SELECTIVE DISSEMINATION OF INFORMATION
As of March 2022

AONLA

Ali, S., Anjum, M. A., Nawaz, A., Ejaz, S., Anwar, R., Khaliq, G., Hussain, S., Ullah, S., Hussain, R., Saleem, M. S., & Hasan, M. U. (2022). Postharvest γ-aminobutyric acid application mitigates chilling injury of aonla (Emblica officinalis Gaertn.) fruit during low temperature storage. *Postharvest Biology & Technology*, *185*, 111803. https://doi.org/10.1016/j.postharvbio.2021.111803

Abstract

Aonla is a nutrient rich underutilized subtropical fruit. It has short shelf life and is prone to chilling injury (CI) below 6 °C. So, the effect of γ-aminobutyric acid [5 mmol L−1 (GABA)] was investigated on aonla fruit CI mitigation during low temperature storage at 5 ± 1 °C for 24 d. Results showed that GABA treatment markedly suppressed CI, decay incidence, membrane permeability, malondialdehyde, superoxide anion and hydrogen peroxide in contrast with control. Treated fruit showed higher activity of glutamate decarboxylase (GAD) and GABA transaminase (GABA-T) enzymes which ultimately resulted in increased endogenous GABA content accumulation. Similarly, GABA application stimulated the activities of Δ1-pyrroline-5-carboxylate synthetase (P5CS) and ornithine aminotransferase (OAT) enzymes which thus enhanced proline accumulation. The GABA treated fruit exhibited higher phenylalanine ammonia lyase (PAL) and reduced polyphenol oxidase (PPO) enzyme activity and showed higher total phenols accumulation. In addition, total flavonoids, ascorbic acid and glutathione content were also significantly higher in GABA treated aonla fruit. In addition, GABA treated aonla fruit exhibited markedly higher ascorbate peroxidase (APX) catalase (CAT), peroxidase (POD) and superoxide dismutase (SOD) activities in comparison with the control. In addition, GABA treated fruit showed lower total soluble solids, ripening index and juice pH along with markedly higher concentration of titratable acidity. In conclusion, GABA treatment could be used for CI mitigation and overall quality maintenance of cold stored aonla fruit.

Keywords: /Aonla fruit/ /Antioxidant enzymes/ /Chilling injury/ /*Emblica officinalis* Gaertn./ /Oxidative stress/ /Proline accumulationγ-aminobutyric acid/

APPLE

Li, Y., Zheng, C., Wang, C., Golding, J. B., & Ru, L. (2022). Comparative transcriptome reveals molecular mechanism in apple genotypes differing in CO2 tolerance in CA storage. *Postharvest Biology & Technology*, *185*, 111807. https://doi.org/10.1016/j.postharvbio.2021.111807

Abstract

Internal browning is physiological storage disorder in many apples often associated with high CO_2 during controlled atmosphere (CA) storage. However the underlying molecular mechanisms leading to internal browning are poorly understood. This study examined changes in the apple transcriptome associated with internal browning related to high CO_2 in CA storage by comparing the responses of a CO_2 sensitive cultivar 'Han Fu' and the CO_2 tolerant cultivar 'Golden Delicious'. The apples were harvested at optimum maturity for long term storage and stored in a CA of 3 % O_2 and 6 % CO_2 at 4 ℃ for 60 d. The CO_2 sensitive 'Han Fu' showed severe browning symptoms within 30 d storage in CA, while no internal browning symptoms were detected in 'Golden Delicious' even after 60 d storage under the same storage conditions. PPO activity was higher in 'Han Fu' apples after 30 d storage. Differences in the expression profile between cultivars were assessed using RNA-sequencing techniques to identify candidate genes associated with internal browning in a cultivar specific manner. The RNA sequencing results showed that higher expression of the related to apetala 2 (RAP 2) and pyruvate decarboxylase (PDC) encoding genes in 'Golden Delicious' apples were associated with higher CO_2 tolerance in this cultivar. Conversely, the higher expression of key genes from lactate production (lactate dehydrogenase, LDH), lipid catabolic (patatin-like protein, PLP), polyphenol biosynthesis (phenylalanine ammonia-lyase, PAL), polyphenol

oxidase (PPO) were associated with the internal browning development in ‘Han Fu’ apple in CA storage condition. A conceptual model elucidating the molecular mechanism of browning development in ‘Han Fu’ and CO_2 acclimation in ‘Golden Delicious’ during storage in CA is proposed. The further elucidation of this mechanism will lead to a theory to optimize cultivar breeding in apples.

Keywords: /Apples/ /Controlled atmosphere/ /Internal browning/ /RNA-sequencing/

Settier-Ramírez, L., López-Carballo, G., Hernández-Muñoz, P., Fontana-Tachon, A., Strub, C., & Schorr-Galindo, S. (2022). Apple-based coatings incorporated with wild apple isolated yeast to reduce Penicillium expansum postharvest decay of apples. *Postharvest Biology & Technology*, *185*, 111805. https://doi.org/10.1016/j.postharvbio.2021.111805

Abstract

The aim of this work has been to prevent the growth of *Penicillium expansum* on the surface of apples by means of the use of biocontrol agents in combination with edible coatings. For that, *Metschnikowia pulcherrima* yeast isolated from wild apples was incorporated in edible film matrices based on pectins, cellulose ethers with and without the addition of liquid culture medium (yeast extract and glucose) and apple pomace residues. The viability and biocontrol activity of the yeast incorporated in the films were evaluated after film drying process and after being stored for 21 days at 10 °C. Furthermore, the matrix that exhibited the best results was applied as a coating on apples artificially inoculated with *P. expansum* in order to evaluate its antifungal activity against *P. expansum* during storage and to prevent the production of its mycotoxin, the patulin. *M. pulcherrima* remained viable in films after drying step and after 21 days storage, but viability depended on the matrix composition, being lower in pectin films and higher in apple pomace films. The highest antimicrobial activity in vitro was observed in methylcellulose films supplemented with yeast extract and glucose (YEG), and in apple pomace residues films, matrix which was therefore selected to be applied as coatings on apples inoculated with *P. expansum*. The results proved that bioactive coatings significantly reduce *P. expansum* growth and patulin production during storage. The results obtained in this work give added value to the apple industry residues which, in combination with apple isolated *M. pulcherrima* can be applied as coatings on apples to provide protection against blue mold and its mycotoxin as an alternative of postharvest disease management.

Keywords: /Biocontrol/ /*Metschnikowia pulcherrima*/ /*Penicillium expansum*/ /Antimicrobial coating/ /Apple/ /Biopolymers/ /Food waste/

Sottocornola, G., Baric, S., Nocker, M., Stella, F., & Zanker, M. (2022). Picture-based and conversational decision support to diagnose post-harvest apple diseases. *Expert Systems with Applications*, *189*, 116052. https://doi.org/10.1016/j.eswa.2021.116052

Abstract

This article presents the development of an expert system to support the diagnosis of post-harvest diseases of stored apples. We propose a picture-based and conversational interaction with users, where sampled images depicting symptoms of apples with known diseases are presented to users to elicit their feedback on perceived similarities in order to determine the most likely diagnosis of a diseased target apple. This article makes, besides the description of the industrial application scenario, multiple contributions circled around three rounds of user studies: (i) an usability and effectiveness assessment of the approach, where three user interface configurations are put to a test and the effectiveness of different types of user feedback mechanisms is assessed; (ii) contextual multi-armed bandit approaches for dynamic selection of displayed images with symptoms of diseased apples, that clearly outperform random and greedy sampling baseline strategies; (iii) a comparison of two different strategies for determining the context representation of a contextual multi-armed bandit approach, namely based on PCA of image features and a gamified large-scale user study. We therefore provide design insights for the development of such diagnosis applications on diseases that manifest themselves through visual symptoms in general

and, hence, the findings can be also valid for domains other than post-harvest fruit diseases. Picture-based expert system to support the diagnosis of apple diseases. Contextual multi-armed bandit techniques inducing conversational interactions. Large-scale user studies to validate usability and effectiveness of the system.

Keywords: /Contextual multi-armed bandit/ /Conversational interaction/ /Expert system in agriculture/ /Picture-based user interface/

Wang, Z., Jin, L., Wang, S., & Xu, H. (2022). Apple stem/calyx real-time recognition using YOLO-v5 algorithm for fruit automatic loading system. *Postharvest Biology & Technology*, *185*, N.PAG. https://doi.org/10.1016/j.postharvbio.2021.111808

Abstract

Fruit loading and packaging are still labor-intensive tasks during postharvest commercialization, of which the key issue is to realize the real-time detection and adjustment of fruit posture. However, fruit stem/calyx position is a key structural characteristic for fruit posture and will also affect fruit internal quality detection. In this paper, an image acquisition system based on fruit posture adjustment equipment was set up, and the YOLO-v5 algorithm based on deep learning was used to study the real-time recognition of stem/calyx of apples. First, hyperparameters were determined, and the training method of transfer learning was used to obtain better detection performance; then the networks with different widths and depths were trained to find the best baseline detection net; finally, the YOLO-v5 algorithm was optimized for this task by using detection head searching, layer pruning and channel pruning. The results showed that under the same setting conditions, YOLO-v5s had a more superior usability and could be selected as the baseline network considering detection performance, model weight size, and detection speed. After optimization, the complexity of the algorithm was further reduced. The model parameters and weight volume were decreased by about 71 %, while mean Average Precision (*mAP*) and F1-score (F_1) were only decreased by 1.57 % and 2.52 %, respectively. The optimized algorithm could achieve real-time detection under CPU condition at a speed of 25.51 frames per second (FPS). In comparison with other deep learning target detection algorithms, the algorithm used in this paper was similar to other lightweight networks in complexity. Its *mAP* and F_1 were 0.880 and 0.851, respectively. This was better than other one-stage object detection algorithms in detection ability, only lower than that of Faster R-CNN. The optimized YOLO-v5s achieved 93.89 % accuracy in fruit stem/calyx detection for different cultivars of apples. This research could lay the foundation for the automation of fruit loading and packing systems.

Keywords: /Apple stem/calyx/ /Real-time recognition/ /YOLO-v5/ /Algorithmic optimization/

ARTICHOKE

Giménez, M., Giménez-Berenguer, M., García-Pastor, M., Castillo, S., Valverde, J., Serrano, M., Valero, D., & Zapata, P. (2022). Influence of flower head order on phenolic content and quality of globe artichoke at harvest and during twenty-one days of cold storage. Scientia Horticulturae,295, 110846. https://doi.org/10.1016/j.scienta.2021.110846.

Abstract

Artichoke is one of the vegetables with higher content in phenolic compounds, which are responsible for their taste, flavor and health beneficial effects. However, phenolic profile and concentration depends on many factors, such as genotype, harvest date, and environmental and agronomical conditions. The main aim of this study was to perform a phytochemical characterization of artichoke heads, based on their position on plant (main, secondary and tertiary head) and harvest date, during a complete growing season. Results showed that total identified polyphenol concentration was higher in tertiary heads than secondary and main heads, due to their higher concentration in hydroxycinnamic acid and luteolin derivatives. On the other hand, two postharvest storage experiments with main, secondary and tertiary

artichoke heads, harvested in winter and spring, were performed. In addition, tertiary head showed the lowest weight, firmness losses and respiration rate during cold storage which could be attributed to their higher antioxidant compounds. In conclusion, tertiary heads have a greater aptitude to be stored at low temperature from harvesting to consumption since they maintained the quality properties for longer period of time and had higher content of bioactive compounds. However, main artichokes are the most appreciated by consumers due to their larger size.

