione content, protected cytomembrane integrity, inhibited the production of $O_2^{\bullet-}$ and H_2O_2 and browning-related enzymes, and thus delayed the longan pericarp browning.

Keywords: /Longan/ /Browning/ /ROS scavenging/

MANGO

Archana, T. J., Gogoi, R., Kaur, C., Varghese, E., Sharma, R. R., Srivastav, M., Tomar, M., Kumar, M., & Kumar, A. (2021). Bacterial volatile mediated suppression of postharvest anthracnose and quality enhancement in mango. *Postharvest Biology & Technology*, *177*, 111525. https://doi.org/10.1016/j.postharvbio.2021.111525

Abstract

Anthracnose disease incited by *Colletotrichum gloeosporioides* reduces the yield and market-quality of mangoes worldwide. Previous studies have indicated the potential of diverse antimicrobial volatile organic compounds emitted by the endophytic *Pseudomonas putida* BP25 for plant disease suppression. In the present study, we have explored native-volatiles of *Pseudomonas putida* BP25 and a synthetic-volatile, 2-ethyl-5-methylpyrazine, earlier identified in volatilome of *Pseudomonas putida* BP25 for reducing anthracnose in mango cultivar, *Amrapali*. The bacterial volatile compounds displayed fungistatic effects on the mycelial growth of *Colletotrichum gloeosporioides in vitro. In planta* prophylactic fumigation of mangoes with native-volatiles or the bacterial origin synthetic 2-ethyl-5-methylpyrazine for 24 h at 25 °C showed a reduction of anthracnose severity (>76 % reduction over mock) on fruit. Additionally, physicochemical qualities such as total-soluble solids, total-phenols, total-proline, total-carotenoid, total-flavonoid, and fruit-firmness were increased in fumigated fruit as compared to untreated mangoes. Anthracnose suppression coupled with the fruit quality enhancement by bacterial volatiles and synthetic 2-ethyl-5-methylpyrazine presents a new opportunity for postharvest management of mango during the storage, transit, and trade.

Keywords: /*Colletotrichum gloeosporioides*/ /Fumigation/ /Mango/ /Microbial volatiles/ /Postharvest diseases/ /Pyrazines/

Goudarzi, A., Samavi, S., Amiri Mazraie, M., & Majidi, Z. (2021). Fungal pathogens associated with pre- And postharvest fruit rots of mango in southern Iran. *Journal of Phytopathology*, 169(9) 545-555**. https://doi.org/10.1111/jph.13027**

Abstract

This study aimed at identifying fungal pathogens causing pre- and postharvest fruit rots on local cultivars of mango (*Mangifera indica* L.) in the main mango-growing regions of southern Iran. Mango fruits showing rot symptoms from commercial orchards were used for isolation of fungal species associated with preharvest fruit rots. Latent infections were assessed on intact healthy mango fruits which were surface-disinfested and incubated in moist chambers at 25ºC. For evaluation of postharvest wound infections, intact healthy mango fruits were artificially wounded and incubated in moist chambers at 25ºC. In addition, fungal decays were assessed on intact healthy mango fruits stored at 13ºC for up to 4 weeks. Isolated fungi were identified based on morphological characteristics, as well as sequence data from the ribosomal internal transcribed spacer (ITS) region. In addition, the sequence data inferred from translation elongation factor 1-alpha (*tef1*) gene were used for determination of *Fusarium* species and *Alternaria* and *Colletotrichum* isolates were defined genetically based on multi-gene sequencing. Accordingly, eight fungal species, including *Alternaria alternata*, *Neofussicoccum mediterraneum*, *Aureobasidium melanogenum*, *Colletotrichum gloeosporioides*, *Fusarium proliferatum*, *Xenoacremonium falcatus*, *F. verticillioides* and *Diaporthe phyllanthicola*, were identified to associate with preharvest mango fruit rots. Fungi associated with latent infections, mostly stem-end rots, included *A. alternata*, *N. mediterraneum*, *C. gloeosporioides*, *Lasiodiplodia theobromae*, *F. proliferatum* and *A. melanogenum*, and those associated with wound infections were *A. alternata*, *N. mediterraneum*, *Penicillium* spp. and *Cladosporium* spp. *A. alternata* was the only pathogen isolated from the fruits stored at low temperature. Pathogenicity of the selected isolates was demonstrated by fulfilling Koch's postulates.

Keywords: /Mango/ /Fruit rots/ /Postharvest/ /Preharvest/ /Fungal pathogens/

MUSHROOM

Li, D., Wang, D., Fang, Y., Li, L., Lin, X., Xu, Y., Chen, H., Zhu, M., & Luo, Z. (2021). A novel phase change coolant promoted quality attributes and glutamate accumulation in postharvest shiitake mushrooms involved in energy metabolism. *Food Chemistry*, *351*, 129227. https://doi.org/10.1016/j.foodchem.2021.129227

Abstract

Cold chain transportation is an important link in postharvest logistics of agricultural products. In the current study, we developed a novel water-based phase change coolant (PCC), which showed longer effectiveness in maintaining low temperature conditions compared with ice, and applied in preserving the postharvest mushrooms. The results showed that the novel PCC effectively inhibited water loss, as well as maintained quality attributes including firmness, color, phenolics, flavonoids, and thus prolonged the shelf-life of mushrooms. Low temperature conditions created by the novel PCC treatment maintained a high level of energy charge by activating the activities of SDH, CCO, H^+-ATPase and Ca^{2+}-ATPase, resulting in the delay of postharvest senescence. In addition, sufficient energy supply decreased the consumption of glutamate as carbon skeleton by inhibiting GDH activity, improved glutamate accumulation, and therefore maintained sensory properties as a result. Thus, the novel PCC might be an excellent substitute for ice in cold chain transportation of mushrooms.

