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APPLE

Li, L., Peng, Y., Li, Y., Yang, C., & Chao, K. (2020). Rapid and low-cost detection of moldy apple core based on an optical sensor system. *Postharvest Biology and Technology*, *168*, 111276. Doi: 10.1016/j.postharvbio.2020.111276

Abstract

An optical sensor system for the detection of moldy apple core (*Malus domestica* Borkh.) was developed. The cost-effective optical sensor has seven specific wavelengths centered at 425, 455, 515, 615, 660, 700 and 850 nm. However, due to the discrete spectrum, the traditional preprocessing method cannot improve the spectral efficiency. Thus, spectral shape features (SSFs) (i.e., the spectral ratio (SR), spectral difference (SD) and normalized spectral ratio (NSR)) were applied to complete spectral preprocessing and improve the model performance. Principal component analysis was performed prior to linear discriminant analysis modeling (LDA), which can eliminate the multicollinearity problems in the spectral datasets. After LDA models were established, Otsu's method and the maximum entropy (ME) method were proposed for spectral qualitative analysis to determine the optimal threshold. The combination of the NSR, SD and SR, achieved the optimal prediction accuracy. For the calibration set, the accuracy was 98.5 %, and the sensitivity and specificity were equal to 0.98 and 0.99, respectively. The discriminant accuracy was 95.8 % for the independent validation set, and the sensitivity and specificity were equal to 0.97 and 0.95, respectively. The Otsu's method resulted in higher prediction accuracy and was more suitable for threshold determination than the ME method. In summary, the optical sensor system has the advantages of being cost-effective and having a high accuracy, and thus, it is convenient for practical application.

Keywords: /Moldy apple core/ /Optical sensor/ /Spectral shape features/ /Threshold value/ /Qualitative analysis/

Thewes, F. R., Brackmann, A., Both, V., Anese, R. de O., Schultz, E. E., & Ludwig, V. (2020). Dynamic controlled atmosphere based on carbon dioxide production (DCA – CD): Lower oxygen limit establishment, metabolism and overall quality of apples after long-term storage. *Postharvest Biology and Technology*, *168*, 111285. Doi: 10.1016/j.postharvbio.2020.111285

Abstract

The present study aimed to estimate the lower oxygen limit (LOL) by DCA – CD (Dynamic controlled atmosphere based on CO_2 production) for several apple cultivars and seasons and

compare this method with DCA – RQ. The metabolism and overall quality maintenance of fruit stored under DCA – CD was also compared with CA – ULO, DCA – CF and DCA – RQ for 'Imperial Gala', 'Fuji Suprema', 'Golden Delicious' and 'Cripps Pink' apples after 9 months of storage plus 7 d of shelf life at 20 °C. The experiments were carried out over three years. The DCA – CD method, which is based only by CO_2 production by the fruit, correctly estimated the LOL for cultivars and seasons, allowing the pO_2 variation according to fruit metabolism during storage period, with a difference between 0.01 to 0.10 kPa O_2, when compared to DCA – RQ. Storage under DCA – CD allowed the induction of anaerobic metabolism compounds in safe levels, below the odor threshold reported in the literature, and without damaging the cell membranes. Fruit under DCA – CD had lower flesh breakdown incidence and higher flesh firmness and reduced the decay incidence in 'Imperial Gala' and 'Golden Delicious'.

Keywords: */Malus domestica/ /*Extremely low oxygen/ /Respiratory quotient/ /Anaerobic metabolism/ /Quality/

Tian, X., Wang, Q., Huang, W., Fan, S., & Li, J. (2020). Postharvest Biology and Technology Online detection of apples with moldy core using the Vis / NIR full-transmittance spectra. *Postharvest Biology and Technology*, *168*, 111269. doi: 10.1016/j.postharvbio.2020.111269

Abstract

Moldy core is a common disease of apples, but it is difficult to detect because there is no obvious difference in appearance of fruit. In this study, the full-transmittance spectra of apples were collected online with three different orientations at speed of 0.5 m/s using a short-integration-time mode. Spectral measurement orientation has a great influence on the spectral intensity, but no effect on the spectral trends. The spectral intensity of healthy fruit was higher than diseased fruit for all three orientations due to the stronger absorption of damaged tissues. To detect apples with moldy core, four kinds of classification models including naive bayes (NB), linear discriminant analysis (LDA), extreme learning machine (ELM) and support vector machine (SVM) were developed based on the full-transmittance spectra. The results showed that the spectra extracted from the medial zone resulted in better detection performance than for intact fruit, and the T2 orientation was more suitable for moldy core detection. The best classification model was built based on the medial zone spectra collected by T2 orientation with the success rate of 90.4 %, 86.9 % and 93.9 % for total, healthy and diseased samples in the validation set. Overall, it is feasible to online detect moldy core with full-transmittance spectroscopy technology, moreover, the spectral acquisition technology of short-integration-time mode can be used to detect internal defect by extracting the effective discrimination information from infected region.

Keywords: /Moldy core/ /Apple/ /Full-transmittance spectroscopy/ /Online detection/ /Internal defect/

Vanoli, M., Van Beers, R., Sadar, N., Rizzolo, A., Buccheri, M., Grassi, M., … Zanella, A. (2020). Time- and spatially-resolved spectroscopy to determine the bulk optical properties of 'Braeburn' apples after ripening in shelf life. *Postharvest Biology and Technology*, *168*, 111233. https://doi.org/10.1016/j.postharvbio.2020.111233

Abstract

Bulk optical properties, in terms of absorption (μ_a) and reduced scattering coefficients (μ'_s), can be used for the non-destructive monitoring of fruit quality during ripening. In this study, the performance of time-resolved (TRS) and spatially-resolved (SRS) spectroscopy were compared by analyzing 'Braeburn' apples over a 21 d period of ripening. Nine batches of 20 apples each were measured on the blush side by TRS (540−1064 nm) and SRS (550−1000 nm). Every fruit was analyzed for skin color, texture characteristics, relative internal space volume (RISV), total solid soluble and titratable acidity contents. TRS absorption spectra showed two maxima, the highest at 980 nm (water) and the second at 670 nm (chlorophyll), while in SRS spectra the main peak was measured at 550 nm (anthocyanins) followed by that at 670 nm. The values of μ_a580_{SRS} and of μ_a670_{SRS} were much higher than those measured at the same wavelengths by TRS suggesting that TRS and SRS actually explore the apple tissue (skin and/or flesh) in a different way. The values of μ_a980_{TRS} were higher than those of μ_a980_{SRS}, probably due to the fact that water content was lower in the skin (mostly probed by SRS) than in the flesh (mostly probed by TRS). No significant correlations were found between μ_a580_{SRS} and μ_a580_{TRS} and between μ_a980_{SRS} and μ_a980_{TRS} but a low positive relationship was observed between μ_a670_{TRS} and μ_a670_{SRS}. On the contrary, high correlations were found between μ_a670_{SRS} and the spectral index I_{AD} (index of absorbance difference) related to chlorophyll in the skin and between μ_a580_{SRS} and the spectral index ARI (anthocyanin reflectance index), related to anthocyanin content in the peel, suggesting that μ_a580_{SRS} is linked to the development of the red color in the peel. Both μ_a670_{TRS} and μ_a670_{SRS} decreased during fruit ripening, indicating a decline in chlorophyll in the flesh and skin, respectively. During the shelf life period, apples became soft and mealy, as mechanical and acoustic parameters decreased and RISV increased. Fruit softening was accompanied by increasing values of both μ'_{sTRS} and μ'_{sSRS}. The μ'_{sTRS} and μ'_{sSRS} were positively related to each other, were positively correlated to RISV and negatively related to mechanical and acoustic parameters. Both the TRS and SRS technique were able to follow ripening processes in 'Braeburn' apples during the shelf life period, as absorption phenomena were related to changes in pigments present in the fruit flesh and skin, while scattering events mirrored changes in the flesh texture.

Keywords: /Absorption/ /Scattering/ /Apple/ /Non-destructive techniques/ /Quality/ /Texture/ /TRS/ /SRS/

BANANA

Pongprasert, N., Srilaong, V., & Sugaya, S. (2020). An alternative technique using ethylene micro-bubble technology to accelerate the ripening of banana fruit. *Scientia Horticulturae*, *272*, 109566. doi: 10.1016/j.scienta.2020.109566

Abstract

Banana is commercially harvested at the mature green stage, and post-harvest ripening is necessary to increase its marketability and obtain it in its ideal ripened form with the desired color and texture. This study investigated the effectiveness of the ethylene microbubble (C_2H_4-MBs) technique as an alternative to accelerating the post-harvest ripening of bananas (*Musa* spp.). Bananas commercially harvested at the mature green stage were separated into four groups: (1) dipped in aqueous C_2H_4-MBs for10 min; (2) dipped in aqueous C_2H_4-MBs for20 min; (3) fumigated with 1000 mg L^{-1} of C_2H_4 gas at 25 °C for 12 h, and (4) allowed to ripen naturally (untreated controls). Treated fruit were stored at 25 °C for 10 d. The C_2H_4-MBs were successfully generated with a mean diameter of 50 μm, and the size reduced with time. The application of both C_2H_4-MBs and fumigation hastened the ripening of bananas compared to the untreated controls. The treatment with C_2H_4-MBs for just 10 minutes satisfactorily ripened the bananas in a similar manner as the fumigated technique. The treated fruit exhibited earlier climacteric rise in respiration and outburst of C_2H_4 production, accompanied by a drastic acceleration in chlorophyll degradation and yellowing, fruit softening, and total soluble solids content. Present study demonstrated the efficiency and effectiveness of this alternative post-harvest application of C_2H_4-MBs to accelerate banana ripening. This innovative technology is convenient and easy to carry out without the complication of airtight and cooling facilities and, thus, has high commercial potential.

Keywords: /Accelerate ripening/ /Banana/ /Ethylene/ /Microbubbles/

Ge, W., Zhao, Y., Kong, X., Sun, H., Luo, M., Yao, M., … Ji, S. (2020). Combining salicylic acid and trisodium phosphate alleviates chilling injury in bell pepper (Capsicum annuum L.) through enhancing fatty-acid desaturation efficiency and water retention. *Food Chemistry*, *327*, 127057. doi: 10.1016/j.foodchem.2020.127057

Abstract

Chilling injury (CI) restricts the quality and shelf life of bell pepper fruits; reducing these CI-induced detrimental effects is therefore of high economic and agricultural relevance. Here, we investigated the effects of trisodium phosphate (TSP), salicylic acid (SA), and TSP + SA treatments on pepper fruits under cold stress at 4 °C for 25 d. Combined TSP + SA treatment performed an optimal effect. Specifically, TSP + SA treatment enhances fatty-acid desaturation efficiency, as indicated by the increased expression of key fatty acid desaturase genes, and higher content of unsaturated fatty acids. Meanwhile, TSP + SA treatment inhibited the CI-induced membrane damage, manifested as lower electrolyte leakage and malondialdehyde content. Furthermore, low field-nuclear magnetic resonance and proline content also revealed that TSP + SA treatment mitigated CI through enhancing water retention in pepper fruits.

