

**SELECTIVE DISSEMINATION OF INFORMATION**  
**As of September 2020**

**ALSTROEMERIA**

**Langroudi, M. E., Hashemabadi, D., Sepideh, K., & Asadpour, L. (2020). Effects of pre- and postharvest applications of salicylic acid on the vase life of cut Alstroemeria flowers ( Alstroemeria hybrida ) into two. *Journal of Horticulture and Postharvest Research* 3(1), 115–124. doi: 10.22077/jhpr.2019.2409.1053**

Abstract

Purpose: In this study, the effects of different concentrations of salicylic acid on the physiological traits of Alstroemeria (Alstroemeria hybrida cv. 'Summer Sky') cut flowers during pre-harvest and postharvest applications are investigated. The aim of this study was to identify the best treatments and methods affecting the vase life of cut Alstroemeria flowers. Research Method: The study was performed as a factorial experiment based on a completely randomized design using three replications in each combination/mixed treatment. The factors consisted of the pre-harvest foliar and post-harvest (pulsing 24h and continuous) applications of salicylic acid at two concentrations of 30, 200 ppm (SA1) and 50, 300 ppm (SA2), respectively. Findings: The vase life, chlorophylls a, b, and total, relative fresh weight, SOD activity, and the percentages of dry matter and the absorption of preservative solution were evaluated. The results showed that using high concentrations of salicylic acid (SA2) significantly increased the vase life of Alstroemeria. The pre-harvest foliar application of a 300 ppm of salicylic acid would be useful in prolonging the vase life of cut Alstroemeria flowers and thus would help to reduce the losses caused by the rapid senescence of petals which will lead to an increase in the quality of appearance and economic value. Research limitations: There was no significant limitation to be reported. Originality/Value: The positive impact of salicylic acid (50 ppm) in the pre-harvest method (B) was found, and its application improved the vase life of cut Alstroemeria flowers, which should be taken into consideration for commercial uses.

Keywords: /Chlorophyll/ /Pulsing/ /SOD/

**APPLE**

**Chai, Y., Li, A., Wai, S. C., Song, C., Zhao, Y., Duan, Y., ... Lin, Q. (2020). Cuticular wax composition changes of 10 apple cultivars during postharvest storage. *Food Chemistry*, 324, 126903. doi: 10.1016/j.foodchem.2020.126903**

Abstract

Cuticular wax chemicals differ among fruit cultivars and contribute to storage ability. However, wax analysis in apple cultivars, particularly during storage, has not been described. In this work, the chemicals and crystal structures of cuticular wax in 10 apple cultivars were analyzed to observe wax functions in apple during storage. Results showed that alkanes and primary alcohols decreased while fatty acids increased in stored fruits of all cultivars compared with the

fruits before storage. Terpenoids, aldehydes, and phenols were observed in stored fruits but not in the fruits before storage in all cultivars except 'Red Star' fruit. The weight loss rate was significantly correlated with six components including C13 alcohol, C14 alkanes, total alkanes, total wax, C13 alkanes and C54 alkanes in 10 cultivar apple fruits during storage. Our findings indicate that the total wax, particularly alkanes, in the peel of apple fruits is essential for storage and quality control.

Keywords: /Apple/ /Cuticular wax/ /Fruit quality/ /Storage/ /Wax structure/

**Khanal, B. P., Si, Y., & Knoche, M. (2020). Lenticels and apple fruit transpiration. *Postharvest Biology and Technology*, 167, 111221. doi: 10.1016/j.postharvbio.2020.111221**

Abstract

Lenticels are sites of preferential gas exchange and water loss. Here we quantified the water vapor permeance of lenticels and their contribution to total transpiration in different regions of the apple (*Malus × domestica* Borkh.) fruit skin. Along the transect pedicel to calyx, lenticel area decreased (smaller lenticels), while lenticel density per unit area and cumulative lenticel area both increased. Lenticel density was highest in 'Renoir civ' ( $13.6 \pm 0.5 \text{ cm}^{-2}$  in the cheek region) followed by 'Wellant' ( $6.9 \pm 0.5 \text{ cm}^{-2}$  in the cheek region) apple. About 10 % of lenticels had microcracks as indexed by infiltration by a solution containing a silicone surfactant. There was no infiltration in the absence of the surfactant. In 'Wellant' the relative contribution of lenticellular water loss to the total was lower in the pedicel region (14 %) than in the calyx region (25 %). The contribution of lenticels differed among cultivars averaging in the cheek region 19 % in 'Wellant' and 8 % in 'Pinova' apple. The permeance of the periderm of a lenticel exceeded that of a russeted fruit skin 5.8-fold in 'Wellant' and 5.2-fold in 'Pinova'. Skin permeance was positively and significantly related to both lenticel density and cumulative lenticel area within a region or between regions in 'Wellant'. Across nine apple cultivars, permeance was significantly and positively related to lenticel density ( $r^2 = 0.52^*$ ) and to cumulative lenticel area ( $r^2 = 0.84^{***}$ ). The mechanistic basis for the increased water vapor permeability of lenticels is discussed.