Keywords: /Hydroxycinnamic acid/ /Luteolin derivative/ /Antioxidant activity/ /Postharvest quality/ /Respiration rate/

AVOCADO

Garcia, Franciela, Lin, Wei-Jen, Mellano, Valerie, Davidov-Pardo, Gabriel. (2022). Effect of biopolymer coatings made of zein nanoparticles and ε-polylysine as postharvest treatments on the shelf-life of avocados (Persea americana Mill. Cv. Hass). ***Journal of Agriculture and Food Research,*** **7, 100260. https://doi.org/10.1016/j.jafr.2021.100260**

Abstract

Avocados (Persea americana) are a popular fruit produced and consumed all around the world. Due to their climacteric nature, they are predisposed to rapid loss of moisture and firmness after harvest and prior to sale. The prevalence of the fungal phytopathogen Colletotrichum spp. Exacerbates the rate of decay by causing anthracnose, resulting in relatively short shelf-lives, increased waste, and economic losses. The objective of this study was to assess the effect of coatings made of zein nanoparticles (ZNP), zein and ε-polylysine nanoparticles (ZPL), zein solution (ZS), and ε-polylysine solution (PL) on the weight loss, respiration rate, firmness, color, and fungal decay of avocados compared to a control (C). By day 15 in ambient storage, control avocados had scarred surfaces, significant color change, overripe pulp, and clear signs of fungal decay. At this time, avocados treated with ZPL lost the least weight, 20.14%, compared to the control, 28.05%. The lowest respiration rates were seen in ZPL treatment with values of 107.83 mg of CO2/kg/h. The flesh of the ZPL- and ZNP- treated fruit remained firmer, 5.01 and 4.07 N, respectively, compared to the control, 3.67 N. For pulp color, ZPL-treated fruit showed the smallest color difference as measured by total color change, ΔE, 3.67 compared to the control, 15.45. At the conclusion of a 15-day Colletotrichum spp. inoculation study, ZPL treated avocados had the significantly lowest fungal severity score of 3.33, while ZNP-treated fruit and the control had scores of 4 and 4.7, respectively. The results of this project support biopolymeric coatings as a novel technique with the potential to extend shelf-life and reduce avocado waste both at retail and household levels to possibly mitigate economic losses.

Keywords: /Edible coatings/ /Colletotrichum spp./ /Active packaging/ /Antimicrobial/ /Nanotechnology/

Hernández, I., Uarrota, V., Fuentealba, C., Paredes, D., Defilippi, B. G., Campos-Vargas, R., Nuñez, G., Carrera, E., Meneses, C., Hertog, M., & Pedreschi, R. (2022). Transcriptome and hormone analyses reveals differences in physiological age of 'Hass' avocado fruit. ***Postharvest Biology & Technology*****,** ***185*****, 111806. https://doi.org/10.1016/j.postharvbio.2021.111806**

Abstract

The objective of this study was to identify transcripts or hormone-based biomarkers to define the physiological age of 'Hass' avocado fruit and to elucidate the changes at the level of metabolic pathways and their regulation. 'Hass' avocado fruit from orchards in different agroclimatic zones were collected during two harvest periods. Fruit were stored for 30 d under controlled atmosphere and regular air conditions and then transferred to shelf-life conditions at 20 °C. The physiological age as represented by the initial state of a hypothetical enzyme system (E0) of each fruit was obtained through a mechanistic softening model for Chilean 'Hass' avocado previously developed. Fruit from three different E0 ranges

(low, intermediate and high) were selected for transcriptome and hormone analyses. Sequencing data were processed by partial least squares regression analysis, which revealed 46 genes correlated to E0. Different metabolic pathways were over expressed between low and high E0 fruit. Low E0 fruit showed overexpression of genes related to DNA replication, auxin transport, cell wall remodeling, gibberellin synthesis, brassinosteroids and flavonols. On the other hand, fruit with high E0 revealed genes related to ethylene and abscisic acid biosynthesis and related responses and phenylpropanoid biosynthesis. Likewise, targeted hormone analysis revealed higher concentrations of active gibberellins (GA1 and GA4) and jasmonic acid for low E0 fruit and for high E0 fruit higher concentrations of abscisic acid, salicylic acid, dihydrozeatin, indole acetic acid and trans-zeatin, only the latter two being significant for this phenotype. This study reveals the relationship between transcripts and hormones during fruit maturation that is key to evaluate the physiological age of 'Hass' avocado fruit.

Keywords: /Heterogeneity/ /Firmness/ /Hormones/ /Maturation/ /Transcripts/ /*Persea Americana*/

BANANA

Yun, Z., Gao, H., Chen, X., Duan, X., & Jiang, Y. (2022). The role of hydrogen water in delaying ripening of banana fruit during postharvest storage. *Food Chemistry*, *373*, 131590. https://doi.org/10.1016/j.foodchem.2021.131590

Abstract

Experiments were conducted to identify the role of hydrogen water (HW) in banana fruit ripening. Banana fruit soaked with 0.8 ppm HW showed longer ripening than control fruit. HW treatment significantly reduced ethylene production and respiratory rate, and inhibited the expressions of ethylene synthesis- and signaling-related genes. Similarly, HW treatment inhibited the down-regulation of chlorophylls binding proteins and delayed the increase of chromaticity a*, b* and L* in banana peel. Furthermore, HW-treated peel exhibited lower expressions of cell wall degradation-related genes and higher levels of fruit firmness, pectin, hemicellulose and lignin. In addition, HW-treated pulp exhibited higher levels of starch, lower level of total soluble solids (TSS) and lower expression of flavor-related genes. Microstructural observation further confirmed that HW treatment delayed the degradations of starch and cell walls. Those results indicated that HW treatment delayed banana ripening via the role of ethylene in relation to degreening, flavor and softening.

Keywords: /Cell wall degradation/ /Ethylene synthesis and signaling/ /Fruit degreening/ /Fruit flavor/ /Fruit softening/ /Starch degradation/

BELL PEPPER

Fu, A., Zheng, Y., Lv, Y., Watkins, C. B., Bai, C., Ma, L., Yuan, S., Zheng, S., Jia, L., Gao, L., Wang, Q., Mu, J., & Zuo, J. (2022). Multi-omics analysis reveals specific modifications associated with reduced chilling injury in bell pepper fruit by methyl jamonate. *Postharvest Biology & Technology*, *185*, 111799. https://doi.org/10.1016/j.postharvbio.2021.111799

Abstract

Bell pepper is prone to chilling injury during cold storage. In this study, the plant hormone, methyl jasmonate (MeJA), which can stimulate the expression of plant defense genes, was used to investigate its effects on the transcriptome, metabolome and proteome after 6 days at 4 °C. Differentially expressed (DE) mRNAs that were identified with plant hormone signaling included the transcription factor *MYC2*, and those associated with antioxidant properties, membrane lipids and cell wall modification, fruit quality and an important transcription factors pathway -- *calmodulin-binding transcription activator - c-repeat-binding factor - transcription factor ICE1* (*CMAT-CaCBF1A-ICE1*). Effects on the proteome analysis were mainly associated with glutathione metabolism, biosynthesis of unsaturated fatty acids and fatty acid metabolism.

Differentially expressed metabolites were identified as acids, phenolics, and capsaicin. Our study suggests that MeJA treatment mitigates chilling injury of bell peppers though inhibiting the MYC2-JA signaling pathway, enhancing the ASA-GSH cycle, reducing membrane lipid damage, suppressing cell wall disassembly, and activating the CMAT-CBF-ICE pathway. These results provide a theoretical basis for further study on chilling injury of bell pepper fruit.

Keywords: /Chilling injury/ /Green pepper/ /Methyl jasmonate/ /Transcriptome/ /Metabolome/ /Proteome/

BRACKEN

Li, Z., Zhang, W., Li, X., Liu, H., Li, F., & Zhang, X. (2022). Combined effects of 1-methylcyclopropene and tea polyphenols coating treatment on the postharvest senescence and reactive oxygen species metabolism of bracken (Pteridium aquilinum var. latiusculum). *Postharvest Biology & Technology*, *185*, 11813. https://doi.org/10.1016/j.postharvbio.2021.111813

Abstract

Bracken (*Pteridium aquilinum* var. *latiusculum*) is susceptible to senescence and quality deterioration after harvest, which seriously affects its commodity value and shelf-life. In this study, the individual and combined effects of 1-methylcyclopropene (1-MCP) and tea polyphenols coating (TPC) on the postharvest senescence and reactive oxygen species (ROS) metabolism of bracken during storage at 4 ± 1 °C for 15 d were investigated. The results showed that 1-MCP or TPC treatment significantly delayed the reduction of overall quality and nutritional value, suppressed the ethylene production, respiration rate, relative conductivity, malondialdehyde (MDA) content and the accumulation of ROS, increased the ability of antioxidant system in comparison with the control during storage ($P < 0.05$). Notably, the effect of combined treatment of 1-MCP and TPC was more prominent than that of 1-MCP or TPC treatment alone. Furthermore, the Pearson's correlation analysis indicated that postharvest bracken senescence was accompanied by an elevation in ethylene production, respiration rate, relative conductivity, MDA content, ROS levels and decreasing in overall quality, thus further confirming the close relationship between ROS metabolism and bracken senescence. In conclusion, these results demonstrated that combined "1-MCP + TPC" treatment can effectively delay postharvest senescence and maintain the commodity quality of bracken by increasing the ability of the antioxidant system and mitigating ROS accumulation during the storage.

Keywords: /Bracken/ /1-methylcyclopropene/ /Tea polyphenols coating/ /Postharvest quality/ /Antioxidant system/

BROCCOLI

Yang, Q., Zhou, Q., Zhou, X., Fang, H., Zhao, Y., Wei, B., & Ji, S. (2022). Insights into profiling of glucosinolates and genes involved in its metabolic pathway accompanying post-harvest yellowing of broccoli. *Postharvest Biology & Technology*, *185*, 111780. https://doi.org/10.1016/j.postharvbio.2021.111780

Abstract

Postharvest yellowing is the main manifestation in the rapid deterioration of broccoli. Here, we monitored the composition and content changes of glucosinolates accompanying the yellowing process of broccoli to reveal the changes of characteristic bioactive substances along with the appearance changes process. Glucosinolates content was greatly reduced in parallel with the yellowing process. The most prominent reduction was among glucoraphanin and its hydrolysate sulforaphane that decreased by 37 % and 69 %, respectively, during slight yellowing, and up to 85 % and 93 %, respectively when severely yellowed. Among the genes involved in glucoraphanin metabolism pathway, the continuous down-regulation of *BoCYP83A1*, *BoTGG1* and *BoTGG2* genes had the most serious impact on the reduction of

glucoraphanin and sulforaphane content. Postharvest yellowing influenced the appearance of broccoli commodity, while greatly reduced the nutritional value.

