

SELECTIVE DISSEMINATION OF INFORMATION
As of September 2019

***Agaricus bisporus* (MUSHROOM)**

Aghdam, M. S., Luo, Z., Jannatizadeh, A., & Farmani, B. (2019). Exogenous adenosine triphosphate application retards cap browning in *Agaricus bisporus* during low temperature storage. *Food Chemistry*, 293, 285–290. doi: 10.1016/j.foodchem.2019.05.002

Abstract

Exogenous adenosine triphosphate (ATP) treatment at 0, 250, 500, 750, and 1000 μM retarded cap browning in mushrooms by 0, 34, 26, 51 and 32 %, respectively, during storage at 4 °C for 18 days. Triggering signaling H_2O_2 accumulation arising from elevating NADPH oxidase enzyme activity during 6 days of storage at 4 °C may be pivotal for promoting shikimate dehydrogenase enzyme activity in mushrooms treated with ATP during 18 days of storage at 4 °C. Promoting melatonin accumulation (390 $\mu\text{g kg}^{-1}$ FW vs. 160 $\mu\text{g kg}^{-1}$ FW) in mushrooms treated with ATP during cold storage may attribute to signaling H_2O_2 accumulation. Higher DPPH scavenging capacity (72 % vs. 65 %) in mushrooms treated with ATP may attribute to higher phenols accumulation arising from higher phenylalanine ammonialyase/polyphenol oxidase enzymes activity concomitant with higher alternative oxidase gene expression during 18 days of storage at 4 °C.

Keywords: /Adenosine triphosphate/ /DPPH Scavenging Capacity/ /Endogenous Melatonin Accumulation/ /Membrane Integrity/ /Mushrooms Cap Browning/ /Polyphenol oxidase/

Zhang, L., Liu, Z., Wang, X., Dong, S., Sun, Y., & Zhao, Z. (2019). The properties of chitosan/zein blend film and effect of film on quality of mushroom (*Agaricus bisporus*). *Postharvest Biology and Technology*, 155, 47–56. doi: 10.1016/j.postharvbio.2019.05.013

Abstract

A series of chitosan/zein blend films in different proportions were prepared. Firstly, the chitosan and zein solutions were blended in different volume ratios:1:0 (C/Z-0), 1:1 (C/Z-1), 3:1 (C/Z-3) and 5:1 (C/Z-5). The zeta potential was measured to investigate the stability of film-forming solutions. The mean values of zeta potential ranged from + 30.37 to + 44.27 mV, which indicated the excellent stability of all film-forming solutions. The physico-chemical and thermo-mechanical properties of films were evaluated by scanning electron microscopy (SEM), Fourier-transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), and thermogravimetric analysis (TGA). The results indicated that the parameters such as water vapors, oxygen and carbon dioxide barrier in the blend films were improved compared with pure chitosan film. FTIR analysis showed that hydrogen bond interactions existed between zein and chitosan molecules. SEM and XRD results confirmed that chitosan and zein had good binding compatibility. TGA demonstrated that the addition of zein improved the thermal stability of films. In addition, the effects of films packaging on the physicochemical properties of mushroom during storage at 4 °C for 12 d were studied. Among all the treatment groups, mushroom packaged with the blend film with a mixing ratio of zein: chitosan (1:1) exhibited the lowest weight loss rate, respiration rate, relative leakage rate, PPO and POD activity, however, the highest whiteness index.

Keywords: /Edible Films/ /Chitosan/ /Zein/ /Mushroom/

APPLE

Rodríguez-Chávez, J. L., Juárez-Campusano, Y. S., Delgado, G., & Aguilar, J. R. P. (2019). Identification of lipopeptides from *Bacillus* strain Q11 with ability to inhibit the germination of *Penicillium expansum*, the etiological agent of postharvest blue mold disease. *Postharvest Biology and Technology*, 155, 72–79. doi: 10.1016/j.postharvbio.2019.05.011

Abstract

The genus *Bacillus* produces secondary metabolites among which stand out compounds of polypeptide nature for their versatility of applications, one of them is the activity against fungal phytopathogens of agricultural importance. In the present work was evaluated the effectiveness of the crude lipopeptide from *Bacillus subtilis* Q11 against common soil borne pathogens, additionally in vitro and in vivo assays were carried out to determine the ability to inhibit the germination of conidia and reduce the blue mold rot induced by *Penicillium expansum* in apple (*Malus domestica* Borkh) fruit. In antagonistic test, the lipopeptide fraction of Q11 was able to limit the mycelial growth of *Rhizoctonia solani*, *Sclerotium rolfsii*, *Penicillium expansum*, *Fusarium stilboides*, *Colletotrichum gleosporides* and *Botrytis cinerea*, showing higher inhibition at higher lipopeptide concentrations (10, 20, and 30 µg disk⁻¹); however, it was ineffective against *Pseudomonas syringae*, *Xanthomonas campestris*, and *Clavibacter michiganensis*. On the other hand, the conidia of *P. expansum* after being exposed to a concentration of 800 mg L⁻¹ of lipopeptide for 16 h, showed swelling and germination reduction greater than 90%. In fruit assay with apples inoculated with a droplet of conidia suspension (200 conidia) of *P. expansum*, the treatment with the lipopeptide fraction reduced rot lesion severity, registering the greatest effects at 80 µg, which reduced the size of the lesion by more than 60%. The analysis by infrared spectroscopy, HPLC and MALDI-TOF established that the crude lipopeptide is a complex formed primarily by iturin-type compounds with fatty acid chain length of C14–C17 and small proportion of compounds of fengycin A and B type that differ in the length of the fatty acid chain. These compounds could be useful in the development of products for biological control of postharvest blue mold disease in apple.

Keywords: /Iturins/ /Fengycins/ /MALDI-TOF/ /Biological Control/ /Conidia/

Zhang, Q., Qi, Y., Li, R., Yang, Y., Yan, D., Liu, X., & Ren, X. (2019). Postharvest applications of n-butanol increase greasiness in apple skins by altering wax composition via effects on gene expression. *Postharvest Biology and Technology*, 155, 111–119. doi: 10.1016/j.postharvbio.2019.05.017

Abstract

The postharvest development of greasiness in apple skin has negative effects on fruit appearance and market quality and causes significant economic losses. The fluid wax constituents responsible for skin greasiness comprise mainly oleate and linoleate esters of (E,E)-farnesol and short-chain alcohols (C3-C5). Butyl esters are also key components. It is believed that accumulations of volatile alcohols affect the development of skin greasiness by offering substrates for the biosynthesis of the greasy esters. To demonstrate the putative role of volatile alcohols on apple skin greasiness, 'Cripps Pink' apples were treated with either 10 or 25 µL L⁻¹ n-butanol (NBA) and then stored at 20 °C. The composition of each cuticular wax was analyzed, and the expression levels of the related genes were recorded. There was no significant difference in the time course of fruit ripening or senescence among the two NBA treatments and the control. As expected, accumulations of the fluid wax constituents were indeed promoted in the NBA-treated fruit. On day 42, compared with the control, the butyl ester contents of the skins of the 10 and 25 µL L⁻¹ NBA-treated fruits were 1.7 and 2.9 times higher, respectively. Moreover, the 25 µL L⁻¹ NBA-treated fruit showed higher greasiness levels and looked shinier than the fruit exposed to the lower NBA treatment or the control. Several genes were more highly expressed in the NBA-treated

fruit than in the control. These included MdKASIII, MdSAD6, MdWSD1 (related to wax biosynthesis) and MdLTPG1 (related to wax export). We conclude that NBA had no significant effects on fruit ripening or senescence but promoted the development of skin greasiness.

Keywords: /Apple/ /NBA/ /Cuticular Wax/ /Skin Greasiness/ /Esters/ /Gene Expression/

Thewes, F. R., Brackmann, A., & Neuwald, D. A. (2019). Dynamics of sugars, anaerobic metabolism enzymes and metabolites in apples stored under dynamic controlled atmosphere. *Scientia Horticulturae*, 255, 145–152. doi: 10.1016/j.scienta.2019.05.027

Abstract

Apple storage under extremely low oxygen concentrations, as in dynamic controlled atmosphere, changes both aerobic and anaerobic metabolism. In this work we evaluated the effects of controlled atmosphere (CA) and dynamic controlled atmosphere based on respiratory quotient (DCA – RQ), with RQ 1.3 and RQ 1.5, on the dynamics of pyruvic acid, sugars, anaerobic metabolites and enzymes involved in anaerobic metabolism of ‘Elstar’ and ‘Nicoter’ apples after harvest, 6 and 9 months of storage plus 7 days of shelf life. We also investigated the induction of sorbitol and glycerol biosynthesis, as a response to low oxygen stress in apples stored under DCA – RQ, protecting the cell membrane from leakage. Storage under CA and DCA – RQ had different dynamics of sugars accumulation from harvest up to 9 months of storage, especially for sorbitol, which accumulated more over the storage period when fruit are stored under DCA - RQ. Glycerol was not detected in any of the cultivars or storage conditions. Storage under DCA reduces the membrane permeability even with the accumulation of anaerobic metabolism compounds, like acetaldehyde and ethanol. Perhaps, this is a result of the higher sorbitol accumulation, which acts as osmolyte. For both cultivars, the storage under DCA resulted in an increase of PDC enzyme activity from harvest to 9 months of storage. The dynamics of anaerobic metabolism compounds were different for both cultivars: ‘Elstar’ apples showed an increase from harvest to 9 months storage, but ‘Nicoter’ had an increase until 6 months of storage and a sharp reduction until 9 months of storage. The regulation of anaerobic metabolism is performed by PDC enzyme activity, with little influence of ADH enzyme activity, when apples are stored under DCA – RQ. ‘Nicoter’ apples are much more sensitive to low oxygen stress conditions as compared to ‘Elstar’.

Keywords: /Malus domestica/ /‘Elstar’/ /‘Nicoter’/ /Anaerobic Metabolism/ /Sugar Metabolism/ /Membrane Permeability/

BANANA

Chotikakham, S., Faiyue, B., Uthaibutra, J. and Saengnil, K. (2019). Effects of methyl salicylate on senescent spotting and hydrogen peroxide concentration in ripening ‘Sucrier’ bananas. *Acta Hortic.* 1245, 115-122 DOI: 10.17660/ActaHortic.2019.1245.17

Abstract

Senescent spotting is a serious postharvest disorder that occurs in Sucrier banana during the final phase of ripening and is a major constraint for banana growers and traders. This research evaluated the potential of exogenous methyl salicylate (MeSA) in reducing senescent spotting and its interaction with hydrogen peroxide (H₂O₂) in Sucrier banana. Bananas at ripening stage 3 were dipped in 0 (control), 1, 2 and 4 mM MeSA for 30 min. They were then packed into ventilated plastic baskets and kept for 6 days at 25±2°C and 75±5% relative humidity. Spotting score, H₂O₂ content, histological localization of H₂O₂ in banana peel and eating quality were determined. H₂O₂ content in control bananas increased rapidly from day 1 to day 6, together with an increase in peel spotting score. MeSA treatment at 2 and 4 mM effectively reduced H₂O₂ concentration and peel spotting for up to 6 days of storage. Eating quality was

maintained and treated fruit had higher visual quality scores than the control. Thus MeSA decreased H₂O₂ accumulation in Sucrier banana reducing senescent spotting.