Keywords: /*Malus*/ /Lenticel/ /Permeance/ /Periderm/ /Water vapour/

**Zhang, X., Zong, Y., Li, Z., Yang, R., Li, Z., Bi, Y., & Prusky, D. (2020). Postharvest *Pichia guilliermondii* treatment promotes wound healing of apple fruits. *Postharvest Biology and Technology*, 167, 111228. doi: 10.1016/j.postharvbio.2020.111228**

Abstract

*Pichia guilliermondii* is a yeast widely found on soil, leaves and fruit surfaces and is known to have a good biocontrol effect on a variety of postharvest diseases of fruits and vegetables. In this study, artificially wounded apple fruits (cv. Fuji) were treated with *P. guilliermondii*. It was found that *P. guilliermondii* growth increased rapidly at wound sites of fruit in the early stage of healing and later decreased rapidly. The yeast significantly reduced weight loss of wounded fruit

and the disease index of inoculated fruit with *Penicillium expansum*. On the 5 d of healing, the weight loss and disease index of treated fruits were 25 % and 44 % lower than the control, respectively. *P. guilliermondii* also promoted the accumulation of O<sub>2</sub><sup>-</sup> and H<sub>2</sub>O<sub>2</sub>, increased the activity of superoxide dismutase, catalase, peroxidase and polyphenol oxidase in fruit wounds. Furthermore, *P. guilliermondii* activated phenylalanine ammonia-lyase activity and increased the content of total phenols, flavonoids and lignin in the fruit wounds. It is suggested that postharvest *P. guilliermondii* treatment could promote the wound-healing of apple fruit by activating the reactive oxygen species and phenylpropane metabolism in the fruit wound.

Keywords: /Fruit/ /*Pichia guilliermondii*/ /Wound healing/ /Reactive oxygen metabolism/ /Phenylpropanoid metabolism/

## ASPARAGUS

**Lwin, W. W., Srilaong, V., Boonyarittthongchai, P., Wongs-Aree, C., & Pongprasert, N. (2020). Electrostatic atomised water particles reduce postharvest lignification and maintain asparagus quality. *Scientia Horticulturae*, 271, 109487. doi: 10.1016/j.scienta.2020.109487**

### Abstract

Asparagus has a high respiration rate and short shelf-life. The loss in quality is observed through the wrinkling of stems, loss of green colour and toughening. The objective of this study was to reduce the spear lignification and maintain the quality of asparagus using electrostatic atomised water particle (EAWP) treatment. Asparagus were treated with EAWPs for 0 (control) and 90 min and kept at 4 °C for 24 days. The results showed that EAWP treatment for 90 min maintained the colour and total chlorophyll content of the spears. EAWP treatment retarded the respiration rate and ethylene production, reduced weight loss and induced stomatal closure in the stored asparagus. Additionally, the treatment significantly delayed the rise in the activities of phenylalanine ammonia-lyase (PAL), cinnamyl alcohol dehydrogenase (CAD) and peroxidase (POD), which were associated with the inhibition of lignin and cellulose accumulation. Similarly, treated asparagus showed lower hydrogen peroxide content than that of the control but had higher nitric oxide content during the initial days in storage, and decreased thereafter. Distinctly, the total phenolic in EAWP treated asparagus was higher than the control. These findings suggest that EAWPs worked as a stress treatment to inhibit the lignification process and maintained the quality of asparagus during storage at 4 °C.