Keywords: /Broccoli / /Glucoraphanin/ /Glucosinolate/ /Sulforaphane/ /Yellowing/

CABBAGE

Zeng, Z., Wang, C., Zhao, Y., Yang, Y., Shan, W., Kuang, J., Lu, W., Fan, Z., Su, X., Lin, H., & Chen, J. (2022). Molecular characterization of leaf senescence-associated autophagy genes in postharvest Chinese flowering cabbage and identifying their transcriptional activator BrMYB108. *Postharvest Biology & Technology*, *185*, 111785. https://doi.org/10.1016/j.postharvbio.2021.111785

Abstract

Autophagy is a critical intracellular solute trafficking and degradation pathway associated with leaf senescence. Autophagy-related genes (ATGs), are indispensable for autophagosome formation and autophagic process, but the underlying molecular functions of *ATGs* during leaf senescence in harvested leafy vegetables such as Chinese flowering cabbage remain largely unknown. In this study, 53 *ATG* genes from Chinese flowering cabbage were identified and studied. Notably, the expression of three *ATG* genes, *BrATG5b*, *BrATG8e-1* and *BrATG8h-1*, was strongly up-regulated during postharvest leaf senescence. These genes were induced by senescence-promoting phytohormones methyl jasmonate (MeJA) and abscisic acid (ABA), and repressed by senescence-delaying hormones cytokinin 6-benzyladenine (6-BA) and gibberellic acid (GA3). We identified a MYB transcriptional factor, BrMYB108, which showed a similar expression pattern as that of *BrATG5b*, *BrATG8e-1* and *BrATG8h-1*. This was localized in the nucleus and possessed trans-activation activity. Further, DNA-protein interaction assays showed that BrMYB108 directly binds to *BrATG5b*, *BrATG8e-1* and *BrATG8h-1* promoters and enhances their expression. In summary, this study unravels a novel transcription factor that activates the expression of senescence-associated *ATGs*, thereby acting as a potential positive regulator of postharvest leaf senescence in Chinese flowering cabbage.

Keywords: /Chinese flowering cabbage/ /Leaf senescence/ /ATGsMYB/ /Transcriptional regulation/

CANTALOUPE

Zhou, D., Zhang, Q., Wu, C., Li, T., & Tu, K. (2022). Change of soluble sugars, free and glycosidically bound volatile compounds in postharvest cantaloupe fruit response to cutting procedure and storage. *Scientia Horticulturae, 295,* 110863. https://doi.org/10.1016/j.scienta.2021.110863.

Abstract

In order to investigate the effects of cutting procedure and storage on the changes of sugars and volatiles in postharvest cantaloupe and explore the interactions among sugars, free and bound volatile compounds, two comparative groups were designed in this study (whole fruit stored at 4 °C at 0 d *vs* fresh-cut cantaloupe stored at 4 °C at 0 d; fresh-cut cantaloupe stored under 4 °C for 0, 1, 3, 5, 7 d). Changes of sugars, free and bound volatiles, β-glucosidase in whole and fresh-cut cantaloupe were determined. Results showed that most aldehydes, alcohols, esters and ketones in free form exhibited significant enhancements at the early storage period, while most bound volatiles decreased along with the storage. Cutting promoted the decrease of benzaldehyde, nonanal, decanal, 1-octen-3-ol, β-ionone and 3-octanone in bound form, but promoted the emissions of these components in free form correspondingly, which was consistent with the β-glucosidase activity in cantaloupe after cutting process. Besides, the *in vitro* test results indicated that sugars play key roles in the synthesis of bound volatiles in cantaloupe.

Keywords: /Sugars/ /Free volatiles/ /Glycosidically bound volatiles/ /Cutting/ /Cantaloupe/

CITRUS

Romero, P., & Lafuente, M. T. (2022). Ethylene-driven changes in epicuticular wax metabolism in citrus fruit. Food Chemistry, 372, 131320. https://doi.org/10.1016/j.foodchem.2021.131320

Abstract

Epicuticular waxes are important natural compounds that influence cuticle properties and can protect fruit from factors that harm its external quality. We demonstrated that, at a dose that reduces postharvest citrus fruit quality loss (4 d 2 μL L^{-1}), ethylene redirected epicuticular wax metabolism towards the synthesis of primary alcohols, mostly behenyl alcohol, by favouring the acyl-reduction pathway. This treatment also reduced the synthesis of terpenoids by redirecting the mevalonate pathway towards farnesol accumulation to the detriment of the accumulation of most triterpenoids, but not of their precursor squalene. Moreover, the 4 d ethylene treatment sharply increased the synthesis of docosane and lignoceric acid and lowered that of cerotic acid. Longer ethylene exposure (8 d) reversed some of these effects by lowering the contents of most alcohols, lignoceric acid and squalene, while increasing that of its derivative sitosterol. The 8 d ethylene treatment also increased farnesol and docosane contents.

Keywords: /Alcohols/ /Cuticle permeability/ /Orange/ /Postharvest/ /Terpenoids/

Yang, H., Zou, Y., Li, X., Zhang, M., Zhu, Z., Xu, R., Xu, J., Deng, X., & Cheng, Y. (2022). QTL analysis reveals the effect of CER1-1 and CER1-3 to reduce fruit water loss by increasing cuticular wax alkanes in citrus fruit. *Postharvest Biology & Technology*, *185*, 111771. https://doi.org/10.1016/j.postharvbio.2021.111771

Abstract

Postharvest water loss causes fruit softening, wilting, and a decline in quality and commodity value. Cuticular wax is a key barrier against non-stomatal water loss and plays a crucial role in fruit quality maintenance. However, there has been limited research on the genetic basis of fruit wax and postharvest water loss. Here, we found that HJ (*Citrus reticulata*) and ZK (*Poncirus trifoliata*) fruit had significant differences in postharvest water loss and cuticular wax. HJ fruit had a lower wax content and a faster water loss, and the main aliphatic wax components were alkanes and aldehydes. By contrast, ZK fruit had a higher wax content and a slower water loss, and the main aliphatic wax components were only alkanes. Correlation analysis revealed that fruit water loss seemed to be correlated with cuticular wax alkane in the F1 pseudo-testcross population of HJ and ZK. Furthermore, through high-density genetic map and bulk segregant analysis, alkanes and fruit water loss were co-localized to QTL3, resulting in the identification of *CER1-1* and *CER1-3* as the candidate genes. Heterologous overexpression in *Arabidopsis* revealed that they were involved in alkane synthesis and reduction of leaf water loss. In addition, coating with C28 alkane could reduce postharvest fruit water loss of six citrus varieties. Collectively, we speculated that cuticular wax alkanes might play an important role in limiting fruit water loss. The study provides new insights into the development of coating agents and breeding of citrus varieties with better storage performance.

Keywords: /Wax/ /Water loss/ /Citrus/ /QTL/ /Alkane/ /Postharvest/

FRUITS AND VEGETABLES

Chaomuang, N., Singphithak, P., Laguerre, O., & Suwapanich, R. (2022). Temperature control in a horticultural produce supply chain in Thailand and its influence on product quality. *Food Control*, *133*, 108585. https://doi.org/10.1016/j.foodcont.2021.108585

Abstract

The present study was conducted in order to investigate the temperature conditions in the horticultural produce cold chain in Thailand, and fresh-cut baby corn was chosen for a case study. The field investigation together with in-person interviews were performed at 4 growers' premises and one packing house. The information collected provided details on current postharvest conditions at individual stages from the growers' premises to an export distribution center. Temperature measurements were carried out to explore the time-temperature profiles throughout these stages. The results showed that the total duration of these stages was almost 32 h, and the temperature variations were between 6 and 33 °C. Precooling was delayed for at least 9 h, since baby corn cobs were primarily processed by dehusking and bulk packing. The baby corn was maintained at a temperature below 6.0 °C in a cold room for almost half of the total duration. The effect of the postharvest temperature conditions on the product quality evaluation was assessed by measuring various physiological quality attributes during storage. It was found that the marketability of the baby corn subjected to such postharvest temperature conditions remained possible with a salable period of up to two weeks. The result made it possible to identify the stages during which temperature control was inadequate, and recommendations were proposed to the stakeholder partner in order to modify the postharvest conditions in order to extend the product shelf life. The export and domestic fresh baby corn cold chains were investigated. Time-temperature profiles at different stages were examined. A substantial time interval between harvest and precooling was reported. Quality assessment was performed in order to evaluate product marketability. Given the storage conditions, the baby corn cobs remained salable for up to two weeks.

Keywords: /Baby corn/ /Cold chain/ /Field investigation/ /Physiological quality/ /Postharvest handling/ /Temperature/

Shi, L., Liu, Q., Qiao, Q., Zhu, Y., Huang, W., Wang, X., & Ren, Z. (2022). Exploring the effects of pectate and pectate lyase on the fruit softening and transcription profiling of Solanum lycopersicum. *Food Control*, *133*, 108636. https://doi.org/10.1016/j.foodcont.2021.108636

Abstract

In this study, the effects of pectate and pectate lyase (PL) on nutritional quality of tomato fruits were investigated. During postharvest storage, pectate increased the fruit firmness and changed biochemical indicators such as water-soluble pectin (WSP) content and peroxidase activity (POD), simultaneously. RNA-Seq analysis and functional annotation showed that the majority of differentially expressed genes (DEGs) distributed in amino acid metabolism, carbohydrate metabolism, signal transduction pathways in either pectate or PL groups. In view of the opposite effects of pectate and PL on fruit postharvest physiology, 56 DEGs with opposite expression trend were considered to be involved in fruit softening. Subsequently, the qRT- PCR results indicated that transcription of SlPME2.1 , SlCHI19 , SlMal d1 and SlPR-4B related to cell wall tissue or biogenesis as well as pathogenesis were regulated by pecate and PL. The results help clarify the mechanism of pectate treatment on improving the softening of postharvest tomato fruits. Pectate treatment improved tomato fruit quality and delayed fruit decay. A total of 1614 differentially expressed genes (DEGs) were identified using RNA-seq. •DEGs with opposite expression trend may be involved in fruit softening. The expression of PME2.1, CHI19, Mal d1 and PR-4B were regulated by pecate and PL.

Keywords: /Fruit firmness/ /Pectate/ /Pectate lyase/ /Softening/ /Tomato/

GRAPE

Asgarian, Z. S., Karimi, R., Ghabooli, M., & Maleki, M. (2022). Biochemical changes and quality characterization of cold-stored “Sahebi” grape in response to postharvest application of GABA. *Food Chemistry*, *373*, 131401, 131401. https://doi.org/10.1016/j.foodchem.2021.131401

Abstract

In this study, the effect of γ-aminobutyric acid (GABA) at 0 (control), 20 and 40 mM on maintaining postharvest quality, chilling tolerance and fungal decay of 'Sahebi' grapevine (Vitis vinifera L.) was investigated during 60 days storage at 1 °C. GABA-treated fruits especially at 40 mM showed less weight loss (35%), rachis browning (30%) and decay incident (63%) compared to the control. GABA-induced abscisic acid was linked to lower membrane electrolyte leakage (13%) in treated grapes. Moreover, at the end of 60 days, GABA treatment at 40 mM resulted in higher activities of antioxidant enzymes including superoxide dismutase (50%), catalase (35%), guaiacol peroxidase (65%), and ascorbate peroxidase (47%) and lower malondialdehyde (21%) compared to control samples. The highest soluble sugars and organic acids were related to 40 mM GABA-treated grape clusters. Phenolic compounds (phenolic acids, stilbenes, flavonoids and anthocyanidins) and antioxidant capacity increased in 40 mM GABA-treated grapes due to lower polyphenol oxidase activity. Therefore, GABA is recommended for maintaining internal quality and reduction in fungal decay and chilling injury of grapes during postharvest storage.

