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As of June 2021

APPLE

Tokala, V. Y., Singh, Z., & Kyaw, P. N. (2021). 1H-cyclopropabenzene and 1H-cyclopropa[b]naphthalene fumigation downregulates ethylene production and maintains fruit quality of controlled atmosphere stored 'Granny Smith' apple. *Postharvest Biology and Technology*, *176*, 111499. https://doi.org/10.1016/j.postharvbio.2021.111499

Abstract

The 'Granny Smith' is a commercial apple cultivar in Western Australia and popular in the apple world as well, for its unique green colour and flavour. The effects of two new ethylene antagonists namely 1*H*-cyclopropabenzene (BC) and 1*H*-cyclopropa[*b*]naphthalene (NC), as well as 1-methylcyclopropene (1-MCP) on ethylene production, rates of respiration and fruit quality were investigated in controlled atmosphere (CA) stored 'Granny Smith' apple. The apple fruit were fumigated with 1 μM BC (0.09 $\mu L.L^{-1}$) or 1 μM NC (0.14 $\mu L.L^{-1}$) or 18 μM (1 $\mu L.L^{-1}$) 1-MCP for 18 h at room temperature (20 ± 2 °C and 65 ± 5% RH). Following 90 d and 120 d of CA storage (2.5 ± 0.64% O_2 and 1.3 ± 0.45% CO_2 at 0 ± 1 °C), fumigation treatments with 1-MCP, NC and BC effectively suppressed and delayed climacteric peaks of ethylene and respiration as compared to the control fruit. The 1-MCP treatment was relatively more efficient in reducing the rates of ethylene and respiration climacteric peaks than BC and NC. But all the treatments reduced physiological loss of weight (PLW) (up to 1.38 times) and maintained higher fruit firmness (up to 1.16 times), total phenols (up to 1.53 times) and ascorbic acid (up to 1.15 times), compared to the control, following the CA storage period. Therefore, BC and NC possess the potential to act as ethylene antagonists in CA stored 'Granny Smith' apples to retard fruit ripening process and maintain the fruit quality. The effects of different concentrations of BC and NC in antagonising the ethylene action in different cultivars warrants further investigation in CA stored apple fruit.

Keywords: /Ethylene/ /Ethylene antagonists/ /1-Methylcyclopropene/ /Fumigation/ /Climacteric peaks/ /Fruit quality/

BANANA

Othman, S., Abdullah, N., Nordin, N., Shah, N., Nor, M., & Yunos, K. (2021). Shelf life extension of Saba banana: Effect of preparation, vacuum packaging, and storage temperature. *Food Packaging and Shelf Life, 28*, 100667. https://doi.org/10.1016/j.fpsl.2021.100667

Abstract

The shelf life of bananas is very much dependent on the preparation method, packaging method, and storage temperature. Thus, this work is directed to investigate the effect of banana preparation (peeled and unpeeled), packaging method (vacuum packed and non-vacuum packed), and storage temperature (25 and 9 °C) on extending the shelf life of Saba banana. Peeled and unpeeled; and vacuum packed and non-vacuum packed banana was kept at different storage temperatures for 28 days. The shelf life of bananas was investigated in terms of texture, color changes, and moisture content every 7 days. It was found that vacuum packed banana samples kept at 9 °C exhibited non-significant changes in firmness, and minimal changes in moisture content and color compared to non-vacuum packed bananas kept at 25 °C, proving that vacuum packaging and low storage temperature are promising to extend the shelf life of bananas. The unpeeled banana was also demonstrated to exhibit longer shelf life compared to peeled banana because the skin is able to preserve the moisture content inside the banana and prevent the banana from becoming dried and spoilt over time.

Keywords: /Banana/ /Saba/ /Shelf life/ /Temperature/ /Vacuum packaging/

BASIL

López-Gálvez, F., Vermeulen, A., Eriksson, M., Ragaert, P., & Devlieghere, F. (2021). Modelling basil (*Ocimum basilicum*) visual quality as affected by storage temperature. *Acta Horticulturae, 1311*, 55-60. https://doi-org.eu1.proxy.openathens.net/10.17660/ActaHortic.2021.1311.7

Abstract

Visual quality is the main sensory quality factor limiting sweet basil (*Ocimum basilicum* L.) shelf life. The aim of the present study was the development of a model for the prediction of basil visual quality depending on storage temperature and time. Commercial clamshell recycled polyethylene tetraphyte (RPET) packages containing 20 g of basil were stored at eight different temperatures (2, 4, 7, 10, 12, 15, 22, 30°C). Five packages were stored at each temperature. Basil packages were evaluated daily until the end of shelf-life by a panel composed by trained members. Different visual quality characteristics were evaluated (yellowing, chilling injury, mold growth, firmness) to give an overall visual quality score using a hedonic scale. The experiment was repeated three times. Data on the overall visual quality of basil were used for the development of a model for the prediction of basil visual quality decay at different temperatures. First, the kinetics of visual quality deterioration was characterized. Visual quality as a function of time was modelled by a linear, quadratic, logistic, and exponential equations. Based on the goodness-of-fit statistic (R^2) and model complexity the most suitable primary model was chosen. The parameter (decay rate) of this model was fitted by a secondary model to describe the decay rate as a function of temperature. As the data set was limited, primary and secondary Modelling was performed in one step on the global data set. The model was fitted using nonlinear regression. A linear model was selected to model visual quality as a function of time taking into account the complexity of the models tested. A quadratic function was selected to describe the quality decay rate as a function of storage temperature. The coefficient of determination (R^2) of the obtained model was 0.71. The maximum shelf life of 6 days is predicted at 15°C. The model should be validated under dynamic temperature conditions.

Keywords: /Fresh Herb/ /Sensory Quality/ /Deterioration/ /Post-harvest/ /Predictive Model/

BITTER GOURD

Prajapati, U., Asrey, R., Varghese, E., Singh, A.K., Singh, MP. (2021). Effects of postharvest ultraviolet-C treatment on shelf-life and quality of bitter gourd fruit during storage. *Food Packaging and Shelf Life, 28*, 100665. https://doi.org/10.1016/j.fpsl.2021.100665

Abstract

The aim of this experiment was to study the effect of varied UV-C exposure time (20, 30, 40 minutes) on nutraceutical properties, defence-related compounds, and storage life of bitter gourd fruit. Treated fruit was stored in a cold room maintained at 10 °C temperature and 85–95 % relative humidity for 16 days. UV-C treatment for 40 min was found better in improving antioxidant activity by inhibiting DPPH to 57 %, increasing total phenols to 61 %, total carotenoid to 134 % and total chlorophyll to 61.9 % during 16 days of storage period in comparison with control. UV-C treatment for 40 min was unable to maintain ascorbic acid and reduced its level to 15 % as compared to control on 16^{th} day of storage. UV-C 40 min treatment has also shown positive effects in maintaining fruit firmness, reducing weight loss and fruit decay percent. Longer exposure to UV-C seems to enhance the abiotic stress level in bitter gourd fruit and it leads to the formation of defence-related compounds like MDA and proline. These compounds conjoin stored fruit in alleviating stress and maintaining a higher concentration of secondary metabolites. This suggests that the application of UV-C for 40 min can be gainfully utilized for enhancing shelf-life and retaining desirable quality parameters during storage of bitter gourd fruit.

Keywords: /Ultraviolet C radiation/ /Phenolics/ /Antioxidants/ /Ascorbic acid/ /Defence related compounds/

BLUEBERRIES

Rivera, S., Kerckhoffs, H., Sofkova-Bobcheva, S., Hutchins, D., & East, A. (2021). Influence of water loss on mechanical properties of stored blueberries. *Postharvest Biology and Technology*, *176*, 111498. https://doi.org/10.1016/j.postharvbio.2021.111498

Abstract

Moisture loss is considered a main cause of blueberry softening during postharvest storage. However, the causal relationship between softening and water loss has only previously been described by force to 1 mm compression. This study was performed to identify suitable instrumental tests that allow the separation of blueberries with different water loss values during storage. Mechanical properties were measured by double compression (Texture Profile Analysis) and puncture test. Variability on blueberry mechanical properties was created by regulating storage humidity and consequently water loss. As water loss increases during storage, hardness slope (slope of a straight line drawn between the trigger force of 0.06 N and the force at 15 % strain) obtained by the compression test reduces, and the displacement at berry skin break obtained by puncture test, increases. Therefore, these parameters can be potentially used to quantify mechanical changes in stored blueberries.

Keywords: /*Vaccinium* spp/ /Storage humidity/ /Postharvest quality/ /Texture profile analysis/ /Puncture test/

Spinardi, A., Beghi, R., Cocetta, G., & Mignani, I. (2021). Postharvest chitosan treatment on blueberry (*Vaccinium corymbosum*) quality during long-term cold storage. *Acta Horticulturae, 1311,* 61-68. https://doi-org.eu1.proxy.openathens.net/10.17660/ActaHortic.2021.1311.8

Abstract

Maintaining fruit quality is one of the main concerns during postharvest storage of produce and its forecasting could play an important role in orienting and organizing the storage strategies. Bioactive, antioxidant substances, such as polyphenols and ascorbic acid are important quality parameters for blueberry fruits. Blueberries 'Brigitta' were treated with chitosan, a GRAS (generally recognized as safe) compound effective as alternative to conventional fungicides for the control of postharvest diseases of fresh horticultural produce. Berries were cold stored (4°C) in natural air and total polyphenols, total flavonoids, total anthocyanins and non-anthocyanic flavonoids were determined after 0, 30, 60, 90, 120 and 150 days storage. At the same sampling times, ascorbic acid content and antioxidant activity were analyzed to evaluate the antioxidant status of the fruit. The research aimed at defining the impact and effectiveness of chitosan treatment in decreasing postharvest blueberry decay and detrimental effects on fruit quality. Results show a positive effect of postharvest application of chitosan, which can reduce fruit decay and deterioration (including fruit showing rots, shrivel, blemishes and mechanical damage), maintain fruit quality and extend storage life. Moreover, the qualitative analysis performed by PCA (principal component analysis) highlights the samples behavior during the cold storage period, suggesting the possibility to forecast fruit quality traits and storability.

Keywords: /Antioxidant activity/ /Polyphenols/ /Anthocyanins/ /Deterioration/ /PCA/

BROCCOLI

Casajús, V., Civello, P., Martínez, G., Howe, K., Fish, T., Yang, Y., Thannhauser, T., Li, L., & Gómez Lobato, M. (2021). Effect of continuous white light illumination on glucosinolate metabolism during postharvest storage of broccoli. *LWT - Food Science & Technology*, *145*, 111302. https://doi.org/10.1016/j.lwt.2021.111302

Abstract

Broccoli is a vegetable consumed globally due to its important nutritional properties, including high concentrations of glucosinolates. Light treatment can be an important tool to delay postharvest senescence. In this work it was evaluated the effect of postharvest continuous white light illumination on glucosinolate metabolism of broccoli heads. Five glucosinolates were identified, one aliphatic (glucoraphanin) and four indolics (glucobrassicin, neoglucobrassicin, 4-methoxyglucobrassicin and 4-hydroxyglucobrassicin). Level of total glucosinolates decreased from 10.1 μmol/g dry tissue to 1.4 μmol/g dry tissue in control samples after five days of storage, while the decrement was only until 3.0 μmol/g dry tissue in treated samples. The expression of genes associated with glucosinolate metabolism decreased during the first three days but this decrease was greater in illuminated samples. After five days, treated samples showed a higher expression (more than twice) in most of these genes with respect to the controls, coinciding with the higher glucosinolate content. Storage of broccoli heads under continuous white light allows to keep higher values of glucosinolate contents while maintaining at the same time the visual quality.

Keywords: /*Brassica oleracea*/ /Nutraceuticals/ /Senescence/ /Gene expression/

CARROT

Ben-Fadhel, Y., Cingolani, M.C., Li, L., Chazot, G., Salmieri, S., Horak, C., & Lacroix, M. (2021). Effect of γ-irradiation and the use of combined treatments with edible bioactive coating on carrot preservation. *Food Packaging and Shelf Life, 28*,100635. https://doi.org/10.1016/j.fpsl.2021.100635

Abstract

For increasing the shelf-life of carrot slices during storage, a bioactive edible coating was applied. An antimicrobial nanoemulsion (composed of citrus extract, cranberry juice and essential oils) was incorporated into a calcium caseinate (Ca-Cas)-based encapsulation matrix. Gamma-irradiation at 32 kGy was evaluated for its ability to improve the physicochemical properties of the coating via Ca-Cas cross-linking. Irradiation of Ca-Cas was found to be effective in preserving the mechanical properties of the coating containing the nanoemulsion. Pre-cut carrots were then subjected to different coatings applied alone or combined to gamma-irradiation post-treatment at 0.5 kGy. The quality and the shelf-life of carrots were assessed by evaluating the weight loss, texture and color of carrots as well as their microbial quality. The combined treatment of bioactive coating with irradiation showed a synergistic potential and a higher efficiency to extend the shelf-life of carrots and maintain their quality throughout storage, compared to single treatments.