Keywords: /Phase change coolant/ /Shiitake mushrooms/ /Energy metabolism/ /Glutamate metabolism/

OKRA

Rattanakaran, J., Rattapon Saengrayap, R., Prahsarn, C., Kitazawa, H., & Chaiwong, S. (2021). Application of room cooling and thermal insulation materials to maintain quality of okra during storage and transportation. Horticulturae 2021, 7(7), 188; https://doi.org/10.3390/horticulturae7070188

Abstract

A combination of room cooling and the use of thermal insulation materials to maintain okra quality under simulated storage and transportation was evaluated. Okra pods were packed in plastic baskets and either cooled at 18 °C or not cooled in a room for 2 h. After either room cooling or no cooling, the okra pods were covered with three different materials: (1) perforated linear low-density polyethylene (P-LLDPE), (2) two layers of heat-reflective sheet with thin nonwoven (HRS+TNNW), and (3) metalized foam sheet (MFS). Typical handling (TP) without cooling and covering with P-LLDPE was used as the control. The six treatments were conducted during simulated storage (18 °C for 48 h) and transportation (30 °C for 15 h). Results showed that MFS gave the best insulation properties (Q_x and R-values), followed by HRS and TNNW. After room cooling, both HRS+TNNW and MFS materials delayed the time for pulp temperature to reach 18 °C (10 h), compared to P-LLDPE (2 h). TP presented the highest mass loss (17.8%) throughout simulated conditions, followed by cooling plus P-LLDPE (15.2%) and either of the thermal insulation materials with or without room cooling (3.6% to 5.2%), respectively. TP, cooling plus P-LLDPE, and no cooling plus MFS (44% to 56%) showed the highest percentage of decay, while cooling combined with both HRS+TNNW and MFS gave the lowest decay incidence (11–21%). Findings demonstrated that room cooling combined with HRS+TNNW had the highest efficiency for preserving cool temperature and reducing decay, compared to TP and room cooling plus MFS.

Keywords: /Decay/ / Covering/ /Nonwoven/ /Mass loss/ /Metalized foam sheet/

ORANGE

Strano, M. C., Di Silvestro, S., Allegra, M., Russo, G., & Caruso, M. (2021). Effect of cold storage on the postharvest quality of different Tarocco sweet orange clonal selections. *Scientia Horticulturae*, *285*, 110167. https://doi.org/10.1016/j.scienta.2021.110167

Abstract

Fruits of sixteen Tarocco sweet orange (*Citrus sinensis* [L.] Osbeck) clonal selections were compared for their long-period cold storage aptitude, for fresh fruit consumption. Selections were evaluated, for two consecutive seasons, at harvest (T0) and after 30 (T30), 60 (T60) days of storage at 5 ± 1 °C and 85–90% relative humidity (RH), followed by 7 days of shelf-life at 20±2 °C (T60+7). The following parameters were evaluated: fruit weight, peel and pulp color, initial and residual deformation, elasticity, firmness, juice yield, TSS, pH, TA, total anthocyanin content, and for each control: weight loss and physiological disorders (chilling injury and aging). The selections showed significant variability regarding the physiological disorders, especially at T60+7 with a range of 0.0–0.6 for chilling injury index and a range of values of 0–63% for aging. At T60+7 the weight loss range was between 10.0–14.3%. Regarding overall qualitative parameters, relevant changes were observed for firmness which decreased during the storage, with values ranging from 2.58-5.28 (T0) to 2.56–4.41 (T60+7), and for the anthocyanins which increased from a range of 1.67–39.71 (T0) to 30.47–114.86 mg/L (T60+7), with different values depending on the clonal selections. Based on our results, the clonal selections that showed a better aptitude to long-period cold storage were Gangi, 2B-12–9, Pedalino and Amantea, together with the reference cultivars Meli and Messina. These clones resulted particularly tolerant to chilling injury and aging, they maintained the firmness and the most relevant qualitative traits (TSS and TA) and showed the best fruit external appearance after one week of shelf-life (T60+7).

