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As of May 2021

APPLE

Chen, C., Jiang, A., Liu, C., Wagstaff, C., Zhao, Q., Zhang, Y., & Hu, W. (2021). Hydrogen sulfide inhibits the browning of fresh-cut apple by regulating the antioxidant, energy and lipid metabolism. *Postharvest Biology and Technology, 175*, 111487. https://doi.org/10.1016/j.postharvbio.2021.111487

Abstract

Surface browning is the primary limiting factor for the shelf-life of fresh-cut apples. Hydrogen sulfide (H_2S) treatment is known to effectively inhibit the browning, however, little is known about the underlying molecular mechanism. In the present paper RNA-Seq technology was used to analyse the transcript expression profiles of control and H_2S treated fresh-cut apple immediately after treatment (C0 and S0) and 6 d of storage (C6 and S6) at 4 °C. The results identified 3782 and 1164 differentially expressed unigenes (DEGs) in S0 *vs.* C0 and S6 *vs.* C6, respectively. Expression of most DEGs related to antioxidant systems and energy metabolism was up-regulated after H_2S treatment, whilst expression of genes encoding polyphenol oxidase, peroxidase, lipid-degrading enzymes, such as lipoxygenase and phospholipase D, was repressed. Further quantitative real-time PCR testing validated the reliability of our RNA-Seq results. We therefore propose that H_2S treatment inhibits the surface browning of fresh-cut apples by regulating antioxidant, energy and lipid metabolism to maintain the membrane integrity of the plant tissue.

Keywords: /Fresh-cut apple/ /Hydrogen sulfide/ /Browning/ /Transcriptome/

Lan, W., Jaillais, B., Renard, C. M. G. C., Leca, A., Chen, S., Le Bourvellec, C., & Bureau, S. (2021). A method using near infrared hyperspectral imaging to highlight the internal quality of apple fruit slices. *Postharvest Biology and Technology*, *175*, 111497. https://doi.org/10.1016/j.postharvbio.2021.111497

Abstract

The heterogeneity of apple fruit was highlighted by near-infrared hyperspectral imaging (NIR-HSI) using a data analysis in two successive steps. First, NIR-HSI images were acquired on the cut surface of six transverse slices per apple, which were then systematically sampled with 5 or 6 cylinders per slice. PCA carried out on the NIR-HSI images allowed to select 141 representative cylinders from the total dataset (1056 samples), in which the contents of dry matter (DMC), total sugars (TSC), fructose, glucose, sucrose, malic acid and polyphenols were quantified by spectrophotometry and chromatography. In a second step, leave-one-out PLS models were developed and successfully used to describe the distribution of DMC ($R_{cv}^2 = 0.83$, RPD = 2.39) and TSC ($R_{cv}^2 = 0.81$, RPD = 2.20) in each apple slice. A strong heterogeneity of DMC and TSC was detected inside each fruit. Such a simple and rapid method reduced the needs of numerous chemical characterizations to demonstrate the distribution of quality traits within and between fruit and contributed to better manage the fruit quality measurements.

Keywords: /*Malus domestica* borkh/ /Partial least square regression/ /Random forest regression/ /Apple variability and heterogeneity/

Sha, J., Ge, S., Zhu, Z., Du, X., Zhang, X., Xu, X., & Jiang, Y. (2021). Paclobutrazol regulates hormone and carbon-nitrogen nutrition of autumn branches, improves fruit quality and enhances storage nutrition in 'Fuji' apple. *Scientia Horticulturae, 282*, 110022. https://doi.org/10.1016/j.scienta.2021.110022

Abstract

Inhibiting the overgrowth of autumn branches during the fruit enlargement stage is one important way to improve the quality of apple fruits. Here, four levels of paclobutrazol (PBZ) (0, 500, 1000, 1500, and 2000 mg·L−1) were applied to the autumn branch leaves of five-year-old 'Fuji' apples (Malus × domestica Borkh.) trees at the fruit enlargement stage in 2018 and 2019. The results showed that increasing PBZ levels decreased indole-3-acetic acid (IAA) and gibberellic acid (GA3) contents and increased abscisic acid (ABA) contents in the autumn branch leaves. PBZ also reduced the leaf area, branch length, leaf number, and Rubisco enzyme activity in the autumn branches, but had no significant effect on chlorophyll and net photosynthetic rate. Obvious changes occurred when the concentration of PBZ exceeded 1500 mg·L−1, including the inhibition of autumn branch growth. 13C and 15N isotope labeling results indicated that PBZ coordinated the carbon–nitrogen nutrition of autumn branches in the fruit enlargement stage, reduced the δ13C and nitrogen derived from fertilizer (Ndff) in the leaves of autumn branches. PBZ also coordinated the carbon–nitrogen nutrition of fruits, reduced the accumulation of nitrogen in the fruit and increased the accumulation of carbon in the fruit. PBZ increased the content of soluble sugar, starch, soluble protein, and free amino acids in the roots to varying degrees in early spring the following year (2019 and 2020). These results indicated that a moderate PBZ (1000–1500 mg·L−1) application could reasonably regulate carbon-nitrogen nutrition of autumn branches and fruits, then improve fruit quality and the storage nutrition of apple trees.

Keywords: /Apple/ /Paclobutrazol/ /Autumn branch/ /13C/ /15N/ /Fruit quality/ /Storage nutrition/

Wei, C., Zhang, F., Song, L., Chen, X., & Meng, X. (2021). Photosensitization effect of curcumin for controlling plant pathogen Botrytis cinerea in postharvest apple. *Food Control*, *123*, 107683. https://doi.org/10.1016/j.foodcont.2020.107683

Abstract

Photosensitization is a novel, non-thermal and effective technology to inactivate microorganisms. The inhibitory effect and its mechanism of curcumin-based photosensitization on plant pathogen *B. cinerea* are investigated in this study. Significant changes have been observed upon photosensitization, which include a reduction of 96.2% in spore germination when spores were mixed with 0.5 mM curcumin and exposed for 5 min, a complete control on lesion enlargement of gray mold in apple fruit after 10 min. Morphological changes, losses of membrane integrity and variations of cell wall polysaccharide deposition in treated *B. cinerea* cells were observed. Furthermore, after photosensitization, a series of apoptotic characteristics, such as the accumulation of ROS and Ca^{2+}, the decrease of mitochondrial membrane potential (MMP) and nuclear fragmentation were observed. Collectively, these data provided evidence that curcumin-based photosensitization is an effective method to control the plant pathogen *B. cinerea.*

Keywords: /Photosensitization/ /Curcumin/ /*Botrytis cinerea*/ /Apoptosis/ /ROS production/Arugula

CABBAGE

Liang, N., Hu, X., Li, W., Mwakosya, A.W., Guo, Z. Xu, Y., Huang. X., Li, Z., Zhang, X., Zou, X., & Shi, J. (2021). Fluorescence and colorimetric dual-mode sensor for visual detection of malathion in cabbage based on carbon quantum dots and gold nanoparticles. *Food Chemistry, 343,* 128494. https://doi.org/10.1016/j.foodchem.2020.128494.

Abstract

A dual-mode fluorescence/colorimetric sensor based on carbon quantum dots (CQDs) and gold nanoparticles (GNPs) was developed for visual detection of malathion in cabbage. The CQDs-GNPs nanocomposite exhibited emission wavelength at 527 nm and absorption wavelength at 524 nm. The fluorescence intensity increased and absorption decreased with addition of malathion. Fluorescence and colorimetric calibration curves were established based on fluorescence intensity (R2 = 0.9914) and absorbance (R2 = 0.9608) in the range of 1 × 10−9–1 × 10−2 M, respectively. Furthermore, fluorescence and colorimetric standard arrays were prepared for visual detection of malathion according to the change of fluorescence brightness and color. Finally, the approximate concentrations of malathion in cabbage samples were estimated by the standard arrays and naked eyes. The calibration curves were used for accurate detection in cabbage samples with recoveries of 89.9%–103.4% (fluorescence) and 88.7%–107.6% (colorimetric). The established sensor for visual malathion detection in cabbage was accurate with strong application potential, especially for rapid screening.

Keywords: /CQDs-GNPs/ /Malathion/ /Fluorescence/ /Colorimetric/ /Carbon quantum dots/ /Gold nanoparticles/

Liu, C., Song, G., Wang, N., Huang, S., Gao, Y., Fu, W., & Feng, H. (2021). A single SNP in Brcer1 results in wax deficiency in Chinese cabbage (Brassica campestris L. ssp. pekinensis). *Scientia Horticulturae*, *282*, 110019. https://doi.org/ 10.1016/j.scienta.2021.110019

Abstract

Cuticle wax covering the surface of plants is mainly composed of derivatives of long-chain saturated fatty acids. Chinese cabbage leaves with wax deficiency have a bright green phenotype, which makes it attractive and improves its commercial value. In this study, a wax deficiency mutant, *cer1*, was obtained from an ethyl methanesulfonate (EMS) mutagenesis population in Chinese cabbage. Scanning electron microscopy (SEM) revealed that cuticular wax in the leaves and stems of mutants was significantly less than that in the wild type (WT). The mutants decreased the total wax, alkanes, ketones and alcohols contents in leaves, but aldehydes content increased compared to WT. Genetic analysis showed that the mutant *cer1* phenotype was controlled by a single recessive nuclear gene. MutMap and Kompetitive Allele-Specific PCR (KASP) analyses indicated that *BraA09g066480.3C*, which encoded aldehyde decarboxylase, might be the causal gene. A single nucleotide substitution (SNP) from C to T in the fourth exon of *BraA09g066480.3C* resulted in an amino acid substitution from serine to phenylalanine, which led to changes in the three-dimensional structure of proteins. SNP 45,148,866 occurred in the highly conserved fatty acid hydroxylase domain. This study revealed that SNP is effective for marker-assisted selection of wax deficient Chinese cabbage and provides convenience for breeding new varieties exhibiting a wax deficient phenotype.

Keywords: /Chinese cabbage/ /EMS/ /MutMap/ /Wax deficiency mutant/

CELERY

Turner, L., Lignou, S., Gawthrop, F., & Wagstaff, C. (2021) Investigating the factors that influence the aroma profile of Apium graveolens: A review. *Food Chemistry, 345,* 128673. https://doi.org/10.1016/j.foodchem.2020.128673

Abstract

Celery (Apium graveolens) is a regularly consumed vegetable, providing strong, distinct flavours to dishes as well as health benefits. Constituents of the aroma profile of celery include a range of volatile compounds (terpenes, phthalides and aldehydes) that contribute to its characteristic odour and flavour. Vast amount of research has been completed on the aroma profile of celery. However, there is limited

information stating the cultivar, origin and geographical location, despite that research on a plethora of other crops has indicated that these are key factors driving crop performance and quality attributes. This paper characterises the underlying biochemistry that determines the aroma profile of celery, whilst investigating the genetic and environmental influences leading to its variation. We make recommendations for minimum standards (MIAPAE:Minimum Information About a Plant Aroma Experiment) that should be adopted by the scientific community prior to publication of data relating to flavour and aroma characterisation of crops.

Keywords: /Celery/ /Aroma/ /Volatile compounds/ /Phthalides/ /Terpenes/ /MIAPAE/

CHERRY

Ponce, E., Alzola, B., Cáceres, N., Gas, M., Ferreira, C., Vidal, J., & Fuentealba, C. (2021). Biochemical and phenotypic characterization of sweet cherry (Prunus avium L.) cultivars with induced surface pitting. *Postharvest Biology and Technology*, *175*, 111494. https://doi.org/10.1016/j.postharvbio.2021.111494

Abstract

One important physiological disorder in sweet cherry (*Prunus avium* L.) is surface pitting. This disorder involves irregular depressions on the fruit surface and occurs during harvest, but it develops during cold storage. The aim of this research was to understand the phenotypic characteristics and biochemical responses, referring to the metabolomic profile and the composition and disassembly of the cell wall, that underlie the susceptibility to pitting. The study was carried out using cultivars with contrasting pitting behaviors, such as Bing (resistant) and Sweetheart (sensitive), during ripening and postharvest storage. Induced pitting did not have a negative impact on quality parameters except visual quality in sweet cherries during cold storage, and firmness was not a key parameter that explained the susceptibility to pitting. The mechanical stress to induce pitting triggered a significant decline in pectin methylesterase (PME) activity on day 14 of storage for the Sweetheart cultivar. Intensified labeling for methylated homogalacturonan immunostaining of pitted mesocarp cells in Bing was observed. Xyloglucan showed more abundant labeling in pitted samples, which was more pronounced in Sweetheart fruit than Bing cherries. The metabolomic screening showed a higher content of organic acids and amino acids in the Sweetheart cultivar, while the Bing cultivar had higher contents of sorbitol and arabinitol. Proline and 2-oxoglutaric acid emerged as metabolites altered in response to mechanical stress in both cultivars. Furthermore, pitted Bing fruit elicits anthocyanin overexpression. The metabolomic analysis suggests that susceptibility to pitting could depend on the metabolic differences of each cultivar because the induced pitting did not greatly disrupt the studied metabolic responses.