Keywords: /Calcium caseinateγ-irradiation/ /Active coating/ /Minimally processed vegetables/

Papoutsis, K., & Edelenbos, M. (2021). Postharvest environmentally and human-friendly pre-treatments to minimize carrot waste in the supply chain caused by physiological disorders and fungi. *Trends in Food Science & Technology*, *112*, 88–98. https://doi.org/10.1016/j.tifs.2021.03.038

Abstract

Carrot is one of the most important horticultural crops, with an annual worldwide production exceeding 40 million tonnes. Carrots are sold either fresh intact or fresh-cut as minimally processed vegetables (MPV). In the postharvest supply chain, physiological disorders, fungal decay, and their combinations reduce the quality of fresh intact and MPV carrots. MPV carrots are more susceptible to quality changes than fresh intact carrots due to a higher loss of protective epidermis, greater number of wounded cells, and increased respiration rates.The current review summarizes different environmentally and human-friendly treatments applied in the postharvest supply chain to minimize the adverse effects of handling and storage on physiological disorders and fungal decay.Bitterness, white blush, and browning are the most

critical physiological disorders of fresh and MPV carrots. Bitterness can be prevented by storing carrots in well-ventilated rooms without ethylene-producing fruit and vegetables, while white blush and browning can be controlled by the application of heat treatment, ultraviolet (UV)-irradiation, hydrogen sulfide (H_2S), and edible films. *Sclerotinia sclerotiorum*, *Botrytis cinerea*, *Alternaria radicina*, and *Berkeleyomyces* spp. (formerly *Thielaviopsis* spp.) are important fungi causing carrot postharvest losses and waste. Fungal decay of carrots can be controlled by selecting healthy carrots and applying natural compounds, ozone (O_3), heat treatment, UV-irradiation, inorganic salt, and/or biocontrol agents, and their combinations. However, a successful combination of different sustainable treatment methods requires treatment compatibility, and -omics techniques may reveal the best combinations of sustainable treatment methods.

Keywords: /*Daucus carota/ /*Horticulture/ /Supply chain/ /Ozone/ /UV-Irradiation/ /Heat treatment/

CAYENNE

Casquete, R., Velazquez, R., Hernandez, A., de Guia Cordoba, M., Aranda, E., Bartolome, T., & Martin, A. (2021). Evaluation of the quality and shelf-life of cayenne (Capsicum spp.). *LWT - Food Science & Technology*, *145*, 111338. https://doi.org/10.1016/j.lwt.2021.111338

Abstract

A genetic characterization of 13 species of cayenne provided by Spanish milling industries was performed, and their colour, pungency and antioxidant properties were evaluated. Colour parameters (carotenoids, reflected and extractable colour), capsaicinoids, total phenolic compounds and antioxidant activity by the 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical-scavenging method and 2,2′-azino-bis-(3-ethylbenzothiazoline-6-sulfonic acid (ABTS) were determined in the cayenne samples, and the stability of cayenne properties was determined after exposure to UV light. Genetic characterization using different barcode markers (26S large subunit of rDNA, internal transcribed spacer 2, rbcL gene and matK gene) revealed close relationships among samples. However, notable differences were found for most of the quality parameters studied. Specifically, colour parameters were the most important traits for the discrimination of different samples. Samples with high colour quality presented 989.9 μg of capsanthin/g of dry matter, 104.8 ASTA units and 26.6 units in the a* coordinate of the CIELAB space. In contrast, the lowest-quality sample presented 582.7 μg of capsanthin/g of dry matter, 21.1 ASTA units and 15.4 units in the a* coordinate. DPPH and ABTS values ranged from 73.8 to 161.8 and from 217.1 to 325.7 mg Trolox/100 g, respectively. Pungency was highly variable among samples, with values ranging between 68.2 and 751.9 μg of capsaicin/g and 38.7 and 273.5 μg of dihidrocapsaicin/g. Principal component analysis indicated that capsaicinoids and total phenolic compounds are the best indices to determine the antioxidant activity of cayenne, which is highly correlated with the stability of colour and pungency. According to these findings, the desirable technological qualities and the longest shelf-life of cayenne are associated with a high content of capsaicinoids and phenolic compounds, which guarantee good colour stability and pungency associated with high antioxidant activity.

Keywords: /Total extractable colour/ /Carotenoids/ /Pungency/ /Antioxidant/ /Colour stability/

CITRUS

Delali, K. I., Chen, O., Wang, W., Yi, L., Deng, L., & Zeng, K. (2021). Evaluation of yeast isolates from kimchi with antagonistic activity against green mold in citrus and elucidating the action mechanisms of three yeast: *P. kudriavzevii, K. marxianus, and Y. lipolytica*. *Postharvest Biology and Technology*, *176*, 111495. https://doi.org/10.1016/j.postharvbio.2021.111495

Abstract

Many citrus farmers are deprived of their profits as a result of post-harvest losses in citrus production.

Diverse microbial environments including fermented foods are necessary to be explored in the quest to get more novel biocontrol yeasts to control post-harvest pathogens in citrus. 90 yeasts were isolated from kimchi in this investigation. Inhibition tests in vitro showed that 10 of the 90 yeasts reduced the development of fungal mycelia by the formation of an inhibition zone. Molecular methods were used to identify the yeast isolates, and they were Pichia sp., Kluyveromyces marxianus, Yarrowia lipolytica, and Issatchenkia orientalis. Three isolates tested in vivo in citrus were able to reduce disease incidence within the range from 18 % to 57 %. The action mechanisms of the three yeasts were studied subsequently by determining the biofilm formation ability of the yeast isolates, screening of yeast isolates for extracellular lytic enzyme activity, evaluating the effect of yeast isolates' volatile organic compounds (VOCs) on P. digitatum, investigating the competition for nutrients between P. digitatum and yeast isolates, etc. For Pichia kudriavzevii, the most effective one, reduced the incidence of green mold caused by Penicillium digitatum (Pd1 / CECT 20795) by biofilm formation, competition for nutrients, and emitting volatile organic compounds. K. marxianus showed antifungal activity by inducing resistance, and colonization on wound sites. Whereas Y. lipolytica inhibited P. digitatum by adhesion to pathogen mycelia and production of extracellular lytic enzymes. Evidence from this study suggests that some yeast strains isolated from kimchi have the potentials to inhibit green mold in citrus.

Keywords: /Biocontrol/ /Yeast/ /Citrus/ /P. digitatum/ /Kimchi/ /Mechanism of action/

CUCUMBER

Li, M., Yu, H., Xie, Y., Guo, Y., Cheng, Y., Qian, H., & Yao, W. (2021). Effects of double layer membrane loading eugenol on postharvest quality of cucumber. *LWT - Food Science & Technology*, *145*, 111310. https://doi.org/10.1016/j.lwt.2021.111310

Abstract

We prepared double layer membranes containing eugenol (0.2, 0.3, and 0.4 g/100 g) using electrospinning technology and investigated their effects on the postharvest quality of cucumbers. The poly (lactic acid) (PLA) membrane was attached to the collector, and the nanofibers were prepared using an electrospinning device and deposited on the surface of the PLA membrane to form a double layer membrane. The results informed that the shelf life of cucumbers packaged with double layer membranes increased from 15 days to 21 days at 4 °C. The double layer membrane containing 0.3 g/100 g eugenol had greater effects on delaying the spoilage process and prolonging the shelf life of cucumber fruits than other membrane. Compared with unpackaged samples, packaged samples had higher hardness values, Peroxidase (POD), superoxide dismutase (SOD), and catalase (CAT) enzyme activities, and protein and proline content; and they had lower weight loss, skin color differences values, stickiness values, microbial growth, and malondialdehyde (MDA) and total soluble sugar content. Our results suggest that double layer membranes may be used to extend the shelf life of cucumbers at 4 °C.

Keywords: /Electrospinning/ /Active packaging/ /Double layer membranes/ /Cucumbers/ /Postharvest/

CUT FLOWERS

Khandan-Mirkohi, A., Pirgazi, R., Taheri, M. R., Ajdanian, L., Babaei, M., Jozay, M., & Hesari, M. (2021). Effects of salicylic acid and humic material preharvest treatments on postharvest physiological properties of statice cut flowers. *Scientia Horticulturae*, *283*, 110009. https://doi.org/10.1016/j.scienta.2021.110009

Abstract

Statice ornamental plants have a great potential for use in urban landscapes, producing cut flowers and flowering pot plants. Based on the previous reports, it was our hypothesis that the use of humic materials

(HM) and salicylic acid (SA) can improve the growth and yield, and also the resistance of static plants to many harsh environmental conditions. Therefore, the effect of HM at 4 concentrations of 0 (control), 2, 4 and 6 $g.m^{-2}$ (which were added as basal at the beginning of planting at the transplanting stage) and the effect of SA at 4 concentrations of 0 (control), 1, 2 and 3 mM (applied as a foliar solution every two weeks until the flowering stage was started) were evaluated on the growth characteristics of *Limonium sinuatum* (L.) Mill. cv. Qis Mix (Graines Voltz, France) in the research station of the Horticultural department, University of Tehran in 2017−2018. Statice seeds first were planted in 45 cells trays, 50 mL volume each, containing equal volumes of peat and perlite, and 30 days' later seedlings transferred to the pots (4 L of volume) containing sandy loam field soil and kept grown for 4 months in the field condition inside the hole in the soil level prepared for the pots. The results showed that number of cut flowers produced per pot and growth traits was significantly increased under 1 mM treatment of SA and 6 g m^{-2} treatment of HM compared to control, but physiologically responded in terms of reduced ion leakage, less malone dialdehyde accumulation, less accumulation of hydrogen peroxide, and improved antioxidant enzymes activity with 1 mM of SA and with 4 g m^{-2} of HM. Findings reveal that a given concentration of SA foliar application could be an alternative improvement treatment instead of basal application of HM in case facing harsh environmental conditions during statice cultivation.

Keywords: /Antioxidant enzymes/ / Hydrogen peroxide/ /Longevity/ /Malone dialdehyde/ /Urban landscape/

DURIAN

Mohd Ali, M., Hashim, N., & Shahamshah, M. I. (2021). Durian (Durio zibethinus) ripeness detection using thermal imaging with multivariate analysis. *Postharvest Biology and Technology*, *176*, 111517. https://doi.org/10.1016/j.postharvbio.2021.111517

Abstract

The detection of durian ripeness using thermal imaging is an essential study geared towards improving the current analytical methods which rely heavily on routine analysis and human labour skills. Thermal imaging was investigated in this study in order to evaluate the ripeness of durian based on the relationship of physicochemical properties and thermal image parameters. Thermal images of durians were acquired at three different ripening stages (unripe, ripe, and overripe) and the physicochemical properties of the soluble solids content, pH, firmness, moisture content, and colour changes were determined. Partial least squares (PLS) regression was used to develop quantitative prediction models with R^2 values greater than 0.94 for all the physicochemical properties of durians. Principal component analysis (PCA) showed successful clustering ability of three different ripeness levels of durians. Linear discriminant analysis (LDA), k-nearest neighbour (kNN), and support vector machine (SVM) were applied for the establishment of the optimal classification modelling algorithms. The SVM classifier gave the overall best performance for the discrimination of durian ripeness with a classification accuracy of 97 %. The feasibility of thermal imaging coupled with multivariate methods demonstrated huge potential for non-destructive evaluation of durian ripeness levels.

Keywords: /Durian/ /Thermal imaging/ /Multivariate analysis/ /Ripeness detection/ /Machine learning/

EGGPLANT

Babellahi, F., Tsouvaltzis, P., Amodio, M.L., & Colelli, G. (2021). Assessment of eggplant freshness using non-destructive techniques. *Acta Horticulturae, 1311, 149-156. https://doi-org.eu1.proxy.openathens.net/10.17660/ActaHortic.2021.1311.19*

Abstract

Eggplant fruit is a chilling injury sensitive vegetable, which should be stored at temperature of 12°C;

however, at this temperature, the metabolism of the fruit is still intensively active and therefore significant quality deterioration may be induced. Since these quality losses can be difficultly detected by eyes, objective of this study was to develop a novel non-destructive method to estimate freshness of eggplants. Eggplant fruits ('Fantasy') were harvested from a commercial farm in Lecce, Italy, during July 2017. Fruits were stored at 12°C for 10 days. Every 2 days, fruits from were sampled and left at room temperature (20°C), for one additional day, simulating one-day shelf life at the market. Color spectra (360-740 nm), Fourier Transform (FT)-NIR spectra (800-2777 nm) and hyperspectral images (HSI) in the Vis-NIR range (400-1000 nm) were also acquired on each fruit. Partial least square regression analyses were carried out between the data collected and the storage days and appropriate models were built, allowing safe assessment of the freshness of the fruits. According to the results based on whole wavelength ranges, storage days correlated very well with both the FT-NIR spectra and the hyperspectral data extracted from the Vis-NIR imaging system (RC>0.98, RCV>0.94, RMSEC<0.4 and RMSECV<0.8), in contrast to the color measurements with lower RC and RCV values and significantly high root means square errors (1.5 and 1.8, respectively). Moreover, after conducting SPA as a variable selection method, classification models could almost keep the same performance. The results of this study may set the basis to develop a protocol allowing a rapid screening and sorting of eggplants according to their postharvest freshness at distribution center or even upon the reception in the retail market.