Collectively, our results may shed new light on optimizing the low-temperature storage conditions of post-harvest peppers.

Keywords: /Chilling injury/ /*Capsicum annuum* L./ /Fatty acid desaturation/ /Membrane damage/ /Water retention/

Song, Z., Qin, J., Yao, Y., Lai, X., Zheng, W., Chen, W., … Li, X. (2020). A transcriptomic analysis unravels key factors in the regulation of stay-green disorder in peel of banana fruit (Fenjiao) caused by treatment with 1-MCP. *Postharvest Biology and Technology*, *168*, 111290. Doi: 10.1016/j.postharvbio.2020.111290

Abstract

1-Methylcyclopropene (1-MCP) has been widely used to manipulate fruit ripening. However, inappropriate treatment with 1-MCP may cause ripening disorders. In this study, we observed that the appropriate concentration of 1-MCP (400 nl L^{-1}, 6 h) (1-MCP400) significantly delayed the ripening of Fenjiao banana. However, a high concentration of 1-MCP (3200 nl L^{-1}, 6 h) (1-MCP3200) resulted in abnormal Fenjiao banana that ripened with softened fruit that had a green peel. An RNA sequencing analysis showed that a large number of differentially expressed genes (DEGs) in the fruit peel and pulp were screened out from fruit that were ripened as controls. A KEGG analysis revealed that the metabolic pathways of plant hormone signal transduction, starch and sucrose metabolism, phenylpropanoid biosynthesis, photosynthesis and biosynthesis of amino acids were significantly enriched during fruit ripening. The fruit transcript level of fruit was markedly altered by 1-MCP treatment. Large numbers of DEGs were also detected between high and appropriate concentrations of 1-MCP in the peel and pulp. A comprehensive functional enrichment analysis showed that most of the DEGs involved in photosynthesis, cysteine and methionine metabolism, phenylpropanoid biosynthesis, amino sugar and nucleotide sugar metabolism, plant hormone signal transduction, starch and sucrose metabolism were enriched. RT-qPCR verified the RNA-Seq results, which indicated that 1-MCP3200 severely repressed the expression of genes involved in ethylene (*MaACS1*, *MaACO1*, *MaETR2-like*, *MaERF003*, *MaERF012* and *MaERF113*), auxin (*MaARF19-like*, *MaSAUR71-like* and *MaSAUR72-like*) and abscisic acid (*MaPYL3-like* and *MaABI5-like*) signaling pathways, chlorophyll and cell wall degradation, and starch and sucrose metabolism but induced the expression of genes in lignin synthesis. These genes were consistently expressed in the pulp and peel following control and 1-MCP400 treatment, but their expression was inconsistent following 1-MCP3200 treatment, which may result in the failure of the peel to turn yellow in the 1-MCP3200 group.

Keywords: /Fenjiao banana/ /1-MCP/ /Ripening disorder/ /Transcriptome analysis/ /Chlorophyll degradation/

BROCCOLI

Bárcena, A., Bahima, J. V., Casajús, V., Martínez, G., Lauff, D., Guiamet, J. J., & Costa, L. (2020). The degradation of chloroplast components during postharvest senescence of broccoli florets is delayed by low-intensity visible light pulses. *Postharvest Biology and Technology*, *168*, 111249. doi: 10.1016/j.postharvbio.2020.111249

Abstract

Senescence in harvested green organs, such as broccoli inflorescences, is a highly regulated process characterized by a massive degradation of chloroplast components. The dismantling of the chloroplast involves small “senescence-associated vacuoles” (SAVs) with high protease activity. The expression of the senescence associated gene, SAG12 (here BoSAG12), which encodes a senescence associated cysteine protease, correlated with SAVs appearance. One environmental factor that delays senescence is low-intensity visible light. Daily irradiation with pulses of 2 h of low-intensity white light (20–25 μmol m^{-2} s^{-1}) is a promising technology to delay postharvest senescence of broccoli stored at room temperature. The aim of this study was to analyze the effects of low-intensity white (W) and red (R) light treatments on some events related to chloroplast dismantling during postharvest senescence of broccoli inflorescences. We detected that chloroplasts number did not change during postharvest senescence. We found that SAVs participate in the dismantling of chloroplasts during the postharvest senescence of broccoli florets. SAVs appearance occurred earlier than visible yellowing. The two light treatments used, i.e. pulses of low-intensity W and R light, delayed chloroplast changes, including chlorophyll degradation and SAVs appearance. The delay of SAVs appearance was accompanied by the delay of *BoSAG12* induction in broccoli florets. Regarding protein degradation, not all proteins analyzed were affected equally. The light treatments had greater effect on the retention of thylakoid proteins than on Rubisco and apparently, the effects of light treatment were higher on proteins from PSII (LHCII) than on those from PSI (LHCI and PsaA).

Keywords: /Brassica oleracea/ /Light treatment/ /Chloroplast dismantling/ /Senescence associated cysteine protease (SAG12)/ /Senescence-associated vacuoles (SAVs)/

Duarte-Sierra, A., Munzoor Hasan, S. M., Angers, P., & Arul, J. (2020). UV-B radiation hormesis in broccoli florets: Glucosinolates and hydroxy-cinnamates are enhanced by UV-B in florets during storage. *Postharvest Biology and Technology*, *168*, 111278. Doi: 10.1016/j.postharvbio.2020.111278

Abstract

Abiotic stresses are oxidative in nature and cause generation of reactive oxygen species (ROS) in plant bodies. Severe stresses can be harmful to the plant tissue, whereas sub-acute or lower doses of stresses could enhance or induce protective mechanisms, a biological phenomenon known as *hormesis*. The objective of this work was to examine the effect of hormetic as well as high doses of UV-B on the quality along with glucosinolate and hydroxy-cinnamate contents in broccoli florets during storage. An UV-B dose of 1.5 kJ m^{-2} was found to be hormetic from the color retention response. Color development, weight loss and respiration rate were monitored

during 21 d of storage at 4 °C. The gene expression of dihomo methionine N-hydroxylase (*CYP79F1*), tryptophan N-hydroxylase 2 (*CYP79B3*), phenylalanine N-hydroxylase (*CYP79A2*), phenylalanine ammonia-lyase (*PAL*), chalcone synthase (*CH*) and flavanone 3-hydroxylase (*F3H1*) in the treated broccoli was also evaluated. The antioxidant capacity and the profiles of glucosinolates and hydroxy-cinnamates were determined for up to 14 d in broccoli florets stored at 4 °C by LC–MS. The hormetic dose of UV-B was effective in delaying the yellowing of broccoli florets. The initial respiration rate of the florets treated with the hormetic and a high dose (7.2 kJ m^{-2}) was significantly high. The antioxidant capacity of florets was higher in UV-B treated florets relative to the control. The titers of indole-type glucosinolates and hydroxycinnamates in broccoli were significantly ($p < 0.05$) higher with both doses of UV-B compared to the non-exposed florets. UV-B appears to exhibit balanced effects with respect to quality preservation and enhancement of phyto-compounds in broccoli florets. Results showed a good correlation between gene expression of *CYP79B3*, and the titers of indole glucosinolates in the treated broccoli florets, suggesting that the target of UV-B is likely to be the branch pathway of indole glucosinolates.

Keywords: /Broccoli/ /UV-B radiation/ /Oxidative stress/ /Glucosinolates/ /Hydroxy-cinnamates/ /Gene expression/

CABBAGE

Fan, Z., Tan, X., Shan, W., Kuang, J., Lu, W., Lin, H., … Chen, J. (2020). Postharvest Biology and Technology Involvement of BrNAC041 in ABA-GA antagonism in the leaf senescence of Chinese flowering cabbage. *Postharvest Biology and Technology*, *168*, 111254. doi: 10.1016/j.postharvbio.2020.111254

Abstract

Phytohormone abscisic acid (ABA) and gibberellins (GAs) are well-known to be antagonistic in mediating plant development processes. However, the underlying molecular mechanism of this antagonism in leaf senescence of economically important leafy vegetables is largely unclear. In this study, we report that a Chinese flowering cabbage NAC transcription factor BrNAC041, mediated the ABA-antagonized GA accumulation in ABA-induced leaf senescence. Exogenous ABA treatment accelerated Chinese flowering cabbage leaf senescence, with decreasing maximum quantum yield (Fv/Fm) and total chlorophyll content, as well as up-regulating the expressions of senescence-associated genes. Notably, ABA treatment enhanced endogenous ABA accumulation and reduced GA_3 level in senescing leaves. Consistently, down-regulation of one ABA catabolism gene *BrCYP707A3* and two GA biosynthesis genes *BrKAO2* and *BrGA20ox2* was observed following ABA application. Furthermore, a NAC transcription factor, BrNAC041, a homolog of Arabidopsis ANAC041, was isolated and characterized. BrNAC041 was senescence-/ABA-up regulated and localized in the nucleus acting as a transcriptional repressor. Further *in vitro* and *in vivo* experiments demonstrated that BrNAC041 repressed *BrCYP707A3*, *BrKAO2* and *BrGA20ox2* transcription by targeting their promoters via the NAC-binding sequence (NACBS). Collectively, our findings reveal BrNAC041 as a novel

regulator involved in the antagonism of ABA on GA in the leaf senescence of Chinese flowering cabbage, through the transcriptional repression of ABA catabolic and GA biosynthetic genes.