Keywords: /Sweet cherry/ /Surface pitting/ /Cell wall enzymes/ /Metabolomic/

Zhang, Q., Yang, W., Liu, J., Liu, H., Lv, Z., Zhang, C., & Jiao, Z. (2021). Postharvest UV-C irradiation increased the flavonoids and anthocyanins accumulation, phenylpropanoid pathway gene expression, and antioxidant activity in sweet cherries (Prunus avium L.). *Postharvest Biology and Technology*, *175*, 111490. https://doi.org/10.1016/j.postharvbio.2021.111490

Abstract

Ultraviolet (UV) influences postharvest changes in secondary metabolites of fruit. In this study, sweet cherries were treated with UV-C irradiation (1.05, 2.10, and 4.20 kJ/m^2) for different treatment periods, they were stored at room temperature (25.0 ± 2.0 °C) for 6 days. The results showed that the total phenolics, flavonoids, and anthocyanins increased in response to UV-C during storage. UPLC-ESI-MS analysis indicated that the individual flavonoids and anthocyanins contents increased, including cyanidin 3-*O*-galactoside, cyanidin *O*-syringic acid, cyanidin 3-*O*-glucoside, pelargonidin 3-*O*-glucoside, tricin 5-*O*-hexoside, luteolin *C*-hexoside, Di-*O*-methylquercetin, and naringenin-7-*O*-glucoside. Furthermore,

UV-C (2.10 kJ/m^2) treatment upregulated the enzyme activity and gene expression of the phenylpropanoid pathway. Highly significant correlations were found among flavonoids, anthocyanins, phenylalanine ammonia lyase (PAL) and genes expression of *ANS*, *DFR*, *UFGT* ($r > 0.6$, $p < 0.01$) and cinnamate 4-hydroxylase (C4H) and *PAL*, *C4H*, *4CL*, *CHI*, *ANS*, *DFR* expressions ($r > 0.6$, $p < 0.01$). These results contribute to illustrating the molecular mechanism of flavonoids and anthocyanins biosynthesis under the UV-C irradiation in sweet cherries and promote the development of postharvest in agriculture.

Keywords: /UV-C irradiation/ /Sweet cherry/ /Flavonoids/ /Enzyme activity/ /Gene expression/ /Antioxidant activity/

CITRUS

Lafuente, M. T., Ballester, A. R., Holland, N., Cerveró, J., & Romero, P. (2021). Interrelation between ABA and phospholipases D, C and A2 in early responses of citrus fruit to Penicillium digitatum infection. *Postharvest Biology and Technology*, *175*, 111475. https://doi.org/10.1016/j.postharvbio.2021.111475

Abstract

We investigated whether phospholipases play a role in citrus fruit susceptibility to be infected by *Penicillium digitatum,* and whether a connection exists between hormone abscisic acid (ABA) and phospholipases in the citrus fruit-*P. digitatum* interaction. Changes in both the activity of enzymes PLD, PLC and PLA_2 and the expression of a set of genes encoding them in response to infection in Navelate (*Citrus sinensis* (L.) Osbeck) orange and its ABA-deficient mutant Pinalate, which is less resistant to infection, were compared. The results showed the activation of PLD and PLC in infected Navelate fruit before disease development, and this activation was attenuated in the mutant, which suggests that both enzymes play a protective role in citrus fruit to cope with *P. digitatum* infection and the participation of ABA in their regulation. The transcriptional analyses further demonstrated a differential activation of various phospholipases-encoding genes by the fungus. Of the *CsPLD* genes (*CsPLDα, CsPLDβ, CsPLDδ, CsPLDγ, CsPLDζ*), the fungus had a stronger effect on *CsPLDγ* and *CsPLDζ*. This is the first report to suggest the participation of a *PLDζ* isoform in the plant-microbe interaction, and to indicate that this gene may be modulated by ABA in response to infection. The results also revealed that the *CsPLC* isoforms encoding both non-specific PLC (NPC) and phosphoinositide-specific PLCs (PI-PLC) may participate in the citrus fruit-*P. digitatum* interaction, and that ABA action occurs upstream of *CsPI-PLC* gene activation in infected citrus fruit. The changes induced by the fungus in PLA_2 activity and gene expression were less relevant.

Keywords: /Abscisic acid-deficiency/ /Fungal disease/ /Green mold/ /Phospholipase isoforms/ /Resistance to infection/

Sun, C., Aernouts, B., & Saeys, W. (2021). Effects of harvest time, fruit size and cultivar on the bulk optical properties of Satsuma mandarin. *Postharvest Biology and Technology*, *175*, 111412. https://doi.org/10.1016/j.postharvbio.2020.111412

Abstract

As Satsuma mandarin is a multi-layered fruit, the optical properties of the different tissue layers influence the performance of spectroscopy-based quality detection models. Therefore, the variation in the bulk optical properties (BOP) of the inner (juice vesicles) and outer (flavedo) tissue layer of Satsuma mandarin was investigated for different harvest times, fruit sizes and cultivars. Satsuma mandarin fruit from three different cultivars (Iwasaki, Okitsu and Goku Wase) were harvested at three different times around the recommended harvest date and the BOP of the inner and outer tissue layers were estimated from double integrating spheres measurements. Along the harvest time, the absorption peak related to carotenoids in

the bulk absorption coefficient (μ_a) spectrum increased in both tissue layers, while the values attributed to chlorophylls decreased in the flavedo. Moreover, a slightly increasing trend over the harvest time was observed in the bulk scattering coefficient (μ_s) spectra of juice vesicles, especially at the early stage. The μ_a values of both tissue layers and the μ_s values of juice vesicles deviated among different fruit sizes, which can be related to the development stage. Smaller fruit presented a higher carotenoids concentration in juice vesicles, an advanced color change in flavedo throughout the maturation stages and higher μ_s values in juice vesicles at earlier maturation stages. The μ_a differences in pigment absorption among different cultivars were related to the maturation order. Earlier maturing cultivars possessed higher μ_a values related to carotenoids absorption in juice vesicles and advanced color changes in flavedo. The μ_s values of the flavedo differed among the cultivars and these differences were enhanced during maturation. These insights in the sources of variation in the bulk optical properties of Satsuma mandarin tissues can be used for simulation-based optimal design of an optical measurement configuration and interpretation of the acquired signals in spectroscopy-based quality detection and monitoring.

Keywords: /Flavedo/ /Juice vesicle/ /Absorption coefficient/ /Scattering coefficient/ /Spectroscopy/ /Citrus fruit/

FOOD PACKAGING

Becerril, R., Nerín, C., & Silva, F. (2021). Bring some colour to your package: Freshness indicators based on anthocyanin extracts. *Trends in Food Science & Technology*, *111*, 495–505. https://doi.org/10.1016/j.tifs.2021.02.042

Abstract

Nowadays, consumers are more aware about what they eat and how it is packaged. Food quality is of paramount importance and consumers are eager to be constantly updated about the perishability and shelf-life of the food products they buy. This gave rise to intelligent packaging (IP) materials and devices that can communicate with all people throughout the entire food route. One of the main colour-based IP systems is based on the use of anthocyanin (ATH)-based natural dyes by exploiting their pH-dependent colour changes that can be easily readable by the naked eye. This review focuses on recent studies regarding ATH-based sensor packaging materials development for IP applications, offering valuable insights regarding the main factors that affect the efficacy of the developed IP, such as the material where the ATH is anchored, ATH type and concentration, the ingredients used in the formulation of the sensor and the storage conditions of the food product. Additionally, the last ATH-based IP developed are also summed and discussed in detail to identify the major bottlenecks that need to be overcome for accelerating the commercial application of ATH-based sensors in IP. Although ATH-based indicators are able to correctly indicate food shelf-life in several products at a laboratory scale, their industrial production is still impaired by the production methods used for this type of sensors. Furthermore, ATHs are labile compounds that require stabilization in the packaging material to yield stable, standardized and durable IP materials.

Keywords: /Freshness sensor/ /Intelligent packaging/ /Anthocyanin/ /pH indicator/

Daniloski, D., Petkoska, A.T., Lee, N.A, Bekhit, A.E.D., Carne, A., Vaskoska, R., & Vasiljevic, T. (2021). Active edible packaging based on milk proteins: A route to carry and deliver nutraceuticals. *Trends in Food Science & Technology, 111*, 688-705. https://doi.org/10.1016/j.tifs.2021.03.024

Abstract

Environmental awareness and consumer demand for healthy diets and wellness have directed the attention of academia and the food industry towards discovering sustainable packaging materials,

including active edible type of packaging. Numerous active edible films and coatings use milk proteins in their formulations. Milk proteins, comprising of caseins and whey proteins, are important for human nutrition, but also gain importance as natural product polymers with potential to be used as encapsulation carriers for nutraceuticals for various food and biotechnological applications. This review provides an overview of the recent trends and advances in active edible packaging materials originating from milk proteins and their technological characteristics (delaying moisture loss, providing oxygen barriers, exhibiting good tensile strength and elongation, offering flexibility, and generally having neutral taste and flavour). Recently, significant achievements have been made to increase the shelf life of perishable food and control the release and transport of nutraceuticals and bioactive molecules by using milk proteins. The results presented here show that packaging materials comprised of milk proteins can be optimised by the food industry and be employed as active edible packaging for improved quality and safety features of fresh food products. Active edible packaging materials made from milk proteins provide great potential for improving food safety, quality and versatility, and could potentially decrease the number of concerns from suppliers and consumers. Nevertheless, certain critical aspects, such as regulatory issues (migration of active substances, labelling, and allergenicity), economics and customer desires, should be considered for the successful introduction of active edible packaging solutions in the food sector. It is to be expected that the milk protein-based vehicle systems present alone or as part of novel sustainable packaging forms will become an essential strategy for launching safe food products, and therefore have the potential for increasing profit margins for the food industry.

Keywords: /Active edible packaging/ /Films and coatings/ /Milk proteins/ /Shelf life/ /Nutraceuticals/ /Carrier/

Hazer, B. & Ashby, R.D. (2021). Synthesis of a novel tannic acid-functionalized polypropylene as antioxidant active-packaging materials. *Food Chemistry 344,* 128644. https://doi.org/10.1016/j.foodchem.2020.128644

Abstract

This work focuses on the synthesis of novel tannin-functionalized polypropylene copolymers that are designed to inhibit the oxidation of vegetable oils for potential use as packaging materials. An empty glass Petri dish (control), a chlorinated polypropylene-coated glass Petri dish (control) and a series of the tannin-functionalized polypropylene coated glass Petri dishes overlaid with linseed oil were exposed to air and additional white light. Oligomerization of the oxidized linseed oil was assessed by measuring the flow properties of the exposed oil using a viscometer. The antioxidant effect of the tannic acid grafted polypropylene copolymers (PP-Tann) retarded oligomerization of the linseed oil. The molar mass of the linoleic acid overlaid onto the PP-Tann films was the lowest among the tested samples after each time period indicating that tannin-grafted polypropylene may be a promising packaging material for vegetable oils.

Keyword: /Linseed oil/ /Linoleic acid/ /Antioxidant activity/ /Food packaging/ /Tannic acid/

Hemmati, F., Bahrami, A., Esfanjani, A.F., Hosseini, H., McClements, D.J., & Williams, L. (2021). Electrospun antimicrobial materials: Advanced packaging materials for food applications. *Trends in Food Science & Technology, 111*, 520-533. https://doi.org/10.1016/j.tifs.2021.03.014

Abstract

The food industry is developing natural antimicrobial materials for food preservation applications in response to the increasing demand for more sustainable and environmentally friendly consumer products. In particular, there is interest in the creation of natural antimicrobial packaging materials to enhance the safety and extend the shelf-life of foods. However, the production of these materials is often challenging because of their low stability during food processing and storage, their interactions with components in foods, and the uncontrolled release of encapsulated active components during storage. Some of these

limitations can be overcome by using electrospun antimicrobial hybrid mats, in which natural antimicrobials are trapped within nanofibers fabricated by electrospinning. This review summarizes the principles underlying the formation and application of innovative materials consisting of natural antimicrobials encapsulated within nanofiber structures produced by electrospinning. In particular, the application of these nanocomposite materials to a number of important food groups are critically discussed, including meat, dairy, fruit, and vegetable products. Electrospinning is an effective, straightforward, and cost-effective method to produce fibers with high porosity and surface-to-volume ratio which impede the primary fast release of entrapped compounds and provide their controlled release into the food system. Hence, according to these structural advantages, loading bioactive compounds into electrospun fibers improves their functionality, stability, bioavailability, and controlled release, which makes them a favorable option to be used in several applications including food packaging.

Keywords: /Antimicrobial agents/ /Electrospinning/ /Antimicrobial packaging/ /Biopolymer/ /Electrospun fibers/

Sharma, S., Barkauskaite, S., Jaiswal, A. K., & Jaiswal, S. (2021). Essential oils as additives in active food packaging. *Food Chemistry*, *343*, 128403. https://doi.org/10.1016/j.foodchem.2020.128403

Abstract

Food packaging can be considered as a passive barrier that protects food from environmental factors such as ultraviolet light, oxygen, water vapour, pressure and heat. It also prolongs the shelf-life of food by protecting from chemical and microbiological contaminants and enables foods to be transported and stored safely. Active packaging (AP) provides the opportunity for interaction between the external environment and food, resulting in extended shelf-life of food. Chemoactive packaging has an impact on the chemical composition of the food product. The application of natural additives such as essential oils in active packaging can be used in the forms of films and coatings. It has been observed that AP helps to maintain temperature, moisture level and microbial and quality control of the food. This review article provides an overview of the active packaging incorporated with essential oils, concerns and challenges in industry, and the effect of essential oil on the packaging microstructure, antioxidant and antimicrobial properties.

Keywords: /Essential oils/ /Food packaging/ /Active food packaging/ /Shelf life/ /Antimicrobial activity/ /Antioxidant property/ /Food safety/

FOOD SAFETY

Almasi, L., Radi, M., Amiri, S., & Torri, L. (2021). Fully dilutable Thymus vulgaris essential oil:acetic or propionic acid microemulsions are potent fruit disinfecting solutions. *Food Chemistry*, *343*, 128411. https://doi.org/10.1016/j.foodchem.2020.128411

Abstract

The aim of this study was to evaluate the effect of acetic (AA) or propionic (PA) acid as a cosurfactant on the microemulsion (ME) characteristics of *Thymus vulgaris* essential oil (TVO). The results showed that addition of propylene glycol to TVO/AA or PA:T80/water MEs gave dilutable systems with particles ~59 nm in diameter. Plain TVO showed the highest antimicrobial activity against *E. coli, S. aureus,* and *S. typhi* in *in vitro* antimicrobial tests, followed closely by AA/PA-MEs. The antimicrobial activity of AA/PA-MEs used as a washing solution on cucumber and strawberry samples was remarkably greater than those of free TVO, TVO nanoemulsions, and chlorhexidine solutions against *E. coli* and *S. aureus*. The sensory properties of the samples were not changed by the use of AA/PA-MEs at 0.05 or 0.1% TVO. The results introduce dilutable TVO:AA/PA-MEs for incorporation of TVO in aqueous systems for use as a fruit/vegetable disinfecting agent.