Keywords: /Peel Spotting/ /Harvested Banana Fruit/ /Eating Quality/

BARLEY

Nazareth, T. D. M., Quiles, J. M., Torrijos, R., Luciano, F. B., Mañes, J., & Meca, G. (2019). Antifungal and antimycotoxigenic activity of allyl isothiocyanate on barley under different storage conditions. *Lwt*, 112, 108237. doi: 10.1016/j.lwt.2019.06.004

Abstract

The present study evaluated the efficacy of allyl isothiocyanate (AITC) in avoiding the growth of *Penicillium verrucosum* and consequent ochratoxin A (OTA) production in barley during storage for 90 d. Environmental humidity was controlled using saturated salt solutions and moisture content (MC) of the grain was analyzed. Moreover, the residual concentration of AITC on stored barley was also examined. Samples with 20.6% of MC presented the highest absorption of AITC with levels ranging from 75 to 4 mg/kg at day 1 and 90, respectively. The population of *P. verrucosum* was significantly reduced after 24 h of AITC exposure. After 90 d, the non-treated control group reached a fungal population of 8.3 log CFU/g and 1.5 mg/kg of OTA. On the other hand, AITC at 50 µL/L was able to reduce the fungal population as well as the production of OTA to levels that were below the limit of detection, independently of the MC and the time of exposure. In conclusion, the AITC was absorbed by the barley and released gradually, inhibiting the growth of *P. verrucosum* and the production of mycotoxin. Therefore, AITC could be used as a fungicide to prolong the shelf life of the barley improving its safety.

Keywords: /*Penicillium verrucosum*/ /Malting/ /Ochratoxin AAITC/ /Mycotoxin Reduction/

BLUEBERRY

Shi, Z., Deng, J., Wang, F., Liu, Y., Jiao, J., Wang, L., & Zhang, J. (2019). Individual and combined effects of bamboo vinegar and peach gum on postharvest grey mould caused by *Botrytis cinerea* in blueberry. *Postharvest Biology and Technology*, 155, 86–93. doi: 10.1016/j.postharvbio.2019.05.016

Abstract

The effects of bamboo vinegar (1.5% v/v) and peach gum (2% w/v), either individually or combined, on reducing grey mould decay caused by *Botrytis cinerea* in blueberry fruit was investigated. Bamboo vinegar combined with peach gum reduced disease incidence and lesion diameter more than treatments with either substance alone. Furthermore, fruit dipped with 1.5% bamboo vinegar combined with 2% peach gum showed higher plant defence mechanisms than the controls and other individually treated fruit. The combined treatment increased the activities of defence enzymes, including chitinase; β-1,3-glucanase; phenylalanine ammonia-lyase; peroxidase and polyphenol oxidase, whereas fruit treated with only bamboo vinegar or with peach gum showed lower effects on the induction of plant defence mechanisms. Additionally, the treatments, either alone or combined, did not degrade fruit postharvest sensory and nutritional qualities, such as titratable acid, total soluble solids, ascorbic acid and surface colour in blueberry fruit. Therefore, the synergistic effects of bamboo vinegar and peach gum in combination can effectively contribute to the control of grey mould disease development in blueberry fruit.

Keywords: /Blueberry/ /Bamboo Vinegar/ /Peach Gum/ /Grey Mold/ /Storage/

CACTUS

D'Aquino, S., Inglese, P., Liguori, G., Ochoa, M.J. and Palma, A. (2019). Reducing postharvest decay in cactus pears by dip treatment with imazalil or azoxystrobin. Acta Hort. 1247, 41-46 DOI: 10.17660/ActaHortic.2019.1247.6

Abstract

Postharvest decay in cactus pear is a minor problem in fruit marketed directly after harvest, while it may represent a major cause of losses when fruit are cold stored or subjected to cold quarantine treatments. Unfortunately, to date, no postharvest fungicide has been registered to control postharvest decay of cactus pears. Thus, the objective of this study was to evaluate the efficacy of two globally known fungicides, imazalil (IMZ) and azoxystrobin (AZO), registered for postharvest treatment of various fresh produce species, to control decay on cactus pears. Second-crop cactus pears Gialla fruits were dipped in 500 mg L⁻¹ IMZ or AZO and stored at 1 or 8°C and 90-95% RH for 2 or 3 weeks, respectively, plus 1 additional week at 20°C and 55-60% RH to simulate retail conditions. At the end of storage, decay incidence ranged between 16 and 23% in control fruit, while the percentage of losses in treated fruit ranged between 3% (IMZ) and 5% (AZO). Although no significant difference was detected between the two fungicides in terms of percentage of rotten fruit, IMZ seemed to be more active than AZO in controlling *Penicillium* decay. Both chemicals ameliorated fruit responses to chilling injury, but a slightly higher decline in freshness, associated with faster transpiration activity, occurred in AZO-treated fruit. Based on these results, considering the complexity of the registration process of new chemicals and the easier procedure required for manufacturers to apply for extension of use of already registered pesticides, both chemicals could be good candidates as potential fungicides to control postharvest disease of cactus pears.

Keywords: /Azoxystrobin/ /Cactus Pears/ Decay/ /Imazalil/ /Storage/

Sortino, G., Inglese, P. and Allegra, A. (2019). Effect of 1-methylcyclopropene on cactus pear fruit at different maturity stages during storage. Acta Hort. 1247, 221-228 DOI: 10.17660/ActaHortic.2019.1247.30

Abstract

1-Methylcyclopropene (1-MCP) is an ethylene antagonist widely used to retain quality and prolong the postharvest storage period of various climacteric fruits. To date, there is little information about the effects of 1-MCP on postharvest storage performance of cactus pear fruits. Recently, data revealed that exposure of 1-MCP at 1000 ppb had several beneficial effects in preserving postharvest quality of cactus pear fruits, as indicated by inhibition of peel color change. In this paper, we investigated the effect of 1-MCP on quality of cactus pear fruit harvested from the scozzolatura crop at early and late ripeness stages. Fruit was tested at two different ripening stages: commercial ripe (CR; fruit commercially ripe with 90% green ground-color and 10% orange color) and ripe on tree (ROT; late fruit ripe on tree with 100% orange color and no green ground-color). Fruit was sanitized by immersion in 200 mg kg⁻¹ sodium hypochlorite for 5 min, and stored at 8°C for 30 days. Color (L* and ΔE), visual appearance, crunchiness score, carotenoids, phenolic content and respiration rate were measured at harvest and after 7, 14, 21 and 30 days. The results did not show beneficial effects of 1-MCP in terms of color or visual or crunchiness score; in contrast, significant differences occurred in all samples in terms of carotenoid and polyphenol content.

Keywords: /Respiration Rate/ /Decay/ /1-methylcyclopropene/ /Sensory Test/ /Shelf Life/

CARROTS

Xylia, P., Clark, A., Chrysagyris, A., Romanazzi, G., & Tzortzakis, N. (2019). Quality and safety attributes on shredded carrots by using *Origanum majorana* and ascorbic acid. *Postharvest Biology and Technology*, 155, 120–129. doi: 10.1016/j.postharvbio.2019.05.015

Abstract

The increased need for consumption of raw vegetables has led to the production of minimally processed products like shredded carrots. There is a current trend towards the use of natural agents for the preservation of fresh produce quality, as alternatives to synthetic compounds such as chlorine. The purpose of this study was to evaluate the effects of different washing treatments with aqueous solutions of marjoram (*Origanum majorana*) essential oil (EO) (1:1500 v/v), marjoram hydrosol (Hyd) (1:15 v/v), ascorbic acid (AA) (1%) and their respective combinations on the quality of shredded carrot under storage at 4 °C for 9 d. The EO-treated carrots had acceptable aroma and AA-treated carrots obtained acceptable carrot-like aroma. The carrots' orange color preserved with the AA application compared to the untreated control but marjoram Hyd application resulted to a final product with darker color and increased respiration after 6 and 9 d of storage at 4 °C and 90% RH. Furthermore, the application of AA increased total phenolic content and antioxidant activity of shredded carrots, while the combination of AA with EO and Hyd increased carotenoid content. Total soluble solids were increased following the application of marjoram Hyd. The application of AA increased total acidity and lowered pH values of shredded carrots at the 9th day of storage. Decay incidents, as observed by the total viable counts and yeast and filamentous fungi, were decreased by single or combined treatment during storage. Ascorbic acid alone or in combination with Hyd or EO maintained quality and preservation of processed carrots and in that way can be proposed as alternative sanitizers.

Keywords: /Ascorbic Acid/ /Daucus carota/ /Fresh Produce/ /Essential Oil/ /Hydrosol/ /Minimally Processed Products/

CASHEW APPLE

Sena, E. D. O. A., Silva, P. S. O. D., Araujo, H. G. S. D., Batista, M. C. D. A., Matos, P. N., Sargent, S. A., ... Carnellosi, M. A. G. (2019). Postharvest quality of cashew apple after hydrocooling and cold room. *Postharvest Biology and Technology*, 155, 65–71. doi: 10.1016/j.postharvbio.2019.05.002

Abstract

Cashew (*Anacardium occidentale* L.) is composed of two distinct parts: the nut (fruit), which represents only 10% of the total weight of the harvested product, and the cashew apple (pseudo-fruit), usually known as cashew. This study aimed to determine the hydrocooling temperature of cashew apples and its effects on quality maintenance. Cashews were hydrocooled (HC) by immersion in chlorinated water at 1, 3, 5 and 7 °C. Fruit were cooled in a refrigerator at 5 °C as controls. After treatments, all the fruit were stored at 5 °C for 15 d, and cooling rate, color, freshness, visual assessment, weight loss, and thermal properties were evaluated. Fruit hydrocooled at 1 and 7 °C had lower visual quality and wilting, and greater weight loss, 3 °C was discarded by did not show evident results. A temperature of 5 °C was selected for further studies. Cashew apples were HC at 5 °C, and control treatment cooled in display cold room (CR) at 5 °C, and then fruit from both treatments were stored for 25 days. Samples were taken for physical, physico-chemical and enzymatic analyses at 5 days intervals. HC fruit showed greater freshness, higher firmness and acidity, and slower losses of fresh weight loss and vitamin C when compared with CR. Total phenolic contents decreased during storage, but little effect of treatment on the rate of decline was detected. However, activities of polyphenol oxidase and peroxidase were generally higher in cashew

apples with CR than after HC. Red color loss of the cashew apples was constant during storage, regardless of the cooling method. Our study shows that 5 °C is the minimal temperature for hydrocooling of cashew apples, to decrease the risk of damage by cooling, and that this temperature is the optimal temperature for storage of cashew apples.

Keywords: /Anacardium occidentale L./ /Cooling Method/ /Oxidative Enzymes/ /PPO/POD/

CHERRY TOMATO

Chen, H., Zhang, Y., & Zhong, Q. (2019). Potential of acidified sodium benzoate as an alternative wash solution of cherry tomatoes: Changes of quality, background microbes, and inoculated pathogens during storage at 4 and 21°C post-washing. Food Microbiology, 82, 111–118. doi: 10.1016/j.fm.2019.01.013

Abstract

To evaluate the feasibility of acidified sodium benzoate (NaB) as alternative washing solutions of fresh produce, the survival of inoculated pathogens, the background molds and yeasts counts, and quality parameters were compared during 4 and 21 °C storage of cherry tomatoes washed with 3000 ppm NaB at pH 2.0, 200 ppm free chlorine at pH 6.5, water adjusted to pH 2.0, and distilled water. The acidified NaB solution was the most effective in reducing the population of *Escherichia coli*O157:H7, *Salmonella enterica* and *Listeria monocytogenes* cocktails on tomatoes (>4 log CFU/g). NaB was more effective than free chlorine ($P < 0.05$) in reducing the two Gram-negative bacteria on tomatoes, while the reduction of Gram-positive *L. monocytogenes* by NaB (5.49 log CFU/g) and chlorine (4.98 log CFU/g) was similar ($P > 0.05$). No recovery of bacteria was found in all treatments during storage for 15 days. The acidified NaB effectively controlled yeasts and molds on cherry tomatoes to <1 log CFU/g or below the detection limit at both temperatures during 15-d storage, while free chlorine did not. Compared to unwashed controls, NaB had no effect on color, weight loss, firmness, and total soluble solids content of tomatoes during storage. The effect of NaB reducing pathogenic and spoilage microorganisms on tomatoes and maintaining quality during storage suggests its potential as an alternative wash solution in postharvest processing of fresh produce.

