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APPLE

Anese, R. de O., Thewes, F. R., Brackmann, A., Schultz, E. E., Wagner, R., Klein, B., Berghetti, M. R. P., & Wendt, L. M. (2020). Growth regulators on quality traits and volatile organic compounds profile of 'Royal Gala' apple at harvest and after dynamic controlled atmosphere storage. *Postharvest Biology and Technology*, *164*. Doi: 10.1016/j.postharvbio.2020.111158

Abstract

Growth regulators are widely used by apple growers, however there is few information about the effect on fruit stored under new dynamic controlled atmosphere. The aim of this study was to evaluate the effects of naphthalene acetic acid (NAA) and aminoethoxyvinylglycine (AVG), isolated and combined, on the quality and volatile organic compounds profile of 'Royal Gala' apples at harvest and after 9 months of storage under controlled atmosphere (CA), dynamic controlled atmosphere with chlorophyll fluorescence (DCA-CF) and dynamic controlled atmosphere with respiratory quotient 1.3 (DCA-RQ1.3) conditions. Pre-harvest treatments were: [1] Control: water only; [2] NAA (0.04 kg ha−1 of NAA - Fruitone™) applied 7 d before harvest (BH); [3] AVG (0.83 kgha−1ofRetainat15 %a.i.)30dBH;[4]AVG +NAA(30+7dBH,respectively). Eachpre-harvest treatment was stored under the following conditions: [1] CA (1.2 kPa O2 + 2.0 kPa CO2); [2] DCA-CF with 1.2 kPa CO2; [3] DCA-RQ1.3 + 1.2 kPa CO2. AVG + NAA application in pre-harvest caused an increase in some important volatile organic compounds such as 2-methylbutyl acetate, hexyl acetate and butyl acetate in 'Royal Gala' apples after long-term storage under CA, when compared to DCA-CF and DCA-RQ1.3 storage. These growth regulators showed fruit with higher titratable acidity. DCA-RQ1.3 had reduced mealiness incidence in fruit with NAA application, in spite of did not differ from DCA-CF. 'Royal Gala' apples with AVG + NAA application and stored under DCA-CF or DCA-RQ1.3 had higher flesh firmness, reduce physiological disorders and higher percentage of healthy fruit. However, NAA and AVG did not increase the concentration of volatile compounds in 'Royal Gala' apples stored under DCA-CF and DCA-RQ1.3. AVG and NAA applied isolated maintain higher total esters after CA storage. DCA-CF and DCA-RQ1.3 reduces the negative impact of NAA application on quality maintenance of 'Royal Gala' apples.

Keywords: /Aminoethoxyvinylglycine/ /Naphthalene acetic acid/ /Respiratory quotient/ /Chlorophyll fluorescence/ /Physiological disorders/

Klein, B., Falk, R. B., Thewes, F. R., Anese, R. de O., Santos, I. D. dos, Ribeiro, S. R., Donadel, J. Z., Brackmann, A., Barin, J. S., Cichoski, A. J., & Wagner, R. (2020). Dynamic controlled atmosphere: Effects on the chemical composition of cuticular wax of 'Cripps Pink' apples after long-term storage. *Postharvest Biology and Technology*, *164*. doi: 10.1016/j.postharvbio.2020.111170

Abstract

The effects of controlled atmosphere (CA) and dynamic controlled atmosphere based on chlorophyll fluorescence (DCA-CF) and respiratory quotient (DCA-RQ; RQ = 1.3 and 1.5) on the metabolism, decay incidence, concentration and chemical composition of 'Cripps Pink' apple peel wax after 8 months of storage plus shelf life at 20 °C were studied. DCA-RQ1.3 stored fruit had the lowest respiration rate, evidencing low metabolism, corroborating with the highest number of healthy fruit and consequently being the best storage condition. The mean wax concentration found 21.23 g m^{-2}, although it was lower for the DCA-RQ1.5 condition after 7 d. There was increase in wax concentration for DCA treatments from 7 to 14 d of shelf life. Chromatographic analysis allowed the identification of palmitic, stearic, oleic and linoleic fatty acids, with an increase in cis-11,14-eicosadienoic acid in all treatments and in palmitic acid in CA at 14 d. Triterpenoids, such as ursolic acid and oleanolic acids, were higher in CA, while alcohols such as

10-nonacosanol was higher in both DCA-RQ treatments. All treatments had high concentrations of nonacosane and tetracosanal. DCA-RQ decrease the incidence of greasiness. The supposed induction of anaerobic metabolism by extremely low oxygen levels and consequently higher concentration of ethanol, which were monitored by the two levels of RQ, induced the formation of compounds that may favor some mechanisms of adaptation against the low oxygen partial pressure (pO_2).

Keywords: /Apple peel wax/ /Chlorophyll fluorescence/ /Fruit/ /'Pink Lady'/ /Postharvest/ /Respiratory quotient/

Mctavish, C.K., Poirier, B.C., Torres, C.A., Mattheis, J.P., & Rudell, David R. (2020). A convergence of sunlight and cold chain: The influence of sun exposure on postharvest apple peel metabolism. *Postharvest Biology and Technology, 164, 111164.* doi: 10.1016/j.postharvbio.2020.111164

Abstract

Excess solar irradiation is responsible for commercially significant annual losses of apple fruit, and those losses are expected to increase in the majority of the world's apple production regions. Losses are not limited to the orchard but are also represented by disorders that develop in the cold chain such as sunscald and elevated lenticel damage. Similarly, metabolism during storage would reflect changes and even diverge during ripening and cold storage depending upon relative amount of light exposure in the orchard. To determine and track these changes alongside changes of appearance, 'September Wonder Fuji', 'Gala', 'Granny Smith', and 'Honeycrisp' apples were selected from the periphery on the south-facing side of trees for contrasting sun exposure on opposite aspects, stored in 1 °C air, and peel from opposing sides sampled sequentially from 0 to 6 months. Additional sunburned peel was sampled at 0 and 6 months. Sun exposure provoked broad relative responses from multiple pathways indicative of solar stress response. Responses include accumulation of well-characterized photoprotective responses including accumulation of flavonol glycoside and carotenoid, compatible solutes, and primary metabolites. Others include previously unreported or lesser understood responses such as those potentially impacting membrane properties (including changes in levels of monogalactosyldiacyglycerides and stigmasteryl glycosides), epicuticular surface metabolites (including pentacyclic triterpenes and diacylglycerides), and production of volatile alkenals indicative of residual solar stress during storage. Taken together, metabolic evidence indicates orchard light environment continues to impact not only appearance, but also rate of ripening and potentially fruit quality, even on the same apple. In this way, light exposure of any given apple could influence every cold chain management decision, and sorting apples at-harvest according to cumulative light exposure would improve apple consistency while potentially avoiding losses due to peel disorders.

Keywords: /*Malus domestica* (Borkh.)/ /Sunscald/ /Sun stress/ /Storage/ /Metabolic profiling/ /Diacylglycerides/ /Phenylpropanoids/ /Triterpenes/ /Hydroxycinnamic acyl esters/ /Volatile alkenals/

Poles, L., Gentile, A., Giuffrida, A., Valentini, L., Endrizzi, I., Aprea, E., Gasperi, F., Distefano, G., Artioli, G., La Malfa, S., Costa, F., Lovatti, L., & Di Guardo, M. (2020). Role of fruit flesh cell morphology and MdPG1 allelotype in influencing juiciness and texture properties in apple. *Postharvest Biology and Technology*, *164*. doi: 10.1016/j.postharvbio.2020.111161

Abstract

Apple fruit quality is strongly influenced by the interplay between juiciness and texture. To better decipher the complexity underneath the control of such quality traits, a multidisciplinary approach combining the mechanic and acoustic profiling of texture, juice analysis, cell morphology, sensory and genetic analysis was carried out. The analyses were conducted after 1.5 months of cold storage on fourteen accessions employed in novel breeding schemes for texture and juiciness. The food matrix structure was exploited

focusing on both the cell morphology (employing an optical microscope) and the intercellular space (using an X-ray computed micro-tomography scanner).Themechanicalandacousticpropertiesoftexturewereprofiledwithatextureanalyser,whilethejuice was extracted using a mechanical press. In parallel to the analytical assessments, fruit texture, juiciness and flavourwere also evaluated by sensory analysis.The results highlighted a positive correlation between cell shape and the intercellular volume. Apple accessions distinguished by round cells were characterized by a reduced intercellular space, while cell with an angular cell shape had a higher intercellular space. While the cell shape was associated with juiciness, the firmness response was more influenced by cell size. The interplay between cellular morphology and juiciness was also investigated together with the allelotype variability of a genetic marker designed for MdPG1, a polygalacturonase gene known to control the regulation of fruit texture in apple. The highest juiciness was found in apples with both a high fraction of round cells and the presence of the MdPG1 allele associated with low softening rates. The elucidation of the role of cellular morphology in the control of fruit texture and juiciness, and their association with the MdPG1 alleles, provided valuable information for a more detailed and informative analysis of fruit quality, enabling a more precise characterization and selection of superior apple accessions.

Keywords: /X-ray computed micro-tomography/ /Malus domestica/ /Sensory analysis/ /Cellular shape/ /Cellular size/ /Molecular marker/

Lemmens, E., Alós, E., Rymenants, M., Storme, N. D., & Keulemans, W. (. (2020). Dynamics of ascorbic acid content in apple (Malus x domestica) during fruit development and storage. *Plant Physiology and Biochemistry, 151*, 47-59. doi:10.1016/j.plaphy.2020.03.006

Abstract

Vitamin C is a crucial antioxidant and cofactor for both plants and humans. Apple fruits generally contain low levels of vitamin C, making vitamin C content an interesting trait for apple crop improvement. With the aim of breeding high vitamin C apple cultivars it is important to get an insight in the natural biodiversity of vitamin C content in apple fruits. In this study, quantification of ascorbic acid (AsA), dehydroascorbic acid (DHA), and total AsA (AsA + DHA) in apple pulp of 79 apple accessions at harvest revealed significant variation, indicating a large genetic biodiversity. High density genotyping using an 8 K SNP array identified 21 elite and 58 local cultivars in this germplasm, with local accessions showing similar levels of total AsA but higher amounts of DHA compared to elite varieties. Out of the 79 apple cultivars screened, ten genotypes with either the highest or the lowest concentration of total AsA at harvest were used for monitoring vitamin C dynamics during fruit development and storage. For all these cultivars, the AsA/DHA ratio in both apple pulp and peel increased throughout fruit development, whereas the AsA/DHA balance always shifted towards the oxidized form during storage and shelf life, putatively reflecting an abiotic stress response. Importantly, at any point during apple fruit development and storage, the apple peel contained a higher level of vitamin C compared to the pulp, most likely because of its direct exposure to abiotic and biotic stresses.

Keywords: /Vitamin C/ /*Malus* x *domestica*/ /Apple fruit/ /Fruit development/ /Harvest/ /Cold storage/ /Shelf life/

APRICOT

Cui, K., Shu, C., Zhao, H., Fan, X., Cao, J., & Jiang, W. (2020). Preharvest chitosan oligochitosan and salicylic acid treatments enhance phenol metabolism and maintain the postharvest quality of apricots (Prunus armeniaca L.). *Scientia Horticulturae*, *267*(February), 109334. doi: 10.1016/j.scienta.2020.109334

Abstract

To improve the apricots quality of preharvest spray with 0.05 % chitosan oligochitosan (COS) or/and 1 mmol L^{-1} salicylic acid (SA) were applied on the tree. The postharvest quality parameters and phenol metabolism of 'xiaobai' apricot fruit were evaluated during the storage at 2 °C for 70 d. The result showed that the treatment with COS or SA could decayed the rise decay rate, fruit softening, color change, and the decrease in total soluble solid and titratable acidity content during the apricot storage; however the combined treatment of with COS and SA could more effectively delay postharvest senescence of the apricot than the individual treatment of COS or SA. Furthermore, the COS + SA treatment alleviated chilling injury and delayed the increases of ion leakage, internal browning index and malonaldehyde content, effectively. In addition, the COS + SA treatment remarkably activated the activity of defense enzymes, as well as maintained higher bioactive level of phenol compounds, and enhanced antioxidant capacity in apricots. In conclusion, these results indicated the preharvest treatment of combined COS + SA can be applied for reducing chilling injury and improving the quality of apricots during low temperature storage.