Keywords: /*Thymus vulgaris* essential oil/ /Microemulsion/ /Nanoemulsion/ /Antimicrobial activity/ /Cosurfactants/

Balbinot, S., Srivastav, A.M., Vidic, J., Abdulhalim, I., & Manzano, M. (2021). Plasmonic biosensors for food control. *Trends in Food Science & Technology, 111*, 128-140. https://doi.org/10.1016/j.tifs.2021.02.057

Abstract

Food safety is becoming increasingly important because the food industry must provide quality products to minimize the health risks. Traditional methods to assure food safety, such as plate count and polymerase chain reaction are accurate and robust but can hardly satisfy the needs of the food industry because they are costly and time consuming. Therefore, optical biosensors that can analyze food in a low-cost, facile, fast, sensitive, and selective manner started to emerge. This review presents plasmonic biosensors including surface plasmon resonance (SPR), localized SPR (LSPR), fiber optic SPR (FO-SPR), surface enhanced Raman scattering (SERS), surface-enhanced fluorescence (SEF), and total internal reflection (TIR) based sensors and their applications in food pathogens monitoring. Moreover, the strengths and weaknesses of plasmonic biosensors implementation in food control are showcased.Plasmonic biosensors could simplify procedure and radically reduce time, price and consummation of reactants, compared to traditional microbiological methods. Optical biosensors, in particular SPR, have been developed for detection of different foodborne pathogens. In parallel, analytical improvements have been achieved by coupling different techniques (fiber optics, Raman, fluorescence, luminescence) to plasmonic sensors in order to reduce the limits of detection and to improve sensitivity. The future improvements include the miniaturization of instruments to handheld devices and simplification of analysis to enable direct target detection in food matrices. Plasmonic technology can certainly have a long lasting impact because the need for a simple and rapid food assay is pressing and guarantees the future development in this field.

Keywords: /Plasmonic sensors/ /Food security/ /Detection/ /Aptasensor/ /Immunosensor/ /SPR/

Du, T., Huang, L., Wang, J., Sun, J., Zhang, W., & Wang, J. (2021). Luminescent metal-organic frameworks (LMOFs): An emerging sensing platform for food quality and safety control. *Trends in Food Science & Technology, 111*, 716-730. https://doi.org/10.1016/j.tifs.2021.03.013

Abstract

Along with the intensification of global food supply, food security has become a fateful barrier throughout the global food trade and delivery. Reliable analytic techniques are in strong need to keep up with the continuous demand for food quality and safety monitoring. In this review, the current strategies for different fluorescence mechanisms of MOF-based sensors for food detection are classified and we highlight the construction strategy of MOFs to obtain high performance and multiple photonic function. In addition, recent applications of LMOFs in food safety analyzing as well as the typical sensing mechanisms are reviewed. Finally, we also outline the challenges in these fields and put forward the prospects for future development of LMOFs in food analysis. Fluorescent MOFs have been utilized as sensors to alleviate the food safety problems. The vast combination possibilities, synergistic effects, as well as controllable and ordered arrangements of multiple fluorescent units have distinguished MOFs from other analysis techniques and enabled them to be a promising platform for food quality and safety control. Reasonable crystal engineering principles offers MOFs with the structure–property correlations and varied fluorometric sensing properties, resulting in a rapidly increasing application in food safety.

Keywords: /Metal-organic frameworks/ /Food security/ /Fluorescence mechanisms/ /Food analysis/ /Chemical detection/

Han, Y., He, X., Yang, W., Luo, X., Yu, Y., Tang, W., Yue, T., & Li, Z., (2021). Ratiometric fluorescent sensing carbendazim in fruits and vegetables via its innate fluorescence coupling with UiO-67. Food Chemistry, 345, 128839. https://doi.org/10.1016/j.foodchem.2020.128839

Abstract

A ratiometric fluorescent sensor was facilely fabricated using innate fluorescence of carbendazim (MBC) and fluorescent UiO-67 to sensitively and selectively detect MBC in food matrixes. The innate fluorescence of MBC provided a signal at 311 nm (F311), and the fluorescent UiO-67 at 408 nm (F408) could recognize MBC through π-π stacking inducing fluorescent quenching relied on photoelectron transfer (PET). The ratio (F311/F408) of the fluorescence enhancement of MBC and the quenching of UiO-67 linearly responded to the MBC concentrations of 0–47.6 μmol/L with a low limit of detection (LOD) of 3.0 × 10−3 μmol/L. The reverse response signals of the sensor enhanced the sensitivity toward MBC and presented remarkable anti-interference capability in complex matrices. The as-prepared sensor was applied to detect MBC residues in apple, cucumber and cabbage, obtaining satisfactory accuracy and precision with the recovery of 90.82–103.45% and RSDs of lower than 3.03%.

Keywords: /Food safety/ /Ratiometric fluorescence/ /MOFs/ /Pesticide/ /Carbendazim/

Kalinowska, K., Wojnowski, W., & Tobiszewski, M. (2021). Smartphones as tools for equitable food quality assessment. *Trends in Food Science & Technology, 111*, 271-279. https://doi.org/10.1016/j.tifs.2021.02.068

Abstract

The ubiquity of smartphones equipped with an array of sophisticated sensors, ample processing power, network connectivity and a convenient interface makes them a promising tool for non-invasive, portable food quality assessment. Combined with the recent developments in the areas of IoT, deep learning algorithms and cloud computing, they present an opportunity for advancing wide-spread, equitable and sustainable food analytical methods that could be used at each stage of food production and distribution. This review focuses on the use of smartphone-based methods in food quality assessment and monitoring, with particular emphasis on the ones in which smartphones are used as detectors, either on their own or in conjunction with more elaborate analytical procedures. The role of these methods in common and equitable access to information on food quality is discussed, together with a consideration of the sustainability and greenness of the smartphone-based methods and a perspective on the methodology and validation. Additionally, recent developments and future research trends are also outlined. Despite the persisting limitations resulting from technical difficulties and the complexity of the food sample matrix, smartphones will play an increasingly important role in popularizing the access to food analytical techniques for on-site analysis as a readily available and convenient integrated interface, connectivity and remote sensing platforms.

Keywords: /Food quality and safety/ /Biosensors/ /Smartphone/ /Equitable analytical chemistry/ /On-site sensing/

Xu, Y., Li, X., Zhang, W., Jiang, H., Pu, Y., Cao, J., & Jiang, W. (2021). Zirconium (Ⅳ)-based metal-organic framework for determination of imidacloprid and thiamethoxam pesticides from fruits by UPLC-MS/MS. *Food Chemistry, 344,* 128650. https://doi.org/10.1016/j.foodchem.2020.128650

Abstract

Zirconium(Ⅳ)-based metal-organic framework (MOF)-UiO-66-NH2 was fabricated to adsorb the imidacloprid and thiamethoxam in fruit samples before analysis using UPLC-MS/MS. The UiO-66-NH2

was confirmed by SEM, FTIR, and XRD. Key experimental parameters were investigated by response surface methodology (RSM). The desirability recovery of imidacloprid was 94.52% under optimum conditions (mount of adsorbent = 52.48 mg, volume of eluent = 5.18 mL, pH = 9, extraction time = 15 min). The desirability recovery of thiamethoxam was 93.57% under optimum conditions (mount of adsorbent = 50.58 mg, volume of eluent = 2.6 mL, pH = 5.65, extraction time = 11.94 min). Under the optimal conditions, the actual recovery of imidacloprid and thiamethoxam was 92.39% and 94.37%, respectively. Besides, the method was applied successfully to detect imidacloprid and thiamethoxam in different fruit samples. The results demonstrated that the UiO-66-NH2 is an excellent adsorbent for the extraction imidacloprid and thiamethoxam from fruit samples.

Keywords: /Metal-organic framework/ /Pesticide/ /Fruit/ /Adsorption/ /Response surface methodology/

FLOWER

Akhtar, G., Rajwana, I. A., Sajjad, Y., Shehzad, M. A., Amin, M., Razzaq, K., Ullah, S., Faried, H.N., Farooq, A., & Samiullah. (2021). Do natural leaf extracts involve regulation at physiological and biochemical levels to extend vase life of gladiolus cut flowers? *Scientia Horticulturae*, *282*, 110042. https://doi.org/10.1016/j.scienta.2021.110042

Abstract

Gladiolus is among the most versatile cut flowers and available in an array of colors. However, it has a relatively short vase life, associated with increased postharvest losses and decreased quality. Commercially, synthetic chemicals are applied to enhance its postharvest vase life, but in general they are not environmentally friendly. The current research aimed to evaluate whether natural plant extracts can serve as effective preservatives to extend the postharvest vase life of gladiolus spikes. There is no record in the literature of the use of leaf extract of *Calotropis procera* as a vase-life extender for cut flowers, though its leaf extract has been shown to have antimicrobial, antioxidant and insecticidal activity. In contrast, leaf extract of *Moringa* sp. and *Mentha* sp. are commonly known to extend the vase life. The leaf extracts of *Moringa oleifera*, *Mentha piperita* and *Calotropis procera* at 2 and 4 % were used in holding solutions to compare their effects on vase life, physiological and metabolic activities of gladiolus cut spikes. In current results, *Calotropis procera* leaf extract (CPLE) at 2 % exhibited maximum vase life up to 14.50 days, open florets (64 %) and RFW (40 %) in comparison to *Moringa oleifera* leaf extract (MOLE) and *Mentha piperita* leaf extract (MPLE). Similarly, maximum RWC (41 %), MSI (30 %), and CAT (66 %), POX (74 %), SOD (57 %) and reduced bacterial count (64 %) was also recorded in 2 % CPLE than MOLE and MPLE over untreated spikes. The cut spikes preserved in 2 % MOLE described maximum Chl *a*, (71 %), Chl *b* (64 %) and Car (49 %) contents than CPLE. Hence, CPLE at 2 % appears to be an effective natural preservative to prolong the vase life of gladiolus cut spikes.

Keywords: /Cut flower/ /Vase life/ /Calotropis/ /Antibacterial/ /Enzyme activity/

Sun, X., Yuan, Z., Wang, B., Zheng, L., & Tan, J. (2021). Exogenous putrescine activates the arginine-polyamine pathway and inhibits the decomposition of endogenous polyamine in Anthurium andraeanum under chilling stress. *Scientia Horticulturae*, *282*, 110047. https://doi.org/10.1016/j.scienta.2021.110047

Abstract

Chilling temperature is an important abiotic stress that affects the product quality of *Anthurium andraeanum*. Exogenous putrescine (Put) can reduce the physiological damage caused by chilling stress on anthurium seedlings, and induce the synthesis of endogenous arginine (Arg). In this study, anthurium seedlings were pretreated with Put, Put+D-arginine (D-Arg), Put+difluoromethylornithine (DFMO), and Put+D-Arg+DFMO solutions for four weeks. Subsequently, the seedlings were subjected to chilling stress at 6 ºC for three days, followed by a recovery at 25 ºC for one day. The contents of endogenous Arg and

polyamines (PAs), as well as the activities of arginine decarboxylase (ADC), ornithine decarboxylase (ODC), diamine oxidase (DAO), and polyamine oxidase (PAO) in the roots and leaves of each treatment group were measured during the experiments. The results were further confirmed on the transcriptional level via transcriptome sequencing and qRT-PCR. We found that the supplementation of Put promoted the synthesis of endogenous Arg and its conversion to PAs, and reduced the decomposition rate of endogenous PAs under chilling stress. ADC was the main enzyme that promoted the synthesis of endogenous Put. The supplementation of D-Arg or/and DFMO inhibited the synthesis of endogenous Arg and its conversion to Put, and accelerated the decomposition rate of endogenous PAs. The qRT-PCR confirmed four DEGs related to ADC, amino-acid acetyltransferase NAGS1 and polyamine biosynthetic process identified from the sequencing results. In summary, the supplementation of Put activated the arginine-polyamine pathway in anthurium under chilling stress, increased the activity of ADC and the expression of related genes, and moderately inhibited the decomposition of endogenous PAs. The supplementation of D-Arg or/and DFMO exhibited the opposite effects, which confirmed the effects of Put.

Keywords: /*Anthurium andraeanum*/ /Putrescine/ /Arginine/ /Arginine decarboxylase/

Williamson, V. G. (2021). A comparison of scanning electron microscopy preparation methods to observe anatomical features and microbial changes during the vase life of Acacia and Rosa. *Scientia Horticulturae, 282,* 110039. https://doi.org/10.1016/j.scienta.2021.110039

Abstract

There are several sample preparation methods used to observe plant material in scanning electron microscopy (SEM) and choosing the most appropriate method can be difficult. This choice is especially critical when investigating bacterial colonisation of cut stem ends during vase life, in case some preparation methods remove microbial material. When critical point drying (CPD) was used to compare bacterial colonisation at days 0, 1, 3 and 5 of vase life in *Acacia amoena* (Wendl.), few bacteria were observed by 3 d. Colonisation only became evident after 5 d. Because our previous study's enumeration of bacteria revealed high numbers (10^3 cfu mL^{-1}) by 3 d, it was hypothesised that the numerous changes of solution during CPD had removed bacteria. To test this, three SEM preparation methods: air drying (AD); CPD; and freeze-drying (FD), were compared, based on their ability to detect microbial changes and observe anatomical features in *Rosa hybrida* L. 'Sonia', a well-studied plant. The choice of CPD, AD or FD did not markedly affect bacterial colonisation in *Rosa*, implying that CPD was not the cause of lower bacterial numbers in *Acacia*. Amorphous deposits found in both plant genera were likely to be the bacterial biofilms seen by others. Vestures and warts were observed on inner xylem vessel walls and pits in *Acacia*, but not definitively in *Rosa*. All SEM preparation methods provided clear images of plant anatomy and microbial colonisation in *Rosa*, suggesting that they can also be used validly in the study of other genera like *Acacia*, although AD preserved bacterial biofilms more clearly. The easiest preparation method in terms of equipment required and labour intensity was AD but, overall, CPD provided the highest quality images with no surface distortion. When choosing the most appropriate SEM preparation method, it is also important to consider the purpose of the observations.