Keywords: /Acidified Sodium Benzoate/ /Cherry Tomatoes/ /Storage/ /Pathogens/ /Quality/

Bastante, C. C., Cardoso, L. C., Fernández-Ponce, M., Serrano, C. M., & Ossa, E. M. D. L. (2019). Supercritical impregnation of olive leaf extract to obtain bioactive films effective in cherry tomato preservation. Food Packaging and Shelf Life, 21, 100338. doi: 10.1016/j.fpsl.2019.100338

Abstract

The promising prospective in the use of natural extracts has encouraged researchers to study techniques for its incorporation into polymers. This study has focused on supercritical solvent impregnation (SSI) of polyethylene terephthalate/polypropylene (PET/PP) films with olive leaf extract (OLE). The % co-solvent and the ratio OLE/polymer (w/w) were evaluated for producing antioxidant (AO) films. Besides, the antimicrobial (AM) capacity of both OLE and impregnated films were studied against *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Salmonella enteritidis*. The highest AO capacity and phenolic loading were found in films impregnated at 7% co-solvent and a ratio OLE/polymer of 1, where c.a. 5 mg AO/g and 60 µg total polyphenols/g films were obtained. The antimicrobial capacity of the impregnated films varied respecting that found in the extract, especially in the case of *S. enteritidis* and *P. aeruginosa*. The bioactivity of films was also demonstrated by extending cherry tomatoes' shelf-life by 20 days.

Keywords: /Supercritical Impregnation/ /Olive Leaf Extract/ /Food Preservation/ /Co-solvent/ /Active Packaging/

CHICKPEA

Iturralde-García, R. D., García-Regueiro, J. A., Castañé, C., & Riudavets, J. (2019). Sorption of carbon dioxide by chickpeas packaged in modified atmospheres. *Journal of Stored Products Research*, 83, 54–60. doi: 10.1016/j.jspr.2019.05.008

Abstract

Modified atmospheres (MAs) with high CO₂ concentrations are used for packaging several commodities with different purposes, including as an alternative method for pest control. When used in gas-tight flexible packages, sorption by the commodity produces a vacuum effect that causes the package to adopt a random shape and makes it impossible to reshape it without opening the package. Other than storage problems in retail storehouses, sorption can affect the amount of gas inside the packages needed for pest control. This study reports the amount of CO₂ sorption by chickpeas packaged with different MAs and the negative pressure produced due to the decrease in the partial pressure of the gas. Trials were conducted in 710 mL semi-rigid plastic containers filled up to 24%, 48% and 96% of their capacity (filling ratios). Three MAs (90%, 70% and 50% CO₂ with a residual of 3%, 6% and 10% O₂, respectively, and balanced by N₂) were used during 24 h, 48 h, 240 h and 384 h of exposure at 20 °C. The maximum sorption (1.28 g CO₂/kg of chickpea) was obtained with the lower filling ratio (24%) and with an initial concentration of 90%. Sorption decreased with the decline in the initial CO₂ concentration and with the rise in the filling ratio. The time needed to reach the equilibrium sorption varied between 141 h and 27 h, depending on the initial CO₂ concentration and the filling ratio of chickpeas. The vacuum effect produced inside the containers by sorption produced a negative pressure that increased with the increase in the filling ratio and the initial CO₂ concentration. Whether the amount of CO₂ available in packages after gas sorption is still effective for controlling chickpea pests remains to be tested.

Keywords: /Packaging/ /Legumes/ /Vacuum/ /Equilibrium Sorption/ /Pest Control/

CITRUS

Wu, W., Cronjé, P., Verboven, P., & Defraeye, T. (2019). Unveiling how ventilated packaging design and cold chain scenarios affect the cooling kinetics and fruit quality for each single citrus fruit in an entire pallet. *Food Packaging and Shelf Life*, 21, 100369. doi: 10.1016/j.fpsl.2019.100369

Abstract

Optimizing fresh fruit supply chains is essential to reduce food losses and the associated environmental impact, as large amounts of energy and natural resources are embodied in these lost products. Proper refrigeration of these perishable items is essential here, and the used ventilated packaging design and cold chain scenario play a key role. This study pioneers in unveiling how package design, package position on a pallet, package stacking pattern and cold chain scenarios affect the cooling kinetics and fruit quality evolution for every single fruit of the thousands of fruit inside a pallet. This enables us to identify fruit quality heterogeneities on a pallet level, where previous studies typically focused on an order of magnitude less fruit. For this purpose, our recently developed virtual cold chain methodology is applied to these large ensembles of fruit, which relies on computational fluid dynamics simulations. Of the three evaluated packaging designs for citrus fruit, the Supervent package outperforms the Standard and Opentop packaging by providing the overall fastest and most uniform cooling. Supervent's performance is attributed to the alignment of ventilation pathways through the lateral vent holes. The performance of the Standard package is very similar, apart from the inefficient cooling at lower speeds. The Opentop

packaging exhibits lengthy and non-uniform citrus fruit cooling, due to the unequal distribution of the vent openings on its long and short sides, and near the top surface. This unequal distribution fosters the creation of preferential pathways and faster cooling of the top layer of fruit in each box. Concerning the cold chain scenarios, forced-airflow precooling is the fastest to bring down the temperature after harvest. The promising scenario “ambient loading”, where citrus fruit are loaded at ambient temperatures in the container, proves to be a worthy alternative. We could also show that stacking the pallet in a mechanically more stable way negatively affects the cooling heterogeneity. Finally, our methodology enables us to identify, for a certain cold chain, which box on the pallet the customer should choose to have the longest shelf life, or which box the retailer should sell first.

Keywords: /Virtual Cold Chain/ /Citrus Fruit/ /CFD/ /Open/ /FOAM/ /Fruit Quality/ /Cooling/

Wang, L., Ning, T., & Chen, X. (2019). Postharvest storage quality of citrus fruit treated with a liquid ferment of Chinese herbs and probiotics. *Scientia Horticulturae*, 255, 169–174. doi: 10.1016/j.scienta.2019.03.030

Abstract

In this study, we produced a novel liquid fermentation compound (LFC) from the co-fermentation of probiotics and Chinese herbs and assessed its benefits on the postharvest storage quality of citrus fruit. Harvested fruit were treated with sterile water (Control), probiotic suspensions (PS), a combination of Chinese herbs (CHC) or LFC for 5 min and then stored at 20 °C and 85–90% RH for 42 d. The results of in vitro tests showed that LFC strongly inhibited the growth of *P. digitatum*. Storage trials showed that PS, CHC and LFC treated fruits had lower weight loss and higher vitamin C and total soluble solid contents at day 42 after treatment. However, there were no significant differences in firmness among all groups. Only LFC-treatment significantly delayed the loss of titratable acidity content at day 21 after treatment. Interestingly, decay incidence in LFC treated-fruit was also significantly lower than both CHC- and PS-treated fruit ($P < 0.05$). PAL and PPO activity in LFC-treated fruit were significantly higher than other groups at days 4 and 6, respectively, after incubation ($P < 0.05$). After incubation with green mold for 8 d, the disease index of fruit treated with PS, CHC, or LFC was 50, 58.3 and 33.3%, respectively, whereas complete decay was observed in water-treated fruit. A significant reduction of lesion diameters, was recorded for LFC-treated fruit, as compared to other treatments. Based on these results, LFC can be considered as a novel, efficient and natural antistaling agent for citrus fruit.

Keywords: /Probiotics/ /Chinese Herbal Combination/ /Liquid Fermentation Compound/ /Storage Quality/ /Citrus Fruit/

CURRY LEAVES

Venkatachalam, K. (2019). Enzymatic activities of curry leaves (*Murraya koenigii* L.) during storage in chilling temperature. *Acta Hort.* 1245, 145-152 DOI: 10.17660/ActaHortic.2019.1245.21

Abstract

Curry leaves are highly susceptible to chilling injury (CI) under prolonged storage at 4–8°C. CI in plants is a complicated process interconnected through several biochemical reactions especially enzymatic activities. Present study monitored the activities of polyphenol oxidase (PPO), peroxidase (POD), phenylalanine ammonia lyase (PAL), lipoxygenase (LOX), superoxide dismutase (SOD), catalase (CAT) and glutathione peroxidase (GPX) in curry leaves stored at 4°C under perforated LDPE packaging (100 g package-1). Leaves without packaging served as control. Surface colour (L^* , a^* , and b^*), electrolytic leakage, chlorophyll content, total phenolic content (TPC) and total antioxidant activity (TAA) were measured in leaf samples. Samples were analysed every 3 days for 15 days. Prolonged chilling

temperature induced CI in curry leaves. Leaf surface colour such as (L* and b*) gradually decreased while leaf redness (a*) gradually increased, reflecting browning enzymatic activities and chlorophyll degradation. Electrolytic leakage was severe in control leaves. TPC influenced the TAA activities in curry leaves, and the values tended to decrease with time (P<0.05). During the initial storage period (0-8 days), enzymatic activities remained constant but increased markedly during 9-15 days at 4°C. LOX increased in control leaves throughout storage, and as a consequence, PPO, POD and PAL activities were also higher in control. Similarly, SOD, CAT, and GPX were also found higher in control, indicating that prolonged chilling increased reactive oxygen species in control samples. The LDPE package that acted as a barrier between the package and samples and slightly reduced the CI in curry leaves.

Keywords: /Curry Leaves/ /Low Temperature/ /Chilling Injury/ /LDPE Package/ /Enzymes/

EGGPLANT

Huang, Q., Qian, X., Jiang, T., & Zheng, X. (2019). Effect of eugenol fumigation treatment on chilling injury and CBF gene expression in eggplant fruit during cold storage. Food Chemistry, 292, 143–150. doi: 10.1016/j.foodchem.2019.04.048

Abstract

The effect of eugenol (EUG) on chilling injury (CI) to eggplant fruit (*Solanum melongena* L.) was investigated. Eggplant fruit were pre-treated with 25 µL/L EUG, and then stored at 4 °C for 12 days. Results showed that EUG fumigation treatment effectively retarded the CI development, reduced pulp browning, weight loss, and malondialdehyde (MDA) content, and sustained soluble solids content (SSC) and proline content. Moreover, the activities of polyphenol oxidase (PPO) and peroxidase (POD) were inhibited by EUG. C-repeat/dehydration-responsive element binding factors (CBF) genes are transcription factors playing a critical role in cold acclimation. To illuminate the molecular regulation of EUG on chilling tolerance in eggplant fruit, a 1151 bp SmCBF gene was identified and the effect of EUG on SmCBF expression was determined by RT-qPCR. EUG resulted in a higher SmCBF expression. These findings suggested that EUG treatment had potential effect on alleviating CI in eggplant fruit.