Keywords: /Eggplant/ /FT-NIR/ /hyperspectral/ /PLS-R/ /SPA/

FOOD PACKAGING

Gaglio, R., Botta, L., Garofalo, G., Miceli, A., Settanni, L., Lopresti, F. (2021). Carvacrol activated biopolymeric foam: An effective packaging system to control the development of spoilage and pathogenic bacteria on sliced pumpkin and melon. *Food Packaging and Shelf Life, 28*, 100633. https://doi.org/10.1016/j.fpsl.2021.100633

Abstract

A commercial biodegradable starch-based polymer (Mater-Bi) was activated with carvacrol to develop a biodegradable and compostable polymer to be used in food packaging. Based on previous tests, carvacrol was added at 20 % weight of foam. MB foams, with and without carvacrol, were tested for their morphological characteristics, mechanical tests and kinetics of carvacrol release under refrigerated storage conditions. Carvacrol slightly increased the porosity of the foams, induced a reduction of the compressive elastic modulus (E_{com}) of foamed MB from 6 to ~ 3.4 MPa and a decrease of the tensile elastic modulus from ~70 MPa to ~16.5 MPa. Carvacrol release from the foam at 4 °C was almost 7% of the initially loaded amount at the fifth hour, while 35.4 % at the end of the test (900 h). MB containing carvacrol was active against several pathogenic and spoilage bacteria *in vitro*. Trays made of MB containing carvacrol were put in contact with meat, fish and vegetable food systems, artificially contaminated with *Pseudomonas poae* 4G558 and *Listeria monocytogenes* 13BO. No antimicrobial effect of MB foams was registered for ham and salmon trials, while a clear inhibitory effect of carvacrol activated MB foams was observed for contaminated melon and pumpkin in which both bacteria decreased of about 1 log cycle after 3 d and completely disappeared from the 7th d of refrigerated storage. This study provided evidence on the suitability of MB foams containing 20 % carvacrol as active packaging systems for vegetables even though it negatively affected their physicochemical parameters and overall quality.

Keywords: /Antibacterial properties/ /Biopolymeric foams/ /Carvacrol/ /Food model systems/ /Food packaging/ /Spoilage and pathogenic bacteria/ /*In vivo* activity/

Li, Q., Ren, T., Perkins, P., Hu, X., & Wang, X. (2021). Applications of halloysite nanotubes in food packaging for improving film performance and food preservation. *Food Control*, *124*, 107876. https://doi.org/10.1016/j.foodcont.2021.107876

Abstract

Food packaging, particularly active packaging, plays an important role in maintaining food quality and safety. Incorporating antimicrobial agents into films usually enhances the antimicrobial activity, but easily provokes a burst release of antimicrobials and degrades film performance. Recent studies found that addition of reinforcement agents effectively improved mechanical strength and barrier properties of packaging films. Halloysite nanotubes (HNTs) are natural clays with a unique tubular structure, possessing large surface areas and negatively charged exteriors. These properties not only prepare HNTs as a satisfactory reinforcement agent, but also enable active agents to be loaded into the lumen or attached to the exteriors of HNTs, achieving a sustained controlled release of antimicrobials. HNTs have shown great application potential in the food industry, but currently there are no systematic reviews in this field. This review is focused on HNTs' roles as nano-filler and nano-carrier when incorporated into food packaging systems, improving food preservation without sacrificing film performance. Effects of incorporation techniques and polymeric matrixes on film behavior were systematically reviewed, with a profound explanation on the mechanisms of carrying food preservatives. In addition, antimicrobial activities and release kinetics of HNTs based active agents were discussed in detail. Current problems and directions for the future applications of HNTs in the food packaging system were analyzed in the end. In conclusion, proper use of HNTs in food packaging systems is a promising way to achieve controlled release of antimicrobials, enhancing the quality and safety of fresh food during storage and transportation.

Keywords: /Halloysite nanotubes/ /Food packaging/ /Barrier property/ /Mechanical strength/ /Controlled release/

Liu, Y., Sameen, D. E., Ahmed, S., Dai, J., & Qin, W. (2021). Antimicrobial peptides and their application in food packaging. *Trends in Food Science & Technology*, *112*, 471–483. https://doi.org/10.1016/j.tifs.2021.04.019

Abstract

Food safety and spoilage prevention are the main concerns in the food packaging industry. Microbial contamination is one of the biggest causes of food deterioration and may occur immediately after harvesting. Therefore, there is an increased demand for antimicrobial food packaging. Active packaging carries active compounds, such as antimicrobial peptides (AMPs), encapsulating them in various nanocarriers to ensure their controlled release for food preservation during storage. AMPs have gained increased attention in recent years as potential ingredients in packaging, as they demonstrate a broad range of antimicrobial and immunomodulatory activities against foodborne pathogens and infectious bacteria.This review will describe AMPs and their use in the food packaging industry along with their characteristics, functions, properties, types, and mechanisms of action in active food packaging systems. The encapsulation of AMPs is also highlighted. AMPs have potential applications in the food packaging industry. They are used in very small amounts and can exert notable effects against microbial growth and contamination. They also reduce lipid oxidation in various meat products. Moreover, active packaging is a promising technique to incorporate carry microcapsules and nano-encapsulated structures with AMPs as the core to ensure their sustained release upon various triggers. These characteristics depend on the type of AMPs and their effectiveness. Various strategies can be developed to enable cost-effective and efficient AMP encapsulation techniques. There is a great need to evaluate and utilize the potential of AMPs improved food preservation.

Keywords: /AMPsActive packaging/ /Phospholipids/ /Gram-positive bacteria/ /Gram-negative bacteria/

Kumar, S., Basumatary, I. B., Sudhani, H. P. K., Bajpai, V. K., Chen, L., Shukla, S., & Mukherjee, A. (2021). Plant extract mediated silver nanoparticles and their applications as antimicrobials and in sustainable food packaging: A state-of-the-art review. *Trends in Food Science & Technology*, *112*, 651–666. https://doi.org/10.1016/j.tifs.2021.04.031

Abstract

Nanotechnology is an emerging, novel area of applications in antimicrobial and eco-friendly food packaging that have tremendous potential benefits. Silver nanoparticles (AgNPs) have been extensively studied and frequently used in food packaging applications due to their superior physicochemical, biological and antimicrobial properties. Recently, plant extract-mediated synthesis of AgNPs has gained enormous popularity due to environment-friendliness, relatively economical synthesis, and effective functionality in food packaging applications. Numerous medicinal plant extract(s) are used in the synthesis of AgNPs, which are most commonly spherical in shape and within 2–80 nm range in size. Amount and composition of plant extract, metal ion concentration, reaction temperature and time, and pH of the reaction mixture are the key factors affecting shape, size, morphology and crystallinity of the synthesized AgNPs. Compared to other synthesis methods, including microbial synthesis, plant-mediated synthesis of AgNPs is faster, more convenient, and can be effective in utilization of wastes generated by fruit and vegetable producers and handlers. Plant-mediated AgNPs are effective against both Gram-positive and Gram-negative foodborne pathogens and spoilage bacteria. Silver (Ag^+) ions of AgNPs bind with negatively charged functional groups present in the microbial cell membrane, thereby increasing permeability of the membrane disturbing the cellular transport system leading to cell death. In addition, entry of Ag^+ ions into the cell cytoplasm may damage DNA, RNA, peptide forming compounds and metabolic enzymes resulting in the inhibition or hampering of cell division and microbial respiration. Scientific efforts are being made on the application of plant-mediated AgNPs in bionanocomposite films and coatings, as effective food preservation strategies. This review highlights innovative applications of plant-mediated AgNPs in sustainable antimicrobial food packaging.

Keywords: /Green synthesis/ /AgNPs/ /Bio-nanocomposite/ /Antimicrobial food package/ /Edible films and coatings/ /Food toxicology/

FRUIT

Fiore, M., Di Modugno, N., Bruno, C., De Nicolo, T., & Fioretti, M. (2021). Microwaves for mild postharvest fruit treatment. *Acta Horticulturae, 1311,* 403-410. https://doi-org.eu1.proxy.openathens.net/10.17660/ActaHortic.2021.1311.51

Abstract

Mild postharvest treatments, including microwave (MW) and pulsed electric fields (PEF), are increasingly required to meet high demand of shelf-stable fresh fruit worldwide and to produce fruit extracts of high quality without using chemical additives. An innovative microwave treatment, based on highly accurate state-of-the-art solid-state technology, has been applied to fresh cherries in an experimentation work performed at FraVa Srl, Rutigliano, Italy. A specific set of radiation parameters (i.e. frequency, power, waveform, treatment time) were analyzed in order to minimize the presence of spoilage microorganisms while preserving the organoleptic properties of the product. The treatment has been modeled considering the Maxwell equations for the electromagnetic pattern and Lambert's law for the thermal profile dynamics of the treated cherries. Also, the dependency of the dielectric properties from moisture and temperature have been considered for the process assessment. Encouraging results have shown reduction of microbial charge and minimum impact over texture and color characteristics of the product. The research work also gave a useful indication of the most suitable radiation parameters among different combinations tested. The overall effect of the microwave treatment is a significant shelf-life extension of the fresh product aimed at long-haul export targets.

Keywords: /Solid-state/ /Disinfection/ /Pulsed/ /Enhancement/ /Shelf-life/ /physical/

Tongonya, J., Gwanpua, S.G., & East, A.R. (2021). The potential to adopt the Hill equation to describe ethylene effects on postharvest fruit softening. *Acta Horticulturae, 1311,* 273-280. https://doi-org.eu1.proxy.openathens.net/10.17660/ActaHortic.2021.1311.34

Abstract

Ethylene (ethene, C_2H_4) is a gaseous phytohormone that regulates quality changes during fruit ripening. Ethylene has found application in active ripening of fruits allowing provision to the market of ready-to-eat fruit. In other cases, ethylene is deliberately removed from the environment, or effects actively blocked (with 1-MCP) in order to prolong fruit storage. Fruit softening is one of the most important quality changes regulated by ethylene during ripening. Mathematical models have been developed for describing the time-progress of postharvest softening, as influenced by ethylene. Such models are useful tools for designing ripening protocols, or describing softening in ethylene influenced environments. Research aimed at understanding fruit specific molecular responses to environmental conditions during softening can be used to inform model development. Several softening models have been developed for different fruits. This review discusses approaches applied for mathematical modelling of fruit softening that incorporates C_2H_4 effects. Although simple models are required to enable industry application, sufficient knowledge is required to ensure adequate model performance. The objective of this paper is to discuss model development considerations (e.g. ethylene concentration-response relationships) and in particular the potential for the Hill equation to be applied to describe ethylene effects on postharvest softening in order to create models for firmness progression.

Keywords: /Softening/ /Ethylene/ /Sensitivity/ /saturation/ /Hill equation/

GRAPE

Gomes, E. P., Vanz Borges, C., Monteiro, G. C., Filiol Belin, M. A., Minatel, I. O., Junior, A.P., Tecchio, M.A., & Lima, G. P. P. (2021). Preharvest salicylic acid treatments improve phenolic compounds and biogenic amines in 'Niagara Rosada' table grape. *Postharvest Biology and Technology*, *176*, 111505. https://doi.org/10.1016/j.postharvbio.2021.111505

Abstract

The 'Niagara Rosada' (*Vitis labrusca*) grape is widely consumed for its nutritional qualities and flavor, in addition to presenting a great diversity of phytochemical compounds, mainly polyphenols. 'Niagara Rosada' has a limited shelf life, especially when kept at room temperature, a common form used by markets in Brazil. Salicylic acid (SA) is a low-cost alternative postharvest technique, due to its accessibility (low cost) and potential to mitigate postharvest losses, in addition to maintaining quality. Exogenous application of salicylic acid in the pre-harvest period was studied to improve the postharvest quality of 'Niagara Rosada' grapes with the aim of increasing its shelf life. SA was applied in different doses, in two stages during the pre-harvest, in the season of berry growth and during veraison. The results show that 1 and 2 mmol L^{-1} were efficient in reducing the incidence of berry drop and decay of berries. Treatments with SA provided an increase in phenolic compounds. Among the phenolic acids, there was an increase in chlorogenic acid and gallic acid, related to antifungal action. Regarding polyphenols, rutin, cyanidin-3,5-diglucoside and 3-O-glycosidic delphinidin were the major compounds found in all treatments. Salicylic acid induced an increase in serotonin and melatonin content, as well as in the aminoacids (tryptophan and 5-hydroxytryptophan). During the storage, there was a decrease in histamine and dopamine levels. These alterations may be used as a tool to induce fruit resistance during storage, leading to an increase of crop yields. Thus, exogenous treatment using 1 and 2 mmol L^{-1} SA increases postharvest life, improves biochemical quality of the musts and induces increased antioxidant compounds.