Keywords: /Air dried/ /Bacteria/ /Biofilms/ /Critical point dried/ /Freeze dried/ /Vestures/

FRESH CUTS

Zhu, Y., Du, X., Zheng, J., Wang, T., You, X., Liu, H., & Liu, X. (2021). The effect of ultrasonic on reducing anti-browning minimum effective concentration of purslane extract on fresh-cut potato slices during storage. *Food Chemistry, 343,* 128401. https://doi.org/10.1016/j.foodchem.2020.128401

Abstract

Enzymatic browning is one of the major difficulties for the preservation and commercial value of fresh-cut products. To research more healthy and inexpensive anti-browning methods, we investigated the effect of ultrasonic coupling purslane extract on the browning resistance of fresh-cut potato during 8d storage at 4 °C. Firstly, the optimal ultrasonic time (10 min) was obtained. Then, the results showed that the combined application with lower purslane extract concentration (0.02%, w/w) could achieve a better anti-browning effect than the optimal concentration of alone purslane extract (0.05%, w/w). The combined application not only significantly inhibited the key enzyme activities of polyphenol oxidase (PPO) and peroxidase (POD), but also effectively reduced the damage to cell membrane, maintained its integrity and permeability. Meanwhile, it also improved antioxidant capacity during storage. Overall, the ultrasonic cavitation combined with purslane extract would be a promising method for fresh-cut industry.

Keywords: /Fresh-cut potato slices/ /Enzymatic browning/ /Ultrasonic treatment/ /Purslane extract/

FRUITS AND VEGETABLES (BIOLOGICAL CONTROL)

Shuang, Y., Zhang, T., Zhong, H., & Li, L. (2021). Simultaneous enantiomeric determination of multiple triazole fungicides in fruits and vegetables by chiral liquid chromatography/tandem mass spectrometry on a bridged bis(β-cyclodextrin)-bonded chiral stationary phase. *Food Chemistry, 345*, 128842. https://doi.org/10.1016/j.foodchem.2020.128842

Abstract

A LC-MS/MS method for simultaneous determination of twelve triazole enantiomers (hexaconazole, tebuconazole, triticonazole, flutriafol, diniconazole, paclobutrazol) in six fruits and vegetables was established based on a stable and self-made bridged bis(β-cyclodextrin)-bonded chiral stationary phase. Simultaneous enantio-separation of multiple analytes was achieved with resolution ca. 1.67–2.14. Magnetically assisted QuECHERS was used to simplify and optimize sample pre-treatment. The new method was validated (accuracy, precision, matrix effect, etc.). Good linearity (0.5–20 μg/L, R2 > 0.99) and high recoveries (76.1–103.4%) based on intra- and inter-day relative standard deviation (RSDs) (2.6–11.9%), were obtained. Furthermore, a total of 90 samples were analyzed using this method and enantiomeric fractions (EF) for tebuconazole in strawberry and cucumber (0.63 and 0.43, respectively) were determined as well as 0.57 for flutriafol in tomato. This high-throughput detection method supported a convenient enantiomeric monitoring for chiral pesticides in fruits and vegetables.

Keywords: /LC-MS/MS/ /Bridged bis(β-cyclodextrin)-bonded chiral stationary phase/ /Simultaneous enantiomeric determination/ /Triazole fungicides/ /Fruits and vegetables/

GRAPE

Wu, Z., Dong, C., Wei, J., Guo, L., Meng, Y., Wu, B., & Chen, J. (2021). A transcriptional study of the effects of nitric oxide on rachis browning in table grapes cv. Thompson Seedless. *Postharvest Biology and Technology*, *175*, 111471. https://doi.org/10.1016/j.postharvbio.2021.111471

Abstract

Rachis browning is an unfavorable trait of postharvest table grapes (*Vitis vinifera* L.) and considerably decreases the market value. In this study, we investigated how nitric oxide (NO) delayed the rachis browning progress during cold storage at 0 ± 0.5 °C and during shelf life at 8 ± 0.5 °C and 20 ± 0.5 °C, respectively. The role of NO was explored by changes of storage quality, enzyme activity, and related family gene expression in table grapes cv. Thompson Seedless. The results of transcriptome analysis showed that enzymatic browning might be a main reason for rachis turning brown. NO with 500 μL L^{-1} treatment was the most effective on inhibiting rachis browning. NO significantly prevented the browning

by delaying water loss, reducing phenols accumulation, inhibiting PPO activity, and inducing POD activity. At transcription level, NO significantly down-regulated *PPO1*, up-regulated *POD3*, and affected the expression of *PAL2* and *PAL3* in grape rachis. The expressions of *PAL2* and *PAL3* showed a positive relation with phenols accumulation. Furthermore, Pearson correlation demonstrated very significant interaction between PPO activity and *PPO1* expression, suggesting that *PPO1* was the major gene contributing to the observed enzymatic activity. Extremely consistent with the corresponding enzymatic activity and the browning index, suggesting that *PPO1* might be crucial to code the enzyme PPO. Based on these findings, NO might be a promising strategy for improving the rachis freshness and extending the shelf life of postharvest table grapes.

Keywords: /Table grapes/ /Nitric oxide/ /Rachis browning/ /Phenolic metabolism/ /Gene expression/

KIWIFRUIT

Wang, Z., Künnemeyer, R., McGlone, A., Sun, J., & Burdon, J. (2021). Comparison of a dual-laser and a Vis-NIR spectroscopy system for detection of chilling injury in kiwifruit. *Postharvest Biology and Technology*, *175,* 111418. https://doi.org/10.1016/j.postharvbio.2020.111418

Abstract

A novel dual-laser system with laser wavelengths of 730 nm and 850 nm has been developed for the non-destructive detection of chilling injury in *Actinidia chinensis* var. *chinensis* 'Zesy002' kiwifruit. Chilling injury in kiwifruit is a physiological disorder that may occur during low-temperature storage, with symptoms that are often not evident until the fruit is cut open. This study involved a sample of 162 kiwifruit with differing severity of chilling injury, and a performance comparison between the novel dual-laser system and a standard visible – near infrared (Vis-NIR) interactance spectroscopy approach proven in a prior study. The dual-laser system involved scanning the laser beams across the fruit to generate spatial profiles of light transmission in the fruit. Data analysis with supervised model training, using a support vector machine algorithm, was successfully used to achieve cross-validation prediction accuracies higher than 90 % for distinguishing sound and chilling-injured kiwifruit. The performance was equivalent to that achieved by the Vis-NIR interactance spectroscopy approach, suggesting that the dual-laser method is an alternative and more attractive option because of its easier system layout for high-speed on-line sorting of kiwifruit for chilling injury disorder.

Keywords: /Chilling injury/ /NIR/ /Kiwifruit/ /Non-destructive detection/ /Supervised classification/

Wei, xiaobo, Guan, weiliang, Yang, yajie, Shao, yelin, & Mao, linchun. (2021). Methyl jasmonate promotes wound healing by activation of phenylpropanoid metabolism in harvested kiwifruit. *Postharvest Biology & Technology*, *175*, 111472. https://doi.org/ 10.1016/j.postharvbio.2021.111472

Abstract

A rapid wound healing in vegetables and fruit is instrumental in maintaining fruit quality and extension of shelf life. In this study, wounded kiwifruit were separately treated with methyl jasmonate (MeJA) and diethyldithiocarbamic acid (DIECA, an inhibitor of jasmonate biosynthesis) to evaluate the effect of MeJA on wound healing of kiwifruit. The results showed that MeJA treatment leads to increases of endogenous JA biosynthesis, lipoxygenase (LOX) and 12-oxo-phytodienoic acid reductase (OPR) activities, and JA synthesis genes expression, while DIECA represses these processes. Meanwhile, MeJA promoted the autofluorescence of suberin polyphenolic (SPP) and the accumulation of SPP monomers. The MeJA-treated group demonstrated significantly enhanced total phenols, flavonoids, and lignin contents. Besides, MeJA promoted the activities of phenylalanine ammonia-lyase (PAL), cinnamic acid-4-hydroxylase (C4H), 4-COumaric-COA ligase (4CL), peroxidase (POD), polyphenol oxidase (PPO), and the respective gene expression levels. Results suggest that wound healing in kiwifruit could be promoted by MeJA via activation of phenylpropanoid metabolism.

Keywords: /Kiwifruit/ /Wound healing/ /Suberin polyphenolics/ /Phenylpropanoid / /metabolism/ /Methyl jasmonate/

LETTUCE

Cocetta, G., Passera, A., Vacchini, V., Shahzad, G. i. R., Cortellino, G., Picchi, V., Ferrante, A., Casati, P., & Piazza, L. (2021). Use of microbial inoculants during cultivation maintain the physiological, nutritional and technological quality of fresh-cut romaine lettuce. *Postharvest Biology and Technology*, *175,* 111411. https://doi.org/10.1016/j.postharvbio.2020.111411

Abstract

Nutrition-sensitive agriculture is a novel concept in the agri-food system, which considers the implementation of techniques able to guarantee the nutritional value of the produce, the sustainability of the production and, at the same time, to reduce the ecological impact of agricultural practices. These principles can be also introduced in the fresh-cut market with the aim of maintaining the produce quality during shelf life. In this context, the use of bio-based products is rapidly increasing for improving economic and environmental sustainability of cropping systems during cultivation and shelf life. The aim of this work was to evaluate the effects of three different bacterial-based formulations (*Paenibacillus pasadenensis*, *Bacillus amyloliquefaciens*, *Pseudomonas syringae*) applied during romaine lettuce cultivation by monitoring the changes of several quality indexes at harvest and during storage. Results showed that the application of microbial inoculants during romaine lettuce cultivation contributed to the maintenance of nutritional, functional and perceived quality attributes of leaves during shelf life. The microbial inoculants prevented the development of postharvest fungal pathogen *B. cinerea*. Moreover, the study evidenced different modes of action of the different inoculants and, in the case of *Pseudomonas syringae* 260-02 application, a direct involvement of ascorbic acid-mediated antioxidant mechanisms was observed.

Keywords: /Antioxidants/ /Bio-based products/ /*Botrytis cinerea*/ /Leafy vegetables/ /Nutrition-sensitive agriculture/ /Postharvest quality/

Han, R., Liao, X., Ai, C., Ding, T., & Wang, J. (2021). Sequential treatment with slightly acidic electrolyzed water (SAEW) and UVC light-emitting diodes (UVC-LEDs) for decontamination of Salmonella Typhimurium on lettuce. *Food Control, 123,* 107738. https://doi.org/10.1016/j.foodcont.2020.107738

Abstract

The present study investigates a small-scale system comprising a sequential treatment with slightly acidic electrolyzed water (SAEW) washing and UVC light-emitting diodes (LEDs) for the inactivation of Salmonella on lettuce. Lettuce was inoculated with a Salmonella cocktail to achieve a final concentration of 6.67 log10 CFU/g. Alone treatment by SAEW washing (available chlorine concentration-ACC 20–80 ppm, 1–7 min) or UVC-LED irradiation (50–200 μW/cm2, 1–30 min) resulted in the reduction of 1–1.8 log10 CFU/g Salmonella on lettuce. The sequential treatment with SAEW washing and UVC-LED significantly ($p < 0.05$) enhance the reduction of Salmonella on lettuce to 2.56–2.97 log10 CFU/g. The results also revealed that the sequential treatment did not result in obvious compromise in the qualities (color, chlorophyll, and total soluble solid content) of lettuce. Therefore, the proposed sequential treatment of SAEW washing and UVC-LED in this study has the potential to assure the food safety of fresh produce.

Keywords: /Slightly acidic electrolyzed water/ /UVC light-emitting diode/ /Sequential treatment/ /*Salmonella* Typhimurium/ /Lettuce/

LONGAN FRUIT

Wu, F., Jiang, G., Yan, H., Xiao, L., Liang, H., Zhang, D., Jiang, Y., & Duan, X. (2021). Redox regulation of glutathione peroxidase by thioredoxin in longan fruit in relation to senescence and quality deterioration. *Food Chemistry, 345*, 128664. https://doi.org/10.1016/j.foodchem.2020.128664

Abstract

Thioredoxins (Trxs) are important redox regulators in organisms. However, their involvement in fruit senescence and quality deterioration remains unclear. In this study, one Trx (DlTrx1) and one NADPH-dependent Trx reductase (DlNRT1) cDNAs, were cloned from longan fruit. The DlTrx1 could be effectively reduced by the DlNTR1. Expression of DlTrx1 and DlNTR1 were up-regulated during fruit senescence and quality deterioration. We further identified 33 potential Trx target proteins in longan, including one glutathione peroxidase (DlGpx). DlTrx1 could physically interact with DlGpx. DlTrx1 in combination with DlNTR1 effectively activated DlGpx activity by regulating its redox state. Cys90 in DlGPx could form a disulfide bond with either Cys42 or Cys71, which were the sites of redox modulation. Furthermore, DlGpx exhibited a higher ratio of disulfide bonds to sulfhydryl groups in senescent or deteriorative fruit. We propose that Trx-mediated redox regulation of DlGpx is involved in senescence or quality deterioration of harvested longan fruit.