Keywords: /Citrus sinensis/ /Low temperature/ /Physiological disorders/ /Quality/ /Shelf-life/

PEACH

Zhong, Y., Bao, Y., Chen, Y., Zhai, D., Liu, J., & Liu, H. (2021). Nutritive quality prediction of peaches during storage. *Food Science & Nutrition*, *9*(7), 3483–3490. https://doi.org/10.1002/fsn3.2287

Abstract

Peaches (Prunus persica L. Batsch) are commonly consumed fruits with high nutritional value. We evaluated the nutritive qualities of peach fruit during storage. Heatmap analysis showed that protein, ash, and crude fiber contents clustered together, whereas fat and reducing sugars clustered separately. We then classified the nutrients into two clusters; cluster 1 showed low fat and reducing sugar levels and high protein, crude fiber, and ash levels, whereas cluster 2 showed high fat and reducing sugar levels and low protein, cruder fiber, and ash levels. Partial least squares regression and random forest analyses showed accuracies of 67% and 61%, respectively. Spectra at 1,439 and 1,440 nm indicated reducing sugars, and the spectrum at 2,172 nm indicated protein. Thus, Fourier transform-near infrared spectroscopy could predict the two clusters based on five nutritive qualities. Our findings may help to establish guidelines for promoting the acceptability of peach fruits among consumers.

Keywords: /Fourier transform-near infrared spectroscopy/ /Nutritive quality/ /Peach/ /Random forest/ /shelf-life/

PEAR

Huang, Y., Cai, Y., & Yu, T. (2021). Sodium glutamate as a booster: Inducing Rhodosporidium paludigenum to enhance the inhibition of Penicillium expansum on pears. *Journal of Applied Microbiology*. https://doi.org/10.1111/jam.15212

Abstract

This research sought to improve the ability of biocontrol yeast to suppress postharvest fungal disease and explore possible mechanisms of action. The addition of 2% sodium glutamate (SG), which is edible and recognized as safe, enhances the inhibitory effect of Rhodosporidium paludigenum Fell & Tallman on Penicillium expansum in vivo and in vitro. R. paludigenum cells grown in medium with a final concentration of 2% SG, displayed viability under a variety of stress conditions, including sodium chloride (NaCl), calcofluor white (CFW), Congo red (CR), and sodium dodecyl sulfate (SDS). Activity and relative gene expression levels of antioxidant-related enzymes in R. paludigenum, including peroxisomal catalase (CAT), thioredoxin reductase (TrxR), glutathione peroxidase (GSH-PX), glutathione reductase (GR), and superoxide dismutase (SOD) were altered in the presence of SG. Levels of reactive oxygen species (ROS) increased in cells grown in the presence of SG as well as the content of several amino acids.In the presence of 2% SG R. paludigenum inhibited P. expansum and exhibited tolerance to a number of stressful conditions which may involve the upregulation of antioxidant enzymes and amino acids. The ability of culture conditions to enhance the fungal suppressive abilities of yeast has the potential to enhance the management of postharvest disease in fruit.

Keywords: /Penicillium expansum/ /Biocontrol/ /Postharvest/ /Sodium glutamate/ /Yeast/

PEPPER

Mason, T. J., Bettenhausen, H. M., Chaparro, J. M., Uchanski, M. E., & Prenni, J. E. (2021). Evaluation of ambient mass spectrometry tools for assessing inherent postharvest pepper quality. *Horticulture Research*, *8*(1), 160. https://doi.org/10.1038/s41438-021-00596-x

Abstract

Horticulturists are interested in evaluating how cultivar, environment, or production system inputs can affect postharvest quality. Ambient mass spectrometry approaches enable analysis of minimally processed samples under ambient conditions and offer an attractive high-throughput alternative for assessing quality characteristics in plant products. Here, we evaluate direct analysis in real time (DART-MS) mass spectrometry and rapid evaporative ionization-mass spectrometry (REIMS) to assess quality characteristics in various pepper (Capsicum annuum L.) cultivars. DART-MS exhibited the ability to discriminate between pod colors and pungency based on chemical fingerprints, while REIMS could distinguish pepper market class (e.g., bell, lunchbox, and popper). Furthermore, DART-MS analysis resulted in the putative detection of important bioactive compounds in the human diet such as vitamin C, p-coumaric acid, and capsaicin. The results of this study demonstrate the potential for these approaches as accessible and reliable tools for high throughput screening of pepper quality.

Keywords: /Postharvest quality/ /Pepper/ /Mass spectrometry/

PERSIMMON

Chen, Y., Zhang, X., Luo, Z., Sun, J., Li, L., Yin, X., Li, J., & Xu, Y. (2021). Effects of inside-out heat-shock via microwave on the fruit softening and quality of persimmon during postharvest storage. *Food Chemistry*, *349*, 129161. https://doi.org/10.1016/j.foodchem.2021.129161

Abstract

Rapid postharvest softening largely limits the shelf-life of persimmon (*Diospyros kaki* L.) fruit. Microwave is a new environmental-friendly inside-out heat-shock approach, whose effect on the fruit softening and quality has not yet been investigated. The current study applied two kinds of microwave treatments (low-power long-time, LPLT, or high-power short-time, HPST) to persimmon fruit with comparison to the hot water (HW) treatments. The results showed both microwave treatments maintained firmness, facilitated the deastringency, and increased soluble solid contents (SSC) and sugar-acid ratio of persimmon fruit. The microwave treatments reduced the cellulose and pectin degradation, and inhibited the cellulase activity, resulting in a significantly higher firmness than HW treatment and control after 2 and 4 days of storage. Moreover, application of HPST treatment down-regulated gene expression of *DkPG1*, *DkPE2* and *DkEGase1* compared with untreated fruits. These results indicated that microwave treatment is a promising soft-delaying method for the preservation of persimmon fruit.