Keywords: / Growth regulator/ /*Vitis labrusca*/ /Antioxidant/ /Quality/ /Storage/ /Serotonin/

Guzmán, Y., Pugliese, B., González, C. V., Travaglia, C., Bottini, R., & Berli, F. (2021). Spray with plant growth regulators at full bloom may improve quality for storage of "Superior Seedless" table grapes by modifying the vascular system of the bunch. *Postharvest Biology and Technology*, *176*, 111522. https://doi.org/10.1016/j.postharvbio.2021.111522

Abstract

The quality traits of table grapes most appreciated by the consumers are berry size, bunch architecture, and freshness appearance (especially after post-harvest cold storage). Loss of bunch freshness reduces the value and selling potential for the market. Application of plant growth regulators (PGRs) may improve quality, particularly in seedless cultivars that naturally set compact bunches with small berries. PGRs as auxins and gibberellins are involved in fruit set, growth, development and ripening processes, including vascular tissues differentiation. This study aimed to determine if the combination of auxin indole-3-butyric acid (IBA) and gibberellic acid (GA_3) improve quality attributes of 'Superior Seedless' bunches. Field grown vines were sprayed at full bloom, with 20 mg L^{-1} IBA and 20 mg L^{-1} IBA +10 mg L^{-1} GA_3, to evaluate their effects on bunch quality at harvest and post-harvest (after 60 d of cold storage; 0 °C and 95 % RH). IBA + GA_3 treatment produced looser bunches with larger berries as compared to Control. Total vascular bundle area (xylem and phloem) and rachis hydraulic conductivity were increased by IBA + GA_3. As well, IBA + GA_3 improved rachis and berries firmness, also freshness appearance after 60 d cold storage. In conclusion, a single spray of IBA + GA_3 at full bloom improved the quality and cold storage capacity of 'Superior Seedless' table grape, but it is not clear if GA_3 or the combination of IBA and GA_3 contributed to the observed effects.

Keywords: /Auxins/ /Gibberellins/ /PGRs/ /Post-harvest quality/ /*Vitis vinifera* L./

Ehtesham Nia, A., Taghipour, S., & Siahmansour, S. (2021). Pre-harvest application of chitosan and postharvest Aloe vera gel coating enhances quality of table grape (Vitis vinifera L. cv. 'Yaghouti') during postharvest period. *Food Chemistry*, *347*, 129012. https://doi.org/10.1016/j.foodchem.2021.129012

Abstract

The present study evaluated the impact of pre-harvest foliar spraying with chitosan (2.0% and 3.0%) and post-harvest *Aloe vera* gel (AVG) coating (25% and 33%) to determine the quality of table grapes during storage. The results showed that both treatments significantly influenced the storage lifetime of this fruit. In addition, the chitosan and AVG combinations minimized the incidence of decay and reduced the weight loss more than that of chitosan, AVG and control samples. 25 days once the foliar application of chitosan 3.0% with AVG 33% coating extending the storage life of fruit up to 15 days by significantly reducing decay index, malondialdehyde, weight loss and polyphenol oxidase also, maintaining the overall quality index, firmness, antioxidant capacity, peroxidase, total phenols, anthocyanin, SSC and vitamin C. Based on the findings, these natural compound treatments could be considered as suitable alternatives to extend the marketable period of table grapes and minimize post-harvest losses.

Keywords: /*Aloe vera* gel/ /Chitosan/ /Decay incidence/ /Fruit coating/ /Table grape/

Wu, P., Xin, F., Xu, H., Chu, Y., Du, Y., Tian, H., & Zhu, B. (2021). Chitosan inhibits postharvest berry abscission of 'Kyoho' table grapes by affecting the structure of abscission zone, cell wall degrading enzymes and SO2 permeation. *Postharvest Biology and Technology*, *176*, 111507. https://doi.org/10.1016/j.postharvbio.2021.111507

Abstract

SO_2 treatment is currently the preferred method for postharvest preservation of table grapes, while an

inappropriate amount of environmental SO_2 would render kinds of physiological damage, including tissue bleaching, flavor destroying and berry abscission. Our previous study has reported that 1.5% chitosan solution treatment could inhibit postharvest berry abscission of the ‘Kyoho’ table grapes, especially caused by excessive SO_2 treatment. However, the physiological mechanism of chitosan inhibiting SO_2-induced berry abscission still remains unclear. This study further focused on physiological changes of the abscission zone (AZ) between stalk and pedicle, including fruit detachment force (FDF), the microscopic structure, cell wall degrading enzymes and SO_2 permeation, during storage of the ‘Kyoho’ table grapes with different postharvest treatments. The results showed that the 1.5% chitosan treatment remarkably suppressed the decrease of FDF, and delayed the structural deterioration in AZ during storage. Meanwhile, this chitosan treatment also distinctly suppressed the increase of cell wall degrading enzymes activity and SO_2 permeation into AZ, which showed statistically linear relationship with abscission index. Those results contribute to elucidate the physiological mechanism of chitosan-inhibited berry abscission and develop new preservation technology with greater commercial value for postharvest table grapes in the future.

Keywords: /‘Kyoho’ table grape/ /Chitosan/ /$SO_{2/}$ /Physiological mechanism/

KIWIFRUIT

Feng, J., Wohlers, M., Nangul, A., Martin, P., & Brummell, D. (2021). Deviation from the biological age model as an early indication of chilling injury on kiwifruit. *Acta Horticulturae, 1311*, 31-38. https://doi-org.eu1.proxy.openathens.net/10.17660/ActaHortic.2021.1311.4

Abstract

Firmness at harvest is considered an indication of biological age for the prediction of softening during storage for kiwifruit (*Actinidia* spp.). Firmer fruit should remain firmer after storage if fruit softening is solely dependent on aging. However, batches of fruit harvested early at high firmness may become softer after long-term cold storage. Such a deviation of the biological age model may be the consequence of chilling injury or differences in storage conditions such as temperature and ethylene gradients within and among storages and packages. This study investigated if deviation from the biological age model across individual fruit within fruit batches can be used as an early indicator of chilling injury risk before the occurrence of visible chilling injury symptoms. *Actinidia chinensis* var. *chinensis* 'Zesy002' kiwifruit were harvested from eight vines of a commercial orchard in Te Puke, New Zealand, on four occasions from early April to late May, 2017, to obtain fruit with different susceptibilities to chilling injury. Acoustic firmness (AF) of the same 80 fruit (10 fruit per vine) from each harvest was measured non-destructively at 2-week intervals during the first 6 weeks of storage using an Aweta™ Acoustic Firmness Sensor. Flesh firmness and visible chilling injury were measured after 3 or 6 months of cold storage. The results indicated that correlation the relation between AF measured at harvest and that measured after 6 weeks of storage may have the potential to be used as an early indication of chilling injury risk. This would allow high-risk fruit batches to be marketed earlier to avoid fruit loss.

Keywords: /Acoustic Firmness/ /Harvest Maturity/ /Prediction/ /Storage/ /Disorders/

Jiao, C. (2021). IP3 mediates NO-enhanced chilling tolerance in postharvest kiwifruit. *Postharvest Biology and Technology*, *176*, 111463. https://doi.org/10.1016/j.postharvbio.2021.111463

Abstract

The function of inositol 1,4,5-trisphosphate (IP3) in nitric oxide (NO)-induced chilling tolerance in postharvest kiwifruit was revealed. The fruit were treated using sodium nitroprusside (SNP; exogenous NO donor) and neomycin (IP3 inhibitor). Data demonstrated that compared with the control, chilling injury (CI) index and firmness decreased and increased upon SNP treatment in kiwifruit. SNP treatment

enhanced phosphoinositide-specific phospholipase C (PI-PLC) activity, and consequently induced IP3 production. Moreover, SNP treatment down regulated malondialdehyde (MDA) content and electrolyte leakage as well as the activity and gene expression of lipoxygenase (LOX) in kiwifruit. In addition, the gene expression of transcription factors, including C-repeat binding factor1 (CBF1), WRKY1 and NAC5 was induced by SNP treatment. The above effects induced upon SNP treatment were inhibited by neomycin treatment. Neomycin treatment alone also led to the increase in CI index, MDA content and electrolyte leakage as well as the activity and gene expression of LOX, and the decrease in firmness, PI-PLC activity and IP3 production and gene expression of *CBF1*, *WRKY1* and *NAC5*. Thus, IP3 mediated the alleviation of membrane damage, and the induction of CBF1, WRKY1 and NAC5 by SNP, thereby delaying CI in kiwifruit.

Keywords: /Sodium nitroprusside/ /Inositol 1,4,5-trisphosphate/ /Chilling injury/ /Malondialdehyde, electrolyte leakage and lipoxygenase/ /Transcription factors/ /Kiwifruit/

Jin, M., Jiao, J., Zhao, Q., Ban, Q., Gao, M., Suo, J., Zhu, Q., & Rao, J. (2021). Dose effect of exogenous abscisic acid on controlling lignification of postharvest kiwifruit (Actinidia chinensis cv. hongyang). *Food Control*, *124*, 107911. https://doi.org/10.1016/j.foodcont.2021.107911

Abstract

Postharvest ‘Hongyang’ fruit is susceptible to low temperature in storage, which results in black patches on the peel and lignification in the pulp. Abscisic acid (ABA) has been shown to enhance the cold tolerance of many other postharvest fruits. This study investigated whether applying ABA can control chilling injury (CI) of ‘Hongyang’ during storage at 0 °C. Fruit were pretreated with 0–50 mg/L ABA, and then the CI symptoms and lignin accumulation processes were analyzed and microscope observations were performed during low temperature storage. The results showed that there is a dose effect on controlling lignification. For example, 50 mg/L ABA treatment increased phenylalanine ammonialyase (PAL), cinnamyl alcohol dehydrogenase (CAD) and peroxidase (POD) activity, which are crucial for lignin synthesis, and sharply upregulated expression of the *AcPAL*, *AcCAD* and *AcPOD* genes. However, 20 mg/L ABA alleviated black patch symptoms, increased lignin content in the peel, and did not negatively affect fruit quality. The higher total antioxidant capacity (ORAC) of the edible part was maintained by 20 mg/L ABA treatment. Furthermore, microscope observations showed that 20 mg/L ABA decreased the number of lignin cells with a diameter of 40–80 μm, thus reducing the chance of lignification in the pulp.

Keywords: /*Kiwifruit/ /Abscisic acid/ /Lignification/ /Gene expression/ /Paraffin section/*

Zhang, S., Wang, W., Wang, Y., Fu, H., & Yang, Z. (2021). Improved prediction of litchi impact characteristics with an energy dissipation model. *Postharvest Biology and Technology*, *176*, 111508. https://doi.org/10.1016/j.postharvbio.2021.111508

Abstract

A model of elastic impact (EI) and a model that considers energy dissipation (CED model) were developed to describe the deformation behavior during litchi impact. In the CED model, dissipation energy is due to damping effect and the change of elastic modulus after impact. Drop tests of fruit onto a fixed plate were conducted with a pendulum device for three litchi cultivars (‘Nuomci’, ‘Guiwei’, and ‘Lvhebao’) to test the accuracy of the two models. The results show that the CED model better simulated the change of fruit velocity during impact and better predicted the occurrence time of maximum impact force and maximum deformation compared to the EI model. Both models accurately predicted the maximum impact force of ‘Guiwei’ litchi with all errors less than 5 %, but had errors up to 24.8 % for the prediction of the maximum impact force of ‘Nuomici’ and ‘Lvhebao’ litchis at high drop heights (drop height ≥ 400 mm). The CED model accurately predicted maximum deformation (errors less than 8 %) but the EI model over-predicted maximum deformation with errors ranging from 12.2 % to 39.2 % at all drop heights for the

three tested cultivars. Both models predicted the contact time with low-level errors (<10 %). With a reliable theoretical model, the impact characteristics of litchis can be calculated and then applied to assess the fruit damage degree.

Keywords: /Litchi/ /Energy dissipation/ /Impact force/ /Deformation/ /Theoretical model/

LETTUCE

López-Gálvez, F., Vermeulen, A., Devlieghere, F., Tudela, J.A., Jacxsens, L., & Gil, M.I. (2021). Modelling visual quality losses of fresh-cut romaine lettuce. *Acta Horticulturae, 1311*, 23-30. https://doi-org.eu1.proxy.openathens.net/10.17660/ActaHortic.2021.1311.3

Abstract

Models for the prediction of quality loss of fresh-cut lettuce can have different uses. For example, they can be used by the industry to take product management and logistic decisions, and they can also be useful for Quantitative Microbiological Risk Assessment studies (QMRA). Such models should include the effect of modified atmosphere packaging. Changes in the visual quality of fresh-cut lettuce as affected by temperature and gas composition were assessed using controlled atmosphere experiments. Four temperatures (2, 4, 7 and 12°C) and five oxygen concentrations (0.1, 0.5, 1, 3, and 5%) were combined to a total of 20 different storage conditions. Carbon dioxide level was 10% in all cases. Visual quality was analysed throughout the storage period. A visual quality model applicable to a range of storage conditions relevant for the preservation of fresh-cut lettuce quality (i.e., 2-12°C, 0.1-5% O_2) was developed. Based on the goodness-of-fit statistic (R^2) and model complexity, a linear model as the most suitable primary model was selected. Moreover, secondary models were used to model the quality loss rate as a function of temperature or temperature plus O_2 concentration. Primary and secondary modelling was performed in one step on the global data set. Parameters were estimated by nonlinear regression analysis, and a model with a coefficient of determination (R^2) of 0.78 and a mean squared error (MSE) of 0.81 was selected. The visual quality model was further combined with respiration models of fresh-cut lettuce and packaging film permeability models, selected from the scientific literature. The output of the integrated model was the prediction of visual quality level as a function of storage temperature and packaging design.