Keywords: /Chinese flowering cabbage/ /ABA/ /GA/ /Leaf senescence/ /NAC/

CALADIUM

Zhang, Y. S., Chen, J. J., Cao, Y. M., Duan, J. X., & Cai, X. D. (2020). Induction of tetraploids in 'Red Flash' caladium using colchicine and oryzalin: Morphological, cytological, photosynthetic and chilling tolerance analysis. *Scientia Horticulturae*, *272*, 109524. doi: 10.1016/j.scienta.2020.109524

Abstract

In vitro pre-cultured leaf segments of 'Red Flash' Caladium (*Caladium* × *hortulanum* Birdsey) were treated with 0.1%, 0.2% and 0.3% (w/v) colchicine, or 0.001%, 0.002% and 0.003% (w/v) oryzalin for 2, 4 and 6 days, respectively, with the aim to develop an efficient polyploid induction protocol for caladium, and to identify promising caladium variants for cultivar development and chilling tolerance breeding. A total of 206 out of 723 plants were found to exhibit stable and remarkable morphological changes, and were grouped into 10 variant types based on differences in leaf shape, color, and/or coloration. As many as 93 plants were identified preliminary as tetraploids by flow cytometry, and the most efficient way for chromosome doubling seemed to be exposed to 0.002% oryzalin for 6 days. Chromosome counting was performed to further determine the ploidy level of the variants as extensive variation of mean fluorescence intensity (MFI) was recorded among them, and results showed that chromosome gains or losses occurred frequently in the established variants. As compared to the wild type, tetraploidization resulted in plants with rounder and thicker leaves, larger petiole diameter, higher plant height, lower leaf number per plant, and lower stomatal density, and significantly increased the net photosynthesis rate, transpiration rate, and stomatal conductance. Furthermore, enhanced chilling tolerance were observed in the tetraploids (T1), as evidenced by their higher superoxide dismutase (SOD) activity, peroxidase (POD) activity and proline (Pro) content, and a lower relative electrical conductivity (REC) and malondialdehyde (MDA) content in the leaves compared with those of the diploid counterparts and the diploid aneuploids (SVT1) during chilling stress. The variants associated with valuable phenotypic traits including the tetraploids, diploid variants, diploid aneuploids, and tetraploid aneuploids hold considerable potential for cultivar development, genetic study and chromosome engineering in caladium.

Keywords: /Chromosome counting/ /Chromosome doubling/ /Flow cytometry/ /Photosynthesis/ /Variants/

CARROT

López-Gámez, G., Elez-Martínez, P., Martín-Belloso, O., & Soliva-Fortuny, R. (2020). Pulsed electric fields affect endogenous enzyme activities, respiration and biosynthesis of phenolic compounds in carrots. *Postharvest Biology and Technology*, *168*, 111284. Doi: 10.1016/j.postharvbio.2020.111284

Abstract

Pulsed electric fields (PEF) can be applied to induce accumulation of bioactive compounds in plant tissues to obtain commodities with health-promoting properties. However, causes of this accumulation are not fully understood as it may result from either an improvement in extraction or an activation of stress-related biosynthetic pathways. The objective of this study was to investigate the effects of PEF on the physiological response and elucidating the causes underpinning changes in carrot phenolic contents. Respiration rate, oxidative and pectinolytic enzyme activities, synthesis, and content of phenolic compounds were evaluated in PEF-treated (580 J kg^{-1}) carrots after treatment and through storage (12, 24 and 36 h) at 4 °C. The highest production of CO_2 and volatile organic compounds was observed 12 h after PEF treatment whereas the largest increases in total phenolic content (80.2 %), *p*-OH-benzoic (94.7 %), chlorogenic acid (74.9 %) and ferulic acid (52.2 %) occurred 24 h after treatment. Enhanced in phenylalanine ammonia lyase activity indicated that the increase in phenolic compounds may be mainly due to the triggering of biosynthesis pathways instead of structural modifications of the food matrix. Electropermeabilization also induced considerable changes in pectinolytic enzyme activities (increases in pectinmethylesterase and decreases in polygalacturonase) whereas no clear trends were observed for oxidative enzyme activities (peroxidase and polyphenol oxidase) during storage. These results suggest that volatile compounds generation, changes in respiration rate and the biosynthesis of phenolic compounds are induced by PEF application, as a plant defence response to stress.

Keywords: /Pulsed electric fields/ /Phenolic compounds/ /Respiration/ /Phenylalanine ammonia lyase/ /Polyphenol oxidase/ /Pectinmethylesterase/

CITRUS

Alhassan, N., Bowyer, M. C., Wills, R. B. H., Golding, J. B., & Pristijono, P. (2020). Postharvest dipping with 3,5,6-trichloro-2-pyridinyloxyacetic acid solutions delays calyx senescence and loss of other postharvest quality factors of 'Afourer' mandarins, Navel and Valencia oranges. *Scientia Horticulturae*, *272*, 109572. doi: 10.1016/j.scienta.2020.109572

Abstract

The effects of postharvest treatment of three citrus fruit types with 3,5,6-trichloro-2-pyridinyloxyacetic acid (TPA) on the deterioration of calyx quality, decay incidence and internal quality parameters in long-term storage were investigated. Navel oranges and 'Afourer' mandarins were treated with TPA concentrations of 0, 2, 4, 8, 16 and 32 μM, while Valencia oranges were treated at concentrations of 0, 15, 30, 60 and 120 μM. Fruit was stored in air at 20˚C for 32 and 28 days, respectively. TPA treatment exhibited a concentration-dependent effect on fruit quality, with higher concentrations resulting in a reduced incidence of calyx deterioration and decay, a lowering of respiration rate, ethylene production and ethanol accumulation, and inhibition of change in TSS and TA levels and hence maintaining the TSS/TA ratio. The results show that postharvest TPA treatment can be used to alleviate calyx senescence and maintain postharvest quality in citrus fruits.

Keywords: /Citrus/ /Calyx senescence/ /Ethylene exposure/ /Quality/ /Storage/ /TPA auxin.

Martínez-Blay, V., Taberner, V., Pérez-Gago, M. B., & Palou, L. (2020). Control of major citrus postharvest diseases by sulfur-containing food additives. *International Journal of Food Microbiology*, *330*, 108713. doi: 10.1016/j.ijfoodmicro.2020.108713

Abstract

Sodium metabisulfite (SMBS), potassium metabisulfite (PMBS), aluminum sulfate (AlS) and aluminum potassium sulfate (AlPS), common sulfur-containing salts used as food additives, were evaluated for their antifungal activity against *Penicillium digitatum*, *Penicillium italicum* and *Geotrichum citri-aurantii*, the most economically important pathogens causing postharvest diseases of citrus fruits. In vitro radial mycelial growth was measured on potato dextrose agar (PDA) Petri dishes amended with five different concentrations of the salts (10, 20, 30, 50, 100 mM) after 7 d of incubation at 25 °C. SMBS and PMBS at all concentrations, and AlS and AlPS above 20 mM, completely inhibited the growth of these fungi. The curative antifungal activity of the four salts to control citrus green (GM) and blue (BM) molds and sour rot (SR) was evaluated on 'Valencia' oranges artificially inoculated in rind wounds with *P. digitatum*, *P. italicum* and *G. citri-aurantii*, respectively. In vivo primary screenings showed no significant antifungal activity of AlS and AlPS to control the three diseases at any dose tested, but SMBS and PMBS reduced the incidence and severity of GM, BM and SR at various concentrations.

Effective salts and concentrations were selected for in vivo dip treatments in small-scale trials. Dips at room temperature (20 °C) in SMBS and PMBS at 20 and 50 mM for 60 or 120 s significantly reduced the incidence and severity of GM and BM, with PMBS at 50 mM for 120 s the most effective treatment. Conversely, dips in SMBS and PMBS at 50 mM for 60 or 120 s did not reduce SR incidence and severity. SMBS and PMBS treatments are potentially new tools to be included in reduced-risk non-polluting strategies to control Penicillium diseases, but not SR, on citrus fruits.

Keywords: /Antifungal activity/ /GRAS salts/ /Oranges/ /*Citrus sinensis/ /Geotrichum citri-aurantii/ /Penicillium digitatum/ /Penicillium italicum/*

DAHLIA

Shimizu-Yumoto, H., Tsujimoto, N., & Naka, T. (2020). Acid invertase activities of dahlia 'Kokucho' petals during flower opening and following cutting and treatment with 6-benzylaminopurine. *Scientia Horticulturae*, *272*, 109525. doi: 10.1016/j.scienta.2020.109525

Abstract

Extending the vase life of cut dahlia 'Kokucho' flowers through enhanced activities of acid invertases (cell wall, CWIN and vacuolar, VIN) on flower opening and senescence after harvest was investigated. The activities of CWIN and VIN were very low in the outer petals at the tight bud stage (stage 1), increased markedly at the half-open stage (stage 2), and decreased at the fully open stage (stage 3) to levels lower than at stage 2. Glucose and fructose concentrations were very low at stage 1, markedly increased at stage 2, and further increased at stage 3. These results suggest that acid invertase activities play a very important role in increasing soluble sugars of petals during flower opening. Following harvest at stage 3, florets or cut flowers were treated with 50 μmol L^{-1} 6-benzylaminopurine (BA) by dipping or spraying, respectively. These treatments extended vase life longer than in the controls. In the florets experiment, CWIN and VIN activities were significantly higher with a BA dip than in the control for petals at 3 and 6 d, but there were no significant differences in sugar concentrations between the control and BA dip groups. In cut flowers at 3 d after cutting, VIN activity and glucose concentration were higher in the outer petals treated with BA spray than in control petals. From these results, application of exogenous cytokinin has some effect of maintaining high acid invertase activity, and high invertase activity itself may be important for delaying senescence in cut dahlia flowers. BA application is useful for extending petal longevity and is expected to be a popular post-harvest treatment in cut dahlia flowers.

Keywords: /6-Benzylaminopurine/ /Cytokinin/ /Dahlia/ /Invertase/ /Longevity/

FRUITS AND VEGETABLES

Huang, K., Tian, Y., Tan, J., Salvi, D., Karwe, M., & Nitin, N. (2020). Postharvest Biology and Technology Role of contaminated organic particles in cross-contamination of fresh produce during washing and sanitation. *Postharvest Biology and Technology*, *168*, 111283. Doi: 10.1016/j.postharvbio.2020.111283

Abstract

Outbreaks of foodborne illnesses from fresh produce in recent years have prompted the industrial community to consider new practices aimed at reducing the risks of pathogenic microbial contamination on the produce. The presence of organic matter in wash water not only decreases the efficacy of sanitizers to inactivate microorganisms, but also has the potential to transfer microbial contamination to fresh produce. This study aims to comprehensively evaluate the transfer of pathogens from inoculated organic matter to uninoculated fresh produce leaves during washing, as well as determination of the adequate active free chlorine concentration needed to prevent the potential risk of cross-contamination during the produce washing process. In addition, the study also characterized the role of particles in increasing the mechanical shear at the leaf surface using numerical simulation. The results showed that cross-contamination of fresh produce occurred significantly in a short time (< 2 min) if the wash water was contaminated. The presence of contaminated organic matter (COD = 0.05 g/L) in wash water enhanced the transfer of bacteria to the fresh produce surface by approximately 1 log unit when compared to planktonic bacterial cells in the wash water. In addition, the presence of organic matter also significantly increased the shear stress at the leaf surface. The adequate active free chlorine (0.005 g/L) in wash water was able to prevent the cross-contamination of fresh produce and inactivate bacteria inoculated on organic contaminants in wash water during washing process. In summary, this study will contribute to guidelines for the design of fresh produce washing processes.