Keywords: /Postharvest quality/ Antioxidant capacity/ /Apricot/ /Preharvest spray/ /Phenol metabolism/

BANANA

Chowhury, S., Teoh, Y.L., Ong, K.M., Zaidi, N.S.R., & Mah, S.-,K., (2020). Poly(vinyl) alcohol crosslinked composite packaging film containing gold nanoparticles on shelf life extension of Banana. *Food Packaging and Shelf Life, 24, 100463.* doi: 10.1016/j.fpsl.2020.463

Abstract

In this work, gold nanoparticles (AuNPs) and graphene oxide (GO) were successfully incorporated separately into the poly(vinyl) alcohol (PVA) crosslinked composite films. Glyoxal and/or glutaraldehyde (GA) were employed as a crosslinking agent in film fabrication. Through the analytical approach, the success in imparting the crosslink toward PVA by which the relative transmittance intensity of the hydroxyl group is subsided to a greater extent has verified by the FTIR analysis. The dispersion of AuNPs and GO in the PVA crosslinked composites have improved the mechanical or physical properties (tensile strength, Young's modulus value, water vapor transmission rate, water solubility) and making them promising candidates for food packaging application. The outcome of the agar disk diffusion test reveals that AuNPs incorporated PVA crosslinked composite film possess a greater capability with the formation of the larger inhibition zone to prevent the microbial contamination than GO-PVA crosslinked composite film. Banana shelf life has qualitatively improved with PVA-glyoxal-AuNPs composite film for food preservation and affirmed the uses in food packaging applications.

Keywords: /PVA films/ /Graphene oxide/ /Gold/ /Glyoxal/ Glutaraldehyde/

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group is subsided to a greater extent has verified by the FTIR analysis. The dispersion of AuNPs and GO in the PVA crosslinked composites have improved the mechanical or physical properties (tensile strength, Young's modulus value, water vapor transmission rate, water solubility) and making them promising candidates for food packaging application. The outcome of the agar disk diffusion test reveals that AuNPs incorporated PVA crosslinked composite film possess a greater capability with the formation of the larger inhibition zone to prevent the microbial contamination than GO-PVA crosslinked composite film. Banana shelf life has qualitatively improved with PVA-glyoxal-AuNPs composite film for food preservation and affirmed the uses in food packaging applications.

Keywords: /PVA films/ /Graphene oxide/ /Gold/ /Glyoxal/ /Glutaraldehyde/

Chotikakham, S., Faiyue, B., Uthaibutra, J., & Saengnil, K. (2020). Exogenous methyl salicylate alleviates senescent spotting by enhancing the activity of antioxidative ascorbate-glutathione cycle in harvested 'Sucrier' bananas. *Scientia Horticulturae, 267*, 109324. doi:10.1016/j.scienta.2020.109324

Abstract

Senescent peel spotting, a physiological disorder, develops during the latter stage of ripening which coincides with the best eating quality of 'Sucrier' banana fruit. It is a major constraint for banana growers and traders. The aims of this study were to evaluate the regulatory roles of methyl salicylate (MeSA) on the senescent spotting and the activity of antioxidative ascorbate glutathione (ASA-GSH) cycle in 'Sucrier' banana during storage. 'Sucrier' bananas (ripening stage 3–4) were immersed in 0 (control) and 2 mM MeSA for 30 min, then air dried and stored at 25 ± 1 °C for 6 d. After treatment, peel spotting, reactive oxygen species (ROS) production (hydrogen peroxide and hydroxyl radical contents), oxidative membrane damage (malondialdehyde and protein carbonyl contents and electrolyte leakage), enzymatic and non-enzymatic components of ASA-GSH cycle were determined. It was shown that the symptoms of peel spotting in the control group was observed on day 2 and the severity increased continuously throughout storage. The occurrence of peel spotting coincided with the marked increase in the ROS production and oxidative membrane damage. The activities of ASA-GSH cycle including ascorbate peroxidase, dehydroascorbate reductase, monodehydroascorbate reductase and glutathione reductase activities as well as ascorbate (ASA) and reduced glutathione (GSH) contents declined with an increase in the severity of peel spotting. However, MeSA treatment caused an overall increase in the activities of enzymatic and non-enzymatic antioxidants as well as ASA/dehydroascorbate and GSH/oxidized glutathione ratios for up to 5–6 d of storage. The increased activity of ASA-GSH cycle was also associated with the decreases in ROS levels, oxidative membrane damage and senescent spotting development, indicating that MeSA treatment could reduce senescent spotting of 'Sucrier' bananas during storage by enhancing the activity of ASA-GSH cycle leading to the induction of antioxidant defense system to overcome ROS production, oxidative damage and fruit senescence.

Keywords: /Antioxidant system/ /ASA-GSH cycle/ /Methyl salicylate/ /'Sucrier' banana/ /Peel spotting/

BELL PEPPER

Buendía, M. L., Soto, J. S., Ros, C. M., Antolinos, L. V., Navarro, S. L., Sánchez, M. M. J., Martínez, H. G. B., & López, G. A. (2020). An innovative active cardboard box for bulk packaging of fresh bell pepper. *Postharvest Biology and Technology*, *164*. doi: 1016/j.postharvbio.2020.111171

Abstract

Active packaging including encapsulated essential oils (EOs) may highly increase the shelf life of

horticultural products due to the higher antimicrobial activity of EOs in the vapour phase through a controlled release from the packaging. In that sense, the aim of the present study was to study the effects of an active packaging (a cardboard box including a βcyclodextrin (βCD) inclusion complex with an EOs mix) on the quality of bell peppers (green, red and yellow) during storage at 8°C (90 % relative humidity) up to 18 d. The EO mix (carvacrol:oregano:cinnamon 70:10:20 v:v:v) was efficiently encapsulated within the βCD inclusion complex by 94 %. Green, red and yellow peppers packaged within the active box showed 1–2 lower log units of enterobacteria than the control (without the active coating) after 11–18 d. Furthermore, green/red and yellow peppers showed lower mould counts (approximately 1 log unit) than control samples at days 6 and 11, respectively. The decay incidence of samples was also highly controlled by the active packaging with percentages lower than 5 % after 18 d while control samples showed decay incidences of 10–15 %. The use of this active box did not negatively affect the physicochemical quality of peppers even showing red and green peppers of the active box better firmness than control samples after 18d. The shelflife of peppers stored within the active box reached 18d while samples stored with the control box were rejected. Carvacrol residues in peppers were very low (below 1mg kg−1) avoiding off-flavours according to sensory results. Conclusively, this active packaging allowed to extend the shelf life of green, red and yellow peppers for at least 18 d at 8°C.

Keywords: /Pepper/ /Active coating/ /Encapsulated essential oils/ /β−Cyclodextrin/ /Inclusion complex/ /Quality/

BLACKBERRY

Van de Velde, F., Méndez-Galarraga, M. P., & Pirovani, M. É. (2020). Effect of enriched O2 and CO2 atmospheres on the overall quality and the bioactive potential of fresh blackberries. *Postharvest Biology and Technology*, *164*. doi:10.1016/j.postharvbio.2020.111166

Abstract

This work aimed to study the effects of the refrigerated storage of blackberries in high O_2 and high CO_2 atmospheres (70 kPa O_2 + 20 kPa CO_2 and 90 kPa O_2 + 10 kPa CO_2) on the quality and bioactive potential. Fruit stored in 90 kPa O_2 + 10 kPa CO_2 controlled the microorganism growth better than in 70 kPa O_2 + 20 kPa CO_2 until the end of storage (18 and 15 d, respectively). Both atmospheres were better than air that only controlled microorganisms for 8 d. Vitamin C retention of samples stored in air was close to 40 % at 8 d, being equal to those registered for the enriched O_2 and CO_2 atmospheres samples, but in the double of time. The retention of the total phenolic compounds of blackberries treated with 70 kPa O_2 + 20 kPa CO_2 experienced a transient increase (around 10 %) on 1 d and then decreased with time, being 90 % at the end of storage (15 d). The antioxidant capacity of fruit stored under air and O_2- and CO_2-enriched atmospheres generally accompanied the evolution of phytochemicals during storage. The refrigerated storage of blackberries in 70 kPa O_2 + 20 kPa CO_2 is recommended based on longer maintenance of fruit quality (compared to fruit stored in air), synthesis of phenolic compounds and the increase in the antioxidant capacity, which offers fruit with enhanced bioactivity. The changes in the blackberry quality attributes and in the antioxidant capacity were better fitted with first order kinetic, and the changes in the phenolic compounds were adequately fitted with a consecutive reaction mechanism kinetic model. Meanwhile, the microbiological evolution was satisfactorily evaluated by the Baranyi-Roberts model.

Keywords: /Vitamin C/ /Phenolic compounds/ /Antioxidant capacity/ /Controlled atmosphere/

CHERRY TOMATO

Liu, X., Gao, Y., Yang, H., Li, L., Jiang, Y., Li, Y., & Zheng, J. (2020). Pichia kudriavzevii retards fungal decay by influencing the fungal community succession during cherry tomato fruit storage. *Food Microbiology, 88*, 103404. doi:10.1016/j.fm.2019.103404

Abstract

In this study, *P. kudriavzevii* was isolated and identified as an effective antagonistic yeast, which could significantly inhibit the rotting rate, weight loss, and delay the color change, with no effect on total soluble solids (TSS), titratable acid (TA), or firmness during cherry tomato storage. High-throughput sequencing was used to survey the effect of *P. kudriavzevii* on fungal community throughout cold storage. The results showed that the biological succession of predominant pathogens was disrupted by *P. kudriavzevii*. The abundance of *Botrytis* and *Alternaria* was higher in the control than upon *P. kudriavzevii* treatment at 28 d, but some yeast genera such as *Naganishia*, *Wickerhamomyces,* and *Cutaneotrichosporon* at 14 d, *Pichia* and *Sporidiobolus* at 21 d, and Cystofilobasidium at 28 d, had relatively higher abundances in *P. kudriavzevii* treatments than the control. Oddly, as an antagonist agent, *P. kudriavzevii* was not the dominant population, indicating that altering the course of succession of the fungal community may be an effective mechanism of antagonistic yeast. Furthermore, the total network correlation analysis of fungal community revealed that the community development was more dependent on similarities in function than on taxonomic relationships.

Keywords: /Biological control/ /Cherry tomato/ /Antagonistic yeast/ /Microbial communities/ /Microbiome/

Böhmer-Maas, B. W., Fonseca, L. M., Otero, D. M., Zavareze, E. D., & Zambiazi, R. C. (2020). Photocatalytic zein-TiO2 nanofibers as ethylene absorbers for storage of cherry tomatoes. *Food Packaging and Shelf Life, 24*, 100508. doi:10.1016/j.fpsl.2020.100508

Abstract

This study is focused on the production of zein-TiO2 nanofibers produced through electrospinning and the evaluation of such fibers as ethylene absorbers when used to improve the storage of cherry tomatoes. Zein (30 % (w/v)) were dissolved in 70 % (v/v) ethanol and incorporated with TiO2 (0 %–5 %). The polymer solutions were evaluated for their electrical conductivity and viscosity, and the nanofibers were evaluated for their morphology, size distribution, thermal properties, Fourier transform infrared and water contact angle. The nanofibers with the smallest diameter were selected for testing as ethylene absorbers in the storage of cherry tomatoes for 22 days. The addition of TiO2 reduced the diameter of the nanofibers and altered their thermal properties. Interactions between the zein and TiO2 were observed based on the infrared spectrum. Containers with sachet of nanofibers exhibited a lower concentration of ethylene, demonstrating their significant potential for use as an active food packaging.