Keywords: /Eggplant/ /Chilling Injury/ /Eugenol/ /Fruit Quality/ /C-repeat/Dehydration-Responsive Element Binding Factors/

FLAXSEED

Bechlin, T. R., Granella, S. J., Christ, D., Coelho, S. R. M., & ViCELLI, C. A. (2019). Evaluation of grain and oil quality of packaged and ozonized flaxseed. Journal of Stored Products Research, 83, 311–316. doi: 10.1016/j.jspr.2019.07.014

Abstract

Flaxseed (*Linum usitatissimum* L.), high in substances with functional properties, depends on good practice for assuring the post-harvest quality and maintenance of its nutritional properties. This study evaluated the effect of ozonation and two types of packaging on the grains and oil quality of brown and golden flaxseed stored. The freshly harvested grains were kept in three different conditions viz. control, polyethylene-coated paper packaging and polypropylene plastic packaging for 90 days at room temperature (21 ± 2 °C), with four replicates of 1.5 kg. Ozone injection occurred within a 110 m³ room containing the packages at 10 ppm for 120 min. The results showed that ozonation on different types of packaging and storage did not influence the moisture content of the grains and index peroxide on flaxseed oil. The golden flaxseed variety showed an increase in free fatty acids after storage, as well as mean values for higher fungi count than those of brown flaxseed, indicating higher contamination. The

packaging influenced the lipid content for both varieties studied, and, for brown flaxseed, the polyethylene-coated paper packaging showed better maintaining of quality after storage. The type of packaging influenced the color parameters only before of the storage, i.e., instants after ozone application, and the polyethylene-coated paper packaging presented color values similar to the control, indicating that exposure to the ozone gas did not alter the grains. Thus, polyethylene-coated paper packaging showed better conservation of lipids and maintenance of color parameters. Further studies are desirable to determine the appropriate package for the ozonation process and storage of golden flaxseed.

Keywords: /Ozonation on Packaged Grains/ /Packaging/ /Storage/ /Cold Extraction/ /Flaxseed Oil Quality/

FRESH FRUITS

Belay, Z. A., Caleb, O. J., & Opara, U. L. (2019). Influence of initial gas modification on physicochemical quality attributes and molecular changes in fresh and fresh-cut fruit during modified atmosphere packaging. Food Packaging and Shelf Life, 21, 100359. doi: 10.1016/j.fpsl.2019.100359

Abstract

The quality of fresh and fresh-cut (FC) fruit can be preserved by creating an optimal atmospheric condition around the product. Extensive research has been reported on the application and effects of initial gas modification on fruit quality. Active modified atmosphere packaging (MAP) is a commonly applied postharvest technology to maintain quality and extend shelf life of fresh fruit; however, the response of individual fruit types to the exposed atmosphere widely varies depending on gas composition and storage condition. Hence, as the demand for active MAP application increases, identifying and understanding the role of gases used for active MAP, their mechanism and effects on the quality of fresh and FC fruit becomes more relevant. This review examined the effects and mechanisms by which initially modified atmosphere affects the quality of fresh and FC fruit with respect to physicochemical quality, and composition of organic acids, bio-active compounds, and secondary metabolites. The review further highlighted on the application of genomic tools towards better understanding molecular changes in fruit subjected to MAP during postharvest handling.

Keywords: /Active Gas Flushing/ /Bioactive Compounds/ /Volatile Organic Compounds/ /Gene Expression/

Hu, B., Sun, D.-W., Pu, H., & Wei, Q. (2019). Recent advances in detecting and regulating ethylene concentrations for shelf-life extension and maturity control of fruit: A review. Trends in Food Science & Technology, 91, 66–82. doi: 10.1016/j.tifs.2019.06.010

Abstract

Fresh fruit are important for a healthy diet, however, their shelf-life can be shortened because of ethylene, a key phytohormone associated with the ripening process. Therefore, detecting ethylene concentration on trace level and regulating its activity by safe and effective approaches are of paramount importance in extending postharvest shelf-life and controlling maturity of fruit. In this review, ethylene detection technologies as well as ethylene regulating strategies are discussed, aiming to develop more innovative and effective approaches. Effects of ethylene on quality and shelf-life of fruit are presented. Ethylene detection and monitoring technologies available such as gas chromatography, electrochemical, optical, chemical methods, especially novel methods such as those based on colorimetric, luminescence, metal-organic frameworks, organic field effect transistors and surface enhanced Raman spectroscopy are described. In addition, shelf-life extending technologies for ethylene control, removal or inhibition such as suppressing ethylene synthesis, scavenging or oxidizing or adsorbing ethylene, and blocking ethylene

receptor are summarized. Finally, future perspectives on developing strategies that can simultaneously satisfy the requirements of sensitivity, rapidness and on-line for wide utilization in ethylene monitoring of fresh products are also given. It is expected that miniature and sensitive ethylene detection techniques combined with feasible ethylene control methods should be an effective solution for fruit quality maintenance and shelf-life extension. However, each type of sensors and ethylene control strategies currently available has their own advantages and limitations. Therefore, attempts should be made to exploit more effective ethylene detection and controlling technologies.

Keywords: /Ethylene/ /Fruit Postharvest Shelf-Life/ /Gas Chromatography/ /Electro-chemical Sensors/ /Optical Sensors/ /1-Methylcyclopropene (1-MCP)/

FRESH HERBS

Wilson, M.D., Wang, B. and Huynh, N.K. (2019). Shelf-life extension of fresh basil, coriander, mint and parsley. Acta Hort. 1245, 139-144 DOI: 10.17660/ActaHortic.2019.1245.20

Abstract

Basil, coriander, mint and parsley are the four most common herbs grown in Australia. Fresh herbs have limited shelf-life, thus have been traditionally sold dried or semi-dried. However, consumers are increasingly demanding fresh herbs for their superior taste and health properties. The aim of this study was to evaluate innovative postharvest treatments to prolong shelf-life of fresh herb leaves. Dipping and dry misting leaves with 5-20 ppm electrolysed oxidising water (EOW) increased shelf-life of all four herbs, as indicated by the retention of higher concentrations of total chlorophyll concentrations and carotenoids. Exposing leaves to 96% CO₂ for 1 h benefitted total chlorophyll and carotenoid retention of coriander and parsley, but negatively affected shelf-life of basil. The implications of these findings for commercial supply chains of fresh herbs are discussed.

Keywords: /Packaging/ /Electrolysed Water/ /CO₂ Shock/

FRESH HORTICULTURAL PRODUCE

Acedo, A.L. (2019). Postharvest handling and storage technologies for fresh horticultural produce. Acta Hort. 1245, 93-100 DOI: 10.17660/ActaHortic.2019.1245.14

Abstract

Fruit and vegetables are high-value, nutritious crops that can provide solutions to economic and food insecurity. However, losses between production and postharvest stages are serious, averaging annually at up to 50% or higher in developing Asian countries. Factors contributing to these losses include the lack of postharvest knowledge, techniques and facilities combined with the perishable nature of fruit and vegetables, the complex and inefficient supply chains, and the hot and humid climates in many Asian countries. The United Nations Sustainable Development Goal 12.3 targets reducing food losses by 50% by 2030, providing impetus for postharvest loss reduction efforts. About half of the current postharvest losses can be prevented with a more efficient supply chain. The saved food can feed about one billion extra people. This can reduce the pressure to raise more food to feed an additional two billion people by 2050. As developing countries integrate into the world economy and global value chains proliferate, postharvest technologies can enable these countries to improve the quality of their horticultural produce in domestic and international markets at competitive price. In Asia, a value chain approach was forged to improve postharvest management of fruit and vegetables, comprising value chain analysis, technology generation and capacity building. Practical postharvest technologies and best practices have been developed and introduced to reduce postharvest losses of fruit and vegetables, particularly for

smallholders. These included harvesting, field handling, sorting, washing, sanitizing, modified atmosphere packaging, evaporative cooling, ice cooling and low-cost cold storage techniques. Economic analysis indicated most of these techniques were potentially highly profitable. These postharvest techniques were documented in local languages and disseminated to various stakeholders through trainings and other capacity building programs. Basic to effective mainstreaming of postharvest technologies is for smallholders to organize and collectively deal with markets that should direct production and postharvest efforts. A farm-packhouse-market system has been introduced including financing scheme for farmer groups and cooperatives in three countries for this purpose. The impact of these technological and organizational interventions relative to reducing postharvest losses, increasing and diversifying income sources and promising employment opportunities. Furthermore, there are other postharvest technologies commercially employed in established, export-oriented fruit and vegetable firms, such as ethylene management techniques (e.g., removal with ethylene scrubbers and ethylene inhibition using 1-MCP), insect pest and disease control (slow-release fumigation, hot water treatment, vapour heat treatment), packaging system, controlled atmosphere storage, refrigerated transport and storage, and cold chain. These technologies can be introduced to smallholder groups to capacitate them to engage more competitively with high value markets.

Keywords: /Postharvest Losses/ /Value Chain/ /Fruit/ /Vegetables/ /Postharvest Technologies/

GUAVA

Chumyam, A., Faiyue, B., & Saengnil, K. (2019). Reduction of enzymatic browning of fresh-cut guava fruit by exogenous hydrogen peroxide-activated peroxiredoxin/thioredoxin system. *Scientia Horticulturae*, 255, 260–268. doi: 10.1016/j.scienta.2019.05.042

Abstract

Abiotic stresses in plants are commonly caused by antioxidant system imbalance in their tissues. A peroxiredoxin/thioredoxin (Prx/Trx) system is a ubiquitous antioxidant system involved in sensing and detoxifying hydrogen peroxide (H_2O_2) and other reactive oxygen species (ROS). This study investigated exogenous H_2O_2 potential in reducing browning and its interaction with the Prx/Trx system in fresh-cut guava fruit during storage at 25 °C. Fresh-cut guava samples were immersed in 0 (control) and 250 mM H_2O_2 for 10 min, placed on a foam tray, packed inside a polyethylene bag and kept at 25 ± 1 °C for 48 h. The H_2O_2 treatment reduced browning and maintained fresh-cut guava fruit quality during storage. The H_2O_2 treatment reduced oxidative membrane damage and an accumulation of ROS, but activated the Prx/Trx system by stimulating the activities of peroxiredoxin and thioredoxin reductase, and NADPH-generating dehydrogenases including glucose-6-phosphate dehydrogenase and 6-phosphogluconate dehydrogenase as well as an increase in NADP redox state. The altered redox state and the activation of the Prx/Trx system by H_2O_2 was correlated with delayed browning of fresh-cut guava. Thus, the Prx/Trx system is involved in browning development, and H_2O_2 treatment could delay browning in fresh-cut guava by reducing oxidative membrane damage via stimulating the Prx/Trx system.

Keywords: / H_2O_2 / /Prx/Trx System/ /Redox Balance/ /Browning/ /Fresh-cut Guava/

GRAPE TOMATO

Wang, L., Fan, X., Sokorai, K., & Sites, J. (2019). Quality deterioration of grape tomato fruit during storage after treatments with gaseous ozone at conditions that significantly reduced populations of *Salmonella* on stem scar and smooth surface. *Food Control*, 103, 9–20. doi: 10.1016/j.foodcont.2019.03.026

Abstract

Gaseous ozone was evaluated for its effectiveness in reducing populations of Salmonella and native microorganisms on grape tomatoes and its impact on sensory and nutritional quality of the fruit. Grape tomatoes with Salmonella enterica serovar Typhimurium inoculated onto stem scar and smooth surface were treated with 1.71, 3.43 and 6.85 mg L⁻¹ gaseous ozone for 2 or 4 h. For quality studies, non-inoculated tomatoes were treated with gaseous ozone under the same concentrations and durations and stored at 10 °C for 21 d. Sensory properties (appearance and off-odor), total plate count (TPC), mold and yeast count, instrumental color, firmness, and lycopene and vitamin C content were measured on d 1, 7, 14, and 21 of storage. Results showed that 6.85 mg L⁻¹ ozone for 2 and 4 h treatments reduced Salmonellapopulations by approximately 2 log CFU fruit⁻¹ on both smooth surface and stem scar area of tomatoes. Other treatments did not significantly reduce the populations of Salmonella. Significant reductions on TPC were observed on fruit treated with 6.85 mg L⁻¹ ozone for 2 and 4 h and 3.43 mg L⁻¹ for 2 h on d 1 and 7 of storage. However, mold and yeast counts were not consistently affected by the gaseous ozone treatments. Ozone at 3.43 and 6.85 mg L⁻¹ for 4 h negatively impacted the ratings of appearance and off-odor. In addition, the same treatments significantly reduced firmness and decreased lycopene and vitamin C contents. Overall, our results indicated that gaseous ozone that achieved significant reductions of Salmonellapopulations caused deteriorations in the quality of grape tomatoes.