Keywords: /Leafy Greens/ /Temperature/ /Modified Atmosphere/ /Browning/ /Shelf Life/

LITCHI

Zhang, Z., Wang, T., Liu, G., Hu, M., Yun, Z., Duan, X., Cai, K., & Jiang, G. (2021). Inhibition of downy blight and enhancement of resistance in litchi fruit by postharvest application of melatonin. *Food Chemistry*, *347*, 129009. https://doi.org/10.1016/j.foodchem.2021.129009

Abstract

Litchis are tasty fruits with economic importance. However, the extreme susceptibility of harvested litchis to litchi downy blight caused by *Peronophythora litchii* leads to compromised quality. This study aimed to study the effects of melatonin on postharvest resistance to *P. litchii* in 'Feizixiao' litchis. Results showed that melatonin restricted lesion expansion in litchis after *P. litchi* inoculation. Melatonin enhanced the activities of phenylalanine ammonia-lyase, cinnamate-4-hydroxylase and 4-hydroxycinnamate CoA ligase while promoting the accumulations of phenolics and flavonoids. Nicotinamide adenine dinucleotide phosphate content and glucose-6-phosphate dehydrogenase and 6-phosphogluconic acid dehydrogenase activities were higher in treated fruit than control fruit. Higher energy status along with elevated H^+-ATPase, Ca^{2+}-ATPase, succinate dehydrogenase and cytochrome *C* oxidase activities were observed in treated fruit. Ultrastructural observation showed reduced damage in mitochondria in treated

fruit. The results suggest that melatonin induced resistance in litchis by modulating the phenylpropanoid and pentose phosphate pathways as well as energy metabolism.
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Keywords: /Postharvest disease/ /*Peronophythora litchii/ /*Induced resistance/ /Energy metabolism/ /Phenylpropanoid pathway/

LILY

Huang, D., Li, W., Dawuda, M. M., Huo, J., Li, C., Wang, C., & Liao, W. (2021). Hydrogen sulfide reduced colour change in Lanzhou lily-bulb scales. *Postharvest Biology and Technology*, *176*, 111520. https://doi.org/10.1016/j.postharvbio.2021.111520

Abstract

The present study showed that hydrogen sulfide (H_2S) plays a critical role in reducing the colour change of Lanzhou lily during storage, which has not been previously reported. We detected the colour change, especially the violet-red colour, of lily-bulb scales that were treated with different concentrations of NaHS (a H_2S donor) by the L*, a * and b* and the browning degree of the scale surface. The colour change was reduced as the NaHS concentration increased. Among the different concentrations tested, 0.8 mM NaHS was optimal, which remarkably improved the appearance quality of the scales and decreased the content of total anthocyanins. The results of the HPLC analysis showed that the anthocyanin compounds might be cyanidin. These results indicated that H_2S improves the appearance quality of the Lanzhou lily might by regulating the content of anthocyanins. Moreover, the changes in the anthocyanin synthesis-related gene expression were inhibited by NaHS. This was consistent with the anthocyanin synthesis-related key enzyme activity. Thus, H_2S decreased the colour change caused by anthocyanin accumulation by regulating the activity and gene expression of key enzymes in the anthocyanin synthesis pathway, thereby improving the appearance quality of the scales of Lanzhou lily during postharvest storage.

Keywords: /Hydrogen sulfide/ /Lanzhou lily/ /Anthocyanins/ /Post-harvest preservation/

LOTUS

Min, T., Niu, L.F., Feng, X.Y., Yi, Y., Wang, L.M., Zhao, Y., & Wang, H.-X. (2021). The effects of different temperatures on the storage characteristics of lotus (Nelumbo nucifera G.) root. *Food Chemistry*, *348*, 129109. https://doi.org/10.1016/j.foodchem.2021.129109

Abstract

Lotus root (*Nelumbo nucifera* G.) is a high economic value crop in the world. In this study, the storage characteristics (color, sensory, texture, and fatty acids) of lotus root (“Elian No.5″) were evaluated at different harvest periods (September 2018, October 2018, November 2018, December 2018, and January 2019). Moreover, the storage characteristics were evaluated after the short- term and long-term storage of lotus root at 4 °C and 20 °C. The hardness of lotus root significantly decreased at both temperatures (4 °C and 20 °C) during the first 3 days of storage. In contrast, the decrease in hardness is delayed at 4 °C (beyond 3 days of storage). Further, genes related to hardness at different storage temperatures were identified using the RNA-seq and qRT-PCR. The results of this study provide a reference for lotus root storage and a basis for the molecular breeding of long term-storable lotus root.

Keywords: /Low temperature/ /Texture/ /RNA-Seq/ /Harvest/

MANGOSTEEN

Jamil, I. N., Sanusi, S., Mackeen, M. M., Noor, N. M., & Aizat, W. M. (2021). SWATH-MS proteomics and postharvest analyses of mangosteen ripening revealed intricate regulation of carbohydrate metabolism and secondary metabolite biosynthesis. *Postharvest Biology and Technology*, *176*, 111493. https://doi.org/10.1016/j.postharvbio.2021.111493

Abstract

Mangosteen (*Garcinia mangostana* L.) is a tropical fruit with numerous beneficial properties such as anti-cancer, anti-oxidant, and anti-microbial activity. This is due to the presence of potent secondary metabolites such as phenolics, and xanthones, which are differentially accumulated during ripening. However, the molecular regulation that governs mangosteen ripening and hence metabolic changes has not been fully elucidated, especially at the proteome level. This study details the first proteomic report on mangosteen ripening, particularly utilizing Sequential Windowed Acquisition of All Theoretical-Mass Spectra (SWATH-MS) analysis. Furthermore, postharvest analyses such as color changes, fruit firmness, anthocyanin content, total phenolic content, antioxidant activity, soluble solid content and titratable acidity were performed to further corroborate the proteome changes. Out of 3397 total identified proteins, 277 proteins were statistically measured as differentially expressed proteins (DEPs) and grouped into eight different expression clusters by *k*-means clustering analysis. Some of the key DEPs involved in ripening-related biological processes include 1-aminocyclopropane-1-carboxylate oxidase (ACO) (ethylene biosynthesis), pyruvate kinase (PK) (carbohydrate metabolism), polygalacturonase (PG) (cell wall modification) and phenylalanine ammonia-lyase (PAL) (secondary metabolite biosynthesis) which displayed increasing expression patterns during early (Stage 0 to Stage 2) and/or late (Stage 2 to Stage 6) ripening period. Coherently, the protein trends were also mostly consistent with the recorded postharvest characteristics, highlighting the underlying regulation contributing to the physiological changes of this unique fruit. Interestingly, all five benzophenone synthases (BPS) proteins involved in xanthone biosynthesis were not differentially expressed, speculating that other enzymes within this pathway could be responsible for the compound regulation. Future work should identify and characterize poorly annotated proteins within this dataset to further enrich key metabolic pathways of this species such as the xanthone pathway. Nevertheless, the use of SWATH-MS for proteomics analysis on this non-model fruit has enabled us to comprehend the dynamicity and complexity of its ripening process. This report will certainly aid future molecular research in mangosteen and ultimately contribute to the advancement in postharvest ripening control and preservation of this fruit. The proteome data are available via ProteomeXchange with identifier PXD006295.

Keywords: /Data-independent acquisition/ /Information-dependent acquisition/ /Liquid chromatography–mass spectrometry/ /Mangostin/ /Xanthone

MELON

Amodio, M.L., Pati, S., Derossi, A., Mastrandrea, L., & Colelli, G. (2021). Reaction mechanisms for volatiles responsible of off-odors of fresh cut melons. *Acta Horticulturae, 1311*, 15-22. DOI: 10.17660/ActaHortic.2021.1311.2

Abstract

The aim of this study was to identify the main volatiles responsible for odor imbalance of fresh-cut melons stored in modified atmosphere packaging at different temperatures and to propose reaction mechanisms to model the effect of temperature on the changes on some of them. Fresh harvested melons were cut and packaged in PP-PE PP+PE bags in a passive modified atmosphere (MAP) and stored over 9 days at 3 different temperatures 0, 5 and 15°C. Sensorial evaluation of off-odor and volatile analysis were carried out. As concerns volatile compounds, 48 volatile organic compounds (VOC) were identified in the headspace of all homogenized samples, including 16 acetates and 18 non-acetate esters, 4

sulfur-containing compounds, 5 alcohols, 4 aldehydes, and 1 ketone. Beyond a general volatile compound depletion, greater under MAP at 5 and 15°C, the increase of some VOCs were observed with the time, which did not concern only fermentation related compound, such as ethanol and ethyl acetate, but also flavor-related compounds as the ethyl(methylthio)acetate. For these compounds, consecutive reaction mechanisms were proposed, which were capable of modeling the changes of ethyl(methylthio)acetate, and ethanol and ethyl-acetate, with R^2adj.=93.29 and 96.02%, respectively.

Keywords: /Melon/ /Off-odors/ /Ethanol/ /Ethyl-acetate/ /Mechanism/

MUSHROOM

Louis, E., Villalobos-Carvajal, R., Reyes-Parra, J., Jara-Quijada, E., Ruiz, C., Andrades, P., Gacitúa, J., & Beldarraín-Iznaga, T. (2021). Preservation of mushrooms (Agaricus bisporus) by an alginate-based-coating containing a cinnamaldehyde essential oil nanoemulsion. *Food Packaging and Shelf Life, 28,* 100662. https://doi.org/10.1016/j.fpsl.2021.100662

Abstract

The physicochemical properties of nanoemulsions containing cinnamaldehyde (CIN) at different concentrations (0.025 %, 0.05 %, and 0.1 %, v/v) and Tween 80 (0.05 %, v/v) were investigated. Additionally, the effect of alginate-based coatings [1.0 %, (w/v), glycerol 0.125 (mL/g alginate)] incorporated with CIN nanoemulsions on the quality attributes and shelf life of button mushrooms (*Agaricus bisporus*) during 16 days of storage at 4 °C was evaluated. Nanoemulsions with a CIN:Tween 80 ratio of 1:1 reached the smallest droplet size (183 nm) and were the most stable. The quality of the mushrooms was remarkably improved by the incorporation of CIN nanoemulsions into coatings, decreasing the respiration rate, weight loss, PPO activity, and *Pseudomonas* counts and increasing retention of firmness, color, total polyphenols, and antioxidant capacity of mushrooms compared to those in the control group. These results can be associated with the small droplet size of CIN and its relatively uniform dispersion in the coating. Nanoemulsified coatings represent a promising alternative to maintain the quality of mushrooms and extend their shelf life.

Keywords: /Nanoemulsion/ /Alginate/ /Cinnamaldehyde/ /Coating/ /Mushroom/ /Shelf-life/

Sun, B., Ren, H., Chen, X., Ma, F., Yu, G., Chen, M., & Jiang, F. (2021). Short-term anaerobic treatment combined with perforation mediated MAP on the quality of Agaricus bisporus mushroom. *Postharvest Biology and Technology*, *176*, 111518. https://doi.org/10.1016/j.postharvbio.2021.111518

Abstract

The objective of this paper was to evaluate the combinational effect of different durations of anaerobic treatment and perforation mediated modified atmosphere packaging on the respiration, color, texture, sensory, and amino acid contents of *Agaricus bisporus* mushrooms stored under 5 °C. The anaerobic condition was created by flushing N_2 for 6, 12, and 24 h into a plastic tray sealed with perforated film containing the mushroom samples. The results showed that 6 h treatment combined with perforation mediated MAP was the most effective to maintain the quality of mushrooms, including the appearance, texture, and sensory quality. It reduced the respiration rate by 47.5 % on day 3 compared to control (no anaerobic treatment) and maintained the weight loss under 1.6 % during 15 d storage. Extending the treatment to 24 h accelerated the deterioration of mushroom quality, indicating that extended anaerobic treatment caused irreversible damage to mushroom cells.

Keywords: /*Agaricus bisporus*/ /Short-term anaerobic treatment/ /Quality/ /Perforation mediated MAP/

Wang, T., Yun, J., Zhang, Y., Bi, Y., Zhao, F., & Niu, Y. (2021). Postharvest Biology and Technology Effects of ozone fumigation combined with nano-film packaging on the postharvest storage quality and antioxidant capacity of button mushrooms (Agaricus bisporus). *Postharvest Biology and Technology*, *176*, 111501. https://doi.org/10.1016/j.postharvbio.2021.111501

Abstract

The quality of button mushrooms (*Agaricus bisporus*) deteriorates rapidly in storage, which seriously affects their commodity value and shelf-life. In this work, preservation using ozone fumigation combined with nano-film packaging was used for the first time to maintain the freshness of *A. bisporus*. Three key quality attributes, sensory score, browning index, and weight loss rate, were used to select the optimal ozone treatment dosage of *A. bisporus*. According to the selected optimal ozone fumigation dosage and using untreated mushrooms as controls, comparative freshness was tested in mushrooms treated with ozone fumigation, nano-film packaging, and a combination of ozone fumigation and nano-film packaging. During storage, a series of the quality indicators and antioxidant capacity of *A. bisporus* were determined. The results showed that the ozone fumigation treatment combined with nano-film packaging effectively delayed the deterioration of sensory quality, weight loss, firmness, peak respiration, and browning, while inhibiting the outbreak of epiphytic microorganisms and the accumulation of reactive oxygen species during the postharvest storage of mushrooms. Hence, the mushrooms maintained good appearance and texture characteristics during storage and retained a higher commercial value. Compared with the control group, ozone fumigation combined with nano-film packaging treatment extended the shelf-life by 8–10 d. Therefore, this treatment can be used as an effective composite freshness-keeping technology in the postharvest storage and distribution of *A. bisporus*.