Keywords: /Cross-contamination/ /Fresh produce/ /*Escherichia coli* O157:H7/ /Foodborne pathogen/ /Organic matter/ /Sanitizer/

Lufu, R., Ambaw, A., & Opara, U. L. (2020). Water loss of fresh fruit: Influencing pre-harvest, harvest and postharvest factors. *Scientia Horticulturae*, *272*, 109519. doi: 10.1016/j.scienta.2020.109519

Abstract

Physiological water loss is one of the many postharvest disorders in the fresh fruit industry. Water loss initiates wilting, shrivelling, browning, loss in fruit texture, flavour, and saleable weight and accelerates senescence. Currently, the water loss characteristics of many commercially important fruits are not adequately studied, therefore, a knowledge gap exists in understanding their mechanisms of losing water. A clear understanding of the factors

influencing water loss is crucial in optimising the control strategies. This knowledge is also required to design and operate storage facilities to ensure the extension of the shelf life of fresh fruit and vegetables. This paper systematically identifies, interprets and discusses the major research works and findings relating to the pre-harvest, harvest and postharvest factors influencing the water loss in commercially important fresh fruit. The review acknowledges that postharvest water loss varies greatly among fresh produce given the multitude of factors discussed in this review. The environmental factors (temperature and humidity) have a strong influence on fruit water loss. The rate of water loss also differs among species and even among cultivars of the same species as this determines the fruit factors (the fruit surface-area-to-volume ratio, the surface structure of the fruit, including the number and size of stomata and lenticels, and the thickness and composition of the cuticle). Yet the large biological difference among fruit types makes it difficult to extrapolate such knowledge.

Keywords: /Postharvest loss/ /Weight loss/ /Moisture-loss/ /Transpiration/ /Packaging/ /Irrigation/ /Fruit quality/ /Cold chain/

Mishra, P., Roger, J. M., Rutledge, D. N., & Woltering, E. (2020). SPORT pre-processing can improve near-infrared quality prediction models for fresh fruits and agro-materials. *Postharvest Biology and Technology*, *168*, 111271. doi: 10.1016/j.postharvbio.2020.111271

Abstract

Near-infrared spectroscopy (NIRS) is a key non-destructive technique for rapid assessment of the chemical properties of food materials. However, a major challenge with NIRS is the mixed physicochemical phenomena captured by the interaction of the light with the matter. The interaction often results in both absorption and scattering of the light. The overall NIRS signal therefore contains information related to the two phenomena mixed. To predict chemical properties such as dry matter, Brix and lipids, light reflection/absorption is used. Therefore, when the aim of the data analysis is to predict chemical components, it is necessary to remove as much as possible the scattering effects from the spectra. Several pre-processing techniques are available to do this, but it is often difficult to decide which one to choose. In this article we present the use of a recently developed pre-processing approach, sequential pre-processing through orthogonalization (SPORT), to improve the predictive power of multivariate models based on NIR spectra of food materials. The SPORT approach utilizes sequential orthogonalized partial least square regression (SOPLS) for the fusion of data blocks corresponding to several spectral preprocessing techniques. The results were compared with commonly used pre-processing techniques in the analysis of food materials by NIRS. The comparison was made by analyzing 5 different datasets composed of apples, apricots, olive oils and grapes associated with chemical properties such as dry matter (DM), Brix, lipids and citric acid. The datasets were from both reflection and transmission measurements. The results showed that the fusion-based pre-processing methodology is an ideal choice for pre-processing of NIRS data. For four out of five datasets, the prediction accuracies (high R^2_{pred} and low RMSEP) were improved. The improvement led to as much as a 20 % increase in R^2_{pred} and a 25 % decrease in RMSEP compared to the standard 2nd derivative pre-processing. The pre-processing fusion was more effective for the reflection mode compared to the transmission

mode. Multiple pre-processing techniques provided complementary information, and therefore, their fusion using the SPORT approach improved the model performance. The methodology is not only applicable to food materials but can in fact be used as a general pre-processing approach for all types of modeling of spectral data.

Keywords: /SOPLS/ /Multi-block/ /Chemometric/ /Data-fusion/ /Scatter correction/

Walsh, K. B., Blasco, J., Zude-Sasse, M., & Sun, X. (2020). Visible-NIR 'point' spectroscopy in postharvest fruit and vegetable assessment: The science behind three decades of commercial use. *Postharvest Biology and Technology*, *168*, 111246. doi: 10.1016/j.postharvbio.2020.111246

Abstract

The application of visible (Vis; 400–750 nm) and near infrared red (NIR; 750–2500 nm) region spectroscopy to assess fruit and vegetables is reviewed in context of 'point' spectroscopy, as opposed to multi- or hyperspectral imaging. Vis spectroscopy targets colour assessment and pigment analysis, while NIR spectroscopy has been applied to assessment of macro constituents (principally water) in fresh produce in commercial practice, and a wide range of attributes in the scientific literature. This review focuses on key issues relevant to the widespread implementation of Vis-NIR technology in the fruit sector. A background to the concepts and technology involved in the use of Vis-NIR spectroscopy is provided and instrumentation for in-field and in-line applications, which has been available for two and three decades, respectively, is described. A review of scientific effort is made for the period 2015 - February 2020, in terms of the application areas, instrumentation, chemometric methods and validation procedures, and this work is critiqued through comparison to techniques in commercial use, with focus to wavelength region, optical geometry, experimental design, and validation procedures. Recommendations for future research activity in this area are made, e.g., application development with consideration of the distribution of the attribute of interest in the product and the matching of optically sampled and reference method sampled volume; instrumentation comparisons with consideration of repeatability, optimum optical geometry and wavelength range). Recommendations are also made for reporting requirements, viz. description of the application, the reference method, the composition of calibration and test populations, chemometric reporting and benchmarking to a known instrument/method, with the aim of maximising useful conclusions from the extensive work being done around the world.

Keywords: /Colour/ /Internal/ /Instrumentation/ /Quality/ /Near infrared/ /Spectroscopy/

JUJUBE

Zhang, S., Wang, Q., Guo, Y., Kang, L., & Yu, Y. (2020). Carbon monoxide enhances the resistance of jujube fruit against postharvest Alternaria rot. *Postharvest Biology and Technology*, *168*, 111268. doi: 10.1016/j.postharvbio.2020.111268

Abstract

CO is a gas signal molecule involved in various physiological and metabolic regulation processes in plants. In the present study, we evaluated the effects of CO fumigation on the control of *Alternaria* rot in jujube fruit and explored the mechanism of action. Results showed that CO at 10 μmol L^{-1} significantly reduced lesion diameter in the fruit inoculated with *A. alternata* without showing any antifungal activity *in vitro*. CO treatment enhanced the activities of four representative resistance-related enzymes (phenylalanine ammonia-lyase, polyphenol oxidase, chitinase, and β-1,3-glucanase). Furthermore, CO also led to increase in the content of phenolics, flavonoids, lignin, and H_2O_2. These results indicate that CO induces resistance to *Alternaria* rot primarily by activating disease resistance-related enzymes and enhancing accumulation of antifungal substances, and that CO can be a promising elicitor of plant defense responses to resist *Alternaria* rot in postharvest jujube fruit.

Keywords: /Jujube fruit/ /Carbon monoxide/ /*Alternaria* rot/ /*Alternaria alternate/ /*Induced resistance/

KIWI

Wang, F., Yang, Q., Zhao, Q., & Zhang, X. (2020). Roles of antioxidant capacity and energy metabolism in the maturity-dependent chilling tolerance of postharvest kiwifruit. *Postharvest Biology and Technology*, *168*, 111281. Doi: 10.1016/j.postharvbio.2020.111281

Abstract

To investigate the effects of fruit maturity on chilling injury, antioxidative capacity, and energy metabolism, 'Hongyang' kiwifruit were harvested at three stages of maturity (I, II, and III), based on soluble solid content (4.5–5.5 %, 6.5–7.5 %, and 8.5–9.5 %, respectively). The fruit were cold-stored at 0 °C for 100 d and then subjected to various analyses. Among the three fruit stages, stage II and III fruit were less susceptible to chilling injury and exhibited a higher abundance of antioxidant enzymes (superoxide dismutase, catalase, ascorbate peroxidase, and glutathione reductase) and energy and metabolism-related enzymes (H^+-adenosine triphosphatase, Ca^{2+}-adenosine triphosphatase, cytochrome C oxidase, and succinic dehydrogenase). Moreover, we observed lower levels of superoxide anion, H_2O_2, malondialdehyde content, and relative membrane permeability, and higher levels of ATP and energy charge. These results indicated that the higher resistance of stage II and III 'Hongyang' kiwifruit against chilling injury could be correlated to higher antioxidant and energy metabolism-related enzyme activities, ATP levels, and energy charges. However, the stage III

fruit decayed faster than stage II fruit. The results indicate that the postharvest life of ‘Hongyang’ kiwifruit can be maximized by harvesting and storing kiwifruit at a soluble solids content of 6.5–7.5 %.

Keywords: /Kiwifruit/ /Maturity/ /Chilling injury/ /Antioxidant capacity/ /Energy metabolism/

LETTUCE

Damerum, A., Chapman, M. A., & Taylor, G. (2020). Innovative breeding technologies in lettuce for improved post-harvest quality. *Postharvest Biology and Technology*, *168*, 111266. doi: 10.1016/j.postharvbio.2020.111266

Abstract

Societal awareness of healthy eating is increasing alongside the market for processed bagged salads, which remain as one of the strongest growing food sectors internationally, including most recently from indoor growing systems. Lettuce represents a significant proportion of this ready-to-eat salad market. However, such products typically have a short shelf life, with decay of post-harvest quality occurring through complex biochemical and physiological changes in leaves and resulting in spoilage, food waste and risks to health. We review the functional and quantitative genetic understanding of lettuce postharvest quality, revealing that few findings have translated into improved cultivar development. We identify (i) phytonutrient status (for enhanced antioxidant and vitamin status, aroma and flavour) (ii) leaf biophysical, cell wall and water relations traits (for longer shelf life) (iii) leaf surface traits (for enhanced food safety and reduced spoilage) and (iv) chlorophyll, other pigments and developmental senescence traits (for appearance and colour), as key targets for future post-harvest breeding. Lettuce is well-placed for rapid future exploitation to address postharvest quality traits with extensive genomic resources including the recent release of the lettuce genome and the development of innovative breeding technologies. Although technologies such as CRISPR/Cas genome editing are paving the way for accelerated crop improvement, other equally important resources available for lettuce include extensive germplasm collections, bi-parental mapping and wide populations with genotyping for genomic selection strategies and extensive multi omic data sets for candidate gene discovery. We discuss current progress towards post-harvest quality breeding for lettuce and how such resources may be utilised for future crop improvement.