Keywords: /Pathogen/ /Native Microbiota/ /Color/ /Ascorbic Acid/ /Softening/ /Nutrients/

***Heliconia psittacorum* (FLOWER)**

Sardinha, D. H. S., Rodrigues, A. A. C., Ribeiro, S. S. M., Diniz, N. B., Neto, J. R. M. C., & Reis, F. D. O. (2019). Phytostimulants influence the vase life of *Heliconia psittacorum* CV. golden torch. *Postharvest Biology and Technology*, 155, 140–148. doi: 10.1016/j.postharvbio.2019.05.001

Abstract

Many factors influence postharvest quality of tropical flowers, including preharvest management of the plants. Also, oxidative stress is a major factor for determining quality during vase life, as it reflects complex chemical and physiological changes in the plant. The present study aimed to assess the influence of phytostimulants applied to *Heliconia psittacorum* cv. Golden Torch in quality maintenance during the vase life of this species. Bion®, Agro-Mos®, Quartz®, Ca - Fosfitotal® (calcium phosphite) and K - Fosfitotal® (potassium phosphite) were applied in the field. The flower stems used during the experiment were harvested in the morning to assess the visual aspect, fresh matter loss, electrolyte leakage, lipid peroxidation and the soluble carbohydrates and peroxidase, polyphenoloxidase, and superoxide dismutase activities and total soluble phenolic compounds. Fosfitotal® maintained of stem quality of *Heliconia* during vase life. Fosfitotal®, especially K - Fosfitotal®, resulted in the best scores for the visual aspect, reduced electrolyte leakage and less lipid peroxidation. These results were confirmed with the quantifications of the enzymes peroxidase, polyphenoloxidase, superoxide dismutase and total soluble phenolic compounds. Field treatments, with phytostimulants can maintain the stem quality *Heliconia* during vase life.

Keywords: /Tropical Flowers/ /Oxidative Stress/ /Electrolyte Leakage/ /Lipid Peroxidation/ /Enzymatic Defense/

KIWI

Jamróz, E., Kopel, P., Juszczak, L., Kawecka, A., Bytesnikova, Z., Milosavljevic, V., & Makarewicz, M. (2019). Development of furcellaran-gelatin films with Se-AgNPs as an active packaging system for extension of mini kiwi shelf life. *Food Packaging and Shelf Life*, 21, 100339. doi: 10.1016/j.fpsl.2019.100339

Abstract

Nanocomposite films were obtained by solvent casting method from aqueous solutions of furcellaran (FUR) and gelatin (GEL) with addition of various concentrations of nanoparticles (Se-AgNPs). The incorporation of Se-AgNPs gave rise to changes in the physical and mechanical properties of the nanocomposite films. The increase in the concentration of Se-AgNPs results in change of elasticity and elongation at break. The films with Se-AgNPs possess strong antibacterial activity against *Staphylococcus aureus*, Multi Resistant *Staphylococcus aureus* (MRSA) and *Escherichia coli*. This work aims to study the effect of nanocomposite films on quality of kiwi (*Actinidia arguta*) during storage period. Fresh kiwis in nanocomposite films had longer shelf lives than fruits in LDPE film. It follows from the study that the films are suitable for storage of kiwis.

Keywords: /Furcellaran-gelatin Films/ /Active Packaging/ /Silver Nanoparticles/ /Selenium Nanoparticles/

LEMON

Perez, M. F., Díaz, M. A., Pereyra, M. M., Córdoba, J. M., Isas, A. S., Sepúlveda, M., ... Dib, J. R. (2019). Biocontrol features of *Clavispora lusitaniae* against *Penicillium digitatum* on lemons. *Postharvest Biology and Technology*, 155, 57–64. doi: 10.1016/j.postharvbio.2019.05.012

Abstract

Penicillium digitatum is the main pathogen which causes postharvest decays in lemons, and the use of synthetic fungicides is the principal way of controlling these postharvest infections. In our previous work, identifying biological alternatives to the use of fungicides, a killer strain of *Clavispora lusitaniae* 146, which exhibited highly protective activity against green mold on lemons, was isolated from citrus plants. The aim of the present work was to study the ability of *C. lusitaniae* 146 to colonize wounds in lemon fruit and its effect on *P. digitatum* spore germination. Additionally, the protection efficacy of yeast strain 146 against an imazalil-resistant *P. digitatum* as well as yeast survival on commercial waxes were also evaluated. Results indicated that *C. lusitaniae* 146 exhibited an evident ability to colonize wounds in lemons and continue to grow at both low and room temperatures. In addition, the use of heat-inactivated cells showed a certain degree of efficacy against fruit decays. The ability of *C. lusitaniae* 146 to inhibit spore germination and its high efficiency against both sensitive and resistant fungi to fungicides were also demonstrated. Lastly, it was found that *C. lusitaniae* 146 could survive in natural waxes for 7 d at 25 °C and 40 d at 8 °C. Thus, our studies confirmed the potential industrial use of *C. lusitaniae* 146 as an effective biocontrol agent against postharvest infections of lemons caused by *P. digitatum*.

Keywords: /*Penicillium digitatum*/ /*Clavispora lusitaniae*/ /Lemons/ /Postharvest/ /Biological Control/

LITCHI

Zheng, L., Situ, J., Zhu, Q., Xi, P., Zheng, Y., Liu, H., Zhou, X., Jiang, Z. (2019). Identification of volatile organic compounds for the biocontrol of postharvest litchi fruit pathogen *Peronophythora litchii*. *Postharvest Biology and Technology*, 155, 37-46 doi: 10.1016/j.postharvbio.2019.05.009

Abstract

Litchi is an important economic fruit in subtropical countries. The litchi downy blight (LDB) caused by the oomycete *Peronophythora litchii* severely affects the production and quality of litchi fruit, and is widespread in almost all litchi production regions of China. Therefore, there is an urgent need for effective and sustainable control strategies against LDB. Our previous study showed that *Bacillus amyloliquefaciens* LI24 and PP19, *B. licheniformis* HS10, *B. pumilus* PI26, and *Exiguobacterium acetylicum* SI17 are promising biocontrol agents (BCAs) in controlling LDB, and their volatile organic compounds (VOCs) could inhibit the growth of *P. litchii* in vitro. In this study, we found that pre-exposure of litchi fruit to VOCs produced by PP19, SI17 and PI26 can significantly reduce the severity of LDB during 36 h to 72 h post inoculation. We further analyzed VOCs produced from the three BCAs (i.e., PP19, SI17, PI26) by solid phase microextraction gas chromatography-mass spectrometry (SPME-GC-MS), and found that their chemical compositions varied substantially over incubation time and between BCAs. In total, 70, 98, 101 chemicals were detected in PP19, SI17, PI26 from 24 to 72 h of incubation, respectively; 17 of them were commonly produced at more than one time points by PP19, and 11 were selected for further study. Two of the compounds 1-(2-Aminophenyl)ethanone (EA) and Benzothiazole (BTH) showed inhibitory activity against both *P. litchii* on plates and LDB on litchi fruit when the compounds were directly applied, while another compound α -Farnesene (AF) was able to suppress LDB in vivo, but did not exhibit antagonistic activity against the pathogen in vitro, suggesting that it may act through induction of host defense mechanisms. Our results showed that the bacterial VOCs and compounds of BTH or AF could be promising for the control of LDB on harvested litchi fruit.

Keywords: /Litchi Downy Blight/ /*Peronophythora litchii*/ /Volatile Organic Compounds/ /Biocontrol Efficacy/ /Gas Chromatography–Mass Spectrometry/

Mitra, S.K. (2019). Colour retention of litchi (*Litchi chinensis* Sonn.) after harvest - a review. *Acta Hortic.* 1245, 101-106 DOI: 10.17660/ActaHortic.2019.1245.15

Abstract

The perishability of litchi fruit limits marketing, especially exports to countries with some distance from main areas of production. The major postharvest problem is pericarp browning that is associated with rapid pericarp desiccation, anthocyanins degradation and disease. Low temperature (1-5°C) storage can reduce physiological decay, but it has only a limited role in reducing pericarp browning. Sulphur is often used to reduce both decay and browning, with postharvest fungicides also providing good control of disease. However, there is increasing pressure from consumers to find alternatives to chemicals while still satisfying the demand for sound, blemish-free fruit of good quality. A combination of low temperature (2-5°C), high humid conditions and polyethylene packaging are reported to be effective for control of browning. Other available options include use of VapourGuard and treatment with organic acids, edible coatings, potassium metabisulphite, methyl jasmonate and chlorine dioxide. All these treatments have been reported to reduce postharvest decay and peel browning. This paper reviews the available technology for colour retention of litchi after harvest.

Keywords: /Anthocyanins Degradation/ /Peroxidase/ /Polyphenol Oxidase/ /Sulphur Fumigation/

LONGAN

Intarasit, S., Jungklang, J., Uthaibutra, J. and Saengnil, K. (2019). Low-concentration ascorbic acid dips to prevent pericarp browning of 'Daw' longan fruit during storage. Acta Hort. 1245, 123-130 DOI: 10.17660/ActaHortic.2019.1245.18

Abstract

Ascorbic acid (AsA) plays an important role in protection against oxidative stress in plants. It either directly detoxifies reactive oxidative species or indirectly stimulates antioxidant defence systems. This study evaluated the potential of AsA at low concentrations to reduce oxidative membrane damage and prevent pericarp browning of 'Daw' longan fruit. Fresh fruit were dipped in 0 (control), 1, 2.5 and 5 mM AsA for 5 min and stored at 25±1°C and 82±5% relative humidity for 6 days. All concentrations of AsA reduced pericarp browning (browning index, L* and b* values), polyphenol oxidase (PPO) and peroxidase (POD) activities during 5 days of storage. Membrane integrity (electrolyte leakage (EL) and malondialdehyde content) of longan was retained for 4 days. AsA at concentrations of 1 and 2.5 mM were most effective in reducing pericarp browning and extending shelf-life from 1 to 4 days compared with the control. Thus postharvest application of low-concentrations of AsA could be an effective method for protecting pericarp browning by reducing the activities of PPO and POD and maintaining membrane integrity of 'Daw' longan fruit during storage at 25±1°C.