Keywords: /Button mushroom/ /Ozone fumigation treatment/ /Nano-film packaging/ /Fresh-keeping/ /Storage quality/

Wu, W., Ni, X., Shao, P., & Gao, H. (2021). Novel packaging film for humidity-controlled manipulating of ethylene for shelf-life extension of Agaricus bisporus. *LWT - Food Science & Technology*, *145*, 111331. https://doi.org/10.1016/j.lwt.2021.111331

Abstract

A new polysaccharide multilayer biodegradable film was developed and tested, which can scavenge ethylene and inhibit ethylene action by releasing 1-methylcyclopropene (1-MCP). The film was fabricated with the stacking order of hydrophobic ethyl cellulose outer layer, a mixture of 1-methylcyclopropene and palladium on carbon (1-MCP-Pd/C) middle layer and hydrophilic hydrogel inner layer. The excess water produced by fruits and vegetables was absorbed by the inner layer, avoiding the accumulation of condensed water. Meanwhile, the increase of the permeability of the inner hydrogel layer caused by moisture absorption facilitated manipulation of antistaling agents. SEM, TG and DSC proved that the functional components were successfully loaded on the film. Gas chromatography analysis results demonstrated that the 1-MCP release rate and ethylene removal rate could be controlled by adjusting the humidity (50% RH to 100% RH). The effects of the film on the main quality attributes of *Agaricus bisporus* were evaluated at 20 °C. This prepared functional film could delay the softening, browning and weight loss of mushrooms, maintain the integrity of mushroom cell membrane, maintain ascorbic acid content and soluble solid content, and inhibit the activity of ethylene synthesis-related enzymes.

Keywords: /Humidity responsive/ /1-Methylcyclopropene/ /Palladium on carbon/ /Active packaging/ /Edible fungus/

Xia, R., Wang, L., Xin, G., Bao, X., Sun, L., Xu, H., & Hou, Z. (2021). Preharvest and postharvest applications of 1-MCP affect umami taste and aroma profiles of mushrooms (Flammulina velutipes). *LWT - Food Science & Technology*, *144*, 111176. https://doi.org/10.1016/j.lwt.2021.111176

Abstract

Umami-taste loss and unpleasant odor are the restrictive factors of consumer acceptance of mushrooms (*Flammulina velutipes*). Pre- and postharvest 1-methylcyclopropene (1-MCP) treatments were applied to evaluate the sensory score, ethylene release, respiration rate, umami taste and aroma profiles in mushrooms at 10 °C storage. The results showed that preharvest treatment resulted in a stronger inhibition of respiration and ethylene production than postharvest treatment. Preharvest treatment also had the highest sensory score and flavor 5′-nucleotides content. The EUC values of preharvest and postharvest treatments were 10.5 and 1.4 times of CK on day 0, respectively. Preharvest treatment improved overall flavor by increasing umami scores in electronic tongue analysis and maintaining volatile compounds compared with postharvest treatment. Thus, preharvest 1-MCP treatment could be considered as an alternative approach to preserve the umami taste and aroma profiles in *Flammulina velutipes*.

Keywords: /Preharvest/ /1-Methylcyclopropene/ /Umami taste/ /Aroma profiles/ /*Flammulina velutipes*/

ORANGE

Kumar, A., Zhimo, V. Y., Biasi, A., Feygenberg, O., Salim, S., Wisniewski, M., & Droby, S. (2021). Impact of packhouse treatments on the peel microbiome of mandarin fruit (cv. Orr). *Postharvest Biology and Technology*, *176*, 111519. https://doi.org/10.1016/j.postharvbio.2021.111519

Abstract

Citrus fruits are highly susceptible to infection by several fungal pathogens during postharvest storage. Therefore, harvested citrus fruit receive a series of treatments in the packhouse such as initial drenching, washing and disinfection, immersion in heated solutions of chemical fungicides and waxing that also include fungicides to reduce the inoculum load, eradicate existing infections and protect the fruit from subsequent infections. However, little is currently known about the impact of these packhouse management practices on the naturally-occurring microbiota of citrus fruit. The present study provides a comprehensive information on the effects of packhouse treatments on the peel microbiome of mandarin fruit (cv. Orr). Results revealed significant shifts in the diversity of both bacterial and fungal communities, particularly after hot chemical-drench treatment. Notably, the packhouse treatments did not show significant effect on the relative abundance of *Penicillium* in the peel tissue, which are the most common postharvest pathogen of citrus fruits.. Results of our study at this particular packhouse suggest that the initial drenching treatment had a lesser impact on the peel microbiome, while hot chemical drenching and waxing treatments significantly altered the fruit peel microbial diversity.

Keywords: /Citrus fruits/ /Chemical fungicides/ /Peel microbiome Packhouse treatment/ /Postharvest management/

Riccioli, C., Pérez-Marín, D., & Garrido-Varo, A. (2021). Optimizing spatial data reduction in hyperspectral imaging for the prediction of quality parameters in intact oranges. *Postharvest Biology and Technology*, *176*, 111504. https://doi.org/10.1016/j.postharvbio.2021.111504

Abstract

This study evaluated hyperspectral imaging (900–1700 nm) and the optimal binning strategy for the reduction of spatial data to obtain quantitative maps of some quality attributes in intact oranges. Artificial

neural network (ANN) was used to develop prediction models using 198 oranges. Different levels of pixel binning were tested for predicting the samples of an external test set (N = 66). The best models obtained achieved root mean square error of cross validation (RMSECV) values of 0.87 %, 0.23 g L^{-1}, 2.78 and 1.11 for SSC, TA, MI and BrimA, respectively. Models were then applied to different spatial resolution sample images. The coefficients of determination (R^2) and the root mean square error of prediction (RMSEP) values for the test set were then compared. A chemical image was developed to display the distribution of SSC, TA, MI and BrimA in the binned images of the orange fruit, demonstrating the potential of using a 10 × 10 spatial binning (corresponding to a 99 % reduction in the original dataset) to develop prediction models for quantifying taste attributes in intact oranges.

Keywords: /Internal quality/ /Visible and near infrared hyperspectral imaging/ /Artificial neural network/ /Spatial data reduction/

PEACH

Casagrande, E., Plénet, D., Lurol, S., Charles, F., Génard, M., Lescourret, F., & Bevacqua, D. (2021). Impact of pre- and postharvest factors on spreading of brown rot in nectarine: a quantitative compartmental mode. *Acta Horticulturae, 1311,* 163-168. https://doi-org.eu1.proxy.openathens.net/10.17660/ActaHortic.2021.1311.21

Abstract

Fungal infections caused by *Monilinia* species are responsible for severe losses in the postharvest stage of stone fruit. Storage and market environmental conditions (namely temperature and humidity) could play a key role in brown rot spread. It is recognized that fruit sensitivity to the disease could be influenced by both cultural practices and environmental conditions before harvest. In this context, we try to include these phenomena in a compartmental model, where we consider the classes of susceptible, exposed and infected fruit in order to predict the spread of brown rot during the postharvest stage. We calibrated the model against experimental data of *Prunus persica* var. *nucipersica* (nectarine) grown in Avignon (southern France). Different fruit loads, irrigation conditions and fungicide treatments were applied in the orchard, to induce different fruit sensitivity to brown rot at the beginning of the storage. Then, fruit were subjected to the same standard storage conditions (4°C for 2 days and then 20°C) and were visually assessed to quantify disease spread. Fruit from the well-irrigated treatments were generally more prone to disease spread. The model fits well experimental data, stressing the need to pay more attention to fruit growth conditions, to allow the prediction of brown rot diffusion patterns in the postharvest stage. Moreover, the model could be used to evaluate possible management strategies to reduce the impact of the disease.

Keywords: /Brown rot disease/ /Pre-post-harvest/ /Nectarine/ /Epidemiological modeling/

PEAR

Huang, Y., Fan, Z., Cai, Y., Jin, L., & Yu, T. (2021). The influence of N-acetylglucosamine: Inducing Rhodosporidium paludigenum to enhance the inhibition of Penicillium expansum on pears. *Postharvest Biology and Technology*, *176*, 111486. https://doi.org/10.1016/j.postharvbio.2021.111486

Abstract

On the way to impel *Rhodosporidium paludigenum* to behave like a serviceable and beneficial biocontrol antagonist, it was found that adding different concentrations of N-acetylglucosamine (GlcNAc) during the culture can reduce the incidence of pears caused by *Penicillium expansum*. 0.1 % GlcNAc is an optimal concentration in the range of 0.001 %–2 %. *R. paludigenum*, cultivated and gathered from the medium with a final concentration of 0.1 % GlcNAc, declared the best impact on restraint on *P. expansum* on

pears. This inhibitory effect is analogous to the consequence of spore germination experiments *in vitro*. The *R. paludigenum* gathered after GlcNAc induction, at the same time, displayed exceptional viability and vigour under different stress conditions, including sodium chloride (NaCl), calcofluor white (CFW), Congo red (CR) and sodium dodecyl sulfate (SDS). The enzyme activity and the relative gene expression levels of some antioxidant-related enzymes in *R. paludigenum*, including peroxisomal catalase (CAT), thioredoxin reductase (TrxR), glutathione peroxidase (GSH-PX), glutathione reductase (GR) and superoxide dismutase (SOD), were detected to be up-regulated in further testing. At the same time, the reactive oxygen species (ROS) remained at a low status.

Keywords: /N-acetylglucosamine/ /*Rhodosporidium paludigenum*/ /*Penicillium expansum*/ /Postharvest biocontrol/

Lwin, H. P., Choi, J.-H., Chun, J.-P., Watkins, C. B., & Lee, J. (2021). 1-Methylcyclopropene treatment alters fruit quality attributes and targeted metabolites in "Wonhwang" pears during shelf life. *Scientia Horticulturae*, *284*, 110125. https://doi.org/10.1016/j.scienta.2021.110125

Abstract

'Wonhwang' pears are susceptible to the development of cortex and core browning after harvest. The effects of 1 μL L^{-1} 1-methylcyclopropene (1-MCP) treatment on fruit quality, internal browning incidence, and targeted metabolites were evaluated in fruit stored at 25 °C for up to 30 d. Flesh firmness was higher in 1-MCP-treated fruit than in untreated fruit during storage; however, shrivelling increased in response to 1-MCP treatment. 1-MCP treatment delayed the changes in colour variables in core tissues but not in peel and cortex tissues, delayed cortex and core browning, and increased shrivelling. 1-MCP-treated fruit had higher sucrose, dehydroascorbic acid, alanine, threonine, and γ-aminobutyric acid contents and lower fructose and glucose contents than untreated fruit. The effects of 1-MCP on the physiological and metabolomic responses of fruit were detected using heatmap matrixes and by principal component analysis.

Keywords: /Ascorbic acid/ /Colour variables/ /Flesh firmness/ /Free amino acids/ /Internal browning incidence/ /Soluble carbohydrates/

PEPPER

Rehman, R. N. U., Malik, A. U., Khan, A. S., Hasan, M. U., Anwar, R., Ali, S., & Haider, M. W. (2021). Combined application of hot water treatment and methyl salicylate mitigates chilling injury in sweet pepper (Capsicum annuum L.) fruits. *Scientia Horticulturae*, *283*, 110113. https://doi.org/10.1016/j.scienta.2021.110113

Abstract

Chilling injury (CI) is the major limitation in shelf life extension and quality conservation of sweet pepper fruits subjected to below optimum storage temperature (<10 °C). In the current work, the effect of hot water (HW) treatment (45 °C for 15 min), methyl salicylate (MS, 0.05 mmol L^{-1}), and the combined treatment (HW + MS) of HW and MS was investigated. Results exhibited that HW + MS treated fruits exhibited reduced chilling injury, mass loss, hydrogen peroxide, superoxide anion, and malondialdehyde content, in contrast with control. Likewise, ascorbic acid concentration, total phenolics content, and radical scavenging capacity were observed to be markedly higher in HW + MS treated sweet pepper fruits, as compared to control. In addition to this, HW + MS treatment showed markedly higher activity of peroxidase, superoxide dismutase, catalase, and ascorbate peroxidase, in contrast with control. In conclusion, our study suggested that pre-storage treatment with HW + MS could be considered as a potential approach for reducing chilling injury and maintaining a better quality of sweet pepper fruits during shelf life following cold storage.

Keywords: /Antioxidant enzymes/ /Bell pepper/ /Chilling injury/ /Hot water/ /Oxidative stress/

PINEAPPLE

Ghosh, T., Nakano, K., Mulchandani, N., & Katiyar, V. (2021). Curcumin loaded iron functionalized biopolymeric nanofibre reinforced edible nanocoatings for improved shelf life of cut pineapples. *Food Packaging and Shelf Life, 28*, 100658. https://doi.org/10.1016/j.fpsl.2021.100658.