Keywords: /Aril breakdown/ /Quality deterioration/ /Reactive oxygen species/ /Redox regulation/ /Thioredoxin/ /Glutathione peroxidase/

LOTUS

Gouda, M.H.B., Zhang, C., Peng, S., Kong, X., Chen, Y., Li, H., & Yu, L. (2021). Combination of sodium alginate-based coating with L-cysteine and citric acid extends the shelf-life of fresh-cut lotus root slices by inhibiting browning and microbial growth. *Postharvest Biology and Technology*, *175*, 111502. https://doi.org/10.1016/j.postharvbio.2021.111502

Abstract

The effects of a sodium alginate (SA) coating combined with l-cysteine (L-cys) and citric acid (CA) on browning and microbial growth in fresh-cut lotus root slices during storage at 4 °C were investigated. The SA + L-cys + CA treatment was more efficient than separate SA and l-cys + CA treatments in the maintenance of visual appearance and flavour quality. The SA + L-cys + CA coating improved the ability of antioxidant enzymes (superoxide dismutase, catalase and ascorbate peroxidase) to scavenge reactive oxygen species, including $O_2^{\cdot-}$ and H_2O_2. In comparison to the control, the SA + L-cys + CA treatment lowered the activity of phenylalanine ammonia lyase, peroxidase, and membrane lipid-degrading enzymes (phospholipase D, lipase and lipoxygenase) and furthermore, maintained high amounts of unsaturated and saturated fatty acids as well as low levels of phenolics and malondialdehyde. The bacterial diversity in lotus root slices was also determined and discussed. The SA + L-cys + CA treatment could maintain the shelf-life of fresh-cut lotus root slices for 14 d at 4 °C, which provides a theoretical basis for commercial application.

Keywords: /Fresh-cut lotus root/ /Enzyme/ /Browning/ /Membrane damage/ /Microbial spoilage/

MANGOSTEEN

Owolabi, I. O., Songsamoe, S., & Matan, N. (2021). Combined impact of peppermint oil and lime oil on Mangosteen (Garcinia Mangostana) fruit ripening and mold growth using closed system. *Postharvest Biology and Technology*, *175*, 111488. https://doi.org/10.1016/j.postharvbio.2021.111488

Abstract

Mangostenn (*Garcina mangostana*) is a climacteric fruit and thus, there is need for intervention on its postharvest preservation to delay ripening, reduce spoilage and microbial infestation, and possibly enhance its availability all year round. This study was aimed at determining the best application ratio of the combination of peppermint oil (PO) and lime oil (LO) essential oils (EOs) in slowing down ripening and extending the shelf-life of mangosteen in a closed storage system. Furthermore, the mechanism by which PO and LO inhibit mold and decay on the surface of mangosteen was investigated. Forty microliters of PO and LO at ratios 1:0, 0:1, 1:1, 2:1, and 1:3, respectively, were applied to the fruit in a 1 L storage box and stored at 25 ± 2 °C, 75 ± 5 % RH for 9 days. The ability of the EOs to suppress mold and decay, and their effects on ripening stage were measured. Also, the quality parameters of the fruit pericarp (peel) and aril (pulp) after treating with EOs were evaluated. Results showed that ratio 1:3 of PO and LO had 20 % mold and decay appearance after 9 d, compared with the control (untreated sample) which had 80%. Mangosteen treated with this ratio of EOs attained only stage 4 (red color) of ripening, while the fruit in the control group were completely ripened at the end of storage, reaching stage 6 (dark purple). In addition, the fruit firmness, color (calyx, pericarp, and aril), titratable acidity, pH, total soluble solids, and total phenolic content were maintained with this ratio when compared with the control and other ratios. The potential mode of action of PO and LO was revealed by scanning electron microscopy and gas chromatography - mass spectrometry analysis where main components of these EOs such as menthol, menthone and limonene were released into the treated fruit, with possible interaction with other components for improved antifungal activity. The application of PO and LO at this ratio (1:3) could be formulated as a fungicide on mangosteen for enhanced antifungal activity, improved shelf-life quality, and consumer acceptability of mangosteen fruit.

Keywords: /Mangosteen/ /Peppermint oil/ /Lime oil/ /Ripening/ /Antifungal/ /Mold/

MUSHROOM

Ni, X., Yu, J., Shao, P., Yu, J., Chen, H., & Gao, H. (2021). Preservation of Agaricus bisporus freshness with using innovative ethylene manipulating active packaging paper. *Food Chemistry*, *345*, 128757. https://doi.org/10.1016/j.foodchem.2020.128757

Abstract

Agaricus bisporus produces substantial ethylene during storage and transportation, which accelerates ripening and senescence, thereby shortening the shelf-life. In this study, a novel food packaging material with ethylene removal property was prepared to increase storage time of *Agaricus bisporus.* 1-Methylcyclopropen and molecular sieves loaded with potassium permanganate were used as ethylene scavengers to coat the fresh-keeping paper. SEM, FT-IR and DSC analyses proved that these functional components were successfully coated on the fresh-keeping paper. The qualities of the mushrooms packed by prepared functional paper were then determined. The results showed that this prepared functional paper could delay the softening, browning and weight loss of mushrooms during storage by inhibiting ethylene synthesis-related enzymes and gene expression in the mushroom fruiting body, and continuous adsorption and removal of the exogenous ethylene. Consequently, the functional paper could reduce the biochemical and physicochemical quality loss of *Agaricus bisporus*, thus prolonging its shelf-life

Keywords: /*Agaricus bisporus/ /*Ethylene/ /Active packaging/ /Molecular sieve/ /Potassium permanganate/ /1-Methylcyclopropene/

Subramaniam, S., Jiao, S., Zhang, Z., & Jing, P. (2021). Impact of post-harvest processing or thermal dehydration on physiochemical, nutritional and sensory quality of shiitake mushrooms. *Comprehensive Reviews in Food Science and Food Safety*, *20*(3), 2560–2595. https://doi.org/10.1111/1541-4337.12738

Abstract

Shiitake mushrooms are one of the most popular and highly consumed mushrooms worldwide both in fresh and dry forms. However, it rapidly starts losing its quality immediately after harvest which necessitates processing and/or proper storage before being distributed. However, the processes used for preserving other mushrooms (e.g., Agaricus) become unviable for shiitake due to its uniqueness (higher respiration rate, varied biochemicals, growth, etc.) which demands individual studies on shiitake. This review starts by listing the factors and their interdependence leading to a quality decline in shiitake after harvest. Understanding well about these factors, numerous post-harvest operations preserve shiitake as fresh form for a shorter period and as dried forms for a longer shelf-life. These processes also affect the intrinsic quality and nutrients of shiitake. This review comprehensively summarizes and discusses the effects of chemical processing (washing, fumigation, coating, and ozone), modified atmosphere packaging (including irradiation) on the quality of fresh shiitake while discussing their efficiency in extending their shelf-life by inhibiting microbial spoilage and deterioration in quality including texture, appearance, nutrients, and favor. It also reviews the impact of thermal dehydration on the quality of dried shiitake mushrooms, especially the acquired unique textural, nutritional, and aromatic properties along with their merits and limitations. Since shiitake are preferred to be low-cost consumer products, the applicability of freeze-drying and sophisticated novel methodologies, which prove to be expensive and/or complex, are discussed. The review also outlines the challenges and proposes the subsequent future directives, which either retains/enhances the desirable quality in shiitake mushrooms.

Keywords: /Drying/ /Packaging/ /Post-harvest/ /Product quality/ /Shiitake mushroom/

MUSKMELON

Sun, X., Shokri, S., Wang, Z., Li, B., & Meng, X. (2021). Optimization of explosion puffing drying for browning control in Muskmelon (Cucumis melo L.) using Taguchi orthogonal arrays. *LWT - Food Science & Technology*, *142*, 111021. https://doi.org/10.1016/j.lwt.2021.111021

Abstract

The present study aimed at optimizing explosion puffing drying (EPD) method for browning control in muskmelon (*Cucumis melo* L.) using Taguchi design approach. Results of the pre-study of the EPD process showed that the following steps including color fixation, pre-drying temperature, and drying temperature/time of puffed samples, have the most effects on browning. According to the Taguchi orthogonal experiments design, 0.6% sodium chloride, 0.15% calcium chloride, 0.10% L-cysteine and 0.6% citric acid for color fixative solution, 65 °C for pre-drying and 70 °C during 150 min for drying of puffed samples considered as the optimized condition (OP) to minimize browning during the EPD process. Results of related indexes to browning indicated that OP condition can significantly protect protein, reducing sugars, and phenolic compounds degradation; maintain the pH stability; prevent polyphenol oxidases and peroxidase enzymes activities, control of 5-HMF formation and control of changes in color related parameters (L^*, a^*, b and ΔE^*). This work provides promising results for developing effective drying of muskmelon using EPD.

Keywords: /Explosion puffing drying/ /Browning/ /Muskmelon/ /Taguchi orthogonal arrays/

NECTARINE

Casagrande, E., Génard, M., Lurol, S., Charles, F., Plénet, D., & Lescourret, F. (2021). A process-based model of nectarine quality development during pre- and post-harvest. *Postharvest Biology and Technology*, *175,* 111458. https://doi.org/10.1016/j.postharvbio.2020.111458

Abstract

A new mathematical modeling framework able to simulate the combined effect of fruit growth and post-harvest storage conditions (temperature and relative humidity) on nectarine quality is here proposed. The seasonal course of fruit surface conductance to water vapor, fruit mass loss during storage, and sugar concentration dynamics in fruit pulp were modeled. The three sub-models were integrated into a model capable of calculating a fruit sweetness index and relative water loss during storage, which were selected as nectarine quality criteria. Sub-models parameters were calibrated through results from experiments carried on during 2018 and 2019, where horticultural practices (irrigation and fruit load) and storage conditions were jointly varied. Irrigation level influenced fruit surface conductance to water vapor at harvest, but experimental results point out that this variable may have little influence on fruit mass loss during storage, which was mainly driven by relative humidity in the storage chamber. Irrigation intensity was also influential on sugar dynamics, along with storage temperature, with fruit stored at the higher temperature (25 °C) being sweeter than those stored at lower ones (2 and 15 °C). These experimental results were well replicated by the sub-model outputs. Model simulations during storage revealed a trade-off between the two selected quality criteria, which increased with increasing storage temperature and decreasing relative humidity. The best scenario in terms of acceptable fruit mass loss and sweetness index was for fruit from water-stressed and low crop-loaded trees, 15 °C and 70% relative humidity. Moreover, storage duration was shown to increase fruit mass loss and, to a lesser extent, the sweetness index, while fruit from late harvest dates had higher sweetness at the end of storage. The model can potentially be used to manage and optimize pre-harvest and storage practices that will maximize sweetness and minimize mass loss to meet fruit quality standards along supply chains.

Keywords: /Fruit quality/ /Mathematical modeling/ /Pre-post-harvest/ /Sugars/ /Mass loss/ /Nectarine/

PAPAYA

Fu, C.C., Chen, H.J., Gao, H.Y., Wang, S.L., Wang, N., Jin, J.C., Lu, Y., Yu, Z.L., Ma, Q., & Han, Y.C. (2021). Papaya CpMADS4 and CpNAC3 co-operatively regulate ethylene signal genes CpERF9 and CpEIL5 during fruit ripening. *Postharvest Biology and Technology*, *175*, 111485. https://doi.org/10.1016/j.postharvbio.2021.111485

Abstract

MADS box transcription factors (TFs) play important roles in different biological processes, for example, fruit ripening. However, the roles of MADS box TFs in papaya fruit ripening remain a little known. In this study, a novel MADS-box gene was found, named as *CpMADS4*, and its expression level was decreased during fruit ripening. Protein-protein interaction assays proved that CpMADS4 interacted with CpNAC3. Both CpMADS4 and CpNAC3 had transcriptional activation activities. Moreover, CpMADS4 and CpNAC3 could specifically bind to and activate the promoters of ethylene signal genes *CpERF9* and *CpEIL5*, and the activate activities would be enhanced when both CpMADS4 and CpNAC3 existed at the same time. Our results suggested that CpMADS4 might function in fruit ripening through interacting with CpNAC3 and regulating ethylene signal genes *CpERF9* and *CpEIL5*, which provided new views about the functions of papaya MADS box TFs in regulating fruit ripening.

Keywords: /Papaya/ /MADS/ /NAC/ /Regulate/ /Fruit ripening/

PEACH

Pantelidis, G., Mavromatis, T., & Drogoudi, P. (2021). Consecutive wet days may impede fruit quality of peach and nectarine and cause fruit drop. *Scientia Horticulturae*, *282*, 110011. https://doi.org/10.1016/j.scienta.2021.110011

Abstract

Extreme rainfall events pose a threating factor for the income of growers, processing industry and communities; however little is known on damages caused on peach trees. The pattern of historical trends in precipitation and the Standardized Precipitation Index (SPI) characteristics during the summer months were studied in Naoussa, Northern Greece. Damages from naturally occurring summer rainfalls were recorded in a peach and nectarine cultivar evaluation orchard and effects from a simulated rainfall experiment using prolonged (100 mm in 3 days) and intense (100 mm in 1 day) rainfall treatments were monitored on peach cv. 'Elegant Lady' trees. Results showed that during the summer months of 1967–2019, there was no significant effect in the precipitation totals and the Standardized Precipitation Index (SPI) characteristics, although an increase in the frequency of wet spells is noticeable in the last three years. Fruit drop and symptoms of skin streaking, bronzing, and collapse in skin tissue of peach and nectarine cultivars close to maturity initiated during and continued after the end of severe and extreme wet spells of three or more consecutive rainy days in a summer month in 2017, 2018 (total ca. 100 mm) and 2019 (total 54 mm) were recorded. The type of skin damages differed among peach and nectarine cultivars. Greater extent of damages was documented in the peach cvs 'Kevina®', 'Maura®' and 'Royal Time®' and fewer damages in 'Red Haven', and 'Sweet Scarlet'. The rainfall simulation experiment showed that only the prolonged, and not the intense treatment, caused fruit drop starting two days after the treatment initiation and lasted three days after the end, while streaking symptoms developed mostly in fruit from the prolonged rainfall treatment. In conclusion, the consecutive wet days rather than the total rainfall caused fruit drop and skin damages in peach and nectarine fruits close to harvest, while cultivars differed in the type of damage developing. Insurance programs need to be readdressed, incorporating rainfall frequency rather than total monthly rainfall as indicators of yield, as well as including the symptoms of fruit drop, skin streaking, bronzing and collapse as damages rather than cracking in peach and nectarine.