Keywords: /Anthocyanidins/ /Flavonoids/ /Grape/ /Postharvest/ /Tartaric acid/ /γ-Aminobutyric acid/

JUJUBE

Lei, X., Deng, B., Ruan, C., Deng, L., & Zeng, K. (2022). Phenylethanol as a quorum sensing molecule to promote biofilm formation of the antagonistic yeast Debaryomyces nepalensis for the control of black spot rot on jujube. *Postharvest Biology & Technology*, *185*, 111788. https://doi.org/10.1016/j.postharvbio.2021.111788

Abstract

Microbial biocontrol agents have become an effective way to inhibit post-harvest diseases of fruits and vegetables, where antagonistic yeast with antimicrobial properties are often employed. In this study, *Debaryomyces nepalensis,* isolated from the leaves of jujube and identified with internal transcribed spacer sequences, can effectively control the post-harvest black spot of jujube caused by *Alternaria alternate,* even though it showed no direct inhibitory effects on *A. alternate*. Phenylethanol, as a quorum sensing molecule, was identified by HPLC to be one of the major metabolites during the culture of *D. nepalensis*. Phenylethanol could promote the biofilm formation ability of *D. nepalensis* and increase its adhesion to the surface of jujube fruit, and the control effect of 2 mmol L−1 phenylethanol combined with *D. nepalensis* on jujube fruit black spot was increased by 15 % compared with *D. nepalensis* alone. In conclusion, the results of this work provided a new perspective for improving the biological control efficiency of *D. nepalensis*.

Keywords: /*Debaryomyces nepalensis/ /*Biofilm/ /Phenylethanol/ /Biocontrol/

Yuan, R., Guo, M., Li, C., Chen, S., Liu, G., He, J., Wan, G., & Fan, N. (2022). Detection of early bruises in jujubes based on reflectance, absorbance and Kubelka-Munk spectral data. *Postharvest Biology & Technology*, *185*, 111810. https://doi.org/10.1016/j.postharvbio.2021.111810

Abstract

Bruising is one of the major challenges appearing in the postharvest grading and processing of Lingwu long jujubes, which leads to quality deterioration and microbial infection. In the present work, the spectra of reflectance (R), absorbance (A) and Kubelka-Munk (K-M) in Lingwu were obtained by hyperspectral imaging, and applied to non-destructively detect bruising symptoms. Spectra were preprocessed and characteristic wavelengths were selected by competitive adaptive reweighted sampling (CARS) and the interval variable iterative space shrinkage approach (iVISSA). Classification discriminant models were constructed by partial least squares-discriminant analysis (PLS-DA) and support vector machine (SVM). By comparison, the results revealed that the A-raw-iVISSA-PLS-DA model showed the lowest errors in

cross-validation, while the number of feature variables was the lowest accounting for 28.8 %, and the accuracies of the calibration and cross validation were 88.9 % and 100.0 %, respectively. In particular, this study demonstrated the feasibility to detect the early bruising degree in Lingwu long jujubes based on absorbance spectrum. Consequently, it also laid a foundation for future studies about detecting early bruising in small fruit with a rapid and non-destructive spectral-optical measurement.

Keywords: /Jujube/ /Bruise/ /Reflectance/ /Absorbance/ /Kubelka-Munk/

KIWI

Gwanpua, S. G., Zhao, M., Jabbar, A., Bronlund, J. E., & East, A. R. (2022). A model for firmness and low temperature-induced storage breakdown disorder of "Hayward" kiwifruit in supply chain. *Postharvest Biology & Technology*, *185*, 111789. https://doi.org/10.1016/j.postharvbio.2021.111789

Abstract

Flesh softening and chilling injury related storage breakdown disorder (SBD) are the most important quality issues in the kiwifruit industry. This study was aimed at developing a mathematical model that could describe and predict evolution of storage breakdown disorder and firmness. A mechanistic modeling approach was adopted, with different concepts used to model the three phases of softening often observed in kiwifruit. The initial rapid softening phase was modeled as a function of starch breakdown, the slow softening phase was modeled as function of pectin degradation, while the final softening phase often characterized by tissue collapse, was modeled as a function of chilling injury related storage breakdown disorder. The model was calibrated using data collected from three seasons, across multiple maturity areas and subjected to different cooling and storage temperature regimes. 93 % of the total variance in the firmness data could be explained by the model. A mean absolute error of 0.2–2.2 % was obtained for SBD predictions. The developed model could be used by growers and postharvest managers to predict kiwifruit softening under different supply chain conditions.

Keywords: /Chilling injury/ /Softening/ /Quality/ /Prediction/ /Maturity/

LONGAN

Liu, B., Zhu, Q., Zhou, X., Zhang, X., Dang, Z., Liang, S., Li, G., Zhang, Z., Fang, F., & Pang, X. (2022). Characterization of a pericarp browning related LACCASE 14-4 from longan fruit with a focus on (epi)catechin oxidative polymerization. *Postharvest Biology & Technology*, *185*, 111802. https://doi.org/10.1016/j.postharvbio.2021.111802

Abstract

Polyphenol oxidase (PPO) has long been considered as the key enzyme responsible for the pericarp browning of longan fruit after harvest. However, due to the overlapping substrate ranges of PPOs and laccases, the contribution of laccases in longan pericarp browning is unclear. In this study, we found that the contents of flavan-3-ols and procyanidin A2/B2 in longan pericarp decreased during browning after harvest. It might be caused by high activity of laccases rather than PPOs. A 100-kDa laccase was purified from the pericarp and its protein sequence was identical to the deduced sequence of *LAC14-4*. The laccase was more favored to (−)-epicatechin (EC) than other flavan-3-ols and procyanidin A2/B2 identified in the pericarp. Using EC and (+)-catechin (CT) as substrates, brown products were generated by LAC14-4 and exogenously expressed LAC14-4-3 × HA *in vitro*; isomers of procyanidin polymers were detected in the products. Transient expression of LAC14-4-GFP in tobacco leaves showed that *LAC14-4* was located in the vacuoles and endoplasmic reticulum. In situ hybridization showed that *LAC14-4* mainly expressed in the outer part of mesocarp close to the brachysclereid layer. The transcript, protein and activity levels of *LAC14-4* in pericarp were upregulated during browning. In summary, longan pericarp

contains high levels of *LAC14-4* that catalyzes the procyanidin polymerization leading to longan pericarp browning.

Keywords: /Longan/ /Pericarp browning/ /Laccase/ /(−)-Epicatechin/ /Oxidative polymerization/

LOTUS

Chen, J., Xu, Y., Yi, Y., Hou, W., Wang, L., Ai, Y., Wang, H., & Min, T. (2022). Regulations and mechanisms of 1-methylcyclopropene treatment on browning and quality of fresh-cut lotus (Nelumbo nucifera Gaertn.) root slices. *Postharvest Biology & Technology*, *185*, 111782. https://doi.org/10.1016/j.postharvbio.2021.111782

Abstract

The quality of fresh-cut lotus root slices is greatly affected by enzymatic browning. In this study, we investigated the effects of 1-methylcyclopropene treatment on browning and quality deterioration of lotus root slices. When fresh-cut lotus root slices were immersed in 0.1 mg L−1 1-MCP for 1 h and stored at 10 ℃ for twelve days, microbial growth, respiration, total phenolic content, phenylalanine ammonia lyase activity, polyphenol oxidase activity, and soluble quinone levels in fresh-cut lotus root slices were suppressed. Furthermore, 1-MCP treatment improved the antioxidant capacities, peroxidase activities, superoxide dismutase activities, catalase activities, and DPPH free radical scavenging rates in fresh-cut lotus root slices. In addition, 1-MCP treatment inhibited the production of reactive oxide species, which delayed quality deterioration of fresh-cut lotus root slices. Based on transcriptomics and real-time quantitative PCR results, gene expression levels of *NnmetK2*, *NnACO*, *NnETR2*, *NnEIN3*, and *NnERF1* were up-regulated while expression levels of *NnEBF1* were down-regulated. These findings indicate that 1-MCP inhibits ethylene biosynthesis and signal transduction, which suppresses a series of ethylene-induced physiological and biochemical reactions. Based on our findings, we propose a new strategy for inhibiting enzymatic browning in fresh-cut lotus root slices.

Keywords: /1-MCPEnzymatic browning/ /Phenylpropane metabolism/ /Ethylene biosynthesis/ /Ethylene signal transduction/

MANGO

Sanches, A. G., Silva, M. B. da, Wong, M. C. C., Oliveira, A. R. G. de, Pedrosa, V. M. D., Fernandes, T. F. S., Gratão, P. L., & Teixeira, G. H. de A. (2022). Sorbitol immersion controls chilling injury in CA stored "Palmer" mangoes. *Postharvest Biology & Technology*, *185*, 111800. https://doi.org/10.1016/j.postharvbio.2021.111800

Abstract

Chilling injury (CI) in mangoes can be reduced using a controlled atmosphere (CA) and sorbitol immersion, although studies combining these treatments have yet to be recorded. Therefore, the objective of this study was to use multivariate analysis to evaluate the effectiveness of these methods in controlling CI. 'Palmer' mangoes were immersed in 0.1 and 2.5 % (w/v) sorbitol solutions and stored under CA (5 % O2 + 5 % CO2) at 8 °C for 30 d. The evaluations were performed under CA storage conditions (0, 10, 20, and 30 d), after which the fruit were transferred to an ambient temperature environment (~23 °C) for a further 7 days. CI was minimized in mangoes treated with 2.5 % sorbitol and stored in a CA. In addition, the physicochemical variables (soluble solids content, titratable acidity, SSC/TA ratio, and pH), firmness, and mesocarp color (L*, hº, and C*) were not affected. CI development was associated with increased fresh weight loss and epicarp color (L*, hº, and C*). Hydrogen peroxide (H2O2) levels were related to CI symptom development, which intensified with the transfer to an ambient temperature, mainly due to increased electrolyte leakage (EL), lipid peroxidation (LP), and polyphenol oxidase (PPO) activity. CI inhibition in mangoes treated with 2.5 % sorbitol under a CA was related to the

non-enzymatic (vitamin C and total polyphenols) and enzymatic (superoxide dismutase – SOD, catalase – CAT, and ascorbate peroxidase – APX) defense metabolisms, allowing for the quality of the fruit to be maintained for up to 30 d at 8 °C.

Keywords: /*Mangifera indica* L./ /Enzymatic metabolism/ /Non-enzymatic metabolism/ /Principal component analysis/ /Physiological disorder/

Zhang, Y., Gao, Z., Hu, M., Pan, Y., Xu, X., & Zhang, Z. (2022). Delay of ripening and senescence in mango fruit by 6-benzylaminopurine is associated with inhibition of ethylene biosynthesis and membrane lipid catabolism. *Postharvest Biology & Technology*, *185*, 111797. https://doi.org/10.1016/j.postharvbio.2021.111797

Abstract

6-Benzylaminopurine (6-BA), a synthetic cytokinin compound, plays a vital role in modulating diverse physiological processes in plants and is widely applied in agriculture. This study aims to investigate the effects of 6-BA on ripening and senescence and its possible mechanisms in harvested 'Guifei' mango fruit. The results exhibited that the application of 0.2 g L−1 6-BA to mango fruit inhibited the changes in firmness, flesh color, soluble solids content (SSC), titratable acidity (TA) and contents of carotenoid and chlorophyll, while retarded the climacteric process of respiration and ethylene. The delay of ethylene production due to 6-BA application was correlated with suppressed activities of 1-aminocyclopropane-1-carboxylic acid (ACC) synthase (ACS) and ACC oxidase (ACO) in mango fruit. 6-BA treatment also reduced the accumulation of reactive oxygen species (ROS) (·O2- and H2O2) and malonaldehyde (MDA) and maintained a lower membrane permeability. Moreover, 6-BA treatment inhibited the activities of phospholipase D (PLD) and lipoxygenase (LOX) and downregulated the relative expression of *MiPLD* and *MiLOX,* which resulted in reduced degradation of phosphatidylcholine (PC) to phosphatidic acid (PA) and limited lipid peroxidation. The results suggest that 6-BA could delay ripening and senescence in mango fruit through regulating ethylene biosynthesis, ROS production and membrane lipid metabolism.