Keywords: /Pericarp Browning/ /Dimocarpus longan Lour./ /Membrane Damage/

MAIZE

Bosomtwe, A., Danso, J.K., Osekre, E.A., Opit, G.P., Mbata, G., Armstrong, P., Arthur, F.H., Campbell, J., Manu, N., McNeill, S.G., Akowuah, J.O. (2019). Effectiveness of the solar biomass hybrid dryer for drying and disinfestation of maize. Journal of Stored Products Research, 83, 66-72 <https://doi.org/10.1016/j.jspr.2019.05.011>

Abstract

The Solar Biomass Hybrid Dryer (SBHD) is a new technology developed in Ghana for grain drying and utilizes biomass (agro-residues, timber scraps, etc.) along with solar drying, and is especially useful for drying during rainy periods of the year when solar drying cannot be relied on. This study assessed the effectiveness of a 5.0-MT SBHD comprising a solar tent and a furnace for thermal drying and disinfestation of maize. Mortalities of adults of *Sitophilus zeamais* (Motschulsky), *Tribolium castaneum* (Herbst) and *Cryptolestes ferrugineus* Stephens were assessed. Additionally, mortalities of immatures of these three species were assessed. Internal and cage temperatures (°C) in the SBHD, sun drying (SD) and laboratory (control) were monitored, as were moisture content (MC) and thermally (stress) damaged kernels (TDK) (%). During the 7-h experiment, mean internal temperatures in the SBHD, SD and laboratory were 52.3 ± 1.0 °C, 41.4 ± 0.8 °C and 30.3 ± 0.2 °C, respectively. Similarly, temperatures in cages in the SBHD (49.5 ± 1.0 °C) were higher than those for cages in the laboratory (29.9 ± 0.2 °C) and SD (38.2 ± 0.6 °C). Reduction in the moisture content of maize dried using SBHD, SD and under laboratory conditions were 7.7, 5.2 and 2.9%, respectively. This corresponded to grain MC reduction rates of 1.1%, 0.74% and 0.4% per hour. There was 100% mortality of *S. zeamais* and *C. ferrugineus* adults achieved in only the SBHD; some immatures of all three species survived in all three treatments. However, survival of immatures was highest in the laboratory, followed by SD and lowest in the SBHD for all three species. Percent TDK was higher in the SBHD (6.7 ± 0.9) than SD (3.3 ± 0.3) and laboratory (2.7 ± 0.3). These data show that the SBHD is effective for both drying and disinfestation of grain.

Keywords: /Post-harvest System/ /Thermal Disinfestation/ /Solar Biomass Dryer/ /Food Security/

PEACHES

Zhou, D., Sun, Y., Li, M., Zhu, T., & Tu, K. (2019). Postharvest hot air and UV-C treatments enhance aroma-related volatiles by simulating the lipoxygenase pathway in peaches during cold storage. *Food Chemistry*, 292, 294–303. doi: 10.1016/j.foodchem.2019.04.049

Abstract

Hot air (HA) treatment and ultraviolet C (UV-C) irradiation have been demonstrated to control chilling injury in peaches. However, little is known about the effects of HA and UV-C treatments on volatiles changes in peach fruit during cold storage. In this study, peaches were treated with HA at 40 °C for 4 h or irradiated with UV-C lamp (1.5 kJ/m²), and then stored at 1 °C for 35 days plus 3 days of shelf life at 20 °C. Results showed that HA and UV-C suppressed chilling injury significantly, exhibiting lower internal browning index. Also, the two treatments enhanced emissions of esters and lactones in peaches by increasing enzymes of alcohol acyltransferase (AAT), fatty acid desaturase (FAD) acetyl coenzyme A transferase (ACX). These suggested that the increase of fruity note aromas in peaches by the two treatments is closely associated with aroma-related metabolism (LOX pathway and lactone pathway).

Keywords: /Volatiles/ /Gene Expression/ /LOX Pathway/ /Chilling Injury/ /Peaches/

Jiao, C., & Duan, Y. (2019). Guanosine 3',5'-cyclic monophosphate mediates gibberellic acid-induced chilling tolerance and defense response in postharvest peach fruit. *Postharvest Biology and Technology*, 155, 80–85. doi: 10.1016/j.postharvbio.2019.04.018

Abstract

The mediation of stimulation of chilling tolerance and defense response by guanosine 3',5'-cyclic monophosphate (cGMP) in response to gibberellic acid (GA₃) treatment in peach fruit was explored. The fruit were treated with exogenous GA₃ and LY83583 (cGMP inhibitor). It turned out that exogenous GA₃ treatment mitigated chilling injury (CI) in postharvest peach fruit. Further, GA₃ treatment enhanced guanylyl cyclase (GC) activity, and thereby induced cGMP accumulation. GA₃ also up regulated the gene expression of superoxide dismutase (SOD), peroxidase (POD), catalase (CAT), ascorbate peroxidase (APX), glutathione reductase (GR) and glutathione S-transferase (GST). In addition, GA₃ treatment enhanced the gene expression of methionine sulfoxide reductase (MSR), and inhibited the gene expression of lipoxygenase (LOX) and phospholipase D (PLD). These above exogenous GA₃-stimulated effects were weakened by the addition of LY83583. Overall, cGMP mediated GA₃-induced chilling tolerance and defense response in postharvest peach fruit.

Keywords: /GA₃/ /GMP/ /Antioxidant System/ /MSR/LOX and PLD/

Liu, H., Jiang, W., Cao, J., & Li, Y. (2019). Effect of chilling temperatures on physiological properties, phenolic metabolism and antioxidant level accompanying pulp browning of peach during cold storage. *Scientia Horticulturae*, 255, 175–182. doi: 10.1016/j.scienta.2019.05.037

Abstract

The aim of this experiment was to assess the effect of chilling temperatures on the quality, phenolic metabolism as well as antioxidant capacity accompanying pulp browning (PB) development of peach fruit over the long-term refrigerated storage. Fresh peaches were exposed to chilling storage at 0, 2, 4, 6 °C for 30 or 50 d. Pulp browning index, TSS, TA, vitamin C, phenolics content and antioxidant activity were assessed, along with PAL and PPO enzymatic activity. Our results indicated that lower temperatures (0

and 2 °C) retarded the development of PB and maintained the fruit appearance during refrigerated storage. The storage life based on fruit quality was longer at 0 or 2 °C than at 4 or 6 °C. Additionally, peaches exposed to 4 or 6 °C accumulated higher amounts of phenolics and antioxidant activity than those exposed to 0 or 2 °C to overcome the more seriously cold stress. In conclusion, for short storage life or immediate consumption, keeping peach fruit at warmer temperature (4 or 6 °C) is favorable for obtaining high antioxidants. However, if the goal is extending the cold storage period of the fruit, keeping the fruit at 0 or 2 °C is recommended.

Keywords: /Low Temperature/ /Phenolics/ /Antioxidant/ /Pulp Browning/ /Peach/

PEAR

Torregrosa, L., Echeverria, G., Illa, J., & Giné-Bordonaba, J. (2019). Ripening behaviour and consumer acceptance of 'Conference' pears during shelf life after long term DCA-storage. *Postharvest Biology and Technology*, 155, 94–101. doi: 10.1016/j.postharvbio.2019.05.014

Abstract

With the increasing demand for ready to eat fruit, understanding how pear quality evolves during shelf life (SL) is of paramount importance for retailers. Accordingly, the relationships between physicochemical quality parameters, the emission of volatile compounds and consumer satisfaction were investigated in 'Conference' pears from different orchards and stored at 20 °C following 8 months of cold storage (-0.5 °C) under dynamic controlled atmosphere (DCA). Our results showed that DCA storage strongly inhibits firmness loss (<5%) without negatively affecting other quality traits. Upon removal from cold storage and ripening at 20 °C, 'Conference' pears loss nearly 80% of its initial firmness in only 5 d. Firmness evolution from harvest to 5 d of SL was successfully fitted with a reverse Gompertz equation ($R^2 > 0.96$). Prolonged DCA storage of Conference did not completely impede ripening as indicated by the reducing trend of IAD and the ethylene postclimacteric behavior of the fruit during SL. In parallel to the decrease of firmness during SL, there was a consistent increase in most ester-type volatiles and especially in hexyl acetate and butyl acetate. Generally, the highest consumer satisfaction after DCA cold storage of 'Conference' pears was reached after 3 d at 20 °C. In this sense, the most appreciated pears by consumer were those showing high flavour in combination with firmness values in the range of 10–30 N. The Partial Least Square (PLS) model showed that total soluble solids (TSS), the ratio TSS/TTA (total titratable acidity), consumer flavour perception and some particular volatile compounds (i.e. methyl, ethyl and hexyl acetates as well as ethyl trans,cis-2,4-decadienoate) were positively correlated to consumer's overall liking while firmness, TTA and index of absorbance difference (IAD) had a negative correlation and higher prediction capability.

Keywords: /Esters/ /Overall Liking/ /Physicochemical Parameter/ /PCA/ /PLS/ /Reverse Gompertz/ /VOC/

PEONY (*Paeonia lactiflora* Pall.)

Xue, J., Tang, Y., Wang, S., Xue, Y., Liu, X., & Zhang, X. (2019). Evaluation of dry and wet storage on vase quality of cut peony based on the regulation of starch and sucrose metabolism. *Postharvest Biology and Technology*, 155, 11–19. doi: 10.1016/j.postharvbio.2019.05.007

Abstract

Herbaceous peony (*Paeonia lactiflora* Pall.) is one of the most important cut flowers worldwide, but the short natural florescence seriously affects its industrial development. In this study, the cut peony 'Yang Fei Chu Yu' was preserved in dry storage (DS) and wet storage (WS), respectively, at 0–4 °C. We set two treatments of short- and long-term storage (S-tS, 3 d; L-tS, 23 d). We assessed the postharvest

performance; determined the changes in starch, sucrose, glucose, and fructose; and then analyzed the expression of a subset of representative genes that regulate starch and sucrose metabolism by RT-qPCR. When compared to WS, our results indicated that DS treatment exhibited significantly higher vase quality of cut peony after both S-tS and L-tS. For S-tS, this effect should be due to faster starch consumption during storage of 1–3 d and sucrose hydrolysis at the beginning of the vase period. The change in starch hydrolysis can be attributed to increased expression of PISPS1 and PISPS4 as well as decreased expression of PISUS4, whereas the sucrose metabolism should be associated with the inducing of PISUS3 expression. During S-tS, PICWIN1 may positively and PIVIN1 may negatively affect vase quality by adjusting water use efficiency. Inducing expression of PICIN1 and PICIN2 may also improve cut flower quality, probably via other pathways. For L-tS, the higher level of glucose and fructose content at the end of the period may be more beneficial in improving vase quality. The increasing expression of PISUS3 and the decreasing expression of PIVIN1 as well as the inducing expression of the three PICINs may regulate this process at the transcriptional level. Based on these results, we recommend that DS is used for cut peony cold storage within a prescribed period, regardless of the storage time.

Keywords: /*Paeonia lactiflora*/ /Cold Storage/ /Sucrose Phosphate Synthase/ /Sucrose Synthase/ /Invertase/ /Gene Expression/

PINEAPPLE

Yousuf, B., & Srivastava, A. K. (2019). Impact of honey treatments and soy protein isolate-based coating on fresh-cut pineapple during storage at 4 °C. Food Packaging and Shelf Life, 21, 100361. doi: 10.1016/j.fpsl.2019.100361

Abstract

This work investigates the effectiveness of various combinations of honey treatments at different concentrations (0 mL/L, 50 mL/L, 100 mL/L and 150 mL/L) and soy protein isolate (SPI) coating (0 g/L and 50 g/L) to maintain quality and prolong shelf life of fresh-cut pineapple stored at 4 °C for 16 days. Changes in headspace gases, color, phenolic content, microbiological and various other physiochemical attributes such as percentage weight loss, total soluble solids, pH, titratable acidity, ascorbic acid and ripening index were measured throughout the storage life. SPI coating coupled with honey treatments synergistically caused greater retention of phenolic compounds. Storage time and treatments/coating had a significant effect on the headspace gas concentration of fresh-cut pineapple. Coatings helped to retard microbial growth, with 150 mL H/L of H₂O + 50 g SPI/L of H₂O yielding the best results. Ripening index increased initially and then decreased towards the end of storage. Remarkable differences were observed in chroma, hue angle and color change of control and coated/treated samples.