Keywords: /Climate change/ /Standardized Precipitation Index/ /Summer rainfall damages/ /Simulated rainfall/

Xu, Y., Wei, J., Wei, Y., Han, P., Dai, K., Zou, X., & Shao, X. (2021). Tea tree oil controls brown rot in peaches by damaging the cell membrane of Monilinia fructicola. *Postharvest Biology and Technology*, *175*, 111474. https://doi.org/10.1016/j.postharvbio.2021.111474

Abstract

This study tested the efficacy of plant essential oils (EOs) for controlling rot in post-harvest peaches. Three fungal pathogens from naturally infected peaches were isolated and identified, and their pathogenicity was confirmed on peach fruit. *Monilinia fructicola* was the most pathogenic of the three isolates (*M. fructicola*, *Penicillium expansum* and *P. spinulosum*). The antifungal effects of four EOs (tea tree oil (TTO), thyme oil, rosemary oil, and lemon oil) were then evaluated against *M. fructicola*. TTO had the strongest antifungal activity against *M. fructicola in vitro* and inoculated peach fruit. Experiments designed to probe the antifungal mechanisms of TTO revealed that the EO affects the composition of the *M. fructicola* cell membrane, leading to changes in mycelial morphology, membrane permeability, and levels of intracellular reactive oxygen species. Based on these results, we conclude that TTO is effective against infection by *M. fructicola* in post-harvest peaches. TTO should be considered as a viable substitute for conventional fungicides that are currently used to control rot in peaches.

Keywords: /Tea tree oil/ /Peach/ /*Monilinia fructicola/* /Antifungal mechanism/

PEARS

Chai, Z., Zhang, F., Liu, B., Chen, X., & Meng, X. (2021). Antibacterial mechanism and preservation effect of curcumin-based photodynamic extends the shelf life of fresh-cut pears. *LWT - Food Science & Technology*, *142*, 110941. https://doi.org/10.1016/j.lwt.2021.110941

Abstract

Foodborne pathogens are a major threat to human health. In this study, we evaluated the bactericidal efficacy of curcumin-based photodynamic inactivation (PDI) against *Listeria monocytogenes*, elucidated its underlying bactericidal mechanisms including membrane damage, oxidative stress and protein degradation. Depending on curcumin concentration and illumination duration, the reactive oxygen species (ROS) increased rapidly after PDI treatment, resulting in severe cell membrane damage and protein degradation. Meanwhile, the activity of ROS defense enzymes such as superoxide dismutase (SOD), catalase (CAT) and glutathione peroxidase (GSH-Px) was inhibited significantly ($p < 0.05$), amplifying the oxidative damage to bacteria. Besides, fresh-cut pears were treated by PDI and then stored at 4 °C for 6 d to investigate the changes of color and hardness. The populations of *L. monocytogenes* on fresh-cut pears were significantly ($p < 0.05$) reduced by 3.43 log CFU/g after PDI without causing quality deterioration. After storage for 6 d, pears treated by PDI remained higher ($p < 0.05$) L* (60.91 ± 4.48) and hardness (51.19 ± 3.77 N). These results suggested that curcumin-based PDI to inactivate foodborne pathogens could be applied as a potential food safety technology.

Keywords: /Curcumin-based PDI/ /*L. monocytogenes*/ /Reactive oxygen species/ /Antioxidant system/ /Fresh-cut pears/

PERSIAN LEEK

Rahi, S., Mobli, H., Jamshidi, B., Azizi, A., & Sharifi, M. (2021). Achieving a robust Vis/NIR model for microbial contamination detection of Persian leek by spectral analysis based on genetic, iPLS algorithms and VIP scores. *Postharvest Biology and Technology*, *175*, 111413. https://doi.org/10.1016/j.postharvbio.2020.111413

Abstract

Microbial contamination of vegetables is always known as a major food safety challenge. Persian leek is one of the most widely used herbs. Detection of *Escherichia coli* (*E. coli* ATCC 8739) in vegetables is a very important issue for post-harvest management. Non-destructive assessment of *E. coli* ATCC 8739 contamination of leek as a main aim of this study were investigated using visible/near-infrared spectroscopy combined with three variable selection approaches and partial least squares discriminant analysis as a promising chemometrics tool: Genetic Algorithm-PLSDA, interval PLS algorithm-DA and variable influence on projection scores-PLSDA. Reflectance spectra in interactance mode were measured on different treatments of *E. coli* ATCC 8739 solution (0.1, 0.2 and 0.3 mL) on leek samples in the spectral range of 350–1100 nm. The spectra (R) were captured at three different positions of sample by random in triplicate. The calibration and internal validation sets were created with 150 (75 %) and 50 (25 %) leek samples, respectively. In order to prevent incorrect results due to over-fitting, the final developed model has been deeply validated with an external validation set of 50 samples. Five key features selected by genetic algorithms showed high performance of *E. coli* ATCC 8739 detection with 100 %, 98 % and 0.8 of sensitivity, specificity and classification error, respectively. Besides, a high prediction ability (>95 % correct classification in internal validation set and >89 % in external validation set) were achieved between 490, 500, 570, 740, and 970 nm spectral distances and the presence of *E. coli* ATCC 8739 contamination. In general, The Vis/NIR spectroscopy method for non-destructive detection of *E. coli* ATCC 8739 contamination on Persian leek in food safety application is feasible and practical. We further demonstrate the capability of genetic algorithms to detect the bacterial cells in the samples at the early growth stage.

Keywords: /Post harvest quality/ /Food contamination/ /Spectral analysis/ /Machine learning/

POSTHARVEST DISEASE

Ngolong Ngea, G. L., Qian, X., Yang, Q., Dhanasekaran, S., Ianiri, G., Ballester, A.-R., Zhang, X., Castoria, R., & Zhang, H. (2021). Securing fruit production: Opportunities from the elucidation of the molecular mechanisms of postharvest fungal infections. *Comprehensive Reviews in Food Science and Food Safety*, *20*(3), 2508–2533. https://doi.org/10.1111/1541-4337.12729

Abstract

Fruit-based diets have been adopted by the public worldwide because of their nutritional value. Many advances have also been made in the elucidation of host–pathogen interaction in the postharvest phase of fruits, in the hope of improving the management of diseases caused by pathogenic molds. In this study, we presented the molecular mechanisms by which pathogenic mold infects fruit in the postharvest phase, and focused on the knowledge gained from recent molecular techniques such as differential analysis of gene expression, targeted insertion, and mutagenesis. Current postharvest pathogenic fungal control strategies were then examined on the basis of their mechanisms for altering the infection process in order to explore new perspectives for securing fruit production. We found that biotechnological advances have led to an understanding of the new basic molecular processes involved in fruit fungal infection and to the identification of new genes, proteins and key factors that could serve as ideal targets for innovative antifungal strategies. In addition, the most commonly used steps to evaluate an approach to disrupt the fruit fungal infection process are mainly based on the inhibition of mycelial growth, spore germination, disruption of Adenosine triphosphate (ATP) synthesis, induction of oxidative stress, cell wall membrane damage, and inhibition of key enzymes. Finally, the alteration of the molecular mechanisms of signaling and response pathways to infection stimulation should also guide the development of effective control strategies to ensure fruit production.

Keywords: /Antifungal strategies/ /Fruit security/ /Infection process/ /Pathogenic fungi/

POSTHARVEST TECHNOLOGY

Mas, F., Manning, L.A., Alavi, M., Osborne, T., Reynolds, O., & Kralicek, A. (2021). Early detection of fruit infested with Batrocera tryoni. *Postharvest Biology and Technology*, *175*, 111496. https://doi.org/10.1016/j.postharvbio.2021.111496

Abstract

Fruits worldwide are prone to insect damage, particularly from the Tephritidae fruit flies. The Queensland fruit fly (“QFF”, *Bactrocera tryoni*) is one of the worst economic pests in the Pacific. Females oviposit in a wide variety of fruit and larvae develop inside the flesh with minimal external visual damage early upon infestation. The export of infested fruit into pest-free zones is one of the main pathways of pest incursion. The ability to detect infested fruit early can prevent an incursion, reduce the risk of spread and advise upon fruit quality. With the aim of detecting early QFF infestation, we investigated whether volatile organic compounds (VOCs) could be used as biomarkers. Five types of fruit were exposed to QFF and volatiles were collected at days 1 and 5 after infestation. After chemical analysis and compound identification, classification models were employed to identify volatile predictors. There were no common volatile biomarkers for all QFF infested fruit, but a combination of fruit-specific volatile biomarkers could reach up to 100 % detection of infestation at specific times. Infestations of papaya and tomato were detectable from day 1 with high accuracy (90 and 100 % respectively). Infestations of nectarine and fig were detectable from day 5 with 80 and 90 % accuracy. Early infestation of capsicum with QFF could not be reliably detected based on our models. The strong interaction between time and infestation for all fruit types requires the selection of a suite of fruit-specific volatile biomarkers for the future development of an odorant-based sensor for detection of QFF infestation.

Keywords: /GC–MS/ /Infestation/ /Pest detection/ /Discrimination/ /Sensor/

Mishra, P., Roger, J. M., Marini, F., Biancolillo, A., & Rutledge, D. N. (2021). FRUITNIR-GUI: A graphical user interface for correcting external influences in multi-batch near infrared experiments related to fruit quality prediction. *Postharvest Biology and Technology*, *175*, 111414. https://doi.org/10.1016/j.postharvbio.2020.111414

Abstract

Near infrared (NIR) spectroscopy is widely used for non-destructive prediction of fruit traits. Common traits such as dry matter (DM) and soluble solids contents (SSC) can be predicted with reliable accuracy. However, the main problem with NIR spectroscopy is that a model developed on one batch may not perform very well when tested on other batches. Reasons for that are the physical, chemical and environmental differences between the experiments performed in different batches. To deal with these issues, approaches such as variable selection, dynamic orthogonal projection (DOP) and transfer component analysis (TCA) can be used. However, the techniques are known but it is rarely possible for a new user or non-specialist to implement them in practical situations. To overcome this limitation, for the first time, a graphical user interface-based toolbox (FRUITNIR-GUI) for basic chemometric data processing (regression and variable selection) is developed and presented. The GUI allows performing model adaption and maintenance in the context of multi-batch NIR spectroscopic experiments related to fruit. Furthermore, a case-study demonstrating its effectiveness in correcting for seasonality when predicting DM in apples is presented. The toolbox provides a push-button approach to build chemometric models of varying complexity for the characterization of fruit quality. Moreover, approaches such as variable selection and batch correction with DOP and TCA can improve the model performances on new batches. FRUITNIR-GUI can be freely downloaded at https://github.com/puneetmishra2/FRUITNIR and run using the password “welovenirs” (without quotation marks).

Keywords: /Chemometrics/ /User-interface/ /Non-destructive/ /Fruit quality/

POTATO

Sampaio, S.L., Barreira, J.C.M., Fernandes, A., Petropoulos, S.A., Alexopoulos, A., Santos-Buelga, C., Ferreira, I.C.F.R., & Barros, L. (2021). Potato biodiversity: A linear discriminant analysis on the nutritional and physicochemical composition of fifty genotypes. *Food Chemistry, 345*, 128853. https://doi.org/10.1016/j.foodchem.2020.128853

Abstract

Fifty potato genotypes from twenty-four different countries of origin, four different flesh colours (yellow, purple, red and marble) and different cultivation types (Andean accessions, landraces, breeder lines and cultivated varieties) were studied in terms of their nutritional and physicochemical characteristics. In general, cultivated varieties and breeder lines showed the highest similarity (slight differences only in some particular fatty acids distributions: C10:0, C12:0 and C22:0) concerning the physicochemical parameters assayed in this work, independently of the geographical origin or tuber flesh colour of these genotypes. Nonetheless, some of the studied landraces and Andean accessions proved to be similar enough to be considered as genotypes with good potential for commercial cultivation. These results can contribute to the supply of new potato genotypes into sustainable farming systems, supporting the protection of potato biodiversity, particularly Andean accessions, landraces and coloured genotypes (red or purple flesh) which are not widely cultivated so far.

Keywords: /Potato/ /*Solanum tuberosum* L./ /Nutritional analysis/ /Physicochemical characterization/ /Linear discriminant analysis/ /Biodiversity/ /Food security/

SHELF-LIFE

Du, X., Chen, H., Zhang, Z., Qu, Y., & He, L. (2021). Headspace analysis of shelf life of postharvest arugula leaves using a SERS-active fiber. *Postharvest Biology and Technology*, *175*, 111410. https://doi.org/10.1016/j.postharvbio.2020.111410

Abstract

The increasing market demand for Ready-To-Eat fresh produce promotes the keen interest in developing a rapid, sensitive and reliable method for determining the shelf life of fresh-cut produce. In this study, we developed a non-destructive headspace detection approach using gold nanoparticles (AuNPs) coated fibers coupled with surface-enhanced Raman spectroscopy (SERS), to detect volatile biochemical changes during postharvest storage of arugula leaves. The headspace detection revealed significant spectral changes during the freshness decline, in the shifts around 500, 950 and 1030 cm^{-1}. These changes were analyzed using principal component analysis (PCA) to classify and establish a prediction model for remaining shelf life determination. Through analyzing reference standard volatile organic compounds (VOCs), we identified dimethyl disulfide (DMDS), methanethiol (MT) and 1-propanethiol were most likely to account for the signature spectra of arugula headspace at the late storage period due to the growth of spoilage bacteria. In conclusion, headspace detection based on SERS fibers provides a new strategy for monitoring the quality and shelf life of fresh produce and thus reducing food waste.