Keywords: /Mango/ /6-benzylaminopurine/ /Postharvest ripening/ /Ethylene/ /Reactive oxygen species/ /Phospholipase D/

MUSHROOM

Gong, M., Wang, Y., Su, E., Zhang, J., Tang, L., Li, Z., Zhang, L., Zou, G., Wan, J., & Bao, D. (2022). The promising application of a β-glucosidase inhibitor in the postharvest management of Volvariella volvacea. *Postharvest Biology & Technology*, *185*, 111784. https://doi.org/10.1016/j.postharvbio.2021.111784

Abstract

Cryogenic autolysis of *Volvariella volvacea* restricts the postharvest storage and sale of this commercially cultivated mushroom. Previous studies have shown that the specific ubiquitin-binding enzyme E2 (UBEV2) inhibitor (L345-0044) is an effective agent to prevent cryogenic autolysis. The safety of L345-0044 as a food preservative is debatable. Thus, it is essential to find a safer food additive for the preservation of *V. volvacea*. In this study, absolute quantitative transcriptome and metabolome analyses were performed to analyze the gene and metabolite expression profiles of the fruiting bodies treated with L345-0044 at 4 °C. Correlative pathway analysis of the associated metabolites from the correlation analysis of differentially expressed metabolites and genes (> 3) screened out the pathways of tyrosine metabolism and carbon metabolism (*Impact* > 1) in which tyrosinase and β-glucosidase were the two most strongly associated enzymes. qPCR confirmed that chilling stress (CS) induced abnormal up-regulation of β-glucosidase (BGVV1) and tyrosinase. Western blot and enzyme activity assays further confirmed our results that CS-induced cryogenic autolysis could be alleviated by inhibitors of

β-glucosidase and tyrosinase. The activities of β-glucosidase and tyrosinase were increased by 23.34 % and by 250.34 %, respectively, after CS treatment for 24 h but were reduced by 27.25 % and by 73.20 %, respectively, after treatment with inhibitors that included conduritol B epoxide and arbutin, respectively. Among the inhibitors, D-Glucono-1,5-lactone prevented autolysis at 4 °C for more than 24 h. As a safe conventional food additive, its excellent performance in preventing autolysis indicates that it has a very promising application in the postharvest management of *V. volvacea*.

Keywords: /*Volvariella volvacea/* /Cryogenic autolysis/ /Absolute quantitative transcriptome/ /Metabolomeβ-glucosidase/

Gao, F., Xie, W., Zhang, H., Li, Z., Li, S., & Li, T. (2022). Metabolomic analysis of browning mechanisms of morels (Morchella sextelata) during storage. *Postharvest Biology & Technology*, *185*, 111801. https://doi.org/10.1016/j.postharvbio.2021.111801

Abstract

Browning is a major problem affecting the quality of the morel. This study aims to clarify the browning mechanisms of the morel in terms of metabolite changes during storage. Morels were stored at 20 °C and 4 °C, respectively, and browned gradually with the extension of the storage periods. The soluble quinone content was increased, while the total phenolic content was decreased in the later storage periods. Metabolomics analysis revealed that many metabolic profiles of substances in morel were altered with increased amino acids and fatty acids and decreased soluble sugars, organic acids and some phenolics with the browning process in storage. Especially dopamine, a precursor of melanin produced from tyrosine oxidation, was up-accumulated after storage. However, quinone, the browning substance, was increased after storage. Through the metabolomic results and correlation analysis, it could be suggested that tyrosine metabolism was a vital pathway leading to the browning of morels during storage. The membrane lipid and energy metabolism involved in the upstream of the tyrosine metabolism pathway might also concern the browning of morels during storage.

Keywords: /Morels/ /Browning/ /Metabolites/ /Tyrosine/

Qu, H., Zhou, H., Ma, T., Zheng, Z., Zheng, E., Yang, H., & Gao, H. (2022). TMT-based quantitative proteomic analysis of postharvest Coprinus comatus fruiting body during storage. *Postharvest Biology & Technology*, *185*, 111786. https://doi.org/10.1016/j.postharvbio.2021.111786

Abstract

Coprinus comatus is a highly perishable edible mushroom and it is difficult to keep fresh after harvest. The high content of moisture, maintained respiration and absence of protective cuticle layer are the main factors of short shelf life. In this study, we used tandem mass tags (TMT)-based quantitative proteomic techniques to investigate the proteome responses of postharvest mushrooms during 16 d of storage at 8 ± 1 ℃. The quality parameters of the mushroom fruiting body including firmness, weight loss, browning index and respiration rate were determined. A total of 168 differentially abundant proteins (DAPs) were overlapped in the comparison groups (8 d-storage treatment group *vs*. control group and 16 d-storage treatment group *vs*. control group), of which 74 DAPs were up-regulated and 86 DAPs were down-regulated during the postharvest storage. Based on Gene Ontology (GO) annotation, the major biological processes were metabolic process and cellular process. Catalytic activity, binding and structural molecular activity were the predominant molecular functions. The cellular components were primarily cell and cell part. Kyoto Encyclopedia of Genes and Genomes (KEGG) pathway analysis indicated that these DAPs were mainly involved in ribosome, glycolysis, citrate cycle and glutamate metabolism. AMPK and FOXO signaling pathways also participated in the postharvest physiology of mushrooms. Our results provide insights into the biological processes of *Coprinus comatus* fruiting body during storage and a theoretical basis for developing effective postharvest technology for fresh *Coprinus comatus*.

Keywords: /*Coprinus comatus*/ /Postharvest storage/ /TMT/ /Proteomics analysis/ /Quality deterioration/

Shi, D., Yin, C., Fan, X., Yao, F., Qiao, Y., Xue, S., Lu, Q., Feng, C., Meng, J., & Gao, H. (2022). Effects of ultrasound and gamma irradiation on quality maintenance of fresh Lentinula edodes during cold storage. *Food Chemistry*, *373*, 131478. https://doi.org/10.1016/j.foodchem.2021.131478

Abstract

Microbial infection, senescence and water losses result in serious quality deterioration of postharvest mushrooms. The aim of this study was to investigate the impact of ultrasound treatment (US), gamma irradiation treatment (GI) and their combination on quality maintenance of fresh Lentinula edodes during storage. The results showed that US + GI was the most effective approach to maintaining the quality of mushrooms. US + GI reduced natural microflora present on L. edodes, such as total number of colonies, molds, yeasts, Pseudomonas and Enterobacteriaceae. Furthermore, US + GI stimulated phenylalanine ammonia lyase, maintained the highest level of total phenolic content (733.63 mg GAE/kg on Day 4), and postponed the occurrence of reduced ascorbic acid (33.7% retention relative to the control), which contributed to strengthening the antioxidant capacity. Additionally, US + GI retarded water mobility and loss. In brief, the US + GI in this study is an effective hurdle technology for preserving the quality of fresh L. edodes during storage.

Keywords: /Antioxidant capacity/ /Gamma irradiation/ /Lentinula edodes/ /Microbial reduction/ /Quality maintenance/ /Ultrasound/ /Water migration/

Wang, L., You, Y., & Wang, X. (2022). Increasing nicotinamide adenine dinucleotide phosphate hydrogen levels via pentose phosphate pathway promotes phyenylpropanoid metabolism of fresh-cut white mushroom (Agaricus bisporus) under high O2/CO2 storage. *Scientia Horticulturae, 295,* 110873. https://doi.org/10.1016/j.scienta.2021.110873.

Abstract

Cutting usually shortens white mushroom shelf life due to wounding stress. The metabolic activities including phenylpropanoid metabolism can promote wound-healing ability in white mushrooms, thus alleviating the negative effect of its cutting process. However, few reports have reported on the relationship between phenylpropanoid metabolism and nicotinamide adenine dinucleotide phosphate hydrogen (NADPH) content. In this study, the effects of high O_2/CO_2 treatment on the phenylpropanoid metabolism and NADPH level produced via the pentose phosphate pathway (PPP) in white mushroom slices were analyzed. White mushroom slices were first treated with 80% O_2+20% CO_2 controlled atmosphere for 3 h. The results showed that high O_2/CO_2 treatment enhanced phenylpropanoid metabolism, which is demonstrated by higher total phenol, flavonoid, and lignin content. High O_2/CO_2 treatment also reduced the total respiratory rate. However, it increased PPP and tricarboxylic acid cycle rates; inhibited decline in ATP content and improved NAD^+ kinase activity. Moreover, NAD^+ and NADH contents decreased, whereas $NADP^+$ and NADPH contents increased. To further investigate the relationship between respiratory metabolism and phenylpropanoid metabolism, whole white mushrooms were immersed in 0.1 mol L^{-1} Na_3PO_4 (a PPP inhibitor) and then the slices were treated with 80% O_2+20% CO_2 for 3 h. This led to lower key enzyme activity and metabolic product content in the phenylpropanoid metabolism compared with no Na_3PO_4 treatment. These results demonstrated that high oxygen treatment can effectively induce phenylpropanoid metabolism by increasing NADPH levels via stimulating the PPP. In conclusion, the PPP might play an important role in phenylpropanoid metabolism in fresh-cut white mushrooms.

Keywords: /Fresh-cut/ /White mushroom/ /Wound-healing/ /High O_2/CO_2/ /Respiratory metabolism/ /Phenylpropanoid metabolism/

Zhang, S., Fang, X., Wu, W., Tong, C., Chen, H., Yang, H., & Gao, H. (2022). Effects of negative air ions treatment on the quality of fresh shiitake mushroom (Lentinus edodes) during storage. *Food Chemistry*, *371*, 131200. https://doi.org/10.1016/j.foodchem.2021.131200

Abstract

Fresh shiitake (Lentinus edodes) is prone to brown, pileus-opening and flavor-loss during storage. Therefore, it is important to find an effective preservation method for fresh shiitake. Negative air ions (NAI) are negatively-charged molecules or atoms in the air, and can affect the physiological metabolism of live cells and be conveniently used with low cost. In this study, NAI treatment was performed at different times and the physico-chemical characteristics, microstructure, membrane potential and energy metabolism of shiitake were determined during storage. Results showed that NAI treatment for 40 min could reduce 29% of browning index and maintain the hardness of shiitake. NAI treatment groups had higher content of sweetness amino acids, umami amino acids, 5'-IMP, eight-carbon alcohols compounds and cyclic sulfides compounds than the control, and comprehensive quality of the group being treated for 40 min was the best. The mitochondria of shiitake swelled and the membrane potential decreased after being treated by NAI. However, NAI treatment for 40 min could improve the contents of ATP and ADP, maintain a relatively stable energy charge level, and promote energy utilization of shiitake during storage. The results demonstrated that NAI treatment had the potential to improve the quality shiitake during storage.

Keywords: /Energy/ /Flavor/ /Lentinus edodes/ /Mitochondrial membrane potential/ /Negative air ions/ /Postharvest/

PACKAGING

Ashfaq, Alweera, Khursheed, Nazia, Fatima, Samra, Anjum, Zayeema, and Younis, Kaiser. (2022) Application of nanotechnology in food packaging: Pros and Cons. *Journal of Agriculture and Food Research,* 7, 100270. https://doi.org/10.1016/j.jafr.2022.100270.