Keywords: /Food safety/ /*Lactuca sativa*/ /Gene editing/ /Plant breeding/

LITCHI

Tang, R., Zhou, Y., Chen, Z., Wang, L., Lai, Y., Chang, S. K., … Huang, H. (2020). Regulation of browning and senescence of litchi fruit mediated by phenolics and energy status: A postharvest comparison on three different cultivars. *Postharvest Biology and Technology*, *168*, 111280. doi: 10.1016/j.postharvbio.2020.111280

Abstract

Pericarp browning is one of the most important factors limiting the shelf life of litchi fruit. The storage behavior of three cultivars of litchi with different shelf life were studied to comprehensively address the importance of phenolic content and energy status in delaying the development of browning in litchi fruit after harvest. Results revealed that slower changes of browning indices; higher content of EGC, EC, ECG, GCG, PA2, total phenols and anthocyanins; lower activities of ANT, LAC, PPO, POD and PAL were detected in 'Jingganghongnuo', as compared to that in 'Guiwei' and 'Nuomici'. The transcript abundant of oxidation-enzyme corresponding genes *LcANT*, *LcLAC*, *LcPPO*, *LcPOD* and *LcPAL* exhibited similar trends as changes of phenolics and enzyme activities in three cultivars. The energy status and the relative expression intensity of ATP metabolic-related genes *LcATPb*, *LcSnRK2*, *LcAAC1*, and *LcAOX1* differed among the three cultivars and maintained higher levels in 'Jingganghongnuo'. Accordingly, the development of pericarp browning was significantly related to the content of phenolics, especially ECG and EC, and to the changes in ATP of litchi fruit after harvest. The comparative study on variety of litchi cultivars evident that the phenolics, energy status as well as the transcript abundant of their corresponding genes are potential indicators to mark the browning change in litchi fruit.

Keywords: /*Litchi chinensis* Sonn./ /Pericarp discoloration/ /Polyphenolics/ /Energy status/ /Transcript abundant of genes/

Yang, J., Zhu, X., Zhang, P., Wang, Y., Xiao, Y., Yang, B., … Jiang, Y. (2020). Detection of toxic methylenecyclopropylglycine and hypoglycin A in litchi aril of three Chinese cultivars. *Food Chemistry*, *327*, 127013. doi: 10.1016/j.foodchem.2020.127013

Abstract

As a subtropical fruit with high commercial values, litchi is also a source of methylenecyclopropyl glycine (MCPG) and hypoglycin A (HGA), which could cause hypoglycemia and fatal encephalopathy in humans. In this work, a quantitative method was developed well to detect MCPG and HGA present in litchi aril of different cultivars. Method validation was evaluated well by linearity, recovery, precision and sensitivity. Among three cultivars, 'Feizixiao' contained the highest toxin level with 0.60–0.83 mg kg^{-1} of MCPG and 10.66–14.46 mg kg^{-1} of HGA, followed by 'Huaizhi' with 0.08–0.12 mg kg^{-1} of MCPG and 0.63–1.54 mg kg^{-1} of HGA, and 'Nuomici' with 0.09–0.11 mg kg^{-1} of MCPG and 0.35–0.91 mg kg^{-1} of HGA. The toxin levels were highly associated with litchi cultivar and storage time. These findings can provide new knowledge to help to recommend the safe consumption of fresh litchi based on human health.

Keywords: /Litchi/ /Cultivar/ /Methylenecyclopropylglycine/ /Hypoglycin A/ /HPLC–MS/MS/ /Storage/

Zhou, Y., Chen, Z., He, M., Gao, H., Zhu, H., Yun, Z., … Jiang, Y. (2020). Unveiling the complexity of the litchi transcriptome and pericarp browning by single-molecule long-read sequencing. *Postharvest Biology and Technology*, *168*, 111252. doi: 10.1016/j.postharvbio.2020.111252

Abstract

Litchi is a perennial fruit crop with a highly heterozygous genome and complex transcripts. Although fruit senescence and pericarp browning have been extensively studied, the underlying regulatory mechanisms are still poorly understood. In this study, we used long-read sequencing technology in combination with RNA-seq analysis to investigate the diversity and complexity of the litchi transcriptome, as well as differential express of transcripts during litchi fruit storage. We obtained a reference transcriptome with 50,808 unique full-length isoforms, including 41,290 coding sequences (CDS), 1658 transcription factors, 22,100 simple sequence repeats, 2434 long noncoding RNAs, and 151 alternative splicing (AS) events. In addition, 41,290 isoforms had transmembrane helical structure, 33,579 isoforms contained Pfam protein domains, 14,348 isoforms contained SMART protein domains, 4180 isoforms had signal-peptide structure, 19,183 isoforms contained glycosylation sites, and 30,436 isoforms contained furin protease cleavage sites. Using this transcriptome, 1272 isoforms were found to be differentially expressed in litchi fruit pericarp during postharvest storage. The postharvest storage could be divided into a 'senescence onset' stage and a subsequent 'browning' stage according to RNA-seq data. During the 'senescence onset' stage, the expression of isoforms related to senescence and stress response was significantly up-regulated. During the 'browning' stage, the expression of isoforms related to cell wall degradation, oxidation, and disease response was significantly up-regulated. In addition, qPCR analysis showed that the expression changes of 30 isoforms during the postharvest storage of both 'Huaizhi' and 'Guiwei' fruit were consistent with the RNA-seq results, indicating high reliability of our results and inferences.

Keywords: /Fruit senescence/ /Full-length transcriptome/ /Litchi fruit/ /Postharvest storage/ /Second-generation sequencing technologies/ /Third-generation sequencing technologies/

LONGAN FRUITS

Lin, Y., Lin, H., Fan, Z., Wang, H., Lin, M., Chen, Y., … Lin, Y. (2020). Inhibitory effect of propyl gallate on pulp breakdown of longan fruit and its relationship with ROS metabolism. *Postharvest Biology and Technology*, *168*, 111272. doi: 10.1016/j.postharvbio.2020.111272

Abstract

An excessive ROS accumulation in harvested longan (*Dimocarpus longan* Lour.) fruit could promote the pulp breakdown and lower the fruit quality. To solve this problem, the influence of propyl gallate, one kind of ROS scavenger, on the ROS metabolism in pulp of postharvest longans and its connection with the breakdown occurrence of longan pulp were investigated. Contrasted to control samples, the propyl gallate-treated group manifested a lower index of pulp breakdown, MDA content, and production rate of $O_2^{\cdot-}$, but higher gene expression levels of *DlSOD, DlCAT* and *DlAPX*, higher SOD, CAT and APX activities, higher levels of AsA,

flavonoid, GSH and total phenolics, and higher ability of scavenging free radicals. These results revealed that propyl gallate inhibited longan pulp breakdown occurrence, which was because propyl gallate enhanced the ROS scavenging ability and reduced ROS generation and accumulation in longan pulp. These activities involved alleviating the oxidative damage of cell membrane and the peroxidation of membrane lipid in longan pulp, which maintained the structural integrity of longan pulp cell membrane and suppressed the pulp breakdown occurrence in postharvest longan fruit.

Keywords: /Propyl gallate/ /Longan pulp breakdown/ /ROS metabolism/ /ROS scavenging capacity/ /ROS scavenging/ /enzymes/ /Gene expression/

LOTUS

Wen, B., Li, D., Tang, D., Huang, Z., Kedbanglai, P., Ge, Z., … Supapvanich, S. (2020). Effects of simultaneous ultrasonic and cysteine treatment on antibrowning and physicochemical quality of fresh-cut lotus roots during cold storage. Postharvest Biology and Technology, 168. Doi: 10.1016/j.postharvbio.2020.111294

Abstract

The effects of ultrasound (US) power of 200 w at a constant frequency of 40 kHz for 2 min, 0.01 % cysteine (Cys) and combinative application of US and Cys (US + Cys) on browning prevention and quality of lotus root slices were compared during storage at 4 °C for 12 d. The visual appearance, colour attributes including L*, b*, hue, chroma, whiteness index (WI), browning index (BI) and colour difference (ΔE*), browning enzymes activities such as polyphenol oxidase (PPO) and peroxidase (POD), total phenols concentration, texture, total sugars concentration and antioxidant activities were evaluated. US + Cys retarded browning incidence being greater than Cys, US and control treatments, respectively. The browning retardation was concomitant with the retention of high L* and WI values and low b*, chroma, BI and ΔE* value. Cys and US + Cys controlled the increased PPO activity rather than the US. All treatments delayed the increased total phenols concentration compared to control. All treatments maintained hardness of lotus root slices, especially US, and did not affect total sugars concentration. Both sonication treatment enhanced ferric reducing antioxidant potential (FRAP) whilst free radical scavenging activity was enhanced by Cys. In conclusion, both the Cys and US could prevent browning and maintain physicochemical quality of lotus root slices and the simultaneous US and Cys treatment exhibited synergistic antibrowning effects.

Keywords: /Browning reaction/ /Cysteine/ /Ultrasonication/ /Lotus root slices/

MANGO

Anderson, N. T., Walsh, K. B., Subedi, P. P., & Hayes, C. H. (2020). Achieving robustness across season, location and cultivar for a NIRS model for intact mango fruit dry matter content. *Postharvest Biology and Technology*, *168*, 111202. doi: 10.1016/j.postharvbio.2020.111202

Abstract

Short wave near infrared spectroscopy has found use in non-invasive assessment of dry matter content (DMC, % fresh weight) of mango fruit, both as a guide to harvest maturity and ensure eating quality of ripened fruit. In this study, this application is optimised in terms of pre-processing of spectra, the source of variations important to model performance documented, and the performance of cultivar or physiological stage specific partial least squares regression (PLSR) models, global PLSR and an artificial neural network (ANN) model are compared. The data set consisted of 4675 samples acquired across four seasons, ten cultivars and two growing regions, with harvest populations used as cross validation groups. The data of the fourth season was reserved as an independent test set. Spectra pre-treatment of mean centred Savitzy-Golay second derivative (second order polynomial using a 17 point interval) and use of the wavelength range 684−990 nm gave the lowest RMSECV for PLSR models, although other ranges had similar statistics. The fruit physiological stage had the greatest impact on PLSR model performance, compared to cultivar, year or growing region, as estimated using a 'variable importance metric' devised and implemented using a random forest regression. The use of specific (cultivar or physiological stage) PLSR models improved prediction results of the independent validation set (RMSEP on DMC decreased from 1.01 to 0.88 %), and was similar to the result of a global ANN model (0.89 %). The use of an ANN model is recommended in terms of ease of use of a single model across all cultivars.