Keywords: /Electrospinning/ /Photocatalysis/ /Active packing/

Mustapha, A. T., Zhou, C., Amanor-Atiemoh, R., Ali, T. A., Wahia, H., Ma, H., & Sun, Y. (2020). Efficacy of dual-frequency ultrasound and sanitizers washing treatments on quality retention of cherry tomato. *Innovative Food Science & Emerging Technologies, 62*, 102348. doi:10.1016/j.ifset.2020.102348

Abstract

Refrigeration is an effective means of reducing losses in fresh fruit; however, its efficacy as a means of preservation is mostly limited to crops that are not vulnerable to chill injury. Cherry tomato is one of these

crops where other supporting processes or storage alternatives are sought. The effect of 10-min post-harvest treatment of cherry tomato with individual or combined application of dual-frequency ultrasound (20/40 kHz) and chemical sanitizers was investigated. The sanitizers used are 200 mg/L sodium dichloroisocyanurate (SD), 40 mg/L peracetic acid (PAA), 40 mg/L peracetic acid with 5% H2O2 (PAAH), and 5% hydrogen peroxide. The results showed that the treatments significantly reduced the natural microbiota (aerobic mesophiles and yeasts and molds) within the values of 0.29–3.10 log CFU/g. The highest inactivation was observed for the PAAH and ultrasound when applied as an individual (2.08–2.32 log CFU/g) and combined (3.07–3.10 log CFU/g) treatment. Also, the ultrasound and combined treatment resulted in higher retention of the total phenolic, and flavonoid contents, but with a loss in firmness of the cherry tomato. Nevertheless, during storage, the treatments when compared with the untreated samples, impede the loss in firmness. The other quality parameters such as pH, total soluble solids, titratable acidity, and maturity index were not affected, which signified that irrespective of the treatment, similar changes take place on the fruit during storage, especially in both control and chemically treated fruit. The combination of 40 mg/L PAAH and 20/40 kHz for 10 min caused ≥3-log CFU/g reduction of the natural microbiota. It mitigated the senescence of the cherry tomato during the refrigerated storage (4 °C), which thereby increased the shelf-life. The results obtained at the end of the storage thereby indicated that the combined treatments could guarantee microbial safety and retain the quality of the cherry tomato.

Keywords: /Dual-frequency/ /Chemical sanitizers/ /Natural microbiota/ /Quality/ /Cherry tomato/

FRUITS AND VEGETABLES

Bi, F., Zhang, X., Liu, J., Yong, H., Gao, L., & Liu, J. (2020). Development of antioxidant and antimicrobial packaging films based on chitosan, D-α-tocopheryl polyethylene glycol 1000 succinate and silicon dioxide nanoparticles. *Food Packaging and Shelf Life, 24, 100503.* doi: 10.1016/j.fpsl.2020.100503

Abstract

Antioxidant and antimicrobial packaging were developed by adding D-α-tocopheryl polyethylene glycol 1000 succinate (TPGS) and/or silicon dioxide nanoparticles (nano-SiO_2) into chitosan (CS) films. The microstructures, physical and functional properties of CS, CS-TPGS, CS-SiO_2 and CS-TPGS-SiO_2 films were compared. Results showed the simultaneous addition of TPGS and nano-SiO_2 into CS film produced a compact inner microstructure and strong intermolecular hydrogen bond interactions. Meanwhile, the addition of TPGS slightly increased the crystallinity of CS-TPGS and CS-TPGS-SiO_2 films. By comparing different films, CS-TPGS-SiO_2 film presented the lowest moisture content, water vapor and oxygen permeability, whereas the highest tensile strength and elongation at break. Moreover, CS-TPGS and CS-TPGS-SiO_2 films possessed stronger free radical scavenging activity than CS and CS-SiO_2 films. CS-SiO_2 and CS-TPGS-SiO_2 films showed higher antimicrobial activity than CS and CS-TPGS films. Notably, CS-TPGS and CS-TPGS-SiO_2 film packaging effectively increased the oxidative stability of soybean oil. Our results suggest CS-TPGS-SiO_2 film can be used as a novel antioxidant and antimicrobial packaging material in food industry.

Keywords: /Active packaging/ /Antimicrobial/ /Antioxidant/ /Chitosan/ /Nano-SiO_2/ /TPGS/

Chaudhary, S., Kumar, S., Kumar, V., & Sharma, R. (2020). Chitosan nanoemulsions as advanced edible coatings for fruits and vegetables: Composition, fabrication and developments in last decade. *International Journal of Biological Macromolecules*, *152*, 154–170. doi: 10.1016/j.ijbiomac.2020.02.276

Abstract

The rejection of chemical additives has attracted the attention of consumers and research personals to continuously improve quality and safety of food. Chitosan is a polyelectrolyte non-toxic, antimicrobial and biocompatible polysaccharide. The annual production of chitin (poly-β-(1–4)-*N*-acetyl-D-glucosamine), the acetylated form of chitosan has been estimated 10^5 million tons and is approved by EU for use in plant protection (Reg. EU 2014/563). The film formation presents 20 to 30% of total chitosan activity apart from elicitation (30 to 40%) and antimicrobial activity (35 to 45%). Chitosan polymer scaffolds particularly nanoemulsions provides a protective covering to the fresh produce and acts as a carrier for antimicrobial agents and various functional compounds. The nanoemulsions are designed as smart functional coatings by microfluidization, high-pressure homogenization, ultra-sonication, phase inversion (PIC and PIT) and spontaneous emulsification. Considering the research reports available in the last decade, chitosan film production and related issues alluded to the possibilities for explorations of commercial applications on fresh foods. Chitosan-based biofilms with specific barriers and functional properties can be produced to address specific requirements of target food. Keeping in view the widespread applications of chitosan nanoemulsions for various food applications, the present review has been compiled to provide an insight into the developments and improvements made in the production, functionality, and delivery of bioactive substances for quality retention of fresh horticultural produce.

Keywords: /Chitosan/ /Synthesis/ /Nanoemulsions/ /Functionality/ /Postharvest management/ /Mechanisms/

Duan, Y., Wang, G.-B., Fawole, O. A., Verboven, P., Zhang, X.-R., Wu, D., Opara, U. L., Nicolai, B., & Chen, K. (2020). Postharvest precooling of fruit and vegetables: A review. *Trends in Food Science & Technology*. doi: 10.1016/j.tifs.2020.04.027

Abstract

Precooling is a critical step in the postharvest cold chain. Studies of the precooling of fruit and vegetables are based on the strong interactions between modelling, engineering, physiology and commercial outcomes. In recent years, new progress in precooling has been achieved. These achievements include different cooling strategies, research into precooling mechanisms, and numerical simulations. This review aims to provide the most recent information about precooling and promote its application in the fruit and vegetable industry. Different precooling strategies are evaluated with respect to the cooling rate, cooling uniformity, and multiscale simulation. An overview of mathematical modeling approaches used to quantitatively describe precooling processes for computer-aided designs is provided. The effect of precooling on fruit quality at the physiological and molecular levels is outlined.Numerical simulations have become widely used to improve the precooling performance. Cooling homogeneity, in particular, has attracted increasing attention in recent studies because of the substantial effects of cooling homogeneity on the precooling efficiency and produce quality. The spatial scale of numerical simulations of the precooling process has started to become more precise and specific. Recent numerical simulations have focused on the bin and package scale. Models of transport processes at multiple spatial scales are investigated using multiscale modeling. Moreover, the effect of precooling on produce quality has recently received increasing attention. In addition, the investigation of the effect of precooling on fruit at the metabolomic and genomic levels has become an emerging trend and has provided deeper insights into the molecular mechanisms underlying the effect of precooling treatments on fruit.

Keywords: /Precooling/ /Fruit and vegetables/ /Precooling technique/ /Numerical simulation/ /Quality/

Huntrakul, K., Yoksan, R., Sane, A., & Harnkarnsujarit, N., (2020). Effects of pea protein on properties of cassava starch edible films produced by blown-film extrusion for oil packaging. *Food Packaging and Shelf Life, 24, 100480.* doi: 10.1016/j.fpsl.2020.100480

Abstract

Starch can be commercially prepared into edible and biodegradable packaging via plasticization and extrusion. However, plasticized starch has poor stability in blown-film extrusion processability and storage properties which can be improved by combinations with protein. Edible films were developed from acetylated cassava starch (AS) and pea protein isolate (PI) using conventional blown-film extrusion. Films with PI up to 20 % were determined for physical, thermal and barrier properties and stability for oil packaging. PI stabilized films during blown-extrusion but decreased flexibility due to strong inter- and intra-molecular interaction with non-homogeneity of AS-PI blend matrices. Protein dispersed in AS matrices at low PI and formed continuous networks at 20 % which led to increased tensile strength. Increase in PI decreased solubility and light transmission but increased protein aggregation and improved crystallinity, surface hydrophobicity and barrier properties against water vapor and oxygen. Increase in PI also reduced glass transition and relaxation temperatures of AS-PI blends. Heat-sealed AS and AS-PI sachets showed effective protection for soybean and olive oil stored for 3 months at different humidities. PI blending effectively prevented humidity-induced shrinkage of AS film (up to 55 %) and enhanced polymer-glycerol interaction which improved thermal stability. Blending of starch and plant-derived pea protein effectively improved blown-film processability and barrier properties for oil-based food products.

Keywords: /Starch/ /Pea protein/ /Edible film/ /Food packaging/ /Lipid oxidation/ /Blown-film extrusion/

Jafarzadeh, S., Jafari, S. M., Salehabadi, A., Nafchi, A. M., Uthaya, U. S., & Khalil, H. P. S. A. (2020). Biodegradable green packaging with antimicrobial functions based on the bioactive compounds from tropical plants and their by-products. *Trends in Food Science & Technology*. doi: 10.1016/j.tifs.2020.04.017

Abstract

Biodegradable packaging from natural biopolymers can be further enhanced with antimicrobial and antioxidant agents to form active packaging. Plant extracts are attractive components for biodegradable food packaging owing to their natural origin and functionality (antimicrobial/antioxidant activity). Here we demonstrate the effect of bioactive contents of tropical plants and their by-products as promising natural ingredients in the fabrication of biopolymer food packaging. Different parts of tropical plants, such as leaves, flowers, seeds, and roots, can potentially be utilized for new and green packaging systems due to their biological nature. In the food industry, lipid oxidation and microbial spoilage are two problems which reduce the shelf life of food products. It seems that the use of potential bioactive agents in biodegradable packaging is a promising strategy to solve this problem, offering a green alternative to traditional packaging and enhancing the shelf-life of food.

Keywords: /Biodegradable packaging/ /Tropical plants/ /Bioactive compounds/ /Antimicrobial/ /Green packaging/

Jeya, J., Chandrasekaran, M., Venkatesan, S. P., Sriram, V., Britto, J. G., Mageshwaran, G., & Durairaj, R. B. (2020). Scaling up difficulties and commercial aspects of edible films for food packaging: A review. *Trends in Food Science & Technology*. doi: 10.1016/j.tifs.2020.04.014

Abstract

Edible food packaging, produced from edible polymers, is a kind of packaging suitable for human consumption along with the contained food. Despite many advantages, the edible films are still produced in laboratory scale due to problems, such as lack of poor elongation, safety and health issues, high cost, processing difficulties, etc. It is essential to overcome these difficulties for scaling up the production to industrial scale and making the edible films commercially successful. Even though some reviews on

edible films and coatings have little discussed, there is no dedicated article on scaling up difficulties and commercial aspects of edible films. This article reviews the research progress, confronting problems, and research opportunities ahead for the industrial scaling up and commercial success for edible films in food packaging. Incorporation of plasticizer, production of multilayers, composites, and nanocomposite films improved the properties significantly, but some fundamental research on the key factors are still not investigated. Current laboratory scale production of edible films has problems like inability to make continuous films, long drying time and inaccurate thickness control, which must be addressed before the industrial scaling up production. Lack of evidence on edibility, biodegradability, toxicological and health effects, inadequate marketing, lack of awareness, cultural issues, can affect the food safety and customer acceptance. Future research must address all these problems from the view of industrial scaling up and commercial aspects in order to make the industrially viable and commercially successful edible films.