Abstract

Nanotechnology used in the synthesis of nanoparticles has attracted great interest in the field of food packaging. It promises the development of food packages with upgraded properties that helps in prolonging the shelf life of food products. This review presents the most commonly used nanoparticles in food packaging, the significant changes they cause in the properties of packaging material, and the commercially available nano-based packaging materials. Nanoparticles are used in the development of improved packaging, active packaging, and intelligent packaging which helps in the maintenance of food quality and traceability during the supply chain. Nanoparticles possess antimicrobial activity, oxygen scavenging ability, UV impermeability, and various other properties that make them valuable for their application in the preparation of nanocomposites. The large surface area to volume ratio sometimes becomes the reason for nanoparticle toxicity so it is important to study their migration and interaction with polymer matrix while developing packaging materials

Keywords: /Nanoparticle/ /Packaging/ /Polymer matrix/ /Toxicity/ /Shelf life/

Chausali, Neha, Saxena, Jyoti, Prasad, Ram. (2022). Recent trends in nanotechnology applications of bio-based packaging. Journal of Agriculture and Food Research, 7, 100257. https://doi.org/10.1016/j.jafr.2021.100257.

Abstract

Nanotechnology has reached almost every sector and amazed the world by offering various potential

applications in these sectors. Nanostructure materials have been known for their unique physical and chemical properties and enhanced performance, hence preferred over their macrostructure counterparts. Food industry is one of the areas in which nanotechnology has transformed the way of preserving, processing, testing and packaging of foods. Nanotechnology based advanced packaging has made it possible to transport food items safely without spoiling the taste, nutrition and quality. Moreover, it also prevents contamination and sustains mechanical, physiological, physical and chemical properties of food items. Various nanomaterials have been used in food packaging to provide improved, active, bio-based, and smart/intelligent packaging. Smart/intelligent packaging ensures food safety by detecting contamination, gasses, moisture, temperature and other food parameters by means of sensors. On the other hand, bio-based packaging employs biodegradable and biocompatible packaging material in place of conventional plastic for the protection from any kind of food spoilage. Although, more efforts are needed to resolve cost and other property related issues of bio-based packaging materials. There are many studies available on nanopackaging such as improved, active and intelligent packaging but only a few have focused on bio-based packaging. Bio-based packaging is next generation packaging that encourages the use of natural polymers instead of conventional plastics. This paper summarizes different types of nanopackaging materials with special focus on bio-based packaging and unique features and attributes of improved, active and intelligent packaging. Recent advances in bio-based packaging and presumed risk of nanoparticle migration have also been discussed.

Keywords: /Nanotechnology/ /Food packaging/ /Food processing/ /Food testing/ /Food preservation/ /Nanomaterial toxicity/

PAKCHOI

Yu, K., Zhou, L., Xu, J., Jiang, F., Zhong, Z., Zou, L., & Liu, W. (2022). Carboxymethyl cellulose-based water barrier coating regulated postharvest quality and ROS metabolism of pakchoi (Brassica chinensis L.). *Postharvest Biology & Technology*, *185*, 111804. https://doi.org/10.1016/j.postharvbio.2021.111804

Abstract

The postharvest preservation of *Brassica* vegetables has received much attention for improving their nutritional and commercial value. In this study, carboxymethyl cellulose (CMC)-based cross-linking coating embedded with liquid paraffin was prepared to preserve fresh pakchoi (*Brassica chinensis* L.) and its effects on postharvest water loss, quality and reactive oxygen species (ROS) metabolism were evaluated. Results showed that ionic cross-linking and liquid paraffin reinforced the structure compactness and water barrier property of CMC coating by uniformly distributing liquid paraffin in a cross-linking network. The novel CMC-based coating effectively reduced water loss and improved appearance and nutrition of fresh pakchoi stored at 25 °C and 60 % relative humidity for 48 h. Furthermore, the coating treatment enhanced ROS scavenging capacity and reduced lipid peroxidation, which was attributed to the improvement of antioxidant enzyme activities, ascorbate-glutathione cycle and phenylpropanoid metabolism. This work demonstrates that the novel CMC-based water barrier coating is promising to control the water loss of pakchoi and further maintain the whole quality by regulating ROS metabolism.

Keywords: /Water barrier coating/ /Carboxymethyl cellulose/ /Pakchoi/ /Water loss/ /Reactive oxygen species metabolism/

PEAR

Hira, N., Mitalo, O. W., Okada, R., Sangawa, M., Masuda, K., Fujita, N., Ushijima, K., Akagi, T., & Kubo, Y. (2022). The effect of layer-by-layer edible coating on the shelf life and transcriptome of "Kosui" Japanese pear fruit. *Postharvest Biology & Technology*, *185*, 111787. https://doi.org/10.1016/j.postharvbio.2021.111787

Abstract

Edible coatings attract much interest today as safe and effective techniques for maintaining quality and extending shelf life of fruit and vegetables. However, the underlying molecular mechanisms remain unclear. The aim of this study was to identify genes involved in enhancement of shelf life in 'Kosui' Japanese pear (*Pyrus pyrifolia* Nakai) fruit by chitosan/alginate-based layer-by-layer (LBL) edible coatings. Both tri-layer and penta-layer LBL coatings effectively minimized fruit respiration and ethylene production rates, inhibited flesh firmness loss, and prevented peel color change for 21 d at 20 °C but had little effect on weight loss. Gas permeability tests on polyethylene terephthalate films revealed that LBL coatings substantially lowered oxygen transmission rates but had little effect on water vapor transmission rate. In an attempt to identify the pathways involved, we monitored gene expression in LBL-coated and uncoated fruit by RNA-Seq analysis. This analysis revealed a clear downregulation of genes associated with ethylene production and fruit ripening, as well as the tricarboxylic acid cycle following application of LBL edible coating. On the other hand, genes associated with the glycolysis pathway were mostly upregulated. Together, these results indicate that prolonged shelf life by chitosan/alginate-based LBL edible coating could primarily result from control of the balance of aerobic-anaerobic metabolism.

Keywords: /Edible coating/ /Fruit ripening/ /Ethylene/ /Respiration/ /RNA-Seq/ /Softening/

Lutz, MC., Colodner, A., Tudela, M., Carmona, M., & Sosa, M. (2022) Antifungal effects of low environmental risk compounds on development of pear postharvest diseases: Orchard and postharvest applications. *Scientia Horticulturae, 295*, 110862. https://doi.org/10.1016/j.scienta.2021.110862.

Abstract

In the main productive area of Argentina, decays caused by *Botrytis cinerea, Alternaria alternata*, and *Alternaria* spp. lead to important postharvest losses in pears during medium- and long-term storage. In view of the problems associated with the use of chemical synthetic fungicides, and attending to current demands for global production of safe food, in this work we evaluated the antimicrobial effect of different low-toxicity compounds, also known as 'biorationals' in the control of *B. cinerea, A alternata,* and *Alternaria* spp, postharvest diseases in pear (*Pyrus communis* L.). Commercial formulations of acibenzolar-s-methyl (ASM), algae extract (AE) from *Ascophyllum nodosum*, chitosan (CH), and potassium phosphite (KPhi) were evaluated after application on orchards (30, 60, and 90 days after full flower, and 10 days prior to harvest) and postharvest (to assess possible curative and preventive effects) in 'Beurrè d'Anjou' and 'Packham's Triumph' pear cultivars. Additionally, the antimicrobial behavior of the above biorationals was evaluated *in vitro* by determining their inhibitory activity (EC50) on *B. cinerea* and *A alternata* mycelial growth. Water was used as negative control, while the chemical fungicide fludioxonil was included in postharvest application experiments as positive control. Both postharvest decay control efficacy and effects on fruit quality parameters varied substantially among the biorationals assayed, depending on cultivar, time of application, and pathogen evaluated. In 'Beurrè d'Anjou', both in-orchard and curative postharvest applications of CH controlled the incidence of *B. cinerea* decays, while orchard applications of KPhi effectively controlled *Alternaria* spp decay incidence. In the 'Packham's Triumph' cultivar, both orchard and postharvest applications of ASM were effective in controlling decays caused by *Alternaria* spp and *A. alternata*, whereas orchard application of AE was effective in controlling *B. cinerea* incidence. Meanwhile, postharvest application of CH provided a curative effect for both *B. cinerea* and *A. alternata* infections and exhibited also preventive efficacy against the latter pathogen. 'Beurrè d'Anjou', but not 'Packham's Triumph', fruit firmness was increased (by 4–7 N) by all the compounds when applied postharvest. In most assay types and for the two cultivars, control fludioxonil treatment outperformed the efficacy of the compounds against both pathogens. For both *B. cinerea* and *A. alternata* spp, the EC50 values of the biorational compounds were considerably higher than those of fludioxonil, and in some cases they could not be determined. Thus, although orchard control results were variable, the postharvest behavior of the biorationals evaluated was generally uniform, affording good control efficiency against *A. alternata* and exerting clear preventive effects in the two cultivars. The studied compounds might hence

represent a useful alternative to traditional agrochemical postharvest practices, leading to a meaningful reduction in the use of chemical fungicides.

Keywords: /Postharvest losses/ /*Pear/ /Postharvest Disease/*

Mattheis, J. P., Felicetti, D. A., & Rudell, D. R. (2022). "d'Anjou" pear metabolism during ultra-low O2, low CO2 controlled atmosphere storage reflects disorder outcome. *Postharvest Biology & Technology*, *185*, 111781. https://doi.org/10.1016/j.postharvbio.2021.111781

Abstract

With increasingly restrictive regulation of postharvest crop protectants and expected year-round availability, pear (*Pyrus communis* L.) production is ever more reliant on precise controlled atmosphere (CA) storage technologies to provide both ripening and disorder control for long term storage. Ultra-low oxygen (ULO; <1 kPa O2) CA storage meets many of these criteria affording control of ripening and superficial scald. However, internal browning often is an unintended outcome caused by atmospheric conditions and other events that occur, similarly to superficial scald, prior to symptom development. While this is often associated with elevated CO2, it also can occur at lower partial pressures (<0.5 kPa CO2) reducing its widespread use for storing pears. We expected levels of specific metabolites in 'd'Anjou', a cultivar susceptible to both disorders, would reflect specific disorder risk under ULO and low CO2. The metabolic profile of pear peel stored at 0.5 °C in air, CA (1.5 kPa O2; 0.5 kPa CO2), or ULO (determined in the first week of storage by monitoring chlorophyll fluorescence; 0.5 kPa O2; 0.5 kPa CO2) was compared at multiple time points during 0−16 weeks storage. Final fruit quality and relative ripeness were assessed at 16 weeks plus 7 d at 20 °C. Quality and ripeness differences and related metabolism followed that established in existing literature regarding peel color, titratable acidity, ethylene evolution, respiration, and sucrose metabolism. Superficial scald developed on air stored fruit and core browning incidence most in pears stored in 0.4 kPa O2. α-Farnesene oxidation increased most in air followed by 1.5 kPa O2 storage indicating risk of this disorder on fruit from those storage conditions. As in other studies, γ-aminobutyric acid (GABA) was elevated most where internal browning had occurred, although levels were also elevated in the peel. Levels of glutamic acid, alanine, and, unique to this study, proline were also most elevated in peels from pears stored in 0.5 kPa O2 indicating their association with conditions that lead to core browning. Monitoring α-farnesene oxidation coupled with GABA, glutamic acid, alanine, and proline levels in peel may be a means to indicate whether ULO CA atmospheres with reduced CO2 levels are accomplishing the critical task of controlling pear superficial scald without causing internal browning before injury occurs.