Keywords: /Asparagus/ /EAWPs/ /Lignification/ /Nitric oxide/

**Pu, Y., Zhou, Q., Yu, L., Li, C., Dong, Y., Yu, N., & Chen, X. (2020). Longitudinal analyses of lignin deposition in green asparagus by microscopy during high oxygen modified atmosphere packaging. *Food Packaging and Shelf Life*, 25, 100536. doi:10.1016/j.fpsl.2020.100536**

### Abstract

Lignification is the most important factor that negatively affects quality of fresh green asparagus and limits its marketability after harvest. The study was to investigate the effect of high oxygen modified atmosphere packaging (high-O<sub>2</sub> MAP) on lignification of green asparagus. The texture and lignin content of green asparagus were determined. Lignin deposition in the cell wall was observed by fluorescence microscopy, light microscopy and transmission electron microscopy (TEM). Lower shearing force and lignin content were found in 60 % and 80 % high-O<sub>2</sub> MAP during 30 days storage time. 100 % high-O<sub>2</sub> MAP slowed the rate of increase in shearing force and lignin levels after 18 days storage time. Microscopic observation results showed that less lignin deposition and cell wall thickening were observed in high-O<sub>2</sub> MAP, especially 60 % and 80 % high-O<sub>2</sub> MAP. The work justified that high-O<sub>2</sub> MAP, especially 60 % and 80 % high-O<sub>2</sub> MAP, could effectively keep the tender texture of green asparagus, retard the lignin deposition and slow down the lignification progress. Comprehensive microscopic observation was feasible to illustrate the lignification of high-O<sub>2</sub> MAP.

Keywords: /Green asparagus/ /High-O<sub>2</sub> MAP/ /Lignification/ /Cell wall/ /Microscopy/

## **BANANA**

**Shan, Y., Huang, H., Lian, Q., Li, F., Zhang, J., Zhu, H., & Jiang, Y. (2020). Characterization and function of banana DORN1s during fruit ripening and cold storage. *Postharvest Biology and Technology*, 167, 111236. doi: 10.1016/j.postharvbio.2020.111236**

### Abstract

*DORN1* as the first plant receptor gene for extracellular ATP (eATP) regulates a series of biological activities, but the biological roles of eATP and *DORN1* remain unclear in postharvest fruit. In this study, a total of 34 *DORN1*s termed as *MaDORN1*s were identified from the banana genome and can be classified into five groups according to the analyses of phylogenetic tree, gene structure and conserved domain. The *cis*-element and microRNA targeting analyses also revealed that *MaDORN1*s might regulate ripening process and cold stress response. Using the molecular docking, the ten highly expressed *MaDORN1* proteins exhibited high binding affinities with ATP, indicating the key interaction sites between *MaDORN1* proteins and ATP. It was noted particularly that the pretreatment with 1 mM ATP for 5 min significantly promoted fruit ripening and enhanced cold tolerance of postharvest banana during storage. The eATP treatment induced rapidly the early expressions of most *MaDORN1*s in association with accelerated ripening at ambient temperature while inhibiting the initial expressions in relation to reduced chilling injury of banana fruit at low temperature, suggesting their early responses in fruit ripening and low temperature storage. This study provides important insights into the roles of eATP and its receptor *DORN1* of banana fruit during ripening and in response to low temperature.

Keywords: /Banana/ /*DORN1* family/ /eATP/ /Fruit ripening/ /Chilling injury/

**Lv, J., Zhang, J., Han, X., Bai, L., Xu, D., Ding, S., ... Li, J. (2020). Genome wide identification of superoxide dismutase (SOD) genes and their expression profiles under 1-methylcyclopropene (1-MCP) treatment during ripening of apple fruit. *Scientia***

Abstract

The objective of this research was to determine the role that ethylene plays in superoxide dismutase (SOD) gene expression of apple fruit (*Malus × domestica* Borkh.) during ripening. Apple fruit at commercial maturity were treated with ethylene antagonists 1-methylcyclopropene (1-MCP) and stored at shelf temperature of 20 °C. Our data indicated that application of 1-MCP resulted in a reduced rate of softening and a delayed peak of ethylene and respiration. 1-MCP treatment reduced accumulation of superoxide anion (O<sub>2</sub><sup>•-</sup>) and hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) in both peel and pulp, enhanced SOD activity in pulp and peel to varying degrees during ripening. Expression of *Cu/ZnSOD2*, *Cu/ZnSOD3*, *Cu/ZnSOD5*, *Cu/ZnSOD6*, *Cu/ZnSOD8*, *MnSOD2*, *MnSOD7* and *MnSOD9* in pulp was enhanced by treatment with 1-MCP during the early ripening period, and conversely, their expression in pulp was reduced by it during the late ripening period compared to control group. Most SOD genes presented a fluctuating pattern of expression in peel after 1-MCP treatment during ripening. Expression of *Cu/ZnSOD10* and *MnSOD7* in peel was promoted by 1-MCP treatment during the late ripening period, while expression of *MnSOD4* and *FeSOD1* in peel was generally enhanced by it during the entire shelf life period compared with controls. Our results suggested that ethylene played a role in regulating SOD genes expression in both pulp and peel of ripening apple fruit.