Keywords: /Food packaging/ /Edible films/ /Commercialization/ /Scaling up difficulties/ /Customer acceptance/ /Nanotechnology/

Liu, C., Huang, J., Zheng, X., Liu, S., Lu, K., Tang, K., Liu, J. (2020). Heat sealable soluble soybean polysaccharide/gelatin blend edible films for food packaging applications. ***Food Packaging and Shelf Life, 24, 100485. doi: 10.1016/j.fpsl.2020.100485***

Abstract

The present study aimed to develop heat sealable soybean polysaccharide (SSPS)/gelatin blend films intended to be used as edible food packaging materials. The films were fabricated by solution casting method using SSPS/gelatin blends and plasticized by glycerol. The results indicated that the heat sealability, stretchability and resistance to fracture of the films were significantly improved by blending SSPS with gelatin. The incorporation of gelatin into SSPS films also increased the thermal stability but decreased the water solubility, rigidity and water vapor permeability of the films. ATR-FTIR spectra and DSC results indicated strong interactions between SSPS and gelatin. The studies of optical properties, SEM, AFM, and XRD revealed that SSPS and gelatin were compatible to a certain degree in this blend system. Packaging tests confirmed that the blend films have showing potential as edible material in food packaging.

Keywords: /Edible film/ /Soluble soybean polysaccharide/ /Gelatin/ /Heat seal/ /Food packaging/

Mukama, M., Ambaw, A., Opara, U.L. (2020). Advances in design and performance evaluation of fresh fruit ventilated distribution packaging: A review. ***Food Packaging and Shelf Life, 24, 100472.*** **doi: 10.1016/j.fpsl.2020.100472**

Abstract

This review was initiated to realise the state-of-the art in optimising the ventilation and structural requirements of corrugated packaging carton design. Researchers have been using computational methods: computational fluid dynamics, particularly, the finite volume method, to analyse the airflow and heat transfer performances, and computational structural dynamics, particularly, the finite element method, to analyse the loss of compression strength due to vent-holes. Models are validated using actual testing: wind tunnel based forced air cooling system to study the produce cooling kinetics and box compression test machine for the package industry to study the structural dynamics. Studies on the rate and uniformity of produce cooling and the loss of structural strength in corrugated cartons as a function of size, shape, and location of vent-holes are reviewed. Based on experimental data, results show that the loss in strength can range between 10–40 % on addition of vent and hand holes on cartons, and reasonable increase in cooling rates is only achieved with increase in carton face ventilation area only up to 7–8 %. With regards to internal packaging components, increasing awareness of consumers to the

environmental degradation of especially disposable plastic packaging means packers and suppliers must devise means to cut back and eventually eliminate plastic packaging from fruit and vegetables.

Keywords: /Package design/ /Ventilated packaging/ /Fruit quality/ /Carton performance evaluation/ /Computational fluid dynamics/ /Finite element analysis/

Yi, L., Qi, T., Ma, J., & Zeng, K. (2020). Genome and metabolites analysis reveal insights into control of foodborne pathogens in fresh-cut fruits by Lactobacillus pentosus MS031 isolated from Chinese Sichuan Paocai. *Postharvest Biology and Technology*, *164*. doi: 10.1016/j.postharvbio.2020.111150

Abstract

The presence of pathogens in fresh-cut fruits represents a risk for the public health since these products generally do not receive any further treatment before consumption. In this study, a Lactobacillus pentosus MS031 was isolated from Sichuan Paocai with broad antibacterial activity against foodborne pathogens. Antimicrobial peptides produced by the L. pentosus MS031 had broad activity and resistance to heat, but they were sensitive to proteinases and their activity vanished under alkaline condition. Bacteriocin-like substance obtained by pHabsorption related methods showed activity only against Staphylococcus aureus. However, cell-absorbed substance and cell-secreted into culture substance had activity against both S. aureus and Escherichia coli. Foodborne pathogens in fresh-cut fruit mixture were controlled by the metabolites of the L. pentosus MS031 that Listeria monocytogenes was reduced by 96.3 %, Salmonella typhi and E. coli were decreased to an undetectable level. The complete genome of the L. pentosus MS031 was sequenced using Illumina and MinION nanopore platform with a size of 3,805,216 bp, consisting of one chromosome and eight plasmids. After mining using BAGEL4, two novel bacteriocins, pentocin MS1 and pentocin MS2, were identified. Furthermore, fragments of 5 antimicrobial peptides were identified by LC–MS/MS in the fermentation supernatant. In addition, antimicrobial cyclic dipeptides and small compounds were identified in the antimicrobial metabolites. The results indicate antimicrobial metabolites of the L. pentosus MS031 can control foodborne pathogens in fresh-cut product during subsequent cold storage, which is significant for food industry.

Keywords: /Fresh-cut product/ /Foodborne pathogens/ /Lactobacillus pentosus/ /Antimicrobial/ /Genome/ /LC–MS/MS/

Mukama, M., Ambaw, A., & Opara, U. L. (2020). Advances in design and performance evaluation of fresh fruit ventilated distribution packaging: A review. *Food Packaging and Shelf Life, 24*, 100472. doi:10.1016/j.fpsl.2020.100472

Abstract

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Keywords: /Package design/ /Ventilated packaging/ /Fruit quality/ /Carton performance evaluation/ /Computational fluid dynamics/ /Finite element analysis/

GARLIC

Ding, Y., Jiang, Y., Deng, Y., Zhao, Y. (2020). Effect of packaging materials and storage temperature on water status, mechanical and thermal properties of black garlic. ***Food Packaging and Shelf Life, 24, 100507.*** **doi: 10.1016/j.fpsl.2020.100507**

Abstract

We examined the effects of the packaging materials [polyethylene terephthalate bottles (PETB), Kraft paper bags (KPB) and aluminum-laminated polyethylene bags (ALPB)] and storage temperatures (4 and 20 °C) on the chemical composition, water status and mechanical and thermal properties of black garlic after 90 days of storage. We found that ALPB retained the highest levels of 5-hydroxymethylfurfural, total sugar and reducing sugars at the same temperature while PETB retained the textural properties of the garlic. Water loss and migration were serious defects in KPB and PETB at 20 ℃. The initial decomposition temperature was highest for KPB while the glass transition temperature was highest for ALPB. The samples stored in ALPB could easily be differentiated from the others using an orthogonal partial least squares-discriminant analysis model and this gave a high predictive power of 98.9 %. Taken together, low temperatures and ALPB most effectively maintained the integrity of the black garlic.

Keywords: /Black garlic/ /Packaging materials/ /Storage temperature/ /Water status/ /Mechanical properties/ /Thermal properties/

Ding, Y., Jiang, Y., Deng, Y., & Zhao, Y. (2020). Effect of packaging materials and storage temperature on water status, mechanical and thermal properties of black garlic. ***Food Packaging and Shelf Life, 24*****, 100507. doi:10.1016/j.fpsl.2020.100507**

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Keywords: /Black garlic/ /Packaging materials/ /Storage temperature/ /Water status/ /Mechanical properties/ /Thermal properties/

GRAPE

Kong, Q., Qi, J., An, P., Deng, R., Meng, J., & Ren, X. (2020). Melaleuca alternifolia oil can delay nutrient damage of grapes caused by aspergillus ochraceus through regulation of key genes and metabolites in metabolic pathways. *Postharvest Biology and Technology*, *164*. doi: 10.1016/j.postharvbio.2020.111152

Abstract

Aspergillus ochraceus (A. ochraceus) infection can cause grape decay and nutritional quality loss during postharvest storage. Previous studies showed that Melaleuca alternifolia oil (MAO) had strong anti-fungal effects, however, research on the effects of MAO on grape metabolisms is lacking. In this study, effects of MAO on mycelial growth and OTA production of A. ochraceus and metabolites of grapes were studied. Results showed that MAO significantly inhibited the mycelial growth and spore germination of A. ochraceus with the increase of concentration. MAO reduced the accumulation of OTA by downregulating the gene of OTA biosynthesis pathway. MAO can alleviate the down-regulation of some metabolites such as sugars and polyphenols in tricarboxylic acid cycle, glycolysis pathway, pentose phosphate pathway and phenols pathway in grape berries infected by A. ochraceus. The results of qRT-PCR showed that the decrease of metabolites caused by A. ochraceus was due to the down-regulation of genes related to those metabolites biosynthesis, but MAO could delay this situation. Therefore, MAO may be used as an alternative preservative for controlling the destruction of nutritional quality of grapes caused by A. ochraceus after harvest.

Keywords: /Melaleucaalternifolia oil/ /Defense A. ochraceus/ /Metabolic changes/ /UHPLC-QTOF-MS2/ /qRT-PCR/

JUJUBE

Nikkhah, M., & Hashemi, M. (2020). Boosting antifungal effect of essential oils using combination approach as an efficient strategy to control postharvest spoilage and preserving the jujube fruit quality. *Postharvest Biology and Technology, 164, 111159.* doi: 10.1016/j.postharvbio.2020.111159

Abstract

Antifungal activity and biochemical changes in jujube fruit treated with the synergistic combinations of some essential oils were investigated to extend the postharvest shelf-life. The combinations of thyme-rosemary and thyme-cinnamon showed synergistic effects (fractional inhibitory concentration index (FICI) ≤0.5) against *Alternaria alternata*. The same interaction was also observed in the dual combinations of cinnamon-marjoram, and thyme-cinnamon in inhibiting the *Penicillium expansum*, and a triple combination of cinnamon-rosemary-thyme. Also, the synergistic effects of the dual treatment of thyme (0.312 g L^{-1})-cinnamon (0.312 g L^{-1}) and triple treatment of cinnamon (0.156 g L^{-1})-rosemary (0.625 g L^{-1})-thyme (0.078 g L^{-1}) in inhibiting both spoilage fungi in jujube fruit were confirmed. Furthermore, the treatment of jujube fruit with dual or triple EOs has been effective on the phenolic compounds, flavonoids, polyphenol oxidase (POD) and phenylalanine ammonia-lyase (PAL) activities. Moreover, controlled respiratory activity and weight loss as well as ascorbic acid stability during the storage period were recorded for jujube fruit treated with EOs

Keywords: /Essential oils combination/ /Jujube fruit/ /Postharvest/ /Fungal decay/ /Quality/

KIWIFRUIT

Wang, Z., Künnemeyer, R., McGlone, A., & Burdon, J. (2020). Potential of Vis-NIR spectroscopy for detection of chilling injury in kiwifruit. *Postharvest Biology and Technology*, *164*. doi:10.1016/j.postharvbio.2020.111160

Abstract

This study examined the non-destructive assessment of chilling injury in Actinidia chinensis var. chinensis 'Zesy002' kiwifruit by means of visible – near infrared interactance spectroscopy. Chilling injury is a physiological disorder which may develop when kiwifruit are stored at commercial storage temperature of 0−1°C. Symptoms may include a granular appearance, corky outer pericarp and water-soaked tissue. The initial symptoms are visible only when the fruit is cut open. The data set used in this study consisted of 129 'Zesy002' kiwifruit, with chilling injury symptoms assessed visually when the fruit was dissected and classified on five-point severity scale from sound to severe. Nearinfrared(NIR) interactance spectral analysis (principal component analysis with standard normal variate (SNV) pre-processing on the wavelength range of 700–1000nm) was effective in segregating the fruit by symptom severity. A stronger separation between severely damaged fruit and sound fruit was achieved when the NIR measurements were made at the stylar end of the fruit. The optical properties of absorption and scattering coefficients were measured on a selection of excised kiwifruit slices and extracted kiwifruit juice using inverse adding-doubling and light transmittance methods, respectively. A comparative examination of impact damaged fruit (dataset of 22 fruit; 11sound, 11 impacted) gave an alternative perspective on water-soaked tissue, which has a similar appearance in chilling injured and impact damaged fruit, but showed different spectral shapes. It is speculated that the presence of water-soaked tissue might be less informative after SNV processing than corky and granular tissue for the detection of chilling injury. This study reports that there is good potential to use NIR spectroscopy for detecting kiwifruit with chilling injury symptoms.