Keywords: /Artificial neural network/ /Herschel/ /Local/ /Near infra-red/ /Non invasive/ /Partial least squares/ /Fruit quality/

Hor, S., Léchaudel, M., Mith, H., & Bugaud, C. (2020). Fruit density: A reliable indicator of sensory quality for mango. *Scientia Horticulturae*, *272*, 109548. doi: 10.1016/j.scienta.2020.109548

Abstract

There is constant demand from the fresh fruit sector for reliable non-destructive indicators to better predict the sensory quality of fruits. The aim of this study was to evaluate the relevance of density to predict mango sensory quality at the ripening stage. Models were built from density and the day of maturation to predict physicochemical indicators of sensory quality. Density of mangoes cv. 'Kent' from Peru, Ivory Coast, and Brazil were assessed at the green mature stage. Sensory characteristics (sweetness, sourness, mango aroma, and firmness intensity) and physicochemical parameters (dry matter content, soluble solids content, total soluble sugar content, titratable acidity, hue angle, and firmness) were assessed on ripe mangoes after storage at 18 °C. Mangoes with a higher density had a significantly higher intensity of sweetness, mango aroma, and lower intensity of firmness than mangoes with the lower density,

whatever the origin. A minimum difference in density of 0.03-0.04 g mL^{-1} was needed to detect significant sensory differences. Physicochemical parameters associated with sensory quality were predicted by density whatever the origin of the fruit. An increase of 0.01 g mL^{-1} in density respectively led to an increase of 0.5% in dry matter content, total soluble sugar content, and 0.5°Brix in soluble solid content, and a decrease in hue angle of about 2° to 2.5°. A density threshold of 1.000 g mL^{-1} could be applied and easily used to sort heterogeneous batches of mangoes early in the supply chain according to their sensory potential.

Keywords: /Mango/ /Density/ /Sensory quality/ /Physicochemical parameters/ /Prediction model/

ONION

Alamar, M. C., Anastasiadi, M., Lopez-Cobollo, R., Bennett, M. H., Thompson, A. J., Turnbull, C. G. N., Terry, L.A. (2020). Transcriptome and phytohormone changes associated with ethylene-induced onion bulb dormancy. *Postharvest Biology and Technology*, *168*, 111267. doi: 10.1016/j.postharvbio.2020.111267

Abstract

Control of dormancy and sprouting in onion bulbs is commercially important for postharvest management. Although ethylene application is sometimes used to extend dormancy, the underlying mechanisms regulating dormancy transition remain unclear. Since the sprout leaves emerge from the bulb baseplate, we used this tissue to assess the impact of ethylene treatment and storage time on the hormone profile and the transcriptome. Reads from 30 libraries were assembled and annotated, with 94,840 unigenes retained after filtering. The *de novo* transcriptome assembly was of high quality and continuity (N50: 1809 bp, GC content: 36.21 %), and was used to analyse differential expression and Gene Ontologies. Across two years, applied ethylene resulted in delayed dormancy break and reduced post-dormancy sprout vigour. Ethylene supplementation enhanced endogenous ethylene production and caused a transient climacteric-like increase in respiration. Significant changes in hormone and associated transcript profiles occurred through storage and in response to ethylene. In particular, abscisic acid (ABA) and its metabolite phaseic acid (PA) increased under ethylene during the longer dormancy period; however, cytokinin increases observed during storage appeared largely independent of ethylene treatment. Several hormone-related transcripts showed differential expression over time and/or in response to ethylene. Expression of ethylene biosynthesis (*ACO*), receptor (*EIN4*) and transcription factor (*EIL3*) genes were modified by ethylene, as were ABA biosynthesis genes such *NCED,* and cytokinin biosynthesis genes such as *LOG* and *CKX*. We conclude that ethylene substantially modifies expression of genes in several phytohormone pathways, and some of these changes may underlie the dormancy-extending effects of exogenous ethylene.

Keywords: /*Allium cepa*/ /Sprout elongation/ /Ethylene supplementation/ /Abscisic acid/ /Cytokinin/ /Gene expression/

PEACH

Yamane, T., Hayama, H., Mitani, N., Inoue, H., & Kusaba, S. (2020). Contribution of several fruit quality factors and mineral elements to water-soaked brown flesh disorder in peaches. *Scientia Horticulturae*, *272*, 109523. doi: 10.1016/j.scienta.2020.109523

Abstract

Water-soaked brown flesh disorder in peach [*Prunus persica* (L.) Batsch] fruit is a known physiological disorder which can affect the economic value of peach crops. The disorder is more severe in high-quality fruit when maturity and/or ripening advances. Principal component analysis (PCA) of fruit with different qualities and mineral concentrations showed that factors contributing to the first component (PC1) were total soluble solids (TSS), fruit weight, pH, B and Ca concentrations, the ratios of Ca:K, Ca:Mg and Ca:(Mg + K), and the severity of the disorder. Firmness was not grouped in PC1. When firmness was low, the disorder appeared in fruit with high TSS (> 15 %) and low Ca concentration (< 24 mg kg^{-1} FW). $CaCl_2$ application significantly increased Ca concentration in the fruit and reduced the symptoms of the disorder. A bagging treatment to minimize fruit transpiration significantly decreased the Ca concentration during the growing period and in the apoplast of the flesh at harvest, resulting in increased symptoms of the disorder. These results indicated that as well as fruit quality factors, such as TSS, pH and fruit weight, Ca concentration is involved in this disorder. Because the contribution of Ca was not strong compared to the other factors, the effect of Ca on the disorder should be considered in terms of its relationships with other contributing factors, such as the condition of the tree and its environment.

Keywords: /Calcium/ /Boron/ /Firmness/ /pH/ /Total soluble solids/ /Watercore/

PERSIMMON

He, Y., Xue, J., Li, H., Han, S., Jiao, J., & Rao, J. (2020). Ethylene response factors regulate ethylene biosynthesis and cell wall modification in persimmon (Diospyros kaki L.) fruit during ripening. *Postharvest Biology and Technology*, *168*, 111255. doi: 10.1016/j.postharvbio.2020.111255

Abstract

Ethylene plays an essential role in climacteric fruit ripening via the ethylene signaling pathway. Ethylene response factor (ERF) is a critical downstream component of the ethylene signaling pathway. However, the transcriptional regulatory mechanism underlying ERF in persimmon fruit ripening remains poorly understood. Here, we explored the role of *DkERF8/16/18* in regulating persimmon fruit ripening. Transmission electron microscopy showed that persimmon fruit softening was associated with middle lamella degradation and cell wall swelling and distortion. The expression of five ERF genes (*DkERF8*/*16*/*18*/*19*/*24*), twelve cell-wall-modifying genes (*DkPG1*, *DkPL1*, *DkPE1/2*, *Dkβ-GAL1*, *DkEGase1*, *DkXTH2/9/10/11*, *DkMAN1*, *DkEXP4*) and

four ethylene biosynthesis genes (*DkACS1/2*, *DkACO1/2*) was induced by ethylene and suppressed by 1-MCP during persimmon fruit storage. Dual luciferase assays, site mutations and electrophoretic mobility shift assays indicated that DkERF8 and DkERF16 activate *DkXTH11* and *DkEXP4*, respectively, by binding to their promoters. DkERF18 binds to the *DkACS2* promoter, increasing its activity. Transient overexpression of *DkERF8* promotes the conversion of acid soluble pectin to water soluble pectin in persimmon fruit. Moreover, transient overexpression of *DkERF18* resulted in increased ethylene production. These results suggest that *DkERF8/16/18* may be involved in persimmon fruit ripening by promoting cell wall modification and ethylene biosynthesis.

Keywords: /ERF/ /Ethylene/ /Fruit ripening/ /Persimmon/ /Softening/ /Transcriptional regulation/

POSTHARVEST DISEASES

Jiao, W., Liu, X., Chen, Q., Du, Y., Li, Y., Yue, F., … Fu, M. (2020). Epsilon-poly-L-lysine (ε-PL) exhibits antifungal activity in vivo and in vitro against Botrytis cinerea and mechanism involved. *Postharvest Biology and Technology*, *168*, 111270. Doi: 10.1016/j.postharvbio.2020.111270

Abstract

ε-Poly-l-lysine (ε-PL) is a non-toxic food preservative, but the antifungal effect of ε-PL against postharvest pathogenic fungi has rarely been reported. Grey mold caused by *Botrytis cinerea* is one of the main postharvest diseases on fruit and vegetables. The objective of this study was to investigate the antifungal activity of ε-PL against *B. cinerea in vivo* and *in vitro*, and elucidate the underlying mechanism involved. ε-PL treatment significantly inhibited the incidence of grey mold rot on cherry tomato, strawberry, grape, and green pepper caused by *B. cinerea*. Moreover, *in vitro* assay showed that ε-PL exerted strongly antifungal activity against mycelial growth, spore germination, and germ tube elongation of *B. cinerea*, with the increase of the concentration of ε-PL. Furthermore, significant leakages of intercellular electrolytes and protein suggested that ε-PL treatment increased the membrane permeability of *B. cinerea*. Malondialdehyde (MDA) content and Annexin V-FITC/propidium iodide (PI) double staining assay confirmed that ε-PL treatment induced membrane disruption of the test pathogen. Morphological alterations after ε-PL treatment revealed severe damage to *B. cinerea* mycelia, which resulted in distortion and shriveling of mycelial surface. The results indicated that ε-PL exerted antifungal activity by inducing the membrane damage of *B. cinerea*, and ε-PL treatment was a promising approach to controlling postharvest grey mold on fruit and vegetables.