Keywords: /Pear fruit/ /Internal browning/ /Superficial scald/ /Fruit metabolism/ /Ultra-low oxygen/ /Controlled atmosphere/

POMEGRANATE

Molla, A., Rastegar, S., Omran, V., & Khademi, O. (2022). Ameliorative effect of melatonin against storage chilling injury in pomegranate husk and arils through promoting the antioxidant system. *Scientia Horticulturae, 295*, 110889. https://doi.org/10.1016/j.scienta.2022.110889.

Abstract

Pomegranate is a tropical and subtropical fruit sensitive to chilling injury during its cold storage, leading to quantitative and qualitative losses, as well as reduced economic value. Recently, melatonin has been considered as an environmentally friendly treatment to maintain the postharvest quality of horticultural products. In this study, the effect of melatonin treatment on chilling tolerance, postharvest quality and antioxidant system of pomegranate fruit was investigated during storage at 4 °C for 120 days. According to the results, pH, titratable acidity and the total soluble solids of the fruit were not influenced by applying melatonin. However, melatonin treatment at 100 μM dramatically improved chilling tolerance in the

pomegranate fruit by reducing electrolyte leakage and increasing the total phenol content, as well as the antioxidant potential. Melatonin significantly reduced polyphenol oxidase (PPO) activity and increased the activity of phenyl alanine amylase (PAL), catalase (CAT), ascorbate peroxidase (APX) and superoxide dismutase (SOD) enzymes in the husk and arils of the pomegranate fruit during storage. In addition, melatonin inhibited H_2O_2 accumulation in the pomegranate fruits. Therefore, our data suggest that melatonin might be useful in improving the postharvest quality and inducing chilling tolerance in pomegranates during the cold storage.

Keywords: /Chilling/ /Enzyme/ /Quality/ /Plant growth regulator/ /Subtropical fruit/

POSTHARVEST DISEASE

Mendes-Oliveira, G., Gu, G., Luo, Y., Zografos, A., Minas, I., & Nou, X. (2022). Edible and water-soluble corn zein coating impregnated with nisin for Listeria monocytogenes reduction on nectarines and apples. *Postharvest Biology & Technology*, *185*, 111811. https://doi.org/10.1016/j.postharvbio.2021.111811

Abstract

A corn zein based water-soluble coating formulation impregnated with nisin at 1 g L^{-1} (CoZWN), or without nisin (CoZW), was evaluated for performance against *Listeria monocytogenes* as edible coating on nectarines and apples. In comparison to uncoated (NC) control and coating with conventional petroleum-based wax (Wax), CoZWN coated nectarine showed higher reduction of *L. monocytogenes* population after storage for 2 d at 2.2 °C in simulation of refrigerated transportation, followed by additional 2 d at 22 °C in simulation of retail display. *L. monocytogenes* populations were reduced by 1.3 or 1.1 log in comparison to uncoated controls when coating was applied before or after *L. monocytogenes* inoculation, respectively. The performance of this nisin-impregnated corn zein formulation was further validated as a post-contamination coating using Gala apples stored at room temperature (22 °C) for up to 10 d in simulation of retail display. Gala apples coated with CoZWN accelerated the decline of *L. monocytogenes* populations during the early stage of simulated storage, and outperformed Wax through the entire period against *L. monocytogenes*. CoZWN did not significantly impact the survival and growth of molds and yeasts on nectarines but performed comparably to Wax against molds and yeasts on Gala apples. Data presented in this study indicated that nisin-impregnated corn zein coating is a promising strategy for mitigating *L. monocytogenes* contamination on fresh produce. It also demonstrated that this water-soluble coating could be impregnated with other natural antimicrobials to target a wide range of foodborne pathogens.

Keywords: /Water-soluble corn zein/ /Edible coating/ /Nisin/ /*Listeria monocytogenes*/ /Nectarine/ /Gala apple/

POTATO

Li, L., Xue, H., Bi, Y., Zhang, R., Kouasseu, C. J., Liu, Q., Nan, M., Pu, L., & Prusky, D. (2022). Ozone treatment inhibits dry rot development and diacetoxyscirpenol accumulation in inoculated potato tuber by influencing growth of Fusarium sulphureum and ergosterol biosynthesis. *Postharvest Biology & Technology*, *185*, 111796. https://doi.org/10.1016/j.postharvbio.2021.111796

Abstract

Fusarium sulphureum is a major causal agent of dry rot of potato and fusarium rot of muskmelon fruit. Ozone (O3), a kind of strong oxidant, is widely tested to control postharvest disease in fruit and vegetables by inhibiting the growth of pathogenic fungi. In this study, the effect of ozone treatment on dry rot development, growth of F. sulphureum, diacetoxyscirpenol (DAS) accumulation in vivo and in vitro, and ergosterol biosynthesis were evaluated. The results showed that 2 mg L−1 O3 treatment effectively

suppressed dry rot development, DAS accumulation in vivo and in vitro, and significantly inhibited mycelial growth of F. sulphureum. The colony edges and scanning electron microscopy (SEM) observation showed that O3 treatment significantly changed morphological structure of the mycelia; it became shorter, shriveled and rough. Transmission electron microscopy (TEM) results revealed that degradation of organelles intensified, distribution of cytoplasm became uneven, and the integrity of cell membrane was destroyed. Moreover, O3 treatment decreased ergosterol content and DAS accumulation by down-regulating expression of genes involved in ergosterol and DAS biosynthesis pathway. In addition, there was a positive correlation between ergosterol content and DAS accumulation in vitro. These results indicate that ozone suppresses dry rot development and DAS accumulation by affecting growth of F. sulphureum and down-regulates expression of genes involved in ergosterol and DAS biosynthesis.

Keywords: /Fusarium sulphureum/ /Ozone/ /Ergostero/ /lDiacetoxyscirpenol/

PUMMELO

Chen, C., Cai, N., Wan, C., Kai, W., & Chen, J. (2022). Carvacrol delays Phomopsis stem-end rot development in pummelo fruit in relation to maintaining energy status and antioxidant system. *Food Chemistry*, *372*, 131239. https://doi.org/10.1016/j.foodchem.2021.131239

Abstract

Pummelo fruit rapidly depreciates in commodity value due to postharvest fungal decay and fruit quality deterioration. Here, we used carvacrol (CVR) to control Phomopsis stem-end rot (SER) caused by Diaporthe citri in pummelo fruit stored at 25 °C. Antifungal activity of CVR inhibited D. citri growth and Phomopsis SER development. Harvested pummelo fruit treated with CVR delayed firmness loss and lowered electrolyte leakage, and retarded hydrogen peroxide (H_2O_2) and malondialdehyde (MDA) accumulation. Unlike the control fruit, the CVR-treated fruit maintained higher levels of adenosine triphosphate and energy charge, and increased ATPase, succinate dehydrogenase (SDH), malate dehydrogenase (MDH), and cytochrome C oxidase (CCO) activities, along with up-regulated expression levels of the respective genes. CVR improved the antioxidant capacity, as evidenced by higher non-enzymatic antioxidants amounts, higher activities of superoxide dismutase (SOD), catalase (CAT), peroxidase (POD), ascorbate peroxidase (APX) and glutathione reductase (GR), and up-regulated expression levels of ROS-scavenging-related genes. Collectively, CVR treatment maintained the energy status and antioxidant capacity in D. citri-infected pummelo fruit, which revealed antifungal mechanisms critical for controlling postharvest fungal diseases.

Keywords: /Antioxidant capacity/ /Carvacrol/ /Diaporthe citri/ /Energy status/ /Phomopsis stem-end rot/ /‘Hongroumiyou’ pummelo/

SPINACH

Zhou, B., Luo, Y., Huang, L., Fonseca, J. M., Yan, H., & Huang, J. (2022). Determining effects of temperature abuse timing on shelf life of RTE baby spinach through microbial growth models and its association with sensory quality. *Food Control*, *133*, 108639. https://doi.org/10.1016/j.foodcont.2021.108639

Abstract

Maintaining cold chain integrity during postharvest handling is of paramount importance to ensure the quality and shelf life of ready-to-eat (RTE) fresh-cut produce. However, breaks in the cold chain may occur due to supply logistical issues and system failures. This study evaluated the effect of temperature abuse encountered i) immediately after processing and ii) in a late stage of shelf life on microbial growth and on related quality attributes of RTE baby spinach. Baby spinach samples, maintained at 1 °C and

transported to the research facility via a refrigerated truck within 2 d of commercial production, were divided into two groups. The first group was immediately transferred to refrigerated rooms maintained at 1, 4, 8, 12, 16, and 20 °C while the second group was transferred to the same storage temperatures after 6 d of storage at 1 °C. Total aerobic bacteria, psychrotrophic bacteria, and yeast and mold counts indicated that all tested microorganisms grew slowly when held consistently at 4 °C, but more rapidly when stored at 8 °C and above. The effect of temperature abuse on microbial growth was described by a no-lag phase (primary) model and a suboptimal Huang square-root (secondary) model, which were validated and therefore can be used to predict the microbial growth in baby spinach with a reasonable accuracy. Indigenous microbial populations were highly associated with sensory attributes, with a negative correlation between aerobic plate count and overall quality. The results of this study accentuate the importance of cold chain maintenance during the distribution of RTE baby spinach and the potential application of predictive modeling for estimating shelf-life. Such models can help the industry make science-based decisions to improve safety and quality of fresh produce. It can also serve as the basis for future artificial intelligence research to optimize the shelf life of RTE produce. Assessed effect of temperature abuse timing on microbial growth on RTE baby spinach. Indigenous microbial populations were correlated with sensory attributes of baby spinach. Mathematical models were developed and validated to predict microbial growth.

Keywords: /Baby spinach/ /Cold chain/ /Growth prediction/ /Natural microorganisms/ /Sensory evaluation/

STRAWBERRY

Saleh, I., & Abu-Dieyeh, M. (2022). Novel Prosopis juliflora leaf ethanolic extract coating for extending postharvest shelf-life of strawberries. *Food Control*, *133*, 108641. https://doi.org/10.1016/j.foodcont.2021.108641

Abstract

Strawberry (Fragaria x ananassa) is a rich source of nutrients, minerals, and antioxidants including vitamin C. Its susceptibility to mechanical injuries, dehydration, and fungal infections make its postharvest shelf-life very short. Prosopis juliflora water-soluble leaf ethanolic (PJ-WS-LE) extract previously described by our team has a strong antifungal activity. The present study investigates the potential effect of PJ-WS-LE extract coating on the extension of strawberries shelf-life, and the values of the extract alone and the extract embedded in 1% chitosan (edible coating) in delaying spoilage-related symptoms and in maintaining good storage quality parameters at 4 °C. PJ-WS-LE extract alone extended strawberries shelf-life at 4 °C by 2.32 times. Best storage quality-parameters were observed with strawberry samples coated with PJ-WS-LE extract embedded in 1% chitosan, this includes liked sensory characteristics, maintenance of firmness and total soluble solids levels, lower surrounding microbial count, lower percent weight loss and lower total antioxidant levels increase. PJ-ES-LE extract extended strawberries shelf-life at 4 °C from 4.3 to 10 days. -PJ-ES-LE extract lowered strawberries surface microbial CFUs. PJ-WS-LE extract in 1% chitosan maintained strawberry quality-parameters at 4 °C.