Keywords: /Persimmon/ /Microwave treatment/ /Fruit softening/ /Postharvest quality/

Niazi, Z., Razavi, F., Khademi, O., & Aghdam, M. S. (2021). Exogenous application of hydrogen sulfide and γ-aminobutyric acid alleviates chilling injury and preserves quality of persimmon fruit (Diospyros kaki, cv. Karaj) during cold storage. *Scientia Horticulturae*, *285*, 110198. https://doi.org/10.1016/j.scienta.2021.110198

Abstract

We studied the effectiveness of the exogenous application of hydrogen sulfide (NaHS; 0, 1, 2, 3 and 4 mM) and γ-aminobutyric acid (GABA; 0, 2.5, 5, 7.5 and 10 mM) in alleviating chilling injury and retaining the quality of persimmon fruit during storage at 2 °C for 45 days. Our results showed that the persimmon fruit treated with 3 mM NaHS or 7.5 mM GABA exhibited lower chilling injury manifested by lower peel browning accompanied by higher total soluble solids (TSS) and titratable acidity (TA). Lower H_2O_2 accumulation along with higher ascorbic acid accumulation in persimmon fruit treated with 3 mM NaHS or 7.5 mM GABA owing to higher activities of superoxide dismutase (SOD), catalase (CAT), and ascorbate peroxidase (APX) enzymes may be accountable for keeping membrane integrity, represented by lower electrolyte leakage and malondialdehyde (MDA) accumulation. Besides, the higher accumulation of phenols and flavonoids owing to the higher phenylalanine ammonia-lyase (PAL) and lower polyphenol oxidase (PPO) activity in persimmon fruit treated with 3 mM NaHS or 7.5 mM GABA may be the explanation for superior DPPH scavenging activity. In addition to the lower chilling injury, persimmon fruit treated with 3 mM NaHS or 7.5 mM GABA exhibited higher firmness owing to lower activities of polygalacturonase (PG) and pectin methylesterase (PME). Hence, our results demonstrate that exogenous application of 3 mM NaHS or 7.5 mM GABA could alleviate chilling injury, thus retaining the quality of persimmon fruit during cold storage.

Keywords: /DPPH scavenging activity/ /Fruit browning/ /Membrane integrity/ /Polygalacturonase/ /Polyphenol oxidase/

POMEGRANATE

Liu, C., Zhang, Z., Dang, Z., Xu, J., & Ren, X. (2021). New insights on phenolic compound metabolism in pomegranate fruit during storage. *Scientia Horticulturae*, *285*, 110138. https://doi.org/10.1016/j.scienta.2021.110138

Abstract

Pomegranates are becoming more popular with consumers because of their pleasant taste and high nutritional value. However, little is known about the changes in phenolic compound contents in

pomegranate fruit during storage. In this study, we monitored changes in the contents of the main phenolic compounds in the peel and arils of Xinjiangdazi and Yushiliu pomegranate (*Punica granatum* L.) fruit during 50 d of storage at 5 °C. The patterns of changes in concentrations differed widely among different phenolic compounds. The main phenolic compounds in pomegranate arils and peel were anthocyanins, phenolic acids, and flavonoids. The anthocyanin content in arils and flavonoid content in peel were related to peroxidase activity. The results illustrate the changes in the concentrations of phenolic compounds in the arils and peel in pomegranate fruit during storage, and show that the abundance of some compounds is related to antioxidant enzyme activity. This information will be useful for the exploitation of pomegranate resources and for developing appropriate postharvest treatments to maintain fruit quality.

Keywords: /Phenolic acids/ /Flavonoids/ /Anthocyanins/ /Postharvest/ /Antioxidant enzymes/ /PomegranateFruit/

POSTHARVEST DISEASE

Zhao, S., Guo, Y., Wang, Q., & An, B. (2021). Antifungal effects of lycorine on Botrytis cinerea and possible mechanisms. *Biotechnology Letters*, *43*(7), 1503–1512. https://doi.org/10.1007/s10529-021-03128-8

Abstract

Botrytis cinerea causes postharvest diseases on fruit and lead economic losses. Application of environment-friendly natural compounds is an alternative for synthetic fungicides to control postharvest disease. Lycorine is an indolizidine alkaloid which is widely used for human drug design, however, application of lycorine in controlling postharvest disease and the underlying mechanisms have not been reported. In this study, the effects of lycorine on mycelium growth, spore germination, disease development in apple fruit, cell viability, cell membrane integrity, cell wall deposition, and expression of mitogen-activated protein kinase (MAPK) and GTPase of B. cinerea were investigated. Our results showed that lycorine was effective in controlling postharvest gray mold caused by B. cinerea on apple fruit. In the in vitro tests, lycorine strongly inhibited spore germination and mycelium spreading in culture medium. Investigation via fluorescein diacetate and propidium iodide staining suggested that lycorine could damage the membrane integrity and impair cell viability of B. cinerea. Furthermore, the expression levels of several MAPK and GTPase coding genes were reduced upon the lycorine treatment. Taken together, lycorine is an effective and promising way to control postharvest disease caused by B. cinerea.