Keywords: /Chilling injury / /NIR/ /Kiwifrui/t /Non-destructive detection/ /Impact injury/ /Inverse adding-doubling/

Xia, H., Wang, X., Su, W., Jiang, L., Lin, L., Deng, Q., Wang, J., Deng, H., Hu, R., Liao, M., Lv, X., & Liang, D. (2020). Changes in the carotenoids profile of two yellow-fleshed kiwifruit cultivars during storage. *Postharvest Biology and Technology*, *164*. doi: 10.1016/j.postharvbio.2020.111162

Abstract

Carotenoid level in fruit changes dynamically in response to storage condition, however, the underlying mechanism remains unclear. Here, we investigated the carotenoid profiles and associated gene expression to reveal its responses to different storage temperature (20 °C and 4 °C) in two kiwifruit cultivars, bright-yellow-fleshed Jinshi 1 and pale-yellow-fleshed Jinyan. At harvest, four main carotenoids were detected in cv. Jinshi 1, while only three in cv. Jinyan, excluding β-cryptoxanthin, which accounted for the majority of carotenoids in 'Jinshi 1'. Storage at 20 °C increased content of the total carotenoid and β-carotene in both cultivars, and up-regulated the expression of biosynthesis gene PSY, but down-regulated the expression of carotenoid degradation genes CCD1 and NCED1. It also induced β-cryptoxanthin and α-carotene production in Jinyan at later stage. On the contrary, storage at 4 °C decreased total carotenoid content, but induced the expression of carotenoid biosynthetic gene PDS, LCYB, LCYE. These results suggested expression of PSY, CCD1 and NCED1 plays an important role in improvement of carotenoids level at 20 °C. Furthermore, high proportion of β-cryptoxanthin might contribute to yellower flesh in Jinshi 1.

Keywords: /Carotenoid/ /Kiwifruit/ /Storage/ /Temperature/ /Yellow flesh/

LETTUCE

Huang, S.-J., Lin, S.-Y., Wang, T.-T., & Hsu, F.-C. (2020). Combining acetic acid and ethanol as an anti-browning treatment for lettuce butt discoloration through repression of the activity and expression of phenylalanine ammonia lyase. *Postharvest Biology and Technology*, *164*. doi: 10.1016/j.postharvbio.2020.111151

Abstract

The enzymatic browning of lettuce(LactucasativaL.) is a main cause of postharvest quality loss, and is controlled by the enzyme phenylalanine ammonia lyase (PAL). However, effective browning inhibitors that prevent lettuce butt discoloration have not been commercially developed, so the effects of such inhibitors on PAL are largely unknown. Here, we not only developed an anti-browning treatment, but also explored the mechanisms of the PAL-associated browning of Iceberg lettuce by profiling all homologs of PAL genes at transcript level. The antibrowning treatment used a combination of 0.25 M acetic acid and 200 mL L−1 ethanol and was able to repress enzymatic browning and microbial growth for two weeks. Notably, the lettuce butt discoloration in stem disks was repressed by 0.5 M acetic acid by inhibiting PAL activity, and this inhibition of PAL activity was also observed in vitro using a crude PAL enzyme extract from lettuce stems. To investigate the anti-browning mechanism at the transcriptional level, we identified and cloned six predicted LsPAL genes in the Lettuce Genome Resource, and further found that four of these (LsPAL1 to LsPAL4) were wound-inducible in the lettuce stem. Among these four wound-inducible LsPALs, LsPAL4 showed the highest wound-induced fold-change, suggesting that LsPAL4 has a key role in lettuce browning. Interestingly, wound-induction of LsPAL genes was dramatically downregulated by application of acetic acid. Taken together, acetic acid treatment of lettuce stems repressed butt discoloration by repressing PAL both enzymatically and transcriptionally, and ethanol provided complementary antimicrobial activity. A combination treatment with acetic acid and ethanol therefore has commercial potential in lettuce head processing.

Keywords: /Phenylalanine ammonia lyase (PAL)/ /Browning Acetic acid/ /Polyphenol oxidase (PPO)/ /Wounding response/

LONGAN

Chen, Y., Sun, J., Lin, H., Lin, M., Lin, Y., Wang, H., & Hung, Y.-C. (2020). Salicylic acid treatment suppresses Phomopsis longanae Chi-induced disease development of postharvest longan fruit by modulating membrane lipid metabolism. *Postharvest Biology and Technology*, *164*. https://doi.org/10.1016/j.postharvbio.2020.111168

Abstract

Salicylic acid (SA) is a crucial endogenous signaling molecule which can activate fruit defense responses to biotic or abiotic stress. The aim of this work was to study the effects of SA on disease occurrence, cell membrane integrity, membrane lipid-degrading enzymes activities, as well as amounts of cell membrane phospholipids and fatty acids in *Phomopsis longanae* Chi-inoculated longans during storage. The results indicated that, compared with the fruit with mere inoculation, SA treatment reduced fruit disease index and pericarp cell membrane permeability in *P. longanae*-inoculated longans. Additionally, SA treatment decreased activities of phospholipase D (PLD), phospholipase C (PLC), lipase, and lipoxygenase (LOX), lowered contents of saturated fatty acids (SFAs), phosphatidic acid (PA) and diacylglycerol (DAG), but suppressed the reductions of phosphatidylcholine (PC), phosphatidylinositol (PI), unsaturated fatty acids (USFAs), ratio of USFAs to SFAs (U/S), and index of unsaturated fatty acids (IUFA) in pericarp of *P. longanae*-inoculated longans. These data demonstrated that SA treatment could retain integrity of membrane structures, enhance fruit disease resistance to *P. longanae*, and thus suppress disease

development in *P. longanae*-inoculated longans during storage. These results indicated that SA was an eco-friendly approach to inhibit disease development and extend storage-life of harvested longan fruit.

Keywords: /Salicylic acid/ /Longan fruit/ /*Phomopsis longanae* Chi/ /Membrane lipid-degrading enzymes/ /Membrane phospholipids/ /Membrane fatty acids/

Li, M., Zheng, Q., Lin, H., Lin, M., Chen, Y., Lin, Y., Fan, Z., & Wang, H. (2020). The influence of ATP treatment on energy dissipation system in postharvest longan fruit during senescence. *Postharvest Biology and Technology*, *164*. Doi: 10.1016/j.postharvbio.2020.111154

Abstract

The harvested longan fruit are prone to senescence, leading to a decline in fruit quality like pericarp browning. There are two energy dissipative proteins involving in fruit senescence: alternative oxidase (AOX) and plant uncoupling mitochondrial protein (PUMP). The purpose of this work was to elucidate the influence of adenosine triphosphate (ATP) treatment on energy dissipation system in postharvest longan fruit during senescence. The results showed that the ATP content in postharvest longan fruit exhibited negative correlations with the expressions of DlAOX1, DlAOX2, DlPUMP3, and DlPUMP5. Moreover, compared to the control longan fruit, the treatment of exogenous ATP prevented the increases in the expressions of DlAOX1, DlAOX2, DlPUMP3, and DlPUMP5, helped maintain higher contents of ATP, ADP and higher level of energy charge, but lower respiration rate, lower cell membrane permeability, and lower pericarp browning index in postharvest longan fruit. These data indicated that the supply of exogenous ATP could reduce the induction of the expressions of DlAOX1, DlAOX2, DlPUMP3 and DlPUMP5, and consequently reduce the energy dissipation and retard the decline of energy level, which lead to the delayed senescence in postharvest longan fruit.

Keywords: /Longan fruit/ /Energy dissipation/ /Alternative oxidase (AOX)/ /Plant uncoupling mitochondrial protein (PUMP)/ /Postharvest senescence/ /Adenosine triphosphate (ATP) treatment/

MACADEMIA NUTS

Gama, T., Wallace H., Trueman, S., Jones, K., Hosseini-Bai, S. (2020). Late-dropping macademia nuts have reduced shelf life. *Scientia Horticulturae, 268, 109378.* doi: 10.1016/j.scienta.2020.109378

Abstract

The quality of tree nuts can be influenced by their harvest time, cultivar and seasonal growing conditions. Some macadamia cultivars retain mature nuts in the tree for several months before fruit abscission and this can result in variations in harvest time. Itis not known how the variations in harvest time affectthe quality and shelf life of macadamia cultivars. We investigated how harvest time and cultivar influence the quality and shelf life of macadamia kernels. We tested the shelf life of kernels using two techniques: (1) a long-term shelf-life method; and (2) a short-term accelerated-aging method that assessed oxidative stability based on hexanal concentrations. Cultivars HAES 344 (344) and Hidden Valley A16 (A16) were harvested in May and late-abscising nuts of cultivar A16 were also harvested in September. Peroxide values, free fatty acid levels and fatty acid composition of kernels in the long-term experiment were measured after 0, 6, 12, 15 and 18 months of storage at 25°C. Kernels in the short-term accelerated aging experiment were incubated at 45°C, and hexanal concentrations were measured before incubation and after 6, 12 and 18 days. Kernels from late-abscising nuts (September) had much higher free fatty acid levels after 18 months of storage than kernels from early-harvested nuts (May). Cultivar A16 (September) kernels had significantly higher hexanal concentrations than cultivar 344 (May) and A16 (September)

kernels at 12 and 18 days of incubation. The accelerated aging technique could detect differences in oxidative stability between different batches. Nuts harvested in September had shorter shelf life by about 3–6 months than those harvested in May, based on both predicted shelf life and actual time taken to reach acceptable-quality limits. Therefore, we recommend harvesting macadamia nuts as soon as possible after maturity to minimise quality losses.

Keywords: /Accelerated aging/ /Fatty acids/ /Hexanal/ /Lipid oxidation/ /Nuts/ /Rancidity/

MORINGA

Hassan, F. A. S., Mazrou, R., Gaber, A., & Hassan, M. M. (2020). Moringa extract preserved the vase life of cut roses through maintaining water relations and enhancing antioxidant machinery. *Postharvest Biology and Technology*, *164*. doi: 10.1016/j.postharvbio.2020.111156

Abstract

The vase life of industrial cut flowers is relatively short and hence seeking eco-friendly strategies to extend its commercially needed. This research was consequently undertaken to study either moringa leaf extract (MLE) or moringa seed extract (MSE) can be applied as a natural preservative to prolong the vase life of cut roses. Both applications were selected and tested because they are natural and have no environmental hazards. Cut flowers of Rosa hybrida cv. 'Upper Class' were overnight pulsed in either MLE or MSE at 1:40, 1:30, 1:20, 1:10 (extract/ water,v/v)and then transferred to distilled water.ThevaselifewassignificantlyextendedbyMLEorMSE, more so with 1:30 and 1:20 extracts. Both MLE and MSE resulted in 8 and 5 days, respectively, longer than the untreated flowers. Pulsing with MLE or MSE significantly maintained the relative water content (RWC) and suppressed the microbial growth at the stembase. However, although SEM investigation showed few bacteria on the cut ends of the flowering stems pulsed with MLE or MSE even on day 5, there was no visual bacterial blockage observed in the xylem vessels. Contrary, the cut ends of untreated flowers were completely covered with bacterial cells and a lot of bacteria were detected inside the xylem vessels. SEM investigation also revealed that MLE or MSE treatment reduced the stomatal aperture which was widely opened in untreated flowers. Additionally, MLE or MSE pulsing increased proline content, reduced H2O2 production and lipid peroxidation, enhanced total phenol content, radical scavenging and the activity of CAT and POX enzymes, which altogether resulted in maintained membrane stability. Expression of RhPIP1, RhTIP1 and RhLAC genes were considerably induced in control samples up to day 4 relative to MLE or MSE treated flowers, but no significant difference was observed between both moringa extracts in this respect. In conclusion, MLE or MSE treatment extended the vase life of cut roses via keeping water relations and enhancing the antioxidant machinery, the impact was more pronounced with MLE. Therefore, MLE as a novel preservative is recommend for future using in floral industry.