Keywords: /Storage quality-parameters/ /Antifungal/ /PJ-WS-LE extract/ /Postharvest diseases/ /Storage shelf-life/ /Strawberry/

TOMATO

Jiang, Z., Xu, M., Dong, J., Zhu, Y., Lou, P., Han, Y., Hao, J., Yang, Y., Ni, J., & Xu, M. (2022). UV-B pre-irradiation induces cold tolerance in tomato fruit by SlUVR8-mediated upregulation of superoxide dismutase and catalase. *Postharvest Biology & Technology*, *185*, 111777. https://doi.org/10.1016/j.postharvbio.2021.111777

Abstract

The impact of ultraviolet-B (UV-B) treatment on oxidative stress, cold damage, and antioxidant enzymes and the role of the UV-B photoreceptor SlUVR8 in tomatoes during cold storage were investigated. Mature-green tomato fruits were irradiated with 1, 10, or 100 μmol m−2 s-1 UV-B for 1, 3, or 6 h respectively before cold-storage. The chilling injury index (CI), H2O2, O2·−, ion leakage, and malondialdehyde (MDA) content in tomatoes stored at 2 ℃ increased during storage, while irradiation with 10 μmol m−2 s-1 UV-B for 3 h before storage significantly reduced H2O2 and O2·−membrane damage and chilling injury. Expression of *CuZuSOD*, *FeSOD* and *CAT1* and the activities of their encoded enzymes superoxide dismutase (SOD) and catalase (CAT) were markedly raised in UV-B-pre-irradiated tomatoes and correlated significantly with the reductions in H2O2, O2·−, ion leakage, MDA, and CI, which suggested that UV-B pre-irradiation might exert its effects by activating the antioxidant enzymes. Silencing *SlUVR8* dramatically counteracted the UV-B-mediated effects on enzyme expression while the contents of H2O2, O2·−, ion leakage, MDA, together with the CI in *SlUVR8*-silenced tomatoes were significantly higher. The data showed that silencing of *SlUVR8* not only suppressed UV-B-activated SOD and CAT expression, but also prevented UV-B-alleviated oxidative stress and chilling injury. The findings indicated that SlUVR8 was required for UV-B-induced cold tolerance in tomato fruit and demonstrated that UV-B irradiation before cold storage activated SOD and CAT in an SlUVR8-dependent manner.

Keywords: /Tomato/ /Chilling injury/ /UV-BSlUVR8/ /Antioxidant enzyme/ /Reactive oxygen species/

Shi, Y., Yang, Q., Zhao, Q., Dhanasekaran, S., Ahima, J., Zhang, X., Zhou, S., Droby, S., & Zhang, H. (2022). Aureobasidium pullulans S-2 reduced the disease incidence of tomato by influencing the postharvest microbiome during storage. *Postharvest Biology & Technology*, *185*, 111809. https://doi.org/10.1016/j.postharvbio.2021.111809

Abstract

Biological control of postharvest fruit diseases by antagonistic microorganisms is considered an effective alternative to chemical fungicides. The influence of microbial antagonists on the fruit-associated microbiome provides a new perspective for the in-depth study of the antagonistic mechanism. In this study, the biocontrol effect of *A. pullulans* S-2 against postharvest diseases of tomatoes was investigated. At the same time, the fungal and bacterial microbiota on tomato surfaces were investigated by high-throughput sequencing. The results showed that *A. pullulans* S-2 could inhibit the decay incidence, maintain fruit firmness and reduce weight loss of tomato. In addition, the treatment group could maintain higher titratable acidity, ascorbic acid and lycopene content than the control group. More dramatic changes in fungal diversity than in bacterial diversity were observed in the microbiota after the application of *A. pullulans* S-2. *Aureobasidium* was significantly enriched in the treatment group, while *Cladosporium*, *Mycosphaerella*, *Alternaria* and *Penicillium* decreased compared to the control group. *Pantoea*, *Brevibacterium*, *Brachybacterium*, *Serratia*, *Glutamicibacter* and *Pseudomonas* also showed significant differences between the two groups. This study shows that the application of *A. pullulans S-2* leads to changes in the bacterial and fungal community that can inhibit plant pathogens and reduce the incidence of fruit diseases. It provides new insights into the dynamics of the surface microbiome of tomato after treatment with microbial antagonists.

Keywords: /*Aureobasidium pullulans/ /Solanum lycopersicum/ /*Biocontrol/ /Fungal community/ /Bacterial community/

Shu, P., Li, Y., Li, Z., Xiang, L., Sheng, J., & Shen, L. (2022). Ferulic acid enhances chilling tolerance in tomato fruit by up-regulating the gene expression of CBF transcriptional pathway in MAPK3-dependent manner. *Postharvest Biology & Technology*, *185*, 111775. https://doi.org/10.1016/j.postharvbio.2021.111775

Abstract

Ferulic acid (FA, 4-hydroxy-3-methoxycinnamic acid) is a phenolic acid derivative of cinnamic acid and plays pleiotropic roles in biotic and abiotic stress response in plants. However, the involvement of FA in chilling stress tolerance and the molecular mechanisms related to mitogen-activated protein kinase (MAPK) in tomato fruit are still elusive. In this study, the effect of exogenous FA on chilling resistance of tomato fruit was investigated. In addition, CRISPR/Cas9-mediated *slmapk3* mutants were used to investigate the relationship between FA and *SlMAPK3* under chilling stress. The results showed that low temperature (4 ℃) induced an increase of FA content and FA synthesis related genes (*SlPAL5*, *SlC3H* and *SlCOMT*) expression. In addition, exogenous FA reduced the severity of cold injury, up-regulated the expressions of *SlMAPK3*, *SlCBF1* and *SlICE1*, and promoted the accumulation of proline and soluble protein content. However, knockout of *SlMAPK3* reduced the chilling tolerance of tomato fruit and inhibited the activities of antioxidant enzymes (APX, POD, SOD and CAT) but induced the accumulation of H2O2. In the condition of low temperature (4 ℃), there was a high correlation between *SlMAPK3* and FA synthesis related genes (*SlPAL5*, *SlC3H, SlC4H* and *SlCOMT*) in control fruit. However, knockout of *SlMAPK3* inhibited the content of FA and the expression of those genes compared with the control, which suggested a close relationship between *SlMAPK3* and FA. Specifically, the effects of FA on osmotic regulatory substance and antioxidant enzyme system as well as the gene expression of CBF (C-repeat binding transcription factor) pathway were reduced after knockout of *SlMAPK3.* These results unveil a function of FA in tomato fruit positively resistance to chilling stress by up-regulating the gene expression of CBF transcriptional pathway in MAPK3-dependent manner.

Keywords: /Ferulic acid/ /Chilling stress/ /Tomato fruit/ /*SlMAPK3/*

Walubengo, Dianah, Orina, Irene, Kubo, Yasutaka, and Owino, Willis. (2022). Physico-chemical and postharvest quality characteristics of intra and interspecific grafted tomato fruits. *Journal of Agriculture and Food Research*, 7, 100261. https://doi.org/10.1016/j.jafr.2021.100261

Abstract

The objective of this study was to evaluate the physico-chemical and postharvest quality characteristics of intra- and interspecific grafted tomato fruit. Anna F1, a commercial tomato variety was interspecifically (Tomato Scion and African eggplant rootstock (Solanum aethiopicum)) and intraspecifically (Tomato Scion and bacterial wilt resistant hybrid tomato rootstock) grafted. The tomatoes were grown in a greenhouse and harvested at mature green, turning and ripe stages respectively. The tomatoes were analyzed for size, weight, cumulative weight loss, color changes, texture, respiration and ethylene gas production rates, vitamin C and lycopene content. Interspecific grafting on Manyire green, AB2, and intraspecific grafting on Armada, and B.B rootstocks significantly improved physical and physiological attributes of the tomato fruit. There was significant difference ($p < 0.05$) in size and weight of grafted tomatoes and control at all the three maturity stages. Intraspecific grafted tomato fruits on Armada rootstocks had the best quality characteristics in terms of firmness, low weight loss, respiration and ethylene production rates which are associated with extended postharvest shelf-life. Intraspecific grafting reduced respiration and ethylene gas production rates with tomatoes grafted onto Armada rootstocks attaining the least climacteric peaks of 20.20 ml CO2 Kg-1h-1 and 0.34 μL C2H4 Kg-1h-1 respectively at mature green stage, thus leading to extended postharvest life of these tomatoes. Tomatoes grafted onto B.B rootstock had the highest vitamin C content (28.11 mg/100 g). In general, intraspecific grafting recorded the best quality traits over the interspecific grafting. However interspecific grafting of tomato onto African eggplant Manyire and AB2 rootstocks had lower but comparable fruit quality to intraspecific grafting.

Keywords: /Maturity stage/ /Respiration rate/ // /Ethylene/ /Vitamin C/ /Lycopene/

Wosene, Gizachew, and Gobie, Wubalem. (2022). Value chain analysis of tomato: The case of Bure, Jabitehinan and North Mecha districts of Amhara regional state, Ethiopia, *Journal of Agriculture and Food Research,* 7, 100272. https://doi.org/10.1016/j.jafr.2022.100272.

Abstract

Ethiopia is still in the early stages of implementing agricultural value chains in general, and the tomato value chain in particular. Tomato production in Bure, Jabitehinan, and North Mecha Districts has played a critical role in generating income and creating jobs for many smallholder farmers, resulting in poverty reduction. Tomato growers, on the other hand, faced numerous challenges, including lack of clear tomato value chain depiction, poor product value addition, frail value chain linkage, and the perishable nature of the crop itself. As a result of these issues, tomato growers experienced low product prices, a lack of market information, and market inefficiencies, all of which limited the potential benefit of tomato value chain actors. Therefore, this study was aimed at mapping tomato value chain actors, their roles and linkages; to identify the major tomato market channels, and analyzing the structure, conduct and performance (S-C-P) of tomato value chain in the selected districts. Data were collected from both primary and secondary sources. Primary data were collected from randomly selected 280 tomato producers and 60 traders. To improve the validity of the data, the researchers used focus group discussion and key informant interviews in two rounds with a total size of 10 participants per discussion and secondary data were included from published articles and unpublished district reports. A multi-stage random sampling procedure was applied to select tomato producers and random sampling for traders. Descriptive statistics was applied to analyze data and generate valuable information on market structure, conduct and performance of tomato value chain. The survey result shows that input suppliers, producers, rural collectors, retailers, wholesaler, processors and consumers were identified as core tomato value chain actors. From the survey result, only 40.7% of the total respondents stated that tomato value addition was implemented and practiced. The perishability nature of the product and the low value addition practice of producers were led to less beneficiary in the tomato value chain. Processors obtained 44.82% of the profit share, which is the highest amount of profit share among other tomato value chain actors. Results from analysis of market concentration indicated that the tomato market was characterized by oligopolistic market structure with the buyers' concentration ratio of 45.53%. Market conduct shows that 73.21% of the price of tomato was set by traders while producers were price takers. Regarding the market performance analysis, the highest TGMM was registered in channel X which accounts for the estimated percentage share of 75% of consumer price. This study recommended that the decision maker should take-up initiative for strengthening of tomato value chain performance by capacitating farmer associations to increase their bargaining power and supporting actors involved in local tomato markets. In addition, it is recommended that the government of the region should develop a policy that reduces the oligopolistic tendency of market structure so as to create a competitive tomato market environment for all actors in the market.

Keywords: /Value chain/ /Actors/ /Mapping/ /Conduct/ /Structure/ /Performance/