Abstract

The current research investigates the development of curcumin (Cur) loaded chitosan (CS)/iron functionalized cellulose nanofibers (mgCNF) based edible coating for perishable cut fruit, which is a non-toxic eatable packaging with improved anti-cancer, physicochemical, thermal, and food properties. The modification in cellulose nanofibres (CNF) through fabricating mgCNF improved the surface properties of Cur loaded CS materials (suggested by FESEM). Further, the weight percentage of various elements such as carbon, oxygen, iron, and nitrogen was found to be as 54.4, 38.4, 5.2, and 1.9 % (w/w), respectively, in the developed Cur loaded CS/mgCNF (1.5 % (w/w)) based materials (obtained by EDX analysis). Interestingly, the work provides value addition to the perishable cut pineapple fruit in the form of eatable packaging materials with the iron content of ~3.6 ppm, which is within permissible limit according to WHO guidelines. It is worth mentioning that the presence of Cur with CS based biocomposites exhibited anti-cancer activity by disrupting the cell membrane of HeLa (cervical cancer) cells with cell viability of ~17 % and ~98 % for CS/mgCNF (1.5 % (w/w)) with and without Cur, respectively. The thermal properties in terms of onset degradation temperatures (10 % weight reduction) for Cur loaded CS, CS/CNF (1 % (w/w)) and CS/mgCNF (1 % (w/w)) were 78.6, 90.8, and 82.3 °C, respectively, which provides an additional approach to use these materials for heat unstable food items. Therefore, the present investigation provides a novel approach towards supplementing the iron functionalized food products with anti-cancer activity and improved performance to reduce food waste.

Keywords: /Cellulose nanofibers/ /Magnetic cellulose nanofibers/ /Chitosan/ /Curcumin/ /Edible coating/ /Packaging/

POSTHARVEST CHAIN

Sarghini, F., & De Vivo, A. (2021). Modeling in postharvest: a multiscale perspective. *Acta Horticulturae, 1311,* 375-384. https://doi-org.eu1.proxy.openathens.net/10.17660/ActaHortic.2021.1311.48

Abstract

The development in plant physiology understanding together with the extension of mechanistic and hybrid models suggests that the use of models in the postharvest chain will always more extended in the next future. Modeling allows not only to verify experimental data under a unifying umbrella, but also to gain an insight in physical and biological process, to predict product characteristics and to optimize the postharvest chain at different scale levels. In this short review a multiscale point of view is presented.

Keywords: /Postharvest chain/ /Modeling/

POSTHARVEST DISEASE BIOCONTROL

You, W., Ge, C., Jiang, Z., Chen, M., Li, W., & Shao, Y. (2021). Screening of a broad-spectrum antagonist-Bacillus siamensis, and its possible mechanisms to control postharvest disease in tropical fruits. *Biological Control, 157*, 104584. https://doi.org/10.1016/j.biocontrol.2021.104584

Abstract

Broad-spectrum antagonist Bacillus siamensis (B. siamensis) was screened from ten biocontrol strains because of its excellent antifungal activity on 21 tested pathogens in vitro. In this study, the biological control capability of B. siamensis and its possible action mechanisms on pathogens in postharvest tropical fruits were investigated. Results showed that the volatile organic compounds (VOCs) produced by B. siamensis exhibited significant inhibition to the tested fungi in co-culture. The gas chromatography-mass spectrometry (GC-MS) equipped with solid-phase microextraction (SPME) was adopted for component identification of VOCs, and fifteen diffusible compounds were detected, with properties of inhibiting the growths of hyphae and conidial germinations of fungi proved. Moreover, through Ultra performance liquid chromatography-triple quadrupole tandem mass spectrometry (UPLC-QQQ-MS) analysis, the possible existence of surfactin lipopeptide was speculated. The extracellular lytic enzymes, including β-1,3-glucanase, cellulase and protease released by B. siamensis were detected. In vivo, the results of biological control efficacy test showed that B. siamensis suppressed the occurrence of diseases and browning of tropical fruits during storage. Compared with the control, the physiological qualities of postharvest tropical fruits in the treatment were maintained well. The combination of different mechanisms of action led to the broad-spectrum capacity of B. siamensis to defense and attack the pathogens whether in vivo or in vitro. Findings above indicate that broad-spectrum antagonist B. siamensis has great biocontrol potential and could be applied in controlling postharvest diseases in tropical fruits.

Keywords: /Bacillus siamensis/ /Broad-spectrum antagonist/ /Antifungal activity/ /Tropical fruit/ /Biocontrol mechanism/

POSTHARVEST TECHNOLOGY

Beghi, R., Giovenzana, V., Tugnolo, A. & Guidetti, R. (2021). Visible/near infrared spectroscopy for horticulture: case studies from preharvest to postharvest. *Acta Horticulturae, 1311,* 123-130. https://doi-org.eu1.proxy.openathens.net/10.17660/ActaHortic.2021.1311.16

Abstract

The Italian agri-food system is mostly characterized by small and medium-sized enterprises (SME). They are characterized by the lack of crucial information for the management and control of their processes. The main parameters related to important information to better lead the decision-making stages of the production process (e.g. monitoring the shelf life and postharvest life, etc.) need to be measured in a simple, non-destructive and quick way. From this point of view, the optical techniques based on visible near-infrared spectroscopy (Vis/NIR) are an established, simple and rapid application for the determination of many parameters related to production quality representing a valid support to the various supply chains. Nevertheless, the available optical systems are complex and expensive devices and their real use in SME is still very limited. The aim of the research was to test commercial hand-held devices and prototypes of low-costs and user-friendly systems, useful for different applications from preharvest to postharvest. This work proposed a collection of case studies regarding the application of Vis/NIR spectroscopy on different matrices with different goals: on (i) grape and (ii) blueberry for ripening evaluation, on (iii) cultivated mushrooms to control quality at harvest, and (iv) for senescence monitoring of fresh-cut baby leaf salad during shelf life. A Light Emitting Diode (LED) based prototype at four specific wavelengths (630, 690, 750 and 850 nm) was proposed and tested on grapes for estimating ripeness analysis. Moreover, a commercial hand-held Vis/NIR device (400-1000 nm) was used for the evaluation of blueberries ripeness, for the postharvest monitoring of mushrooms, and for the senescence evale

Keywords: /Hand-held device/ /Fruits and vegetables/ /Ripeness/ /Chemometrics/

Jalali, A., Linke, M., & Mahajan, P.V. (2021). Model for simulation of gas, moisture and condensation dynamics in packaged fresh produce. *Acta Horticulturae, 1311,* 263-272. https://doi-org.eu1.proxy.openathens.net/10.17660/ActaHortic.2021.1311.33

Abstract

Fresh and minimally processed fruits and vegetables continue physiological and metabolic processes after harvest. These result in loss of nutritional quality and accelerated senescence (at sub-optimal conditions) with limited shelf life. Modified atmosphere packaging systems offers an opportunity that creates an ideal gas conditions suitable for some fresh commodities. However, it also creates an ideal humid environment suitable for increased microbial growth. This study presents an advanced model to simulate gas and moisture inside a packaged fresh produce. This model was developed considering respiration, transpiration of fresh produce and also gas and water vapour permeability of packaging materials. Additionally, active moisture absorber was also added in order to simulate the condensation dynamics and predict relative humidity in the dynamic time-temperature profile. Such active moisture absorber consisted of humidity-regulating trays with salt embedded into the walls of plastic tray. Moisture absorption models have been previously developed to predict moisture sorption characteristics as a function of temperature and humidity and used in this model. The model was further implemented for simulating package atmosphere and experimentally validated under dynamic storage conditions for strawberries and plums. Future prospects of including the shelf-life predictive models to improve the capability of the simulation program are highlighted.

Keywords: /Respiration/ /Transpiration/ /Moisture absorption/ /Modified atmosphere packaging/ /Humidity regulation/

La Fianza, G., Giametta, F., Brunetti, L., Orsino, M., Bianchi, B., Perone, C., & Catalano, P. (2021). Thermal analysis of a cold room. *Acta Horticulturae, 1311,* 217-224. https://doi-org.eu1.proxy.openathens.net/10.17660/ActaHortic.2021.1311.27

Abstract:

The purpose of this research was to study the storage of fresh raw horticultural material processed and frozen in an industrial plant in southern Italy. A simulation technique (validated by experimental tests) was used giving the chance to evaluate the effect of bins location on the cooling capacity of the cold room avoiding expensive experimental tests. An external cooling system and an intermediate fluid ensure the cooling of the products. The air is distributed inside the cold room by two blowers that provide the forced convection of the air itself. First of all, experimental tests were carried out to validate the preliminary results obtained from the previous experiment, and then the authors carried out a computational fluid dynamic (CFD) analysis in order to verify where a good arrangement of the storage bins is achieved inside the room. The tests were carried out in summer (July) on zucchini and peppers. The important deviations in the temperature of the product are mainly due to the different position occupied by the bins in the room. In fact, they are positioned at different distances and heights from the forced convection fans. Both simulation and experimental results show that the raw material cooled in the shortest possible time was the one placed to the shortest distance from the wall and at the lowest height of the room because of the low heat transfer through the floor. By increasing the distance from the access door through which the most significant heat transfer takes place, there is a small variation due to the optimal position of the storage bins inside the room, which still allows a good distribution of air.

Keywords: /Freezing/ /Convection/ /Heat-transfer/ /Cold room/ /Vegetable products/

Torres-Sánchez, R., Martínez-Zafra, M.T.,Castillejo, N., & Artés-Hernández, F. (2021). Environmental variables traceability device to predict postharvest quality and remaining shelf life of fruit and vegetables. *Acta Horticulturae, 1311,* 209-216. https://doi-org.eu1.proxy.openathens.net/10.17660/ActaHortic.2021.1311.26

Abstract

Actual consumers demand nutritive horticultural products with good quality and safety. Therefore, the industry must guarantee these properties throughout the complete supply chain, where environmental factors affecting quality are not usually the recommended ones. Temperature, relative humidity, and several gases (O_2, CO_2 and C_2H_4) partial pressures, are the most important factors to preserve quality and safety. Therefore, knowing such information will lead to making decisions to achieve a better quality of the commodities and reduce food losses. This research aims to develop a useful system able to monitor variables and predict the shelf life during the postharvest storage. The innovation system presented consists of a wireless sensor network able to connect the measuring devices to several independent routers using Wi-Fi technology. Since the measuring devices can send the information to different routers placed in different stages of the supply chains, access to the recorded data is guaranteed offering high communication flexibility. The device is designed to avoid the main disadvantages of the different technologies available in the market, as ZigBee and RFID systems which need proprietary receptors to connect to the Internet and send the information recorded. The developed devices can record the information when WIFI signals are not available. They send the information as soon as an access point signal is in range. To solve the availability of WIFI signals in some stages (like transportation), a portable gateway node has been developed. A methodology for building shelf life models using data recorded in several stages of the supply chain has been proposed. A logistic regression model using machine-learning techniques is proposed in this paper in order to predict the shelf life.

Keywords: /Perishable goods/ /Lettuce/ /Cold-chain/ /Real-time/ /Ripening/ /Climatic chamber/

POTATO

Sanchez, P., Hashim, N., Shamsudin, R., & Nor, M. (2021). Effects of different storage temperatures on the quality and shelf life of Malaysian sweet potato (Ipomoea Batatas L.) varieties. *Food Packaging and Shelf Life, 28,* 100642. https://doi.org/10.1016/j.fpsl.2021.100642

Abstract

In this study, we investigated the effects of different storage temperatures on the quality and shelf-life of Malaysian sweet potatoes in terms of moisture content (MC), soluble solids content (SSC), colour values (L*, a*, b*) and textural properties. Samples from the three locally-produced sweet potato varieties in Malaysia namely: *Keledek Anggun 3* (V1), *Keledek Jingga* (V2), and *Keledek Kuning* (V3) were purchased and stored at 5 °C, 15 °C and 30 °C for a period of 21 d with a relative humidity (RH) range of 80–90%, 70–80% and 50–60%, respectively. A multiple correlation analysis was employed in establishing the relationships between the changes in all the quality parameters (QP). The results showed that the QP of sweet potatoes in all varieties were significantly affected ($P < 0.05$) by the different storage temperatures applied. The results likewise revealed that the changes in the QP of sweet potatoes during storage vary according to varieties. Moreover, the scanning electron microscopy (SEM) analysis showed obvious variations in the microstructural properties of the samples. Among all the measured QP, the textural properties recorded a high relationship ($r > 0.60$; $*P < 0.05$) with the other QP particularly with the flesh colour values *L*, a*,* and *b**. The principal component analysis (PCA) supported the study in discriminating the observed variances of the QP with over 90% explained accuracies. Hence, the study found that the different storage temperatures have a significant effect on the quality and shelf-life of sweet potatoes of different varieties.