Keyword: /ε-Poly-l-lysine/ /*Botrytis cinerea*/ /Antifungal activity/ /Plasma membrane/

POTATO

Cheng, D., Wang, G., Tang, J., Yao, C., Li, P., Song, Q., & Wang, C. (2020). Inhibitory effect of chlorogenic acid on polyphenol oxidase and browning of fresh-cut potatoes. *Postharvest Biology and Technology*, *168*, 111282. Doi: 10.1016/j.postharvbio.2020.111282

Abstract

In our study, the inhibition mechanism of chlorogenic acid (CGA) on PPO was investigated by enzyme kinetic analysis, fluorescence quenching, thermodynamic parameters analysis, circular dichroism and molecular docking. Our results showed that CGA inhibited PPO activity in a reversible mixed-type manner and K_i was estimated to be 3.577×10^{-4} mol L^{-1}. PPO activity was significantly inactivated by CGA in a dose-dependent manner and IC_{50} was calculated as 1.55×10^{-4} mol L^{-1}. CGA interacts with PPO and quenches its intrinsic fluorescence. Furthermore, results indicated that CGA bound with PPO by hydrophobic interaction. In addition, CGA changed the hydrogen bonding network of PPO and resulted in rearrangement of secondary structure. The molecular docking results suggested that CGA bound to the active site of PPO. Importantly, the efficacy of CGA inhibiting the enzymatic browning of fresh-cut potato slices was confirmed by the inhibition of PPO. Therefore, based on the inhibition of PPO, CGA might represent a new type of inhibitor for fresh-cut potatoes.

Keywords: /Chlorogenic acid/ /Polyphenoloxidase/ /Fresh-cut potatoes/ /Inhibition mechanism/ /Molecular docking/

Zhang, H., Zhao, Z., Song, B., Du, P., & Liu, X. (2020). Light-induced ultrastructure changes of amyloplasts and effect of nitrogen fertilization on greening in potato tubers (Solanum tuberosum L.). *Postharvest Biology and Technology*, *168*, 111275. doi: 10.1016/j.postharvbio.2020.111275

Abstract

Tuber greening causes potato quality decline and economic loss. We investigated physiological mechanisms of greening by fluorescence and transmission electron microscopy. We then explored the effect of nitrogen level (0, 210, and 315 kg N ha^{-1}) on starch granule size and tuber greening of three commercial cultivars. Results showed that chlorophyll content of tuber skin increased (5–8 times) in a quadratic manner with increasing duration of light exposure (0–7 d) in all cultivars. Light-induced greening occurred in cortical parenchyma 0–1.5 mm below the periderm, where chloroplast auto-fluorescence was evident under ultraviolet light. The greening process involved membrane loss, starch granule dissolution, and grana formation in amyloplasts, along with chloroplast development. Formation of grana lamellae was observed around amyloplasts with a diameter of 9–30 μm. Nitrogen application increased the percentage of small granule starch (<30 μm) in tuber skin and thereby promoted tuber greening under light

in all cultivars. This study provides new evidence for the mechanisms of tuber greening and nitrogen management in potatoes.

Keywords: /Potato tuber greening/ /Chlorophyll/ /Amyloplast size/ /Fluorescence micrograph/ /Transmission electron microscopy/ /Nitrogen level/

RASPBERRY

Piechowiak, T., Grzelak-Błaszczyk, K., Sójka, M., & Balawejder, M. (2020). Changes in phenolic compounds profile and glutathione status in raspberry fruit during storage in an ozone-enriched atmosphere. *Postharvest Biology and Technology*, *168*. Doi: 10.1016/j.postharvbio.2020.111277

Abstract

The aim of this study was to investigate the effect of ozone treatment on the phenolic compounds profile and glutathione metabolism in raspberry fruit. Raspberry fruit was stored at room temperature for 72 h and ozonated daily with gaseous ozone at the concentration of 8−10 mg L^{-1} for 30 min, every 12 h of storage. Research showed that the ozonation process significantly affects the level of phenolic compounds and glutathione (GSH) in raspberry fruit during storage at room temperature. Ozone treatment inhibited the enzymes involved in phenolic compounds degradation i.e. tannin acyl hydrolase, gallate decarboxylase and polyphenol oxidase leading to reduce the loss of polyphenols during storage. Moreover, ozone treatment increased the activity of glutathione reductase and glutathione peroxidase which contributed to reduce the loss of glutathione (GSH) and higher ability of ozonated fruit to scavenge the hydrogen peroxide.

Keywords: /Antioxidants/ /Berries/ /Oxidative stress/ /Ozonation/ /Shelf-life/

RED BELL PEPPERS

O'Donoghue, E. M., Somerfield, S. D., Chen, R. K. Y., Tiffin, H. R., Hunter, D. A., & Brummell, D. A. (2020). Cell wall composition during expansion, ripening and postharvest water loss of red bell peppers (Capsicum annuum L.). *Postharvest Biology and Technology*, *168*, 111225. doi: 10.1016/j.postharvbio.2020.111225

Abstract

We have investigated the cell wall polysaccharides of a commercially grown blocky-type red bell pepper (*Capsicum annuum* L. 'Funky') during on-plant growth and ripening, and after postharvest water loss. There was no evidence of substantial depolymerisation of cell wall pectic polysaccharides or hemicelluloses at any ripening stage. The onset of fruit ripening was accompanied by a slightly increased solubilisation of very high molecular weight polyuronides.

Measurable polygalacturonase activity was absent, despite an *endo*-polygalacturonase mRNA being present as fruit turned red. The largest cell wall change was a substantial loss of galactose (primarily from Na_2CO_3-soluble rhamnogalacturonan-I) as green fruit approached full size, which could not be directly correlated with conventionally assayed β-galactosidase/galactanase activities. The majority of β-galactosidase/galactanase gene expression and enzyme activity was found in fully ripe fruit, although by this stage galactose loss was comparatively minimal. This suggests that the upregulation in activity has significance beyond wall rheology, or is vestigial. Severe water-stress applied to harvested ripe fruit did not result in any cell wall changes suggestive of cell wall breakdown, compared with cell walls of fruit stored under high humidity conditions. We conclude that this commercial line of bell pepper, which was bred for intensive glasshouse production, has wall characteristics that result in retention of typical crisp texture and extended postharvest storage life.

Keywords: /Capsicum/ /Bell pepper/ /Galactose/ /Pectin/

SPINACH

Torres, I., Sánchez, M. T., & Pérez-Marín, D. (2020). Integrated soluble solid and nitrate content assessment of spinach plants using portable NIRS sensors along the supply chain. *Postharvest Biology and Technology*, *168*, 111273. Doi: 10.1016/j.postharvbio.2020.111273

Abstract

There has been increased interest in the implementation of near infrared spectroscopy (NIRS) as a non-destructive analytical technique to monitor the quality and safety of vegetables during their growing season and after harvest, throughout the food supply chain. The aim of this work was to evaluate the feasibility of using a portable NIR spectrophotometer (the MicroNIR™ Pro 1700 (spectral range 908–1676 nm) working in reflectance mode) based on Linear Variable Filter (LVF) technology to analyse soluble solid content (SSC) and nitrate content in spinach plants *in situ,* in the field and along the supply chain. A total of 77 spinach plants were analysed at three control points of the supply chain: 1) in the field, during the growing season and after harvest, 2) in the lab, simulating conditions at receipt at the processing industry and 3) on the leaves in the lab, after washing, thus simulating the analysis of the processed product ready to be packaged, as a previous step for the novel application of NIRS at delivery points and in the supermarkets. The results confirmed the feasibility of using this spectrophotometer throughout the supply chain to establish product quality and safety, which would allow to make real-time decisions related to the agricultural practices, optimum harvest time, industrial uses and commercial shelf-life. The comparison between the models developed for the NIRS analysis in the three control points studied indicated that the recommended procedure would be to take a single spectrum per plant as a suitable way of predicting quality and safety parameters in the field and at the reception points in the industry. Two spectra on each of the two leaves should be taken after the washing operation in the industry, with values of the standard error of cross validation of 1.0 % for SSC and 766 mg kg^{-1} for nitrate content.

Keywords: /Spinach/ /Supply chain control/ /NIRS/ /Quality and safety assessment/ /Real-time decision making/

SQUASH

Rodov, V., Paris, H. S., Friedman, H., Mihiret, M., Vinokur, Y., & Fennec, A. (2020). Chilling sensitivity of four near-isogenic fruit-color genotypes of summer squash (Cucurbita pepo, Cucurbitaceae) and its association with tocopherol content. *Postharvest Biology and Technology*, *168*, 111279. Doi: 10.1016/j.postharvbio.2020.111279

Abstract

Accessions of *Cucurbita pepo* vary in the sensitivity of their young fruit (summer squash) to chilling injury (CI). The dominant gene *B* (*Bicolor*), which confers yellow fruit coloration, is known to increase susceptibility of summer squash to CI as compared with green, *b/b*, fruit. Another dominant gene, *D* (*Dark stem*), confers dark plant stems and somewhat enhanced coloration of the young fruit. However, the effect of this gene on chilling sensitivity of summer squash is unknown. Freshly harvested fruit of vegetable marrow-type summer squash from four near-isogenic genotypes, *B/B D/D*, *B/B d/d*, *b/b D/D*, and *b/b d/d*, were stored for 14 d at three temperature regimes, 4–5, 8–9, and 11–12 °C. Storage at 4–5 °C resulted in CI development in the fruit of all four genotypes. The yellow, *B/B* genotypes suffered injury also at 8–9 °C, especially the fruit of the light yellow, *B/B d/d* genotype that showed slight CI symptoms even at 11–12 °C. Chilling tolerance of the genotypes was in accordance with the total tocopherol contents of their exocarp, being highest in the green-skinned *b/b* accessions and lowest in the light yellow *B/B d/d* genotype. Relatively higher tocopherol content and lower CI severity were observed in the fruit of the enhanced-yellow *B/B D/D* genotype. The dominant *D* allele can partially alleviate the CI sensitivity of summer squash that is conferred by the dominant *B* allele.