Keywords: /Apple fruit/ /Ripening/ /Superoxide dismutase/ /Gene expression/

## BREADFRUIT

**Molim, S., Vaaiva, V., & Wills, R. B. H. (2020). Effect of low temperatures on the storage life of two Samoan breadfruit ( *Artocarpus altilis* ) cultivars. *Journal of Horticulture and Postharvest Research*, 3, 91–96. Doi: 10.22077/jhpr.2019.2912.1106**

Abstract

Purpose: Breadfruit is a tropical climacteric fruit consumed as an unripe starchy vegetable hence export requires some postharvest technology to inhibit ripening during marketing. Research in the Caribbean found storage at 12 °C was optimal to delay ripening without fruit developing chilling injury. Breadfruit is a major horticultural commodity in Samoa with New Zealand a target export destination. This paper examines the ability of low temperatures to extend the storage life of unripe Samoan breadfruit and thus facilitate export. Research method: Puou and Maafala breadfruit were stored at temperatures from 12 to 25 °C and observed for time to ripen and to exhibit chilling injury symptoms as these factors determine storage life. Main findings: Time to ripen increased as the temperature was lowered but chilling injury occurred on all fruit stored at 12 and 15 °C and many stored at 17 °C. The longest storage life was attained at 17 °C with 11 days for Puou and 16 days for Maafala fruit with storage terminated by a mix of fruit ripening and developing chilling injury. Limitations: Questions remain as to the importance of mild chilling injury to influence purchase. Originality/Value: Samoan breadfruit is more chilling sensitive than Caribbean fruit and thus must be transported at higher temperatures than Caribbean fruit. Use of 17 °C gave the longest storage life for Samoan breadfruit which is sufficient for the 10 days required to export by air to New Zealand but is less than the 21 days required to export breadfruit by sea.

Keywords: /Artocarpus altilis/ /Breadfruit/ /Chilling injury/ /Ripening/ /Storage temperature/

## CHERRY TOMATO

**Aragüez, L., Colombo, A., Borneo, R., & Aguirre, A. (2020). Active packaging from triticale flour films for prolonging storage life of cherry tomato. *Food Packaging and Shelf Life*, 25, 100520. doi: 10.1016/j.fpsl.2020.100520**

### Abstract

Activated packaging boxes with triticale films containing KMnO<sub>4</sub> were prepared. The effects of the incorporation of KMnO<sub>4</sub> and the storage time on the properties (X-ray photoelectron spectroscopy- XPS, color, water vapor permeability and mechanical) of triticale films were studied. Cherry tomatoes were packed in open, control and activated boxes at different temperatures during 20 days. Changes in firmness, weight loss, total soluble solid and pH of the tomatoes were monitored. Tomatoes in active packaging boxes showed lower quality changes, lower weight loss and higher firmness during storage than those in control and open boxes. XPS and color of films confirm the oxidation of ethylene by KMnO<sub>4</sub> and the reduction of Mn<sup>+7</sup> to Mn<sup>+4</sup> in activated triticale flour films. The results suggested that over 20 days of storage the activated film exhibited a continuing ethylene oxidation activity and consequently delayed the ripening process and changes in the quality of the tomatoes.

Keywords: /Tomato/ /Active triticale flour film/ /Ethylene/ /Active packaging/ /Shelf life/

## CUTFLOWER

**Cheng, G., Wang, L., He, S., Liu, J., & Huang, H. (2020). Involvement of pectin and hemicellulose depolymerization in cut gerbera flower stem bending during vase life. *Postharvest Biology and Technology*, 167, 111231. doi: 10.1016/j.postharvbio.2020.111231**

### Abstract

This study was designed to evaluate the modifications of pectin and hemicellulose polysaccharides, as well as their putative effects, during the stem bending of fresh-cut gerbera flowers. Flowers bend in the region 6–12 cm below the capitulum starting after 6 days, and have an average vase life of approximately 9 days. The cell wall structure of the vascular bundles disintegrates with the occurrence of stem bending. The bending of the stem corresponded to an increase in water-soluble pectin (WSP), and gradual decreases in acid-soluble pectin (ASP), 1 M KOH-soluble hemicellulose (HC1), and 4 M KOH-soluble hemicellulose (HC2). The predominant monosaccharide components were galactose, rhamnose, and arabinose for the WSP and ASP fractions, and glucose and xylose for the HC1 and HC2 fractions. The molecular mass decreased for the WSP and increased for the ASP fraction, whereas the HC1 fraction showed a strong increase on day 6 and then decreased on day 11. Enzyme activity analysis showed that the activities of polygalacturonase and cellulase decreased gradually, and pectin

methylesterase first increased and subsequently decreased. These results provide further evidence that the depolymerization of pectin and hemicellulose may affect stem bending in cut flowers. Our findings help our understanding of the physiological and biochemical modifications in the regulation of the mechanical strength of the cell walls of cut flowers during vase life.