Keywords: /Quality/ /Shelf-life/ /Storage/ /Sweet potato/ /Temperature/ /Variety/

PUMMELO

Chen, C., Peng, X., Chen, J., Gan, Z., & Wan, C. (2021). Mitigating effects of chitosan coating on postharvest senescence and energy depletion of harvested pummelo fruit response to granulation stress. *Food Chemistry*, *348*, 129113. https://doi.org/10.1016/j.foodchem.2021.129113

Abstract

The effect of chitosan coating exposure on juice sac granulation and energy metabolism in harvested pummelo fruit was investigated. Pummelo fruits were exposed to 1.5% chitosan coating, and then stored at 20 ± 2 °C for about 150 days. Postharvest chitosan coating treatment apparently alleviated the development of juice sac granulation as well as the increases in weight loss, pulp firmness, cell membrane permeability and cellulose content. The levels of adenosine triphosphate (ATP), adenosine diphosphate (ADP) and energy charge (EC) in the chitosan-coated fruit showed significantly higher levels than those of the respective controls. Meanwhile, the enzymes actively engaged in energy metabolism such as H^+-ATPase, Ca^{2+}-ATPase, Mg^{2+}-ATPase, cytochrome *C* oxidase (CCO), succinate dehydrogenase (SDH) and malate dehydrogenase (MDH) were markedly maintained by chitosan coating. Besides, notably high contents of acetyl-CoA, cis-aconitate, succinate, fumarate and oxaloacetate were observed in the chitosan-coated fruit. The results highlighted that chitosan coating could delay postharvest senescence of pummelo fruit by reducing the rate of energy depletion while maintaining higher levels of key metabolites taking part in tricarboxylic acid (TCA) cycle at room temperature storage.

Keywords: /Chitosan coating/ /Granulation stress/ /Energy loss/ /*Citrus grandis* L. Osbeck/

SPINACH

Torres, I., Pérez-Marín, D., Entrenas, J.A., & Sánchez, M.T. (2021). Online postharvest assessment of quality in spinach plants using near-infrared spectroscopy. *Acta Horticulturae, 1311,* 157-162. https://doi-org.eu1.proxy.openathens.net/10.17660/ActaHortic.2021.1311.20

Abstract

Dry matter (DM) and soluble solid content (SSC) are important attributes to assess the quality and freshness in spinach plants. Currently, these parameters are evaluated using time-consuming and destructive methods. However, over recent years there has been an increasing interest from the vegetable processing industry to incorporate near infrared (NIR) spectroscopy as a non-destructive analytical technology to assess and classify vegetables by quality, which makes it necessary to simulate the working conditions of the industrial processes. The main challenge of this work was to optimize the NIR measurement process and to develop robust and accurate models by means of multivariate analysis strategies for the prediction of DM and SSC in spinaches. For this purpose, 128 spinach plants grown in open-air fields in the provinces of Cordoba and Seville (Spain) were online scanned in reflectance mode, using a fourier transform (FT)-NIR instrument (Matrix-F), working in the spectral range of 834-2,502.40 nm, equipped with a conveyor belt for the movement of the sample. For the construction of the calibration models for the parameters previously cited, modified partial least squares (MPLS) regression and various spectral signal pretreatments were tested. The results obtained showed that NIRS technology has a great potential for the rapid, accurate and non-destructive online determination of DM and SSC in the industry, with a view to guarantee the quality of the processed vegetables.

Keywords: /Spinach plants/ /Dry matter/ /Soluble solid content/ /NIR instrument/ /online analysis/

SWEET POTATO

Shapawi, Z., Ariffin, S.H., Shamsudin, R., Tawakkal, I., & Gkatzionis, K. (2021). Modeling respiration rate of fresh-cut sweet potato (Anggun) stored in different packaging films. *Food Packaging and Shelf Life, 28*, 100657. https://doi.org/10.1016/j.fpsl.2021.100657

Abstract

This study is to model the respiration rate and to evaluate the quality attributes of fresh-cut *Anggun* stored at different storage and packaging treatments. Fresh-cut *Anggun* was packed in three different packaging films; nylon (OTR: 55 cc/m^2/day, WTR: 334 g/m^2/day), polyethylene terephthalate, PET (OTR: 90 cc/m^2/day, WTR: 35 g/m^2/day), and low-density polyethylene, LDPE (OTR: 8000 cc/m^2/day, WTR: 200 g/m^2/day) and stored at 5 ℃ and 30 ℃. Regardless of the film type used in this study, fresh-cut *Anggun* was found to have shelf life up to 14 days when stored at 5 ℃and up to 8 days when stored at 30 ℃. At both temperatures, samples stored in nylon showed the best performance compared to those stored in PET and LDPE by retaining the purplish color longer, having better texture and lowest respiration rate. Uncompetitive Michaelis-Menten model was proven to show good fit in modeling the respiration rate of fresh-cut *Anggun.*

Keywords: /Sweet potato (*Anggun*)/ /Fresh-cut/ /Quality and shelf life/ /Respiration rate/ /Modeling/ /Michaelis-Menten/

TOMATO

Bu, S., Munir, S. He, P. Li, Y., Wu, Y., Li, X., Kong, B., He, P. & He, Y. (2021). Bacillus subtilis L1-21 as a biocontrol agent for postharvest gray mold of tomato caused by Botrytis cinerea. *Biological Control, 157*, 104568. https://doi.org/10.1016/j.biocontrol.2021.104568

Abstract

Gray mold (Botrytis cinerea) is a serious disease causing considerable losses to harvested tomato during storage and transportation. Extensive and unjudicial use of fungicides has certain deleterious effects such as evolved resistance in pathogen and environmental pollution. The ice cold chain transportation is the most commonly used method, but the results are not satisfactory. Currently, the trend is shifting towards prevention and control measures which ensures environmental protection, therefore, the biological control of postharvest diseases has become a hot spot. In this study, Bacillus subtilis L1-21 was used to control gray mold on tomato fruits, by adopting plate confrontation and fruit acupuncture method. To evaluate the preservative effect of biocontrol agent L1-21 on tomato, the gfp-tagged L1-21 was used to study colonization potential in harvested tomatoes assay. Colonization of L1-21-gfp in postharvest tomatoes was stable at 103 cfu/g by soaking and fluorescence method. Whereas inhibition rate of B. cinerea was 39.63% ± 4.73% in plate confrontation. Culture suspension of L1-21 at a concentration of 108 cfu/ml displayed the best control effect: 86.57% ± 2.55% against tomato gray mold. In addition, different components exhibited different results such as cell pellet + saline (72.94% ± 8.49%), supernatant (41.18% ± 16.22%), sterilized culture (28.56% ± 6.54%). Further, suspension of B. cinerea and Bacillus L1-21 injected in tested tomatoes led to maximum control effect (81.40% ± 2.74%) after 4 h. Injection of L1-21 culture into tomato followed by pathogen B. cinerea spore solution resulted in 100%±0% control effect after 48 h. There was no significant difference in fruit quality between treated and untreated tomatoes. Taken together, B. subtilis L1-21 may lay theoretical foundation to be used in prevention of gray mold and other postharvest diseases during storage time.

Keywords: /Bacillus subtilis/ /Tomato/ /Gray mold/ /Postharvest disease/ /Fruit quality/

Ciptaningtyas, D., Kagoshima, W., Iida, R., Umehara, H., Johkan, M., Nakamura, N., Orikasa, T., Thammawong, M., & Shiina, T. (2021). Modeling the change in color of mature green tomato during ripening at different storage temperatures based on cumulative ethylene production. ***Acta Horticulturae,*** ***1311,*** **83-90. https://doi-org.eu1.proxy.openathens.net/10.17660/ActaHortic.2021.1311.11**

Abstract

Harvesting tomato at the mature green stage is recommended to extend the shelf life. However, a non-uniform color appearance of individual tomatoes at the end of the storage period will occur due to early harvesting. This study aims to analyze the relationship between two important parameters for the determination of the tomato ripening process, ethylene production, and change in color. Batches of 5 tomatoes each were stored at 5, 15, and 25°C for more than 30 days. Color (a* value) and ethylene production were assessed daily. A nonlinear least square method was used to develop a mathematical model estimating the a* value based on Sigmoid function, with cumulative ethylene production as the free variable. The goodness of fit of the proposed mathematical models was evaluated by the coefficient of determination (R^2) and root mean square error (RMSE) between the estimated and experimental data. The result showed that 5°C inhibited the ripening process of tomato with the absent of ethylene burst and no red color development until the end of the storage period. On the other hand, tomato stored at 15 and 25°C were undergoing the normal ripening process. Previous research showed that the relationship between a* value and cumulative ethylene production was following the sigmoid function for tomato stored at 25°C. This study found that it is also applicable to other storage temperature as long as the tomato undergoes the normal ripening process. The value of R^2 and RMSE for tomato stored at 15 and 25°C were 0.982, 0.989 and 1.889, 1.485, respectively. These values exhibit the proposed model appears to be suitable for describing the change in color of tomato at different storage temperatures based on the cumulative ethylene production.

Keywords: /Tomato/ /Mature green stage/ /Ripening/ /Ethylene/ /Color/ /Modeling/ /Sigmoid function/

Joung, J., Boonsiriwit, A., Kim, M., & Lee, Y. S. (2021). Application of ethylene scavenging nanocomposite film prepared by loading potassium permanganate-impregnated halloysite nanotubes into low-density polyethylene as active packaging material for fresh produce. ***LWT - Food Science & Technology*****,** ***145*****, 111309. https://doi.org/10.1016/j.lwt.2021.111309**

Abstract

This study reported the development of a potassium permanganate-based ethylene scavenger using halloysite nanotubes (HNTs) as an encapsulation material. Different concentrations of the potassium permanganate-impregnated HNTs (P-HNTs) were loaded into a low-density polyethylene (LDPE) matrix. The results indicated that the loading of the P-HNTs into the LDPE matrix did not optimize the mechanical and barrier properties of the nanocomposite films. However, the loading of 1 g/100 g P-HNTs increased the thermal stability, crystallinity, and ethylene scavenging capacity (by 1700%) of the nanocomposite film. The cherry tomatoes that were wrapped with the 1% P-HNTs/LDPE nanocomposite film (P-HLNF) and stored at 20 °C for 21 d exhibited a low ethylene production rate and respiration rate; furthermore, the nanocomposite film delayed the decrease in the firmness and the color change of the cherry tomatoes.

Keywords: /Active packaging/ /Ethylene scavenger/ /Potassium permanganate/ /Halloysite nanotube/ /Cherry tomato/

Zhou, J., Chen, B., Albornoz, K., & Beckles, D. M. (2021). Postharvest handling induces changes in fruit DNA methylation status and is associated with alterations in fruit quality in tomato (Solanum lycopersicum L.). *Scientia Horticulturae*, *283*, 110090. https://doi.org/10.1016/j.scienta.2021.110090

Abstract

Postharvest handling of tomato (*Solanum lycopersicum* L.), specifically low-temperature storage and early harvest, are used to extend shelf life but often reduce fruit quality. Recent work suggests that DNA methylation dynamics influences fruit ripening through the demethylase *SlDML2* gene. However, the influence of postharvest handling on DNA methylation in relation to fruit quality is unclear. This work aimed to clarify these issues by analyzing DNA methylation using methyl-sensitive amplification polymorphism (MSAP), semi-quantitative transcriptional analysis of marker genes for fruit quality (*RIN*; *RIPENING INHIBITOR*) and DNA methylation (*SlDML2*; *Solanum lycopersicum* L. *DNA demethylase 2*), and, fruit biochemical quality biomarkers. Multivariate analysis of these data suggested that fruit DNA methylation state was associated with different postharvest handling techniques. Chilled postharvest fruit were distinct in their DNA methylation state and quality characteristics, which implied that these three phenomena i.e., chilling, methylation, and quality are highly connected. In addition, different postharvest handling methods modulated *SlDML2* transcript levels but had little effect on the level of *RIN* transcripts in fruit that reached the Turning stage after early harvest, and cold storage. Although not a comprehensive global assessment, these data collectively helped to advance our interpretation of tomato fruit ripening. In conclusion, our findings revealed that postharvest-induced variation in fruit quality is in relation to DNA methylation. Long-term this work will help better connect physiological changes in tomato fruit to events happening at the molecular level.

Keywords: /Tomato fruit ripening/ /Postharvest handling/ /Fruit quality/ /DNA methylation/ /Methyl-sensitive amplification polymorphism/

VEGETABLE

Lee, D., & Robertson, G. (2021). Interactive influence of decision criteria, packaging film, storage temperature and humidity on shelf life of packaged dried vegetables. *Food Packaging and Shelf Life, 28*, 100674. https://doi.org/10.1016/j.fpsl.2021.100674

Abstract

In an attempt to get the overall picture of shelf life dynamics of packaged dried foods, a mathematical simulation model consisting of differential equations of water vapor transmission and quality change was established and solved numerically through the interactive relationships of moisture sorption isotherm, package water vapor permeability and quality deterioration kinetics to predict moisture content and quality changes throughout storage. Estimated shelf lives based on moisture increase and primary quality change as the decision criteria were examined for dried onion flakes, cabbage and green beans packaged in a hydrophobic polyolefin film and a hydrophilic biobased film with different moisture sensitivities and then stored at temperatures of 20−40 °C and relative humidities (RH) of 60–100 %. The range of shelf life estimates varied greatly with product and was affected by the moisture and quality criteria limit values. In general, the temperature effect on shelf life was greater than that of humidity over the ranges examined. The magnitude of the difference in shelf life between moisture content and quality index used as criteria was greater with the less permeable hydrophobic polyolefin film. Accelerated shelf life testing at higher temperatures and humidities was shown to have a greater impact on the estimated shelf life when using specific quality criteria rather than moisture content. Use of moisture-sensitive packaging film accelerated deterioration compared to hydrophobic packaging film. The proposed comparative methodology is helpful for designing accelerated shelf life testing of dried foods.

Keywords: /Onion flakes/ /Dried cabbages/ /Dried green beans/ /BrowningChlorophyl/