Keywords: /Anti-microbial/ /Antioxidant enzymes/ /Gene expression/ /Membrane stability/ /Radical scavenging/

MUSHROOM

Zhang, L., Liu, Z., Sun, Y., Wang, X., & Li, L. (2020). Combined antioxidant and sensory effects of active chitosan/zein film containing α-tocopherol on Agaricus bisporus. *Food Packaging and Shelf Life, 24*, 100470. doi:10.1016/j.fpsl.2020.100470

Abstract

In this work, we have explored a new packaging material for the shelf life extension of *Agaricus bisporus*. The influence of active chitosan/zein films containing α-tocopherol on the physicochemical properties and enzyme activities of mushroom during the storage at 4 ℃ for 12 d was investigated. Mushroom packaged with chitosan/zein/α-tocopherol (C/Z/T) film showed the lower weight loss, relative leakage rate, browning index, respiration rate, polyphenol oxidase, peroxidase activity and malondialdehyde content compared with control, chitosan film and chitosan/zein film. In all treatment groups, mushroom treated with C/Z/T film showed the highest firmness, catalase, superoxide dismutase activities, total phenolic content and DPPH radical scavenging activity. The results implied that C/Z/T film could improve the antioxidant properties and maintain the quality of mushroom.

Keywords: /Active packaging film/ /*Agaricus bisporus*/ /Antioxidant properties/

ONION

Ren, F., Nian, Y., & Perussello, C. A. (2020). Effect of storage, food processing and novel extraction technologies on onions flavonoid content: A review. *Food Research International, 132*, 108953. doi:10.1016/j.foodres.2019.108953

Abstract

Onions play an important part in the daily diet for most populations around the world owing to their nutritional composition and their unique capacity to naturally flavor dishes. Onions contain quercetin and its derivatives - the predominant flavonoid in onions that exert a great contribution to the effective bioactive properties of onion, including its derived products. The present paper comprehensively reviewed flavonoids (with a specific focus on quercetin in onions): their chemical composition, distribution, bioactivities in onion, and impacting factors with a focus on how they can be affected by various post-harvest conditions (storage and food processing). In addition, research on the extraction of flavonoid compounds from onions using a number of novel technologies was also reviewed.

Keywords: /Onions/ /Quercetin/ /Bioactivity of flavonoids/ /Storage/ /Post-harvest processing/ /Innovative extraction techniques/

ORANGE

Koltz, E. A., Santos, I. D., Dallemole-Giaretta, R., Pazolini, K., Leite, C. D., & Steilmann, P. (2020). Combining Brassica sachets and extracts with thermotherapy against postharvest green mold of orange. *Scientia Horticulturae, 268*, 109389. doi:10.1016/j.scienta.2020.109389

Abstract

Green mold is the major source of postharvest decay in oranges worldwide. The disease, caused by *Penicillium digitatum*, is responsible for severe production losses during transportation, storage and commercialization of the fruits. Although green mold is conventionally managed with synthetic fungicides, the use of these products is frequently associated with the emergence of fungicide-resistant strains and new control strategies are needed. The objectives of this study were to test brassica sachets and extract, combined or not with thermotherapy, for green mold postharvest control in oranges. Initially, the effects of canola and mustard extracts and sachets were tested on *P. digitatum in vitro* and on green mold in

inoculated oranges and the best treatments were tested combined with thermotherapy. The best alternative treatments of canola and mustard were compared with the conventional green mold treatment with the fungicide Imazalil. Results demonstrated that fungitoxic volatile compounds were produced by canola and mustard extracts and sachets, reducing *P. digitatum* development *in vitro* and green mold on inoculated oranges. There was no additive effect from the combination of the brassicas treatments with thermotherapy. Sachet treatments showed to be the best alternative control to green mold, mostly the canola sachet which showed the same control as Imazalil on *P. digitatum* sporulation on green mold lesions. Brassica sachets, mainly with canola, produced fungitoxic volatile compounds with great potential as an alternative control for green mold.

Keywords: /Alternative control/ /Sachets/ /Volatile compounds/ /Plant extracts/ /Citrus/

ORNAMENTALS

Caspersen, S., & Bergstrand, K. J. (2020). Phosphorus restriction influences P efficiency and ornamental quality of poinsettia and chrysanthemum. *Scientia Horticulturae*, *267*. doi: 10.1016/j.scienta.2020.109316

Abstract

Better synchronization of plant-available phosphorus (P) with crop P requirement is required to reduce P losses to the environment and to improve resource-efficiency of the exploitation of non-renewable phosphate rock. In horticultural plant production, a restricted availability of P may limit stem length and improve compactness, which are desirable characters for many ornamental plants. In the present study, we investigated the effect of reduced availability of P on plant quality, biomass production and phosphorus efficiency of poinsettia (*Euphorbia pulcherrima* cv. 'Mira Red') and chrysanthemum (*Chrysanthemum* × *morifolium* cv. 'Breeze Cassis'). Five P concentrations (6, 12, 18, 24 or 48 mg L^{-1}) were applied as starter P in the peat-based potting substrate as well as in the nutrient solution given during the experiment. Stem length of both plant species was strongly restricted at 6 mg P L^{-1} but was not significantly affected by higher P levels. For poinsettia, the optimum bract diameter was obtained at 18 mg P L^{-1}. For maximum shoot dry biomass, branching and plant diameter, however, 24 mg L^{-1} was needed. Optimal plant diameter and shoot biomass of chrysanthemum was obtained at 18 mg P L^{-1} while 24 mg L^{-1} was required for maximum flower number. Increasing the P supply to 48 mg L^{-1} did not improve shoot dry matter, branching or flowering of either species, but induced luxury uptake of P. Total shoot P uptake increased linearly over the P fertilizer range tested. For optimal plant biomass combined with optimal ornamental quality, shoot P concentrations at 90 DAP was in the range of 0.30-0.35 % for poinsettia and 0.25-0.30 % for chrysanthemum. Chrysanthemum showed a higher phosphorus efficiency than poinsettia at low P levels, mainly related to a higher internal P utilization efficiency. The P acquisition efficiency was in the range of 55–60 % for both species, and was not significantly affected by the total amount of P applied. In conclusion, with the P fertilization strategy used, P restriction could not be used for plant height restriction of poinsettia "Mira Red" or chrysanthemum "Breeze Cassis" without negative effects on plant quality. However, P fertilization could be markedly reduced without negative effects on plant growth and development, improving phosphorus efficiency and recovery.

Keywords: /Alternative growth regulation/ /Phosphorus acquisition efficiency (PAE)/ /Phosphorus recovery/ /Phosphorus uptake efficiency/ /Phosphorus utilization efficiency (PUE)/

PAK CHOI

Song, Y., Qiu, K., Gao, J., & Kuai, B. (2020). Molecular and physiological analyses of the effects of red and blue LED light irradiation on postharvest senescence of pak choi. *Postharvest Biology and Technology*, *164*. doi: 10.1016/j.postharvbio.2020.111155

Abstract

Pak choi (Brassica rapa ssp. chinensis) is a popular, yet highly perishable, leafy vegetable that is conventionally stored in the dark or shade. In this study, we analyzed the effects of light quality, light intensity, and irradiation duration on its postharvest senescence at 20 °C. Red light most strongly inhibited its senescence as shown by slower loss of photochemical efficiency (Fv/Fm ratio) and higher contents of chlorophyll, vitamin C, and total soluble proteins, while blue light had a much weaker effect. Red light inhibited the expression of putative chlorophyll degradation and senescence-associated genes, while promoting the expression of putative vitamin C biosynthetic genes. A daily irradiation of red light (35 μMm−2 s−1) for eight hours is optimal for delaying the senescence of its leaves. In contrast, far-red light treatment promoted its leaf senescence, indicating that phytochrome signaling is likely involved in the regulation of the postharvest senescence of pak choi.

Keywords: /Pak choi/ /Senescence/ /Quality deterioration/ /LED (light-emitting diodes) irradiation/ /Vitamin C/

PAPAYA

Hanif, A., Ahmad, S., Jaskani, M.J., & Ahmad, R. (2020). Papaya treatment with putrescine maintained the overall quality and promoted the antioxidative enzyme activities of the stored fruit. *Scientia Horticulturae, 268, 109367*. doi: 10.1016/j.scienta.2020.109367

Abstract

Papaya is an emerging, profit generating fruit of Pakistan having high nutritional value. It has very limited shelf life which limits its long distance transport and resulted in high postharvest losses. Putrescine has great potential to maintain the firmness, quality of fruit and reduce the losses. Therefore, the role of putrescine for balancing fruit firmness, enzyme activities and variations in biochemical properties of Red lady papaya fruit were evaluated during storage. Mature unripe papaya fruit were subjected to different concentrations of PUT (0 mM, 1 mM, 2 Mm, 3 mM) and then stored at 12 °C temperature and 90–95 % RH for 28 days. Fruit firmness, weight loss, antioxidant enzyme activities (CAT, SOD and POD), total phenolic, total antioxidants and other biochemical attributes were studied on weekly basis. Fruit firmness was substantially higher in putrescine treated fruits along with less weight loss % during storage. TSS and ripening index were higher in control fruit, while they were lower with PUT treatment. 2 mM PUT suppressed the decay incidence during whole storage period which was almost 2.9 times less than control fruit, similarly the activity of CAT enzyme was maximum (6.94U/mg protein), POD (1.07-fold higher than control) and SOD was also higher in the same treatment. Total antioxidants and total phenolic contents were at upper limits in fruit treated with 2 mM PUT during storage. It can be concluded that 2 mM PUT is helpful for extending the shelf life of papaya fruit by suppressing fruit softening, fruit decaying and by enhancing the enzyme activities and maintaining good keeping quality during storage.

Keywords: /Carica papaya/ /Catalase/ /Peroxidase/ /Superoxide dismutase/ /Total antioxidants/ /Total phenolic contents/ /Shelf life/

Maringgal, B., Hashim, N., Amin Tawakkal, I. S. M., Muda Mohamed, M. T., Hazwan Hamzah, M., Ali, M. M., & Abd Razak, M. F. H. (2020). Kinetics of quality changes in papayas (Carica papaya L.) coated with Malaysian stingless bee honey. Scientia Horticulturae, 267 doi: 10.1016/j.scienta.2020.109321

Abstract

There have been increased efforts to identify new edible coating and preservative compounds derived from natural sources. This study aimed to investigate the effect of two different concentrations (1.0 % and 1.5 %) of Malaysian stingless bee honey (SBH) as an edible coating agent on the quality attributes of papayas (Carica papaya L.) during storage. Quality parameters such as fresh weight loss (FWL), firmness, soluble solids content (SSC), titratable acidity (TA), colour, and respiration rate were investigated during 12 d of storage at 12 ± 1 °C. The results indicated that papayas coated with 1.0 % and 1.5 % of SBH significantly retained their firmness, colour, SSC, and TA, in addition to the reduced FWL and respiration rate as well as delayed decay development in fruits compared to the uncoated samples. The results of the Field Emission Electron Microscopy revealed that the SBH coating also prevented the ultrastructural features of the mitochondria. In addition, the zero-order and first-order kinetic models fitted well with the experimental data for both coated and uncoated papayas using the Arrhenius law approach. These results suggest that the SBH-coated layer not only improved the postharvest quality of papayas during storage but also prolonged their storage life.