Keywords: /Gerbera (*Gerbera jamesonii* Bolus ex Hooker f.)/ /Cut flower/ /Stem bending/ /Depolymerization of polysaccharides/ /Pectin/ /Hemicellulose/

## FRUITS AND VEGETABLES

**Chitranshi, S., Dubey, N., & Sajjad, M. (2020). Sustainable botanical products for safe post-harvest management of perishable produce : A review. *Journal of Horticulture and Postharvest Research* 3(1), 125–140. doi: 10.22077/jhpr.2019.2703.1083**

### Abstract

**Purpose:** The objective of this review is to study the effect of plant-based products on post-harvest management of the horticultural crops. Today when the horticulture crops are loaded with pesticides, the produce does not reach the consumer in a fresh and healthy form, it becomes imperative to look for alternative products which are safe, non-toxic, environment-friendly and do not disturb the eco rhythm. **Findings:** Plant-based products can be utilized at post-harvest stage washing agents, botanical sanitizers, edible coatings (protein, lipid and starch-based, antimicrobial agents, cushioning materials during transport, preservatives and as control measure for storage diseases as various bioactive constituents. To minimize dependence on synthetic pesticides, the use of plant-based antimicrobial substances which includes essential oils, glucosinolates, volatile compounds, acetaldehydes and jasmonates at various stages of plant growth may help in the management of crops, phytopathogens and pests in a very effective manner and will provide an alternative method for sustainable agriculture and opens up a new dimension of research for the scientists. **Limitations:** The author has used all the available resources but some excellent literature is still limited for including in the study due to non-availability to resources. **Directions for future research:** Plant-based products and botanical extracts opens up a new dimension of research. Scientists can easily utilize these for plant protection, cushioning, disease management during storage, extending the shelf-life. Scientists can standardize the edible coatings for various fruits, anti-bacterial, nano-emulsions based delivery of edible coating materials and aromatic extracts for disease management.

Keywords: /anti-microbial/ /botanical washes/ /edible coatings/ /storage diseases/

## GINGER

**Zhang, Y., Peng, Y., Jia, R., Wang, Q., Lou, X., & Shi, J. (2020). Sodium chloride combined with polypropylene film can maintain the quality of fresh-cut ginger. *Food Packaging and Shelf Life*, 25, 100541. doi: 1016/j.fpsl.2020.100541**

### Abstract

Fresh-cut ginger is easy to become browning and wilting. In this study, fresh-cut ginger was dipped with different concentrations of sodium chloride (NaCl), packed with two different films, and stored at 5 °C for 20 d. The results showed that the optimum concentration of NaCl was 0.05 mol L<sup>-1</sup>, the appropriate packaging material was polypropylene (PP, 0.05 mm), and the combined treatment could significantly ( $P < 0.05$ ) maintain the color and nutrient content such as gingerol and ginger flavonoids, inhibit polyphenol oxygenase, peroxidase, phenylalanine ammonia lyase and lipoxygenase activity and the content of malondialdehyde and phenolics, and reduce weight loss rate and softening. The ultrastructure of fresh-cut ginger was investigated by scanning electron microscope and transmission electron microscopy. It was found that NaCl treatment combined with the PP package could maintain cell integrity. In addition, the combined treatment could maintain higher carbon dioxide and lower oxygen concentration in the bags and could inhibit microbial counts. These results indicate 0.05 mol L<sup>-1</sup> NaCl combined with the PP package might be a promising candidate for maintaining the quality of fresh-cut ginger.

Keywords: /Fresh-cut ginger/ /Browning/ /Softening/ /Sodium chloride/ /Packaging materials/

## GRAPE

**Zhang, Z., Zhao, P., Zhang, P., Su, L., Jia, H., Wei, X., ... Jia, H. (2020). Integrative transcriptomics and metabolomics data exploring the effect of chitosan on postharvest grape resistance to *Botrytis cinerea*. *Postharvest Biology and