Keywords: /Summer squash/ /Genotype/ /Color/ /Chilling injury/ /Tocopherol/

STRAWBERRY

An, X., Li, Z., Zude-Sasse, M., Tchuenbou-Magaia, F., & Yang, Y. (2020). Characterization of textural failure mechanics of strawberry fruit. *Journal of Food Engineering*, *282*, 110016. doi: 10.1016/j.jfoodeng.2020.110016

Abstract

Fresh strawberry fruit is highly susceptible to damage during mechanical handlings. To prevent fruit macro-damage from external forces and predict damage evolution in internal tissues, the textural failure mechanics of strawberry fruit and its tissues were characterized by loading-unloading tests at different compression speeds. Strawberry fruit showed expected three stages of deformation during the loading phase, namely elastic, local plastic and structural failure deformation. Their cut-off points depended on the compression speed and loading

direction, which was validated further by the corresponding visible browning processes in tissues from fruit longitudinal equatorial sections. The peak force and absorbed energy depended on the loading direction and compression speed while the percentage of damaged mass only depended on the loading direction. The fruit was most susceptible to mechanical damage when it was compressed along its stem-blossom axis at low percentage deformation and along its radial axis at high percentage deformation. The absorbed energy and percentage of damaged mass of the strawberry fruit was correlated, which suggested that the absorbed energy could be an appropriate and easily measurable mechanical parameter for quantitatively assessing the degree of fruit damage. The failure stress, failure energy and elastic modulus of fruit tissues increased with the compression speed, while this factor did not affect the failure strain. The average failure stress, failure strain, failure energy and elastic modulus of fruit inner tissue were 0.093 MPa, 17.7%, 8.09 mJ, 0.53 MPa, which was 1.27, 1.14, 1.47, 1.15 times enhanced compared to values of outer tissue ($p < 0.05$), respectively.

Keywords: /Strawberry fruit/ /Brown tissue/ /Failure mechanics/ /Elastic modulus/ /Percentage of damaged mass/

Molina-Chavarria, A., Félix-Valenzuela, L., Silva-Campa, E., & Mata-Haro, V. (2020). Evaluation of gamma irradiation for human norovirus inactivation and its effect on strawberry cells. *International Journal of Food Microbiology*, *330* , 108695. doi: 10.1016/j.ijfoodmicro.2020.108695

Abstract

Norovirus (NoV) is the leading cause of epidemic and sporadic gastroenteritis worldwide; a high number of those cases are attributed to the consumption of contaminated food. Crop producers have used several strategies to inactivate the virus present in these products and thus stop the NoV transmission chain. Physical methods such as gamma radiation show excellent results in the inactivation of bacteria, but its effect on NoV has been little studied. This study aimed to evaluate the effect of gamma radiation for NoV inactivation, and over the surface topographic characteristics of strawberry cells, as a prototype of soft fruit. A 10% suspension of GII norovirus-positive stool samples were treated with either 200 mg/L of sodium hypochlorite (NaClO) or gamma-irradiated at doses of 5, 10, 15 and 20 kilograys (kGy). Viral inactivation was determined by measuring the integrity of viral capsid using RNase A alone or in combination with proteinase K followed by RT-qPCR. The effect over cellular surface topology characteristics of the fruit was measured by atomic force microscopy (AFM) and confocal microscopy. High doses of radiation (20 kGy) were necessary to detect a significant ($p < 0.05$) decrease of up to 1.26 $\log_{10}$ viral copy number. This dose significantly ($p < 0.05$) raises the root mean square roughness (Rq), which affects directly the quality and texture of the product. The gamma irradiation doses tested in this study were not enough to inactivate NoV. The allowed gamma irradiation doses for fresh produce does not alter the surface topology of the fruit, but they affect the content of fluorescent compounds, responsible for the antioxidant activity of the fruit.

Keywords: /Viral quantitation/ /Sodium hypochlorite/ /Gamma-irradiation/ /Vegetables/ /Norovirus/

Pang, L., Wu, Y., Pan, Y., Ban, Z., Li, L., & Li, X. (2020). Insights into exogenous melatonin associated with phenylalanine metabolism in postharvest strawberry. *Postharvest Biology and Technology*, *168*. Doi: 10.1016/j.postharvbio.2020.111244

Abstract

Melatonin is a kind of multifunctional hormone, analogous to indoleacetic acid in structure. To uncover the relationship between exogenous melatonin and the phenylalanine pathway, the liquid chromatography mass spectrometry (LCMS) was performed to quantify endogenous melatonin and individual anthocyanin content. RT-qPCR was used to explore the expression of primary genes involved in anthocyanin biosynthesis. In the present study, we found that the morphology and endogenous melatonin content of strawberries showed a significant improvement and increase in the M50 compared with the other groups. Additionally, anthocyanin accumulation and gene up-regulation, in both the M50 and the M100, all revealed higher levels than that of the control. In conclusion, this work revealed the positive relationship between exogenous melatonin and the phenylalanine metabolism of strawberries.

Keywords: /Melatonin/ /Phenylalanine metabolism/ /Morphology/ /Anthocyanin/

Shu, P., Min, D., Ai, W., Li, J., Zhou, J., Li, Z., … Guo, Y. (2020). L-Arginine treatment attenuates postharvest decay and maintains quality of strawberry fruit by promoting nitric oxide synthase pathway. *Postharvest Biology and Technology*, *168*, 111253. doi: 10.1016/j.postharvbio.2020.111253

Abstract

In this study, the impacts of Arginine (Arg) on strawberry fruit quality and postharvest decay caused by fungi, as well as on the nitric oxide synthase (NOS) pathway of strawberry fruit, were considered. Strawberry fruits were first treated with 0, 0.5, 1, 5, and 10 mM Arg solution, and the result showed that treatment with 1 mM Arg was the best in inhibiting fruit decay and maintaining fruit quality, which is indicated by firmness, titratable acid, soluble solid content and respiration rate. To investigate the action mechanism of Arg and determine whether NOS is involved in the process, strawberry fruits were further treated with 1 mM Arg and 0.2 mM N^{ω}-nitro-*L*-arginine (*L*-NNA), a specific inhibitor of NOS, before storage at 20 ± 1 °C. In addition to reducing the decay incidence (DIC) and the decay index (DI), 1 mM Arg triggered NO accumulation, resulting from higher NOS activity, which is associated with a higher vitamin C, anthocyanin and total phenolic content, as well as the activities of the antioxidant enzymes - superoxide dismutase (SOD), catalase (CAT), peroxidase (POD) and ascorbate peroxidase (APX) - which are associated with a lower malondialdehyde (MDA) content. Moreover, the expression level of the pathogenesis-related protein1 (*FaPR1*) and the activities of the defense enzymes - phenylalanine ammonia lyase (PAL), chitinase (CHI), β-1,3-glucanase (GLU) and polyphenol oxidase (PPO) – were higher in the Arg-treated fruits. However, such effects of 1 mM Arg treatment on strawberry fruits were almost reversed by the simultaneous addition of 0.2 mM *L*-NNA, leading to severer fruit decay. In addition, correlation analysis showed that Arg treatment significantly improved the correlation of NO with the activities of GLU (R^2 = 0.72*), CHI (R^2 = 0.85**), PAL (R^2 = 0.67*) and APX (R^2 = 0.72*). These findings indicated that Arg

treatment might be a useful technique to improve quality and delay postharvest decay in strawberry fruit, and the NOS pathway played an important role in this process.

Keywords:/ *L*-arginine/ /Strawberry/ /Fruit quality/ /Postharvest decay/ /NO/ NOS/

TEA LEAVES

Yu, X., Li, Y., He, C., Zhou, J., Chen, Y., Yu, Z., … Ni, D. (2020). Nonvolatile metabolism in postharvest tea (Camellia sinensis L.) leaves: Effects of different withering treatments on nonvolatile metabolites, gene expression levels, and enzyme activity. *Food Chemistry*, *327*, 126992. doi: 10.1016/j.foodchem.2020.126992

Abstract

The influence mechanism of different withering methods (CK, indoor natural spreading; LTD, low-temperature plus dark; LTY, low-temperature plus yellow-light; LTCD, low-temperature plus CO_2) on non-volatile compounds in postharvest tea leaves was investigated by UHPLC-Q-TOF/MS-based non-targeted metabolomic and transcriptomic analyses. Compared with CK, low-temperature withering could slow down polyphenol oxidation by inhibiting polyphenol oxidase activity and keeping the expression of genes for flavanol synthesis. After withering, the proteinaceous amino acid content increased significantly, especially for LTCD and LTY, mainly due to increased peptidase activity and up-regulation of genes involved in the biosynthesis of valine, leucine, aspartic acid, glutamic acid, phenylalanine, and proline. Moreover, LTCD and LTY enhanced the synthesis of γ-aminobutyric acid and metabolism of phenylalanine-methyl salicylate and tryptophan-indole, respectively. Meanwhile, the transformation of theobromine to caffeine was accelerated under low-temperature withering. This research provides a genetic metabolic basis for the application of low-temperature withering to actual green tea processing.

Keywords: / UHPLC-Q-TOF/MS/ /Low-temperature withering/ /Nonvolatile metabolism/ /Green tea/ /Taste quality/

TOMATO

Tang, N., An, J., Deng, W., Gao, Y., Chen, Z., & Li, Z. (2020). Metabolic and transcriptional regulatory mechanism associated with postharvest fruit ripening and senescence in cherry tomatoes. *Postharvest Biology and Technology*, *168*, 111274. doi: 10.1016/j.postharvbio.2020.111274

Abstract

Fruit senescence is an inevitable and negative developmental process during postharvest storage of cherry tomatoes. To characterize the physiological and molecular mechanisms underlying postharvest fruit ripening and senescence, gas chromatography-mass spectrometry (GC–MS) and RNA-Seq were employed to analyze the metabolic and transcriptomic profiles

after 7, 14, 21, and 28 d of storage at different temperatures. Several metabolites, such as GABA, proline, fructose, glucose, mannose, and talose, were accumulated in response to senescence stress at ambient temperature (RT). We also observed an outstanding decrease in organic acids (OAs, e.g., citric acid, malic acid, butanedioic acid, *cis*-aconitic acid) under RT, resulting in fruit quality deterioration. The contents of OAs were maintained upon storage at low temperature. Integrated co-expression network analysis combining transcriptome and metabolite data revealed high correlations between OAs and genes involved in primary metabolic pathways (e.g., *PEPC3*, *IDH3*, *PDHA*, *MDH*, *PEPCK1*), plant hormones (especially ethylene and ABA) and transcription factors (e.g., MYB, AP2/ERF, WRKY, NAC). RNA-Seq data indicates ethylene and ABA biosynthesis and signaling genes, including *ACS2*/*4*, *ACO1/4*/*5*, *EBF*, *NCED*, *ABA8ox1*, *PYR1/PYL4*, may be key regulators in coordinating postharvest fruit senescence in cherry tomato. In summary, our findings reveal the degradation of OA is an indication of fruit senescence, mainly modulated by a network of ethylene, ABA and transcription factors.

Keywords: /Cherry tomato/ /Postharvest fruit ripening/ /Fruit senescence/ /Transcriptome/ /Metabolites/