Keywords: /Headspace detection/ /Surface-enhanced Raman spectroscopy/ /Volatile organic compounds/ /Nanosensor/ /Shelf life/

STRAWBERRY

Aghdam, M., Sayyari, M., & Luo, Z. (2021). Exogenous phytosulfokine α application delays senescence and promotes antioxidant nutrient accumulation in strawberry fruit during cold storage by triggering endogenous phytosulfokine α signaling. *Postharvest Biology and Technology*, *175*, 111473. https://doi.org/10.1016/j.postharvbio.2021.111473

Abstract

In this study, the mechanism by which the exogenous application of 150 nM signaling bioactive peptide phytosulfokine α (PSKα) delays senescence and improves antioxidant nutrient accumulation in strawberry fruit during storage at 4 °C for 18 d was investigated. Results showed that the higher endogenous accumulation of PSKα in strawberry fruit treated with 150 nM PSKα may result from the higher expression of *PSK3* and *PSK6* genes. Besides, the higher endogenous accumulation of Ca^{2+} in strawberry fruit treated with 150 nM PSKα may be ascribed to the higher cytosolic accumulation of cGMP, resulting from the triggering of endogenous PSKα signaling pathway, represented by higher expression of *PSKR1* gene. Besides, the higher endogenous melatonin accumulation resulting from higher expression of *TDC*, *T5H*, *SNAT,* and *ASMT* genes in strawberry fruit treated with 150 nM PSKα may be ascribed to the higher endogenous accumulation of Ca^{2+}. Moreover, the higher ABTS and DPPH scavenging capacity in strawberry fruit treated with 150 nM PSKα may be ascribed to the higher accumulation of phenols, flavonoids, and anthocyanins, resulting from higher gene expression and activities of *PAL* and *CHS*. Based on our findings, the exogenous application of PSKα could be employed as a beneficial procedure for delaying senescence and improving antioxidant nutrient accumulation in strawberry fruit during cold storage, by triggering endogenous PSKα signaling, promoting endogenous melatonin accumulation, and activating the phenylpropanoid pathway.

Keywords: /Antioxidant nutrient accumulation/ /Melatonin/ /Postharvest senescence/ /PSKα signaling/ /Strawberry fruit/

Ahn, D., Kim, I., Lim, J.-H., Choi, J. H., Park, K.-J., & Lee, J. (2021). The effect of high CO2 treatment on targeted metabolites of "Seolhyang" strawberry (Fragaria × ananassa) fruits during cold storage. *LWT - Food Science & Technology*, *143*, 111156. https://doi.org/10.1016/j.lwt.2021.111156

Abstract

'Seolhyang' strawberries are popular in Asian markets owing to their bright-red color and desirable flavor. However, Seolhyang strawberries have a fragile outer layer and a short shelf-life. Therefore, 'Seolhyang' strawberries are often treated with CO_2 to prolong their shelf-life. However, the effects of high CO_2 treatment on the quality of Seolhyang strawberries are unclear. Herein, the effects of a short-term high CO_2 treatment on the decay rate, firmness, color, targeted metabolite profile, and antioxidant activity of Seolhyang strawberries in two ripening stages (i.e., half-red and bright-red) were investigated during a 9-day cold storage period. Targeted metabolites (i.e., sugars, organic acids, and anthocyanins) were investigated using HPLC and/or UHPLC-qTOF. CO_2-treated strawberries exhibited lower (although not significantly) decay rates than untreated strawberry samples. The bright-red samples contained higher levels of anthocyanins than the half-red samples, regardless of CO_2 treatment, during storage. High CO_2-treated half-red and bright-red strawberries exhibited firmness, color, and metabolite profiles similar to those of their controls at the final storage time. Interestingly, CO_2-treated half-red strawberry samples showed higher antioxidant activity than the control. Thus, CO_2 treatment may prolong the shelf-life of Seolhyang strawberries without loss of quality based on improving their targeted metabolite profiles and antioxidant activity.

Keywords: /Modified atmosphere/ /Strawberry fruits/ /Metabolites/ /UHPLC-qTOF/ /Cold storage/

Colussi, R., Ferreira da Silva, W. M., Biduski, B., Mello El Halal, S. L., da Rosa Zavareze, E., & Guerra Dias, A. R. (2021). Postharvest quality and antioxidant activity extension of strawberry fruit using allyl isothiocyanate encapsulated by electrospun zein ultrafine fibers. *LWT - Food Science & Technology*, *143*, 111087. https://doi.org/10.1016/j.lwt.2021.111087

Abstract

The aim of this study was to encapsulate allyl isothiocyanate (AITC) in zein ultrafine fibers and evaluate its effects as active packaging on postharvest quality of strawberry. Fresh strawberries (cv Camarosa) were collected from a local agro-industry at commercial maturity, washed, dried, and stored at 4 °C with 4% and 8% AITC, in free form and encapsulated in zein fibers. The strawberries were analyzed for weight loss, firmness, titratable acidity, soluble solids concentration, and pH from day 0 (fresh strawberries) to 20, every five days. After 15 days of storage, the strawberries were also analyzed for free phenolic content, antioxidant capacity using ABTS and DPPH methods, and total anthocyanin content. AITC successfully reduced weight loss of strawberries for an additional five days. The encapsulation of AITC using zein was efficient when lower concentrations (4%) were applied. The increase of AITC on zein fibers saturated the medium and reduced fruit quality. All AITC treatments significantly reduced the firmness and reddish color of the stored strawberries, the AITC addition suppressed the total phenolic and anthocyanin contents. These findings suggest that low concentrations of AITC encapsulated in zein fiber provide a promising method to maintain strawberry quality.

Keywords: /Allyl isothiocyanate/ /Anthocyanin/ /Active package/ /Storage/

Li, X., Jing, T., Zhou, D., Zhang, M., Qi, D., Zang, X., & Xie, J. (2021). Biocontrol efficacy and possible mechanism of Streptomyces sp. H4 against postharvest anthracnose caused by Colletotrichum fragariae on strawberry fruit. *Postharvest Biology and Technology*, *175*, 111401. https://doi.org/10.1016/j.postharvbio.2020.111401

Abstract

Anthracnose is a fungal disease caused by *Colletotrichum* species, which is detrimental to numerous fruits, including strawberry. Use of fungicides to maintain fruit quality leads to potential environmental pollution and health risk. Biocontrol using beneficial microorganisms such as *Streptomyces* has been applied successfully for controlling postharvest diseases of fruit. In this study, strain H4 with a high antifungal activity against *C. fragariae* was isolated from *Dichotella gemmacea* in Xisha islands of South China Sea. Combining the morphological and biochemical characteristics with the 16S *rRNA* sequence analysis, this strain was assigned as *Streptomyces* sp. A preventive treatment using strain H4 extracts significantly reduced severity and incidence of anthracnose disease and maintained fruit hardness and color on harvested strawberry fruits. A minimum inhibitory concentration (MIC) and a minimum fungicidal concentration (MFC) were 1.563×10^{-3} g L^{-1} and 3.125×10^{-3} g L^{-1}, respectively. Extracts could effectively inhibit mycelial growth and spore germination of *C. fragariae in vitro*. The mycelial structure of pathogenic fungi showed deformation, shrinkage, collapse and tortuosity. A significant decrease in sugar and protein contents was also observed in treated *C. fragariae* mycelia. Fourteen chemical compounds were identified by gas chromatography-mass spectrometer (GC–MS). Dibutyl phthalate was the major constituent. Notably, strain H4 and its extracts exhibited a broad-spectrum antifungal activity against seven selected plant pathogenic fungi. Hence, *Streptomyces* sp. H4 and its metabolites have a high efficiency of antagonistic roles against phytopathogenic fungi diseases. It provides a promising biological agent to control anthracnose of strawberry fruit.

Keywords: /Antagonistic actinomycete/ /Strawberry/ /Anthracnose/ /Biological control/ /Postharvest quality/

Sugino, N., Watanabe, T., Nakamura, N., & Kitazawa, H. (2021). Electrical and mechanical analysis to evaluate the cultivar difference in strawberries with respect to their bruising sensitivities and mass loss acceleration. *Postharvest Biology and Technology*, *175*, 111489. https://doi.org/10.1016/j.postharvbio.2021.111489

Abstract

This study investigated the differences in the bruising characteristics of three strawberry cultivars that were subjected to mechanical compression, while elucidating the effect of bruising on the acceleration of mass loss during storage; these investigations were aimed at achieving long-term transportation. The length of the coordinate at the top of the circular arc of Cole-Cole plots from the origin (LTO) was obtained using electrical impedance techniques and was employed as an indicator of the degree of bruising. The LTO values of the control samples were approximately 30,000 Ω; however, they decreased with the increasing compression strain, so the strain was evaluated to be the primary factor for their bruising. Further, a disparity was observed in different cultivars with regard to their fragilities to compression. Mass loss of samples during storage was approximately 0.01 – 0.03 (-); however, owing to an increase in the degree of bruising, the mass loss for each cultivar was accelerated during storage; moreover, there are significant differences among the cultivars. These findings demonstrate that selecting an appropriate cultivar alleviates bruising and deterioration during transportation. Moreover, the combination analysis using electrical analysis and measurement of quality decline rate may be advantageous for the selection of good cultivars.

Keywords: /Bruising/ /Cultivar difference/ /Fragility/ /Mass loss/ /Strawberry/

Vanti, G. L., Leshem, Y., & Masaphy, S. (2021). Resistance response enhancement and reduction of Botrytis cinerea infection in strawberry fruit by Morchella conica mycelial extract. *Postharvest Biology & Technology*, *175*, 111470. https://doi.org/10.1016/j.postharvbio.2021.111470

Abstract

Over 200 crops worldwide are susceptible to gray mold infection, caused by the phytopathogenic fungus *Botrytis cinerea*, including strawberry fruit, both in the field and after harvest. The disease is normally controlled by chemical fungicides. However, increasing public and environmental concern over pesticide applications has prompted the exploration of eco-friendly approaches to combating pathogens. Morel mushrooms are edible mushrooms with a broad range of bioactive metabolites. We studied the inhibitory effect of *Morchella conica* Pers. mycelial water extract (MWE) on *B. cinerea* infection of strawberry fruit for the first time. In-vivo assay showed reduction of gray mold infection, measured by disease index on MWE-treated fruit compared to controls. Enhancement of a range of biochemical and molecular characteristics related to the fruit's defense system was detected by RNA-Seq analysis, quantitative PCR and quantification of total phenols, flavonoids, antioxidant capacity by DPPH, and enzymatic activities in the fruit. *In-vitro* tests showed no inhibition of *B. cinerea* compared to a control fungicide fludioxonil. The findings demonstrate the beneficial effect of *Morchella conica* metabolites in enhancing fruit resistance to pathogenic fungal attack and improving quality of postharvest strawberry fruit.

Keywords: /Bioactive/ /*Botrytis cinerea*/ /Elicitor/ /*Morchella*/ /Resistance/ /Strawberry/

Wang, J., Yang, E., Chaurand, P., & Raghavan, V. (2021). Visualizing the distribution of strawberry plant metabolites at different maturity stages by MALDI-TOF imaging mass spectrometry. *Food Chemistry*, *345*, 128838. https://doi.org/10.1016/j.foodchem.2020.128838

Abstract

This study aimed to visualize differences in the distribution of citric acid, soluble sugars, and anthocyanins in strawberries at four different maturity stages (green to red strawberries) by matrix-assisted laser desorption/ionization time-of-flight imaging mass spectrometry (MALDI-TOF IMS). Results demonstrated citric acid and sugars are evenly distributed in the entire fruit at all maturity stages, while most anthocyanins are mainly located in the periphery of fruit with increased abundance in red strawberries, indicating a correlation with the colour attributes. Sugar in red strawberries (11.92 brix) increased by two-fold compared to the green ones (6.23 brix). Finally, absolute quantitation of each compound from HPLC analyses support the quantitative results from MALDI-TOF IMS. The results provide a deeper understanding in the changes and distribution of phytochemicals during the growth of strawberries, and demonstrates the usefulness of IMS for plant breeding and postharvest technology.

Keywords: /Strawberry/ /Plant metabolites/ /Colour attributes/ /Anthocyanins/ /Imaging mass spectrometry/

SUPPLY CHAIN

Aworh, O.C. (2021). Food safety issues in fresh produce supply chain with particular reference to sub-Saharan Africa. *Food Control, 123,* 107737. https://doi.org/10.1016/j.foodcont.2020.107737

Abstract

Developing countries including those of sub-Saharan Africa (SSA) bear the greatest burden of food-borne illnesses. Animal-source foods and fresh fruits and vegetables are the leading cause of food-borne diseases in SSA. Pathogenic bacteria, viruses and chemical contaminants including pesticide residues and calcium carbide used for artificial fruit ripening are the primary agents of food-borne illnesses due to fresh produce in SSA. Small, resource-poor farmers account for the bulk of agricultural production in SSA and advocacy, capacity building in food safety and the application of good agricultural practices and good hygienic practices will reduce fresh produce contamination. Improved post-harvest handling practices, transport and market infrastructure including cold chains, the establishment of simple packinghouses

where fresh produce is prepared for the market, developing regulations for the informal food sector, greater capacity to enforce existing regulations and the certification of food management systems will improve food safety throughout the fresh produce supply chain in SSA. The adoption of new, sophisticated and more effective technologies of fresh produce decontamination is hampered by technical and economic constraints. Africa has the fastest-growing number of mobile phone users in the world and mobile phones and internet can improve food quality and safety in SSA and overcome the constraint of access to market information and promote the inclusion of smallholder farmers in SSA in national, regional and global markets.