Keywords: /Antifungal activity/ /Botrytis cinerea/ /Lycorine/ /Postharvest/

POSTHARVEST TECHNOLOGY

Zhang, W., Jiang, H., Cao, J., & Jiang, W. (2021). Advances in biochemical mechanisms and control technologies to treat chilling injury in postharvest fruits and vegetables. *Trends in Food Science & Technology*, *113*, 355–365. https://doi.org/10.1016/j.tifs.2021.05.009

Abstract

Owing to the postharvest mass loss in most tropical and subtropical fruits and vegetables caused by chilling injury (CI), it is necessary to look for effective technologies to alleviate this issue. Studies thus far have found that some postharvest technologies could effectively alleviate CI in post-harvest fruits and vegetables. This review summarizes the temperature and symptoms of CI in common postharvest fruits and vegetables. The postharvest technologies to control CI, which comprised physical (low-temperature conditioning, heat treatment, near-freezing temperature, controlled atmosphere, edible coating and ultraviolet irradiation) and chemical (ethylene and 1-methylcyclopropene, oxalic acid, calcium ions, nitric oxide, melatonin, salicylates and jasmonates, polyamines, and some other chemical substances)

treatments, are also detailed. The potential biochemical mechanisms of different postharvest technologies are also proposed and attributed to the following strategies: maintaining membrane structure and sufficient energy supply, enhancing the antioxidant system, promoting the arginine pathway, regulating sugar metabolism, and activating the C-repeat/dehydration response element binding factor (CBF) genes. This review found that a variety of postharvest treatments have been developed to control CI in postharvest fruits and vegetables. The key findings were that the effects of some postharvest treatments—such as ethylene and 1-methylcyclopropene—on fruit and vegetable CI are contradictory. Some key factors, such as the time and temperature of heat treatment and the dose of ultraviolet radiation, need to be regarded when applying postharvest technologies. Some small-molecule signal substances from natural plants and the combination of different treatments are potential future research directions for controlling CI in postharvest fruits and vegetables.

Keywords: /Postharvest treatment/ /Fruits/ /Chilling injury/ /Biochemical mechanisms/

ROSE

Li, Y., Li, L., Wang, S., Liu, Y., Zou, J., Ding, W., Du, H., & Shen, W. (2021). Magnesium hydride acts as a convenient hydrogen supply to prolong the vase life of cut roses by modulating nitric oxide synthesis. *Postharvest Biology & Technology*, *177*, 111526. https://doi.org/10.1016/j.postharvbio.2021.111526

Abstract

Hydrogen-rich water (HRW), normally produced by water electrolysis, is a major method for hydrogen gas (H_2) delivery, and had beneficial outcomes in postharvest preservation of cut roses. Since the preparation of HRW is complicated and requires a H_2 generator, the development of a convenient hydrogen supply in horticulture is required. In this report, magnesium hydride (MgH_2), a H_2-releasing material used in hydrogen industry and medical research, was tested. Compared to HRW produced by electrolysis, release of H_2 by MgH_2 hydrolysis was more convenient and flexible. Similar to conventional HRW, MgH_2 could contribute H_2 and prolong the vase life of cut roses. This beneficial role of MgH_2 was verified by the observed increase in water content, decreased lipid peroxidation, and increased antioxidant levels. Pharmacologic experiments showed that MgH_2 mimicked the cut flower response of nitric oxide (NO)-releasing compounds by triggering an increase in endogenous NO production. In contrast, the positive effects of MgH_2 on cut flower vase life and lipid peroxidation were impaired by a NO scavenger and its synthetic inhibitor. This indicated a requirement for NO in the MgH_2-mediated pathway for prolonged vase life of cut rose flowers. Therefore, this study identifies a new opportunity for the application of H_2-releasing materials as an alternative approach for more convenient and flexible hydrogen supply in horticulture.

Keywords: /Magnesium hydride/ /Hydrogen gas/ /Nitric oxide/ /Nitrate reductase/ /Vase life/ /Rose/

RUTABAGA

Jakopic, J., Veberic, R., & Slatnar, A. (2021). Changes in quality parameters in rutabaga (Brassica napus var. napobrassica) roots during long term storage. *LWT - Food Science & Technology*, *147*, 111587. https://doi.org/10.1016/j.lwt.2021.111587

Abstract

Rutabaga is a cool-season root vegetable suitable for long term storage. The tubers were stored for more than 17 weeks. During this time, quality parameters, such as dry weight content, firmness, colour as well as individual sugars, organic acids, glucosinolates and phenolics were evaluated. We studied the chemical composition of rutabaga and investigated the changes during. The content of total sugars from

452 g kg^{-1} DW increased immediately after harvest up to 726 g kg^{-1} DW and then slightly decreased to 562 g kg^{-1} DW; similar trends were observed in the content of glucose, fructose and glucose. The content of organic acids mainly decreased during storage. An increase in phenolic content was observed in the rutabaga tubers during the first three months of storage in a cold store but this later decreased. The content of glucosinolates changed during long term storage but after four months again achieved values comparable with those at harvest time. The 4-month storage still provides a rich content of primary metabolites and bioactive compounds, as the content of phenols increased by more than 60% and sugars by 24%, despite a decrease in glucosinolates by 13% and organic acids by 25–54% compared to values at harvest.