Keywords: /Pineapple/ /Edible Coating/ /Minimal Processing/ /Fresh-Cut/ /Honey/ /Soy Protein/

Promsane, S. and Krajayklang, M. (2019). The effect of methyl jasmonate on internal browning incidence and postharvest quality of 'Huai-mun' pineapple fruit. Acta Hort. 1245, 107-114 DOI: 10.17660/ActaHortic.2019.1245.16

Abstract

The effect of methyl jasmonate (MeJA) on internal browning (IB) and postharvest quality of Huai-mun pineapple fruit was investigated. Fruit were harvested at the green mature stage and dipped in MeJA at concentrations of 0 (control), 10⁻², 10⁻³ and 10⁻⁴ M for 5 min prior to storage at 10 °C for four weeks. Each week, fruit were randomly removed to room temperature for ripening prior to fruit quality determinations. A completely randomized experiment was conducted with four replications (1

fruit/replication). Data analysis was performed by using ANOVA and means were compared by using DMRT at 95% confidence level. MeJA did not reduce IB development in this study. The internal browning (IB) symptoms limited storage life to only 1.25 weeks after treatment with 10⁻² M MeJA while it was 1.5 weeks in control fruit and in 10⁻³ M MeJA. A concentration of 10⁻⁴ M MeJA enabled fruit to be stored for 2.5 weeks. In addition, MeJA significantly ($p < 0.05$) delayed fruit ripening as shown by only a small change in shell colour from green to yellow and delayed weight loss, especially at 10⁻⁴ M. Lightness (L^*) value decreased during storage. Vitamin C concentration in the core and flesh decreased throughout storage. 10⁻⁴ M MeJA delayed electrolyte leakage during the first week of storage. Furthermore, MeJA slightly delayed changes in TA and SSC in extracted pineapple juice without any significant ($p > 0.05$) difference. Therefore, the application of 10⁻⁴ M MeJA could maintain the quality of Huai-mun pineapple fruit harvested at a mature green stage for up to 2.5 weeks at low temperature.

Keywords: /Storage Life/

Ao, I., Sema, A., Maiti, C.S., Sarkar, A. and Singh, A.K. (2019). Study of value chain in marketing organic pineapple of Nagaland. Acta Hort. 1245, 157-164 DOI: 10.17660/ActaHortic.2019.1245.23

Abstract

Nagaland produces 1,32,720 t of pineapples in an area of 9,528 ha. This organic fruit has excellent flavour and taste. However, marketing is a constraint because of transportation and distance to metropolitan cities in India. This investigation studied the value chain for marketing organic pineapple of Nagaland. Pineapples were collected from an organic farm at Molvom village Dimapur District, Nagaland during 2014-2016. The experiment was laid out in a split plot design in which the main plot was harvesting stage H1 (fully matured but no colour development), H2 (1/8th colour development), H3 (1/4th colour development) and H4 (1/2 colour development) and packaging containers (P1 - wooden boxes, P2 - bamboo boxes, P3 - CFB boxes and P4 - used carton boxes) as sub plot with three replications. Fruits were harvested and transported to New Delhi (2158 km from production site) by train taking 92 h. Samples were checked for spoilage on arrival and then taken to laboratory for further analysis. Harvesting stage and packaging containers and their interaction significantly influenced physicochemical qualities, organoleptic qualities, shelf life and benefit cost ratio. More matured fruit at harvest (H4) had the best physicochemical qualities and organoleptic scores (sweetness, aroma and fibre content). However, fruit from H1 had less PLW (physiological loss in weight) and postharvest loss (PHL) and thus maximum shelf life followed by H2. Fruit packed in CFB boxes (P3) had higher sweetness, fibre content, shelf life and lower postharvest loss, as well as the best physicochemical parameters. The highest benefit:cost ratio (BCR) was for fruit from treatment H1P4 in both the years.

Keywords: /Benefit:Cost Ratio/ /Harvesting Stages/ /Organoleptic Test/ /Packaging Containers/

PLUM

Martínez-Romero, D., Castillo, S., Guillén, F., Paladine, D., Zapata, P. J., Valero, D., & Serrano, M. (2019). Rosehip oil coating delays postharvest ripening and maintains quality of European and Japanese plum cultivars. Postharvest Biology and Technology, 155, 29–36. doi: 10.1016/j.postharvbio.2019.05.005

Abstract

In the present research the effect of rosehip oil (RO) coating on postharvest ripening process and fruit quality parameters of 'President' and 'Royal Rosa' plums was evaluated. Results show that the ethylene production was significantly reduced in coated plums with respect to controls either during storage at 20 °C or at 2 °C + 2 d at 20 °C, as well as respiration rate. The increase on free and total

1-aminocyclopropane 1-carboxylic acid (ACC) was also decreased in RO coated plums. The evolution of fruit quality parameters related with the plum ripening process, such as firmness, colour Hue and total soluble solid (TSS)/titratable acidity (TA) ratio, during storage at both temperatures was also delayed by the application of RO coating, as well as the increase in phenolic and carotenoid concentrations and the antioxidant activity due to hydrophilic and lipophilic compounds. Thus, RO coating could be considered as a new eco-friendly tool to be applied in the agro-food industry to preserve plum quality and extend its storability.

Keywords: /Ethylene Production/ /Respiration Rate/ /Quality/ /Ripening/ /Polyphenols/ /Anthocyanins/ /Carotenoids/ /Antioxidant Activity/

POMEGRANATE ARILS

Adiletta, G., Petriccione, M., Liguori, L., Zampella, L., Mastrobuoni, F., Matteo, M. (2019). Overall quality and antioxidant enzymes of ready-to-eat 'Purple Queen' pomegranate arils during cold storage. *Postharvest Biology and Technology*, 155, 20-28 <https://doi.org/10.1016/j.postharvbio.2019.05.008>

Abstract

This study evaluated the effectiveness of two different packaging systems, using micro-perforated (MPP) and semipermeable (SP) films, on the physico-chemical and nutraceutical traits, microbial quality, and antioxidant enzymatic system of ready-to-eat pomegranate (*Punica granatum* L.) arils (cultivar 'Purple Queen') stored at 5 °C for 16 d. Statistically significant differences in gas composition and arils qualitative traits such as pH and titratable acidity between the two packaging systems were found. Arils packaged in the SP system had higher polyphenols and anthocyanins contents, followed by a high antioxidant activity, with a positive correlation ($r = 0.610$ and 0.940 , respectively) among them. An increase in the activities of antioxidant enzymes, such as superoxide dismutase, catalase, and ascorbate peroxidase, were registered in the arils in the SP system, with a decrease in polyphenol oxidase and peroxidase activity involved in arils-browning. Overall, SP packaging could be a valid system to preserve ready-to-eat arils within food chains that maintain high qualitative and nutraceutical features up to 16 d of storage.

Keywords: /Soft-seeded Arils/ /Minimally Processed Fruit/ /Qualitative Traits/ /Enzymes Antioxidant/ /Principal Component Analysis/

RAPESEED

Wawrzyniak, J., Gawrysiak-Witulska, M., & Rudzińska, M. (2019). Dynamics of phytosterol degradation in a bulk of rapeseed stored under different temperature and humidity conditions. *Journal of Stored Products Research*, 83, 292–304. doi: 10.1016/j.jspr.2019.07.011

Abstract

Improper rapeseed preservation and storage after harvest may contribute to a reduction of phytosterol contents in the seeds. The aim of the study was to investigate the dynamics of phytosterol degradation in bulks of rapeseed stored under various temperature and water activity conditions. In the experiments a hazardous level of fungal infestation was considered to reflect the population of fungi colonizing seeds during vegetation and harvest at adverse weather conditions. Changes in phytosterol contents intensified with the increase in storage temperature and water activity in seeds. The temperature in the range of 12–24 °C and water activity in seeds $aw = 0.75$ – 0.76 significantly limited phytosterol degradation (6.5% and 8% after 48 and 72 days of storage), whereas in seeds with $aw = 0.90$ stored at 30 °C major phytosterol losses were observed (61% after 48 days of storage). Among the identified phytosterols the

pattern of changes in campesterol content was similar to that for β -sitosterol, whereas brassicasterol degradation proceeded similarly as the reduction in avenasterol and stigmasterol levels. The degradation of stigmasterol, brassicasterol and avenasterol was more rapid than that of campesterol and β -sitosterol. Correlation analysis showed that acid value and seed germination may be used as predictive factors for phytosterol degradation. The correlation between the fungal population and phytosterol concentration was found only in seed samples, in which a substantial mould activity was observed ($a_w \geq 0.80$ at $t = 24-30$ °C and $a_w \geq 0.86$ at $t = 12-18$ °C). The results provide useful quality control points, which may be used to improve the existing postharvest management systems of rapeseed preservation and storage.

Keywords: /Rapeseed Storage/ /Phytosterols/ /Mould/ /Acid Value/ /Germination/

STRAWBERRY

Joshi, K., Tiwari, B., Cullen, P. J., & Frias, J. M. (2019). Predicting quality attributes of strawberry packed under modified atmosphere throughout the cold chain. Food Packaging and Shelf Life, 21, 100354. doi: 10.1016/j.fpsl.2019.100354

Abstract

Modified Atmosphere Packaging (MAP) is used commercially to extend the shelf life of strawberries. The attainment of desired gas (O_2 , CO_2) concentrations inside MAP relies on the product respiration and the mass transfer through packaging and will affect the quality. The objective of this work is to build a mathematical model for strawberries to assess the effect of the uncertainties on headspace gas concentration and quality: 1) cold chain related temperature and relative humidity variations and 2) variability associated to product respiration and quality based on literature. Weight loss was more influenced by the cold chain storage conditions (temperature and RH) whereas spoilage had similar influence of cold chain conditions and product parameters. Waste generated in the cold chain was estimated from industrial standard weight loss and spoilage thresholds. A sensitivity analysis of the stochastic MAP model showed the influence of input parameters on the quality pointing to interventions associated to a reduction of the respiration rate (e.g. modification of packaging) and reduction of water transfer (e.g. coating) may prove more successful than other interventions to which the waste generation of this product is not so sensitive to. As a conclusion this work presents a toolbox to interpret cold chain data: 1) develop mathematical models to predict fate of quality 2) simulate cold chain conditions allowing for uncertainty 3) estimate the waste generation kinetics based in quality criteria and thresholds 4) perform a sensitivity analysis to identify most sensitive technological parameters 5) identify interventions that will affect those technological parameters.

Keywords: /Mathematical Modelling/ /Coating/ /Variability/ /Sensitivity Analysis/ /Strawberry/

TABLE BEET

Purquerio, L.F.V., Sanches, J., Calori, A.H., Tivelli, S.W. and Factor, T.L. (2019). Table beet baby leaf production and postharvest in trays with different cell volumes. Acta Hort. 1249, 23-30 DOI: 10.17660/ActaHortic.2019.1249.5

Abstract

Baby leaf has the increasing potential to stimulate vegetable consumption by the Brazilian population. It can be grown in soil and soilless, inside or outside greenhouses. In Brazil, there are few studies focusing on baby leaf production systems, though growing this vegetable in trays at greenhouses is a possibility. Therefore, the aim of this work was to evaluate table beet cultivar 'Tall Top Early Wonder', production and postharvest viability in trays with different cell volumes. Two attempts (March 19 to May 12 and

September 30 to November 10, 2009) were carried out at the Agronomic Institute (IAC), in Campinas, São Paulo State, Brazil. Aside from them, two others were carried out to evaluate the postharvest storability of table beet baby leaf. The experimental design used for the first two experiments was randomized blocks in split-plot with five replicates. The main treatment was seven tray cell volumes (15, 24, 27, 31, 55, 70, and 100 cm³), and the secondary treatment evaluation times (14, 21, 28, 35, 42, 49 and 56 days after seeding in the first essay, and 21, 28, 35, and 42 in the second). For the postharvest experiments, the experimental design used was split-plot with five replicates. In each evaluated temperature (10±1 and 25±2°C), the main treatment was the same as in the tray cell volumes and the secondary storage days. Considering the results, the cell volumes of 24, 27, and 31 cm³ were the most conducive to significant table beet baby leaf production. In comparison with 25°C, the temperature of 10°C allowed higher quality of baby leaf, resulting in one extra day added to the first assay and three days to the second.