Keywords: /Fruits and vegetables/ /Food-borne diseases/ /Food decontamination/ /Post-harvest handling/ /Digital technology/

Coluccia, B., Agnusdei, G.P., Miglietta, P.P., & De Leo, F. (2021). Effects of COVID-19 on the Italian agri-food supply and value chains. *Food Control, 123*, 107839. https://doi.org/10.1016/j.foodcont.2020.107839

Abstract

The spread of COVID-19 has not only led to many deaths but also to social and economic downturn globally. The study represents an exhaustive compilation of relevant macroeconomic data regarding the status of the agri-food sector from a demand side perspective and an overview of the food product producer and consumer prices after the shock. Its main purpose is to assess the resilience level of the agri-food sector to the coronavirus pandemic, analyzing its effect on commodity prices and focusing on the supply and value chain. The results highlight that fresh and perishable products, whose production or harvest took place during the first wave of COVID-19, have suffered price level effects, while storable products have not registered significant impacts. This phenomenon is mainly due to the vulnerability of the harvest and production phases, which affected fresh and perishable products supply, and to the resilience of transports and logistics, which instead ensured the supply of storable products to the final consumer. Especially in case of future pandemic waves, the implications and information deriving from the present analysis could support researchers, policy makers and managers, serving as an assessment tool to build suitable strategies for the whole agri-food supply chain and thus ensure sector resilience during these unprecedented times.

Keywords: /Coronavirus/ /Pandemic/ /Resilience/ /Prices/ /Food control/ /Supply chain/

SWEET POTATO

Ru, L., Chen, B., Li, Y., Wills, R. B. H., Lv, Z., Lu, G., & Yang, H. (2021). Role of sucrose phosphate synthase and vacuolar invertase in postharvest sweetening of immature sweetpotato tuberous roots (Ipomoea batatas (L.) Lam cv 'Xinxiang'). *Scientia Horticulturae*, *282*, 110007. https://doi.org/10.1016/j.scienta.2021.110007

Abstract

Postharvest sweetening can improve the eating quality of sweetpotato, particularly of immature sweetpotato. In this study, soluble sugar content, activities of sucrose phosphate synthase (SPS) and vacuolar invertase (VIN) enzymes and expression of three *IbSPSs,* five *IbVINs* and two vacuolar invertase inhibitory factor (*IbVIFs*) genes were examined in immature sweetpotato cv 'Xinxiang' during 30 days storage at 20, 13 and 4 °C. Results showed that sucrose content increased at all temperatures, while glucose and fructose mainly increased at 4 °C. However, chilling injury developed at 4 °C and postharvest sweetening at 20 °C is potentially a safer option. The sucrose level was correlated with SPS activity and SPS activity is not manipulated at transcriptional stage. Fructose/glucose content was correlated with VIN activity. Transcript level of *IbVIN1* was correlated with VIN activity and sweetness

index in sweetpotato roots. Therefore, *IbVIN1* could be a candidate gene in cultivating a variety high in sweetness.

Keywords: /Sweet potato/ /Sweetening/ /Sugar content/ /Sucrose phosphate synthase/ /Vacuolar invertase/

Zhimo, V. Y., Kumar, A., Biasi, A., Salim, S., Feygenberg, O., Toamy, M. A., & Droby, S. (2021). Compositional shifts in the strawberry fruit microbiome in response to near-harvest application of Metschnikowia fructicola, a yeast biocontrol agent. *Postharvest Biology and Technology*, *175*, 111469. https://doi.org/10.1016/j.postharvbio.2021.111469

Abstract

Plant-associated microbial communities form complex co-associations that play a role in promoting plant productivity and health, although the underlying mechanisms have not been fully elucidated. The functional role of the microbiome provides a new perspective on how we can potentially utilize the microbiome to maintain the postharvest quality and health of produce. While the composition and dynamics of the microbiome on fruit and vegetables over time and in response to postharvest management practices has begun to be explored, an understanding of their functional role in harvested produce is still lacking, especially in fruit. Therefore, the present study was undertaken to characterize the effect of near-harvest field application of a yeast biocontrol agent *Metschnikowia fructicola*, on the strawberry fruit microbiome. High-throughput sequencing revealed significant shifts in the bacterial and fungal community in response to the application of the yeast biocontrol agent sampled at the time of application, after harvest, and after storage and shelf life. Alterations included an increased bacterial diversity, distinct shifts in community composition and structure, specific microbial interactions and differential enrichment of several potentially beneficial genera (*Methylobacterium*, *Sphingomonas, Rhizobium, Bacillus* and others) in *M. fructicola* treated fruit leading to subsequent postharvest disease suppression. Results of this study provide new insights into the dynamics of the postharvest fruit microbiome that will assist in the development of a targeted, microbiome-driven approach to robust and sustainable disease control strategies.

Keywords: /Microbiome/ /Strawberry/ /Biocontrol/ /Postharvest/ /*Metschnikowia fructicola/ /Botrytis/*

TOMATO

Constantino, L. V., Rossetto, L. M., Benassi, M. T., Oliveira, C., Zeffa, D. M., Koltun, A., & Azeredo Gonçalves, L. S. (2021). Physico-biochemical characterization of mini-tomatoes and internal preference mapping based on consumer acceptance. *Scientia Horticulturae*, *282,* 110034. https://doi.org/10.1016/j.scienta.2021.110034

Abstract

The choice of promising parents represents a crucial step in developing improved cultivars in breeding programs for mini-tomatoes, highly demanded miniature vegetables. The association of non-sensory and sensory features of fruit greatly enhances the generation of cultivars that meet the expectations of the productive and commercial chain of tomatoes, focusing on diverse market niches. Thus, in this study, five genotypes of mini-tomatoes were characterized based on physical, biochemical, and sensory attributes. The genetic material encompasses four cultivars (BRS Iracema, BRS Zamir, Iraí, and Sweet Heaven) and one landrace (UEL 238). The fruits were characterized by their dimension, color, firmness, soluble solids content, acidity, vitamin C, carotenoids, phenolic compounds, flavonoids, and antioxidant activity. In the sensorial test, 109 participants, including 27 chefs, evaluated the shape, size, color, aroma, flavor, texture, and overall liking of the fruit. The cultivar Sweet Heaven, with an oblong red fruit, brought together the main desirable physical traits, such as greater mass, pericarp thickness, firmness, and soluble solids content; while BRS Zamir presented superior values for biochemical characteristics, such

as total phenolic compounds, total flavonoids, and antioxidant activity. Despite the lesser appreciation of the landrace UEL 238, all genotypes were accepted by consumers, especially BRS Iracema (round red fruit), followed by Iraí (oblong yellow fruit). The characterized mini-tomatoes may be explored in breeding programs as promising parents to combine desirable sensory attributes with the highest nutraceutical quality, resulting in superior cultivars that have been increasingly demanded on the market.

Keywords: /*Solanum lycopersicum* var. *cerasiforme/ /*Functional food/ /Antioxidant activity/ /Sensory analysis/ /Postharvest quality/

Escobar, M. R., Ré, M. D., Sossi, M. L., Boggio, S. B., Herrfurth, C., Feussner, I., & Valle, E. M. (2021). Mitochondrial small heat shock protein and chilling tolerance in tomato fruit. *Postharvest Biology and Technology*, *175*, 111491. https://doi.org/10.1016/j.postharvbio.2021.111491

Abstract

Our previous report indicated that tomato (*Solanum lycopersicum*) fruit of two contrasting varieties in the chilling tolerance showed the opposite expression pattern of a mitochondrial small heat shock protein (*M-sHSP23.8*) gene after chilling stress. Thus, the fruit of the relatively tolerant variety Micro-Tom strongly accumulated *M-sHSP23.8* transcripts while the susceptible var. Minitomato fruit did not. To test whether *M-sHSP23.8* is involved in tomato fruit protection mechanisms against chilling stress, Minitomato fruit overexpressing *M-sHSP23.8* (*OE23.8*) and knockdown Micro-Tom fruit with reduced levels of *M-sHSP23.8* (*amiR23.8*) were developed. After chilling treatment, most of the *amiR23.8* fruit failed to ripen normally, showed wilting and skin wrinkles, partial discoloration, and did not reach full red color. On the contrary, these chilling injury symptoms were significantly diminished in *OE23.8* fruit, showing less visible deterioration after chilling. Fruit of *OE23.8* and *amiR23.8* showed opposite patterns of water loss, electrolyte leakage, and expression of the tomato *catalase 1* gene compared to control fruit. Membrane lipidome profile evidenced that *amiR23.8* fruit showed differential adjustment of extra plastidic and plastidic lipids and variations in the lipid remodeling compared to control fruit, suggesting alterations in the membrane integrity. The high sensitivity of Micro-Tom *amiR23.8* fruit and the better performance of Minitomato *OE23.8* fruit to chilling treatment indicate that sHSP23.8 may be crucial in the chilling stress tolerance in tomato fruit.

Keywords: /Chilling injury/ /Fruit/ /Lipids/ /Membranes/ /sHSP/ mz,Mxxx/

Li, X., Tsuta, M., Hayakawa, F., Nakano, Y., Kazami, Y., & Ikehata, A. (2021). Estimating the sensory qualities of tomatoes using visible and near-infrared spectroscopy and interpretation based on gas chromatography–mass spectrometry metabolomics. *Food Chemistry, 343*, 128470. https://doi.org/10.1016/j.foodchem.2020.128470

Abstract

The ability to estimate the sensory quality of intact tomatoes rapidly and non-destructively using visible and near-infrared spectroscopy (Vis-NIRS) is important for the tomato industry. In this study, a combination of partial least squares regression (PLSR) analysis and the stepwise selectivity ratio (SWSR) method was used to study the ability of Vis-NIRS to predict 19 sensory attributes in intact tomatoes. The PLSR models constructed based on the informative wavelengths selected by the SWSR method predicted 8 sensory attributes well, particularly the sweetness attribute (correlation coefficient of validation of 0.92). Moreover, based on the tomato metabolites determined by GC–MS analysis, high intercorrelations between sensory attributes, metabolites, and the selected informative wavelengths were found through principal component analysis, as well as the high correlation coefficients between them. The results confirm the feasibility and reliability of Vis-NIRS and the informative wavelengths selected by SWSR to predict the sensory quality of whole tomatoes.

Keywords: /Sensory attributes/ /Selectivity ratio/ /Informative wavelengths/ /Metabolites/ /Intercorrelations/ /Partial least squares regression/ /Principal component analysis/

Sun, X., Wang, J., Zhang, H., Dong, M., Li, L., Jia, P., Bu, T., Wang, X., & Wang, L. (2021). Development of functional gelatin-based composite films incorporating oil-in-water lavender essential oil nano-emulsions: Effects on physicochemical properties and cherry tomatoes preservation. *LWT - Food Science & Technology*, *142*, 110987. https://doi.org/10.1016/j.lwt.2021.110987

Abstract

This study presented a facile approach for fabricating oil-in-water lavender essential oil nano-emulsions (LEONs) with excellent antibacterial and antioxidant activities. Besides, LEONs with different LEO content (50, 100, 200 and 300 μL/10 mL) were incorporated to the matrix of gelatin (GL) for preparing multifunctional GL-LEONs films, which exhibited strong antibacterial properties against *Staphylococcus aureus*, *Escherichia coli* and *Listeria monocytogenes*, as well as excellent antioxidant activities. Additionally, the GL-LEONs films exhibited sustained release characteristics, excellent UV light barrier performances and good heat-sealing properties. Furthermore, the GL-LEONs films were applied to the preservation of cherry tomatoes at 25 ± 2 °C for 7 days. The results revealed that the deterioration of cherry tomatoes packaged with the GL-LEONs films was suppressed during storage, which mainly reflected in reducing weight loss, delaying the degradation of titratable acids and phenolic components, and inhibiting the growth of microorganisms.

Keywords: /O/W lavender essential oil nano-emulsion/ /Gelatin/ /Antibacterial/ /Antioxidant/ /Cherry tomatoes/

VEGETABLE

Pennisi, G., Orsini, F., Castillejo, N., Gómez, P. A., Crepaldi, A., Fernández, J. A., & Gianquinto, G. (2021). Spectral composition from led lighting during storage affects nutraceuticals and safety attributes of fresh-cut red chard (Beta vulgaris) and rocket (Diplotaxis tenuifolia) leaves. *Postharvest Biology and Technology*, *175*, 111500. https://doi.org/10.1016/j.postharvbio.2021.111500

Abstract

The main objective of this study was to evaluate the physiological and quality changes of fresh-cut red chard (*Beta vulgaris*) and rocket (*Diplotaxis tenuifolia*) leaves illuminated during storage with monochromatic light emitting diode (LED) lamps, featuring different spectral component (red, green, yellow, white, blue and far-red) and same light intensity (35 μmol m^{-2} s^{-1}). As control, storage in darkness was assayed. Biomass, colorimetric and microbiological changes were determined up to 10 d of storage at 5 °C. In addition, total antioxidant activity and bioactive compounds changes along the shelf-life were also monitored. Microbial counts were reduced by yellow and blue light in red chard, and by yellow and green light in rockets. Green and white light enabled to preserve colorimetric indexes and chlorophylls content mostly in rocket and, eventually, increasing carotenoids in red chard. Total antioxidant capacity and total phenols content were stimulated in response to red or blue light application for both species. On the other hand, LED light supply increased weight losses during storage as compared to darkness, although more limitedly in response to yellow and far red light. The study provides solid ground for further exploration on how LED lighting treatment during storage of red chard and rocket may foster product qualitative properties, suggesting that different spectral wavebands may alternatively enhance antioxidant properties and reduce microbiological risks.

Keywords: /*Beta vulgaris* /*Diplotaxis tenuifolia*/ /Postharvest/ /Bioactive compounds/ /Antioxidant capacity/ /Phenols/