Keywords: /SwedeSugars/ /Organic acids/ /Glucosinolates/ /Phenolics/

STRAWBERRY

Du, Y., Yang, F., Yu, H., Cheng, Y., Guo, Y., Yao, W., & Xie, Y. (2021). Fabrication of novel self-healing edible coating for fruits preservation and its performance maintenance mechanism. *Food Chemistry*, *351*, 129284. https://doi.org/10.1016/j.foodchem.2021.129284

Abstract

Coating damage destroys the integrity features critical for maintaining the modified atmosphere inside the fruit. In this study, we developed a self-healing edible coating that maintains its barrier properties for extending the shelf life of strawberries. The coating was fabricated via the layer-by-layer assembly of chitosan (CS) and sodium alginate (SA). $(SA/CS)_3$ formed by three assembly cycles could completely heal the visibly damaged area by treating water. The mechanical properties and the water and oxygen rates of the healed coating were 97%, 63%, and 95%, respectively, of the intact coating. $(SA/CS)_3$ coating effectively delayed strawberry deterioration. Moreover, the coating reduced the impact of coating damage on strawberries by restoring the coating barrier properties. The present findings have important implications for solving the reduction in freshness caused by coating damage.

Keywords: /Edible coating/ /Layer-by-layer/ /Self-healing/ /Strawberry preservation/ /Chitosan/ /Sodium alginate/

Hirsch, M., Langer, S. E., Marina, M., Rosli, H. G., Civello, P. M., Martínez, G. A., & Villarreal, N. M. (2021). Expression profiling of endo-xylanases during ripening of strawberry cultivars with contrasting softening rates. Influence of postharvest and hormonal treatments. *Journal of the Science of Food and Agriculture*, *101*(9), 3676–3684. https://doi.org/10.1002/jsfa.10997

Abstract

Softening is one of the main features that determine fruit quality during strawberries (Fragaria x ananassa, Duch.) ripening and storage. Being closely related to textural changes, the molecular and biochemical bases underlying strawberry cell-wall metabolism is a matter of interest. Here we investigated the abundance of transcripts encoding putative strawberry endo-xylanases in plant tissues, during fruit ripening and under postharvest and hormonal treatments. Total xylanase activity and expression of related genes in strawberry varieties with contrasting firmness were analyzed. FaXynA and FaXynC mRNA abundance was significantly higher than FaXynB in each plant tissue studied. Higher total xylanase activity was detected at the end of the ripening of the softer cultivar ('Toyonoka') in comparison with the firmer one ('Camarosa'), correlating with the abundance of FaXynA and FaXynC transcripts. Postharvest 1-methylcyclopropene treatment up-regulated FaXynA and FaXynC expressions. FaXynC mRNA abundance decreased with heat treatment but the opposite was observed for FaXynA. Calcium chloride treatment down-regulated FaXynA and FaXynC expression. Both genes responded differently to plant growth regulators' exposure. FaXynC expression was down-regulated by auxins and gibberellins

treatment and up-regulated by abscisic acid. FaXynA was up-regulated by auxins, while no changes in mRNA levels were evident by abscisic acid and gibberellins treatment. Ethephon exposure did not change FaXynA and FaXynC expressions. New knowledge about the presence of xylanases in ripening strawberry fruit and their response to postharvest and hormonal treatments is provided. Our findings suggest a role for endo-xylanases in hemicelluloses depolymerization and possibly in strawberry fruit softening.

Keywords: /Abiotic stimuli/ /Endo-xylanases/ /Fruit softening/ /Hemicelluloses metabolism/ /Strawberry/

Matar, C., Salou, T., Hélias, A., Pénicaud, C., Gaucel, S., Gontard, N., Guilbert, S., & Guillard, V. (2021). Benefit of modified atmosphere packaging on the overall environmental impact of packed strawberries. *Postharvest Biology & Technology*, *177*, 111521. https://doi.org/10.1016/j.postharvbio.2021.111521

Abstract

Life cycle assessment (LCA) was used to address the environmental benefit of using Equilibrium Modified Atmosphere Packaging (EMAP) at ambient temperature as an alternative to the use of conventional macro perforated packaging (MPP) and refrigeration in the strawberries' farm to fork system. In this purpose, the environmental impact of strawberries' storage conditions at households in macro perforated packaging put in ambient or cold conditions were compared with that of EMAP used at ambient temperature. LCA was applied from production to consumer level taking into account food losses at each step as well as packaging production, disposal and usage benefit, if any, i.e. food losses reduction. Our findings confirmed that for highly perishable products, the production step is the main driver of environmental impacts. As such, the technology of preservation that permits to minimize losses leads to the lowest environmental impact in spite of its direct impacts. For short storage at households, a well optimized EMAP system is a valuable alternative to MPP for both low and ambient temperatures while for long storage duration (3d), EMAP at ambient temperature could not substitute for MPP at refrigeration temperature. Finally, sensitivity analysis of results to the food losses parameters at both supermarket and household has revealed that conclusions regarding the best packaging strategy are highly sensitive to these parameters. The main conclusions of this study are that (i) EMAP could be, in several conditions, a valuable option compared to standard packaging strategies, (ii) it is needed to inform consumers on packaging functions in order to preserve EMAP benefit until consumption and (iii) better knowledge of food losses among the supply chain is needed to assess environmental impacts more precisely.