Keywords: /Stingless bee honey/ /Papaya/ /Physicochemical quality/ /Kinetic changes/ /Mitochondria/

PEACH

Jiang, L., Kang, R., Feng, L., Yu, Z., & Lou, H. (2020). iTRAC based quantitative proteomic analysis of peach fruit (*Prunus persica* L.) at different ripening and postharvest storage stages. *Postharvest Biology and Technology, 164, 111137*. doi: 10.1016/j.postharvbio.2020.111137

Abstract

To better understand the global and dynamic changes in peach (*Prunus persica* L. cv. Xiahui 8) fruit protein expression, an efficient and reliable proteomic technique, iTRAQ, was used to investigate peach fruit proteome from day -7 to day 8 during storage period at 25 ± 1 °C. A total of 387 proteins with more than 1.2-fold abundance changes were observed. These differentially expressed proteins (DEPs) are mainly related to 17 functional categories. DEPs in day -7 were mainly responsible for sugar and carbohydrate syntheses, protein translation, expression and modification, and maintenance of osmotic balance in high ion and material transport capacities and strong redox reaction environment. Harvesting induced the increase of (small) heat shock protein. Upon harvest, the increased level of respiration rates on day 4 reached the highest level. polygalacturonase (PG), pectase lyase (PL), pectinesterase (PE), chorismate mutase (CM), peptidyl-prolyl isomerase (PPIase) and phytoene synthase (PSY) showed increased abundances and reached a peak at day 6, which significantly positive correlation with 9-cis-epoxycarotenoid dioxygenase (NCED) protein, accelerated fruit softening and metabolism of protein, amino acid and lipid. The emergence of eukaryotic translation initiation factor 5A (EIF5A) on day 8 signified the intensification of apoptosis. Our study facilitated a comprehensive understanding of the complex proteomic reprograming and ripening-associated mechanisms that could be used for endeavors of breeding and postharvest processing to improve peach fruit quality.

Keywords: iTRAQ/ /Peach fruit/ /Proteome/ /Protein quantification/ /Ripening/

Huang, D., Tian, W., Feng, J., & Zhu, S. (2020). Interaction between nitric oxide and storage temperature on sphingolipid metabolism of postharvest peach fruit. *Plant Physiology and Biochemistry, 151*, 60-68. doi:10.1016/j.plaphy.2020.03.012

Abstract

Both nitric oxide (NO) and cold storage have positive effects on the maintenance of fruit quality during storage. However, the roles of NO and storage temperatures in regulating the responses of sphingolipids metabolism to chilling injury of peach fruit during storage remain unknown. Peaches were treated by immersion in distilled water and 15 μmol L−1 NO solution, then stored at 25 °C and 0 °C, respectively. The effects of NO-treatment and storage temperature on the activities of enzymes in sphingolipid metabolism and the contents of sphingolipids in peach fruits were studied. NO maintained higher activities of acid phosphatase (AP) and alkaline phosphatase (ALP) in peach fruits at 25 °C, but promoted the decrease in the activities of AP and ALP at 0 °C, suggesting the regulation by NO on AP and ALP could be modulated by temperature. Compared with the storage at 25 °C, cold storage at 0 °C decreased the activities of phospholipase A (PLA), alkaline phosphatase (ALP), 3-ketodihydrosphingosine reductase (KDSR), sphingosine kinase (SPHK), ceramide synthase (CERS), ceramide kinase (CERK), and the contents of sphingosine (SPH), ceramide (CER), sphingosine-1-phosphate (S1P), ceramide-1-phosphate (C1P), sphingomyelin (SM), and increased the activities of phospholipase C (PLC), phospholipase D (PLD), sphingomyelin synthase (SMS). NO significantly increased the contents of sphingolipid metabolites, and the activities of PLA, KDSR, SPHK, CERS, CERK, but decreased the activities of PLC, PLD, SMS of peaches. The results suggested that NO could maintain sphingolipid metabolism to relieve the response of the postharvest fruit to low temperature.

Keywords: /Sphingolipid/ /Nitric oxide/ /Cold storage/ /Peach/ /Temperature/

PERSIMMON

Fathi-Najafabadi, A., Salvador, A. Navarro, R., Gil, R., & Besada, C. (2020). Effect of temperature during and immediately after CO_2-deastringency treatment on internal flesh browning after cold storage of persimmon fruit. *Scientia Horticulturae, 268, 109363.* doi: 10.1016/j.scienta.2020.109363

Abstract

Currently, a major cause of postharvest loss of ‘Rojo Brillante’ persimmon, the variety mainly cultivated in the Mediterranean Region, is ‘internal flesh browning’ manifestation after storage or shipping at low temperature, whose causes remain unknown. ‘Rojo Brillante’ is an astringent low temperature-sensitive cultivar. Thus fruit is routinely submitted to high CO_2 treatment to remove astringency, and also to 1-MCP treatment before being stored to retard flesh gelling and drastic softening, the main chilling injury symptoms. This study investigates the influence of temperature during CO_2 deastringency treatment and immediately after its application on the incidence of ‘internal flesh browning’ in persimmon fruit. Our results revealed for the first time that the temperature immediately after the CO_2 deastringency treatment was the main factor implied in this alteration. The fruit transferred directly to cold storage after the CO_2 treatment showed internal flesh browning’ after 41 storage d at 1 °C, while a 24-hour attemperation period at 20 °C before storage prevented this disorder from appearing. The main effect of the attemperation period was the enhanced release of CO_2 from fruit after the CO_2 treatment, which resulted in less acetaldehyde (AcH) accumulating after 24 h. Moreover, the temperature of the CO_2 application was observed to influence ‘internal flesh browning’ severity as AcH accumulated at higher concentrations in the fruit treated at 20 °C than at 12 °C. Our preliminary hypothesis is that AcH can act as a precursor of reactive oxygen species that would be implied in this disorder’s development.

Keywords: /Persimmon/ /Attemperation period/ /Flesh browning/ /Gas exchange/ /Respiration/

Zhao, Q., Jin., M., Gou, L., Pei, H., Nan, Y., & Rao, J. (2020). Modified atmosphere packaging and 1-methylcyclopropene alleviate chilling injury of 'Youhou' sweet persimmon during cold storage. ***Food Packaging and Shelf Life, 24, 100479.*** **doi: 10.1016/j.fpsl.2020.100479**

Abstract

'Youhou', one of the main varieties of sweet persimmon in China, produces fruit that softens easily after harvest. Low temperature can postpone the fruit-ripening process while causing chilling injury (CI) due to susceptibility to cold. In this study, we investigated the effects of 1-methylcyclopropene (1-MCP) and combined modified atmosphere packaging (MAP) and 1-MCP treatments on the CI of 'Youhou' sweet persimmon during storage at 1 °C. Flesh browning and gelling were inhibited by 1-MCP treatment, as indicated by the suppression of polyphenol oxidase and peroxidase activities and enhanced pectin solubility. After treatment, the fruits maintained good membrane status and showed lower lipoxygenase activity, less electrolyte leakage and a lower malondialdehyde content than the control fruits. When MAP was added, dramatic changes in the oxygen and carbon dioxide proportions were detected in the packaging bag. This combined treatment was more effective than the 1-MCP treatment in alleviating CI.

Keywords: /Sweet persimmon/ /Chilling injury/ /Modified atmosphere packaging/ /1-Methylcyclopropene/

POMEGRANATE

Hussein, Z., Fawole, O. A., & Opara, U. O. (2020). Effects of bruising and storage duration on physiological response and quality attributes of pomegranate fruit. ***Scientia Horticulturae*****,** ***267*****(February), 109306. doi: 10.1016/j.scienta.2020.109306**

Abstract

This study examined the effects of impact bruise damage on the postharvest physiological, response, physicochemical quality and antioxidant properties of pomegranate fruit. Fruit were subjected to low (20 cm), medium (40 cm) and high (60 cm) drop impacts by falling freely once onto the cheek position to a hard surface. Bruised and control (non-dropped) fruit were further stored at 5 ± 0.5 °C for 90 d plus 4-day shelf storage at 20 ± 2 °C. Fresh arils were obtained from the bruise-damaged and control fruit at 14 d intervals for physico-chemical and phytochemical quality evaluation. Impact bruising induced resulted in a 2-fold fruit respiration rate at least during the first 4 weeks of storage. Changes in total soluble solids (TSS) and titratable acidity (TA) were significantly ($p < 0.05$) induced by bruising at medium and high drop impact. Furthermore, high impact bruising resulted in 30 % of both decay incidence and internal fruit decay of fruit after 12-week storage. Furthermore, the combination of drop impact and storage significantly ($p < 0.05$) affected peel hue angle (hº), as well as aril lightness (L*), redness (a*), chroma (C*) and hº. The radical scavenging activity and total phenolic content were higher in bruised-damage fruit at medium and high impacts.

Keywords: /Respiration rate/ /Storage/ /Mechanical damage/ /Radical scavenging activity/ /Colour/

POTATO

Nikara, S., Ahmadi, E., & Alavi Nia, A. (2020). Finite element simulation of the micromechanical changes of the tissue and cells of potato response to impact test during storage by scanning electron microscopy. ***Postharvest Biology and Technology*****,** ***164*****. doi: 10.1016/j.postharvbio.2020.111153**

Abstract

Impact damage in potatoes affects its microstructure and leads to quality loss. The finite element simulation of the micromechanical alterations in the tissue and cells of potato in response to impact test during storage by scanning electron microscopy (SEM) analysis have been investigated. Two macro-scale and micro-scale finite element method (FEM) models were developed to investigate impact damage of potato tubers and cells, respectively. Physical (density and turgor pressure) and mechanical (modulus of elasticity, yield stress, and tangent modulus) properties of potato tissue were determined during storage. Impact damage at the contact point and cell dimensions were obtained using the SEM images. A macro-scale FEM model, simulating impact damage of a tuber was meshed using the solid elements and the mesh size sensitivity was checked. A mesh is a group of interconnected finite/elements joined together. The impact simulation scenarios included two impact levels of 0.032 J and0.335 J attwoweekintervals duringstorage. The FEMresults revealed that the maximum von Mises stress and impact damage increased at high impact energy while it decreased during storage. The impact damage prediction using the FEM model had a maximum error of 32.279 %. SEM images provided a reliable way to calculate the impact damage. The FEM simulation of impact tests on the micro-scale included a set of potato cells, each made of a cell wall and protoplast. The sensitivity of the mesh was checked and the appropriate element size for the potato tissue model was found to be0.03mm.Theresults showed a decrease in contact force due to the decrease in the elasticity modulus of the cell wall and protoplast during storage. Overall, it is concluded that the impact loading of potato after a period of storage leads to low impact damage and high quality of potato tissue.

Keywords: /Micromechanical changes/ /Scanning electron microscopy/ /Finite element method/ /Impact damage/ /Potato cell/

Zheng, X., Jiang, H., Bi, Y., Wang, B., Wang, T., Li, Y., Gong, D., Wei, Y., Li, Z., & Prusky, D., (2020). Comparison of wound healing abilities of four major cultivars of potato tubers in China. ***Postharvest Biology and Technology, 164, 111167. doi: 10.1016/j.postharvbio.2020.111167***

Abstract

Wound healing ability of potato tubers depends on cultivar. However, there are few researches on the wound healing dynamics of different potato cultivars and reports at biochemical and cellular level. In this study, the healing ability among four major potato cultivars, ‘Atlantic’, ‘Shepody’, ‘Desiree’ and ‘Favorite’ is compared after wounding the tubers artificially. The results indicated that during healing the wounded tubers ‘Atlantic’ had the lowest weight loss and disease index, compared with ‘Shepody’, ‘Desiree’ and ‘Favorita’ which was the highest. ‘Atlantic’ also had the largest accumulation of suberin poly phenolic and lignin at wounded sites of tubers during healing, followed by ‘Shepody’ and ‘Desiree’, and accumulation of ‘Favorita’ was the least. Moreover, ‘Atlantic’ had the highest phenylalanine ammonialyase and peroxidase activities, total phenols, flavonoid and lignin contents, and $ABTS^{+}$ scavenging ability in the tissue of wound sites during healing, followed by ‘Shepody’, ‘Desiree’ and ‘Favorita’. It is suggested that wound healing ability of potato tubers of different cultivar is strongly affected by the activation of phenylpropanoid metabolism and peroxidase.