Keywords: /*Beta vulgaris* L./ /Production System/ /Tray Cell Volume/ /Sustainability/

TABLE GRAPE

Moreira, L., Underhill, A. and Clark, M. (2019). Postharvest evaluation of cold-hardy table-grape breeding lines. Acta Hort. 1248, 101-108 DOI: 10.17660/ActaHortic.2019.1248.15

Abstract

The University of Minnesota grape breeding program has evaluated a small number of cold-hardy cultivars and advanced selections for postharvest storage traits. This is the first experiment for comparing advanced selections to table-grape cultivars for these traits. Nine genotypes were evaluated for cluster weight and fruit chemistry at harvest. Three clusters per genotype were packed in ventilated polyethylene bags and arranged in carton boxes. Paper pads and SO₂ pads were placed on top of the bunches in each carton. The cartons were stored at 2.2°C for 2, 4, 6, and 8 weeks. Clusters were destructively sampled at each storage time point and evaluated for change in fruit weight, berry splitting, berry decay, juice chemistry, and an overall rating of acceptability. An advanced selection, MN1296, was the top-performing seedless cultivar for overall acceptability for postharvest traits, but has berries that tend to shatter. Louise Swenson, Swenson Red, and MN1296 were rated as the best-performing lines for stem dehydration, in descending order. Swenson Red is the largest-fruited Elmer Swenson/UMN cultivar, but has limited commercial planting because of its seeded berries; Swenson Red also had no shattering after storage. Berry splitting was worst in Louise Swenson, a seeded white grape with multiple uses including wine. Jupiter had severe rachis browning after 8 weeks, but little at 2, 4, or 6 weeks, whereas Vanessa and MN1369 both suffered from decay. Jupiter and Vanessa had the largest clusters, but can be grown in Minnesota with only marginal success using the J-vine training system. Additional research on bud survival and consumer preference will be needed to determine whether any of the advanced selections are suitable for cultivar release.

Keywords: /Table Grape/ /Postharvest/ /Cold-Hardy/ /Rachis Browning/ /Visual Quality/

TOMATO

Mata, C. I., Hertog, M. L., Raemdonck, G. V., Baggerman, G., Tran, D., & Nicolai, B. M. (2019). Omics analysis of the ethylene signal transduction in tomato as a function of storage temperature. *Postharvest Biology and Technology*, 155, 1–10. doi: 10.1016/j.postharvbio.2019.04.016

Abstract

This study has focussed on the effect of low temperature storage on the postharvest ripening of green tomatoes; more specifically, on the ethylene signal transduction in relation to the ethylene biosynthesis pathway. To this end, the first elements of the ethylene signal transduction, ethylene receptors, CTR and EIN2 have been analysed in tomatoes stored at three different temperatures in terms of both their gene and protein expression levels. These results have been related to quality changes and enzymes and intermediates of the ethylene biosynthesis pathway to better understand the ethylene control of ripening under low temperatures. The first changes observed during low temperature storage took place at the ethylene biosynthesis level, which might enhance changes in the ethylene signal transduction. Although expression of most ethylene signalling genes decreased with chilling, none of the protein levels showed a significant decrease, pointing at a differential regulation at the gene and protein level.

Keywords: /Ethylene Signal Transduction/ /Storage Temperature/ /Solanum lycopersicum L./ /Postharvest Ripening/ /Targeted Proteomics/ /Gene Expression/

Steelheart, C., Alegre, M. L., Bahima, J. V., Senn, M. E., Simontacchi, M., Bartoli, C. G., & Grozeff, G. E. G. (2019). Nitric oxide improves the effect of 1-methylcyclopropene extending the tomato (*Lycopersicon esculentum* L.) fruit postharvest life. *Scientia Horticulturae*, 255, 193–201. doi: 10.1016/j.scienta.2019.04.035

Abstract

Tomato fruit ripening and postharvest display a complex net of metabolic pathways, which are controlled by different signaling molecules and hormones that coordinate this physiological process. The inhibition of the ethylene action with 1-methylcyclopropene (1-MCP) has proved to be an excellent tool for maintaining fruit quality during postharvest. Along with these findings, nitric oxide (NO) demonstrated different effects on several species in fruit postharvest. The aim of this work was to evaluate the joint effect of 1-MCP and a NO donor (S-nitrosoglutathione, GSNO) during tomato postharvest at 23 °C. Breaker tomatoes were harvested from a local grower and divided in the following treatments: untreated, 1 mM GSNO, 0.5 µL L⁻¹ of 1-MCP, and the combination of 1 mM GSNO + 0.5 µL L⁻¹ 1-MCP. Fruit was stored at 23 °C and analyzed after 5 and 10 d. According to the results, the combination of 1-MCP and the NO donor delayed fruit softening at days 5 and 10, reduced the ethylene synthesis significantly at day 5 and elevated the respiration rate at 10 d, compared to the individual treatments of 1-MCP and GSNO alone. However, the solely application of 1-MCP, independently from the addition of GSNO, showed a strong effect in the rise of the total titratable acidity content, together with the citric acid content. 1-MCP also up-regulated the CAT, SOD and POD activities at 5 and 10 d after harvest. These findings may suggest that some fruit quality parameters in tomato postharvest are controlled by ethylene, while others need the coordination of nitric oxide as a signal molecule.

Keywords: /Firmness/ /Climacteric Fruit/ /Ethylene/ /Organic Acids/ /Respiration Rate/ /Antioxidants/

***Tuber melanosporum* (TRUFFLE)**

Tejedor-Calvo, E., Morales, D., Marco, P., Venturini, M. E., Blanco, D., & Soler-Rivas, C. (2019). Effects of combining electron-beam or gamma irradiation treatments with further storage under modified atmospheres on the bioactive compounds of *Tuber melanosporum* truffles. *Postharvest Biology and Technology*, 155, 149–155. doi: 10.1016/j.postharvbio.2019.05.022

Abstract

The effects of electron-beam or gamma irradiation (both applied at 1.5 kGy and 2.5 kGy) and subsequent storage under modified atmospheres (35 d at 4 °C) were evaluated on total carbohydrates, chitins, β -glucans, proteins, total phenols, sterols and ergocalciferol concentrations of *Tuber melanosporum* ascocarps. Irradiation procedures reduced chitin and protein concentrations and modified total phenol levels depending on the dose and irradiation type utilized. Further storage of irradiated truffles maintained the levels of all determined compounds unchanged except for the phenolic compounds and ergosterol levels that increased probably due to their yeast colonization after 21 d storage. Therefore, irradiation plus storage under modified atmosphere packings could be used as a preservation method to extent truffles quality and shelf life, but it is only recommended up to 21 d. The lower irradiation doses are encouraged to diminish protein degradation.

Keywords: /Gamma Irradiation/ /Electron-beam Irradiation/ /Black Truffle/ /*T. melanosporum*/ /Bioactive Compounds/

WHITE ASPARAGUS

Brueckner, B., & Ruppel, S. (2019). Microbial Status of White Asparagus Spears during Storage in Moist Packages. *Journal of Food Protection*, 82(9), 1479–1483. doi: 10.4315/0362-028x.jfp-18-528

Abstract

White asparagus is a high-value commodity of large economic importance in Germany. Its harvest period lasts only a limited part of the year, during which daily yield and also market demand are highly variable. Harvested asparagus is perishable; thus, quality control and shelf life must be ensured by proper handling, e.g., avoiding fresh weight losses and, at the same time, limiting microbial growth. The aim of this study was to determine the effect of moist asparagus packaging on unpeeled white asparagus (cv. Gijnlim). Water was added to some of the packages to reduce fresh weight losses and to study the consequences for microbial growth. Polythene bag packaging, lined inside with cellulose fleece, was used to hold 500-g bunches of spears, covered partly (open bag) or totally (closed bag). Storage duration was 7 days, at temperatures of 2°C, 8°C, and a combination of 2 and 22°C, simulating retail conditions. Using a standardized cultivation method for food assessment, CFU counts (5.20 to 7.95 log CFU), number of pseudomonads (4.79 to 7.90 log CFU), lactic acid bacteria (<3.00 to 3.94 log CFU), Enterobacteriaceae (4.26 to 7.15 log CFU, including *Escherichia coli* <1.00 log CFU), yeasts (<2.30 to 3.15 to 3.53 log CFU), and molds (<2.30 log CFU), as well as sulfite-reducing clostridia (<1 log CFU) were determined. Temperature was the most important factor for microbial growth. Additional water had no effect in most cases; it inhibited most of the fresh weight losses compared to dry treatments in this study but led to 2% weight increase in closed bags. Our results point to the conclusion that moist packaging would be a feasible alternative to dry wrapping with regard to weight retention, and it did not increase growth of the analyzed microbial groups to an unacceptable value.

Keywords: /Asparagus/ /Enterobacteriaceae/ /*Escherichia coli*/ /Moist Packaging/ /Postharvest/ /*Pseudomonas*/

WINEGRAPES

Segade, S. R., Vincenzi, S., Giacosa, S., & Rolle, L. (2019). Changes in stilbene composition during postharvest ozone treatment of 'Moscato bianco' winegrapes. *Food Research International*, 123, 251–257. doi: 10.1016/j.foodres.2019.04.061

Abstract

Stilbenes, including trans-resveratrol and its derivatives, are compounds naturally present in grapes and have gained a growing interest due to reported health-promoting properties. The production of resveratrol-enriched table grapes has promoted recent research on stress-induced synthesis of stilbenes. The oxidizing properties of ozone have been successfully exploited to its use as sanitizing agent and stilbene elicitor during table grapes storage. In winegrapes, this study represents the first research focused on the effect of postharvest ozone treatments on the accumulation of stilbene compounds. The study was carried out on Moscato bianco winegrapes (*Vitis vinifera* L.) and several gaseous ozone treatments were investigated differing in ozone dose (30 and 60 $\mu\text{L/L}$), exposure time (24 h, 48 h, and several days until 30% of weight loss), and delay time until processing (just after and several days after treatment). The stilbene production induced by ozone exposure was assessed in fresh and partially dehydrated winegrapes up to 5, 10, 15, 20, and 30% of weight loss aiming to evaluate the single and combined effect of oxidative and osmotic stresses. The results obtained showed that short-term exposure of fresh winegrapes at 60 $\mu\text{L/L}$ of ozone for 48 h was not effective in inducing resveratrol accumulation just after treatment, but it had an elicitor effect on total stilbenes (+36%) in grapes subsequently dehydrated up to 20% of weight loss with a significant overproduction of trans-resveratrol and trans-piiceatannol. In addition, long-term and continuous treatments under ozone-enriched atmosphere can be also used during dehydration to sanitize winegrapes without affecting negatively the concentration of stilbenes. Therefore, the use of gaseous ozone during storage and dehydration could be indicated to reduce the use of sulfur dioxide and, depending on ozone dose and exposure time, the synthesis of stilbene compounds could increase.

Keywords: /Ozone/ /Postharvest Treatment/ /Partial Dehydration/ /Stilbene Compounds/
/trans-resveratrol/ /Winegrapes/