Keywords: /Packaging/ /Equilibrium modified atmosphere/ /Food losses/ /Life cycle assessment/ /Environmental impact/

Ventura-Aguilar, R. I., Díaz-Galindo, E. P., Bautista-Baños, S., Mendoza-Acevedo, S., Munguía-Cervantes, J. E., Correa-Pacheco, Z. N., & Bosquez-Molina, E. (2021). Monitoring the infection process of Rhizopus stolonifer on strawberry fruit during storage using films based on chitosan/polyvinyl alcohol/polyvinylpyrrolidone and plant extracts. *International Journal of Biological Macromolecules*, *182*, 583–594. https://doi.org/10.1016/j.ijbiomac.2021.03.187

Abstract

Different formulations based on nanoparticles of chitosan-plant extracts were evaluated to detect the infection process from the earliest stage of the fungus Rhizopus stolonifer on strawberry fruit during storage. Chitosan/polyvinyl alcohol (Ch/PVA) and chitosan/polyvinylpyrrolidone (Ch/PVP) films enriched with nanoparticles (NPs) of chitosan blended with plant extracts were prepared. They were placed inside a plastic package containing inoculated fruits and stored at 25 °C for 72 h. The thickness values of the films were in the range of 0.10 to 0.25 mm. All samples showed a maximum absorbance peak of about

300–320 nm; however, the Ch/PVP films enriched with NPs of chitosan and 10% of radish extract had an evident decrease in the optical absorbance as the fungal infection progressed. Additionally, as observed by scanning electron microscopy, the cross-section and surface morphology of films were not modified during storage, and the growth of R. stolonifer was evident after 48 h. Therefore, the Ch/PVP films enriched with chitosan NPs blended with 10% radish extract could be a reliable indicator of this fungus's growth. Films based on nanocomposites of chitosan/plant extracts showed optical absorbance. Chitosan NPs added with radish extract showed an average size of at least 20 nm. Films of Ch/PVP/10% radish extract could detect fungi infection progress on strawberries.

Keywords: /Intelligent films/ /Microbiological assays/ /Nanoparticles/

Wani, S. M., Gull, A., Ahad, T., Malik, A. R., Ganaie, T. A., Masoodi, F. A., & Gani, A. (2021). Effect of gum Arabic, xanthan and carrageenan coatings containing antimicrobial agent on postharvest quality of strawberry: Assessing the physicochemical, enzyme activity and bioactive properties. *International Journal of Biological Macromolecules*, *183*, 2100–2108. https://doi.org/10.1016/j.ijbiomac.2021.06.008

Abstract

Effect of edible coatings of gum Arabic, carrageenan and xanthan gum containing lemongrass essential oil 1% w/v on postharvest quality of strawberry was studied under refrigeration for a period of 12 days. Results showed all the three coatings maintained fruit quality parameters during storage compared to control. Among all the coatings, carrageenan coated fruits showed delayed weight loss (10.1 to 8%), decay percentage (78.42 to 14.29%), retained ascorbic acid (0.15 to 0.27 g $kg^{-1)}$, antioxidant activity (18.17 to 25.85%), firmness (9.07 to 12.43 N), L* (32.38 to 40.42), a* (16.08 to 17.22) and b* (27.36 to 33.54). Carrageenan gum also showed lowest cellulase activity (0.03 units h^{-1} mg protein $^{-1}$), pectin methylesterase activity (1.13 A620 min^{-1} mg protein $^{-1}$) and β-galactosidase activity (0.51 μmol min^{-1} mg protein $^{-1}$), while showed maximum reduction in polygalacturonase activity (0.07 units h^{-1} mg protein $^{-1}$) at the end of storage. Carrageenan gum was found effective in retention of anthocyanins and phenolic compounds during storage. Coatings loaded with antimicrobial agent inhibited psychrophilic bacteria, yeast and mold growth. It is concluded that carrageenan gum could better retain strawberry quality up to 12 days under refrigeration.

Keywords: /Antioxidant activity/ /Ascorbic acid/ /Decay/ /Edible coatings/ /Enzyme activity/

TEA LEAVES

Ni, T., Xu, S., Wei, Y., Li, T., Jin, G., Deng, W.-W., & Ning, J. (2021). Understanding the promotion of withering treatment on quality of postharvest tea leaves using UHPLC-orbitrap-MS metabolomics integrated with TMT-Based proteomics. *LWT - Food Science & Technology*, *147*, 11614. https://doi.org/10.1016/j.lwt.2021.111614

Abstract

Withering, or “spreading” in Chinese word, is a key process in Chinese green tea production. However, the underlying mechanisms of this treatment remain unclear. To investigate the effect of withering treatment on the quality of postharvest tea leaves, UHPLC-Orbitrap-MS metabolomics and tandem mass tag (TMT)-based proteomics analysis were performed. A total of 69 metabolites were identified, and up to 136 different expressed proteins were obtained through pair-wise comparisons. Comprehensive metabolomics and proteomics analyses revealed a monotonic metabolic shift ascribed to the tea leaves’ response to dehydration stress caused by harvesting. Multiple amino acids were increased in level due to protein degradation; the biosynthesis of catechins and flavonoids were inhibited; the level of glycosidically

bound volatiles were decreased attributed to the metabolism enhancement. These metabolic changes provide a material basis for later processes in green tea production and help with the quality formation of green tea.