Keywords: /Potato tubers/ /Cultivars/ /Wound healing ability/ /Phenylpropanoid metabolism/ /Peroxidase/

STRAWBERRY

Zahedipour-Sheshglani, P., & Asghari, M. (2020). Impact of foliar spray with 24-epibrassinolide on yield, quality, ripening physiology and productivity of the strawberry. ***Scientia Horticulturae, 268*****, 109376. doi:10.1016/j.scienta.2020.109376**

Abstract

Increasing the productivity, yield and quality and modulating the ripening physiology of the fruit is considered as a main concern for the fruit growers. Brassinosteroids (BRs), as natural phytochemicals, are produced endogenously during fruit development and play a vital role in regulating its developmental, ripening and quality formation processes. In this study, the effects of different concentrations of exogenous 24-epibrassinolide (EBL), a common brassinosteroid, on ripening physiology, quality parameters and yield of strawberry fruit was studied. Foliar spray of strawberry plants and developing fruits with EBL significantly modulated the pattern and rate of fruit growth, decreased the fruit growth duration and enhanced the precocity rate. Visual indices such as size, shape and color of the fruits were significantly affected by EBL treatment. EBL at 1 µmol/L enhanced fruit growth rate and had no significant effect on the shape, but at 4 µmol/L significantly decreased the length/diameter ratio and resulted in the production of more spherical fruits with a very short growing period. However, a decrease in flesh firmness was observed in fruit treated with higher EBL concentration. EBL treatment significantly enhanced fruit weight, water content, total phenolics and anthocyanin contents and carbohydrate metabolism. The results indicate that the use of brassinosteroids can be considered as a novel method for modulating the growth pattern, yield and different quality parameters in strawberry fruits.

Keywords: /24-epibrassinolide/ /Ripening physiology/ /Precocity/ /Shape/ /Phenolics/ /Total antioxidants/ /Strawberry/

SWEET CHERRY

Spadoni, A., Ippolito, A., & Sanzani, S. M. (2020). First report of Stemphylium eturmiunum causing postharvest rot of sweet cherry in Italy. *Crop Protection, 132*, 105112. doi:10.1016/j.cropro.2020.105112

Abstract

Italy is the first producing country of sweet cherries in Europe. In June 2019, sweet cherry fruit showing rot symptoms were collected from retailers located in Apulia (Southern Italy). Marginal pieces of rotted tissue of surface-sterilized fruit were plated onto semi-selective PDA medium. Colonies were further purified and grown on Potato Carrot Agar (PCA), looking initially whitish and then turning pale olive green to light brown. Conidia were septate and broadly ovoid or ellipsoid. Based on its micro- and macro-morphological features, the pathogen was identified as *Stemphylium eturmiunum* E.G. Simmons. A multi-locus approach was applied to confirm the identification. ITS-rDNA region and portion of genes coding for the glyceraldehyde-3-phosphate dehydrogenase and the calmodulin were sequenced. Both nBLAST homology and phylogenetic analysis confirmed the pathogen as *S. eturmiunum*. To fulfil Koch's postulates, surface-sterilized sweet cherry fruit, cv. Ferrovia, were inoculated with the strain. Typical disease symptoms were recorded after 7 days and the pathogen's identity was confirmed by re-isolation and characterization. Because of the resemblance with the symptoms caused by *Alternaria* spp., reasonably the incidence of *S. eturmiunum* infections might have been underestimated. This is the first report of *S. eturmiunum* as causal agent of postharvest rot of sweet cherries in Italy.

Keywords: /*Stemphylium* rot/ /*Prunus avium*/ /*Pleospora eturmiuna*/ /New disease report/

SWEET PERSIMMON

Zhao, Q., Jin, M., Guo, L., Pei, H., Nan, Y., & Rao, J. (2020). Modified atmosphere packaging and 1-methylcyclopropene alleviate chilling injury of 'Youhou' sweet persimmon during cold storage. *Food Packaging and Shelf Life, 24*, 100479. doi:10.1016/j.fpsl.2020.100479

Abstract

'Youhou', one of the main varieties of sweet persimmon in China, produces fruit that softens easily after harvest. Low temperature can postpone the fruit-ripening process while causing chilling injury (CI) due to susceptibility to cold. In this study, we investigated the effects of 1-methylcyclopropene (1-MCP) and combined modified atmosphere packaging (MAP) and 1-MCP treatments on the CI of 'Youhou' sweet persimmon during storage at 1 °C. Flesh browning and gelling were inhibited by 1-MCP treatment, as indicated by the suppression of polyphenol oxidase and peroxidase activities and enhanced pectin solubility. After treatment, the fruits maintained good membrane status and showed lower lipoxygenase activity, less electrolyte leakage and a lower malondialdehyde content than the control fruits. When MAP was added, dramatic changes in the oxygen and carbon dioxide proportions were detected in the packaging bag. This combined treatment was more effective than the 1-MCP treatment in alleviating CI.

Keywords: /Sweet persimmon/ /Chilling injury/ /Modified atmosphere packaging/ /1-Methylcyclopropene/

SWEET POTATO

Sanchez, P., Hashim, N., & Shamsudin, R. (2020) Laser-light backscattering imaging approach in monitoring and classifying the quality changes of sweet potatoes under different storage conditions. *Postharvest Biology Technology, 164, 111163.* doi: 10.1016/j.postharvbio.2020.111163

Abstract

Optical imaging techniques have gained wide attention for quality detection of agricultural and food products. In this work, the non-destructive ability of the laser-light backscattering imaging technique (LLBI) for monitoring and classifying the quality changes of sweet potatoes under different storage conditions was investigated. Freshly-harvested sweet potato root samples were stored at 5 °C, 15 °C and 30 °C for a period of 21 d with 120 samples in each storage group. Laser diode emitting light at 658 nm wavelength along with the camera system was employed to capture the backscattered light from the subjected samples. The acquired backscattering images were then pre-processed and segmented, and the intended backscattering parameters (BP) were extracted. Quality parameters (QP) such as moisture content (MC), soluble solids content (SSC), texture and color properties (*L*, a*, b**) were measured using the conventional methods as standard reference data. Multivariate analysis in terms of partial least squares regression (PLSR), principal component analysis (PCA) and linear discriminant analysis (LDA) was carried out to correlate and classify the sweet potatoes based on the BP. Results showed that storage had a significant effect both in the BP and QP of sweet potatoes as well as in the interaction between the BP and the treatments (day and temperature) applied. Among all the QP, SSC gave the most promising results (R = 0.56-0.66; RMSE = 0.76–1.10) across all the storage conditions. The analysis also revealed that 15 °C was the most suitable storage condition with the favourable PLSR results (R > 0.50) in all the examined parameters. Moreover, variations on the BP of the samples with respect to the different storage conditions were correctly classified with over 90 % and 80 % accuracies using the PCA and LDA, respectively. Thus, the study indicates that the LLBI technique is feasible and can be a useful tool for a non-destructive quality measurement and classification of sweet potatoes under different storage conditions.

Keywords: /Backscattering imaging/ /Quality/ /Storage/ /Sweet potato/ /Temperature/

TABLE GRAPE

Sanchez-Ballesta, M. T., Alvarez, I., Escribano, M. I., Merodio, C., & Romero, I. (2020). Effect of high CO2 levels and low temperature on stilbene biosynthesis pathway gene expression and stilbenes production in white, red and black table grape cultivars during postharvest storage. *Plant Physiology and Biochemistry, 151*, 334-341. doi:10.1016/j.plaphy.2020.03.049

Abstract

Phenolic compounds, such as phytoalexin resveratrol, can be induced in grapes in response to biotic and abiotic stresses and have been related in many healthy effects. Stilbene synthases (STSs) are the key enzyme responsible for resveratrol biosynthesis. They have been already isolated and characterized from several plant species, however, VviSTS is a multigene family and little is known about their modulation in response to the application of gaseous treatments that maintain table grapes quality during postharvest. In this work, we have analyzed the effect of a 3-day CO2 treatment on the modulation of 4 *STSs* (*VviSTS6*, *VviSTS7*, *VviSTS16* and *VviSTS46*) and on the accumulation of different stilbene compounds (resveratrol, resveratrol-glucoside, trans-piceatannol, z-miyabenol and pallidol) during the postharvest storage at 0 °C of white (Superior Seedless, Dominga), red (Red Globe) and black (Autumn Royal) table grapes. Results indicated that the accumulation of the stilbene compounds by the application of CO2 and low temperature storage were cultivar dependent. In white Dominga fruit, accumulation of stilbene compounds increased in CO2-treated samples what seems to be modulated by *VviSTS6*, *VviSTS7* and *VviSTS46*. However, in Red Globe the accumulation of compounds was mainly due to the cold storage in air and seems to be also mediated by the induction of the same *VviSTSs*. By contrast, in Superior Seedless and Autumn Royal table grapes the modulation of *VviSTSs* genes and the stilbene accumulation was independent of the atmosphere storage. Further studies would be needed to elucidate the possible role of transcription factors involved on *VviSTSs* modulation.

Keywords: /Carbon dioxide/ /Gene expression/ /Low temperature/ /Stilbene synthase/ /*Vitis vinifera/*

TOMATO

Bohmer-Maas, B.W., Fonseca, L.M., Otero, D.M., Zavareze, E.D., & Zambiazi, R.C. (2020).Photocatalytic zein-TiO_2 nanofibers as ethylene absorbers for storage of cherry tomatoes. *Food Packaging and Shelf Life, 24, 100508.* doi: 10.1016/j.fpsl.2020.100508

Abstract

This study is focused on the production of zein-TiO_2 nanofibers produced through electrospinning and the evaluation of such fibers as ethylene absorbers when used to improve the storage of cherry tomatoes. Zein (30 % (w/v)) were dissolved in 70 % (v/v) ethanol and incorporated with TiO_2 (0 %–5 %). The polymer solutions were evaluated for their electrical conductivity and viscosity, and the nanofibers were evaluated for their morphology, size distribution, thermal properties, Fourier transform infrared and water contact angle. The nanofibers with the smallest diameter were selected for testing as ethylene absorbers in the storage of cherry tomatoes for 22 days. The addition of TiO_2 reduced the diameter of the nanofibers and altered their thermal properties. Interactions between the zein and TiO_2 were observed based on the infrared spectrum. Containers with sachet of nanofibers exhibited a lower concentration of ethylene, demonstrating their significant potential for use as an active food packaging.

Keywords: /Electrospinning/ /Photocatalysis/ /Active packing/

Liu, Z., Li, Z., Yue, T., Diels, E., Yang, Y. (2020). Differences in the cell morphology and microfracture behavior of tomato fruit (*Solanum lycopersicum* L.) tissues during ripening. Postharvest Biology and Technology, 164, 111182. doi: 10.1016/j.postharvbio.2020.111182

Abstract

Fresh tomato fruit (Solanum lycopersicum L.) is very susceptible to microdamage during post-harvest handling. This study reveals the differences in 3D cell morphology (e.g., shape, size, arrangement, and wall thickness) and microfailure behaviour of different tissues in the tomato fruit. At each ripening stage, the 3D shape, size and arrangement of cells in different tissues of a tomato fruit were investigated based on two microscopic orthogonal images. Additionally, the cell wall thickness was determined using transmission electron microscopy, and the microfailure mode of each tissue under shear and tension was quantitatively assessed based on the cell rupture rate in the crack growth path. The cells in different tissues of a tomato fruit showed obvious differences inthe3D shape and growth direction. Septa cells had the largest sizes. Cell wall thickness was closely associated with fruit ripeness and tissue type. Epidermal cell walls in the pink exocarp were the thickest compared with the other tissue cell walls. The cell rupture rate was dependent on the fruit ripening stage, the type of tissue and the direction/mode of the applied force ($p < 0.05$). Two failure modes, namely, cell rupture and separation, were observed in the different tissues of the tomato fruit at each ripening stage under shear and tension. This work provides a vital basis for modelling and simulating microscopic mechanical damage experienced by fresh tomato fruits due to excessive external forces during post-harvest handling.

Keywords: /Tomato fruit / /3D cell morphology/ /Cell wall thickness/ /Microfailure behavior/ /Ripeness/ /Mechanical damage/