Keywords: /Green tea/ /Withering/ /Metabolomics/ /Proteomics/ /Multi-omics/

TOMATO

Raynaldo, F. A., Dhanasekaran, S., Ngea, G. L. N., Yang, Q., Zhang, X., & Zhang, H. (2021). Investigating the biocontrol potentiality of Wickerhamomyces anomalus against postharvest gray mold decay in cherry tomatoes. *Scientia Horticulturae*, *285*, 110137. https://doi.org/10.1016/j.scienta.2021.110137

Abstract

Gray mold decay caused by *Botrytis cinerea* is one of the primary postharvest diseases of cherry tomatoes globally, leading to considerable economic losses. This study aimed to assess the biocontrol efficacy of *Wickerhamomyces anomalus* against postharvest gray mold decay in cherry tomatoes. The results indicated that *W. anomalus* significantly reduced the gray mold decay in cherry tomatoes in a concentration-dependent manner without affecting cherry tomatoes' quality. *W. anomalus* developed rapidly in wounds and on surfaces of cherry tomatoes at both 20 ± 2 °C and 4 ± 2 °C, and reduced the spore germination and germ tube length of *B. cinerea in vitro. W. anomalus* could adapt to the environment and compete for the nutrients and space against the pathogens. Besides, *W. anomalus* significantly enhanced the activities of defense-related enzymes in cherry tomatoes, including polyphenoloxidase (PPO), peroxidase (POD), catalase (CAT), and phenylalanine ammonialyase (PAL). Ultimately, the application of *W. anomalus* induced the disease resistance ability of cherry tomatoes. These findings suggested that *W. anomalus* could be a promising biocontrol agent to manage the postharvest gray mold decay in cherry tomatoes.

Keywords: /*Wickerhamomyces anomalus*/ /Biocontrol/ /Cherry tomatoes/ /*Botrytis cinerea*/ /Enzyme activity/

Uluisik, S. (2021). Chemical and structural quality traits during postharvest ripening regulated by chromosome segments from a wild relative of tomato Solanum pennellii IL4-2 and IL5-1. *Journal of Food Biochemistry*, e13858. https://doi.org/10.1111/jfbc.13858

Abstract

Tomato is usually harvested at an early ripening stage with high firmness suitable for storage and transportation but lacks many quality parameters such as sugars, organic acids, and phenolics. In a recent study, we have selected introgression lines (ILs) IL4-2 and IL5-1, developed from a cross between the Solanum pennellii and the Solanum lycopersicum M82, that exhibit differentiated postharvest shelf-life characteristics in the fruit compared to M82 and the rest of the ILs. Here, we first structurally and biochemically characterized IL4-2, IL5-1, and their parent M82 to decipher the cell wall mechanistic difference between soft (IL4-2) and firm (IL5-1) lines at two postharvest ripening periods. Generally, IL4-2 had more active cell wall modifications in terms of ripening-related gene expression, water-soluble pectin, and cell wall structure under the microscope, which probably makes this line softer than IL5-1. We also evaluated these lines based on commercial quality parameters, sugars, phenolics, organic, and amino acids to gain insight into their commercial and functional quality and reveal noticeable differences. In summary, the contribution of the S. pennellii IL5-1 and IL4-2 to the shelf life of the tomato was structurally characterized, and the component differences meeting the quality criteria were revealed.

Keywords: /Solanum pennellii/ /Cell wall structure/ /Introgression line/ /Shelf-life/ /Tomato ripening/

ZUCCHINI

Zuo, X., Cao, S., Jia, W., Zhao, Z., Jin, P., & Zheng, Y. (2021). Near-saturated relative humidity alleviates chilling injury in zucchini fruit through its regulation of antioxidant response and energy metabolism. *Food Chemistry*, *351*, 129336. https://doi.org/10.1016/j.foodchem.2021.129336

Abstract

To investigate the effect of relative humidity (RH) on chilling injury (CI), zucchini fruit were stored in cold rooms (4 ± 0.4 ℃) with different RHs (near-saturated RH [NSH] with 96–100% and normal RH with 72–76% served as control). Storage in NSH delayed weight loss and CI, maintained firmness and skin color. Higher antioxidant enzyme activities and greater scavenging capacities of free radicals were found in NSH-fruit than in the control fruit. The decrease of the unsaturated fatty acids was delayed in NSH-fruit due to lower activities of related membrane lipid degrading enzymes as compared to the control fruit. NSH-fruit also maintained higher activities of energy metabolism-associated enzymes than control fruit, leading to high levels of adenosine triphosphate (ATP). Taken together, we attributed the alleviation of CI by NSH storage to its enhancement of antioxidant capacities and its effect on maintaining higher energy status in zucchini fruit.

Keywords: /Zucchini fruit/ /Near-saturated relative humidity/ /Chilling injury/ /Antioxidant enzyme/ /Fatty acids/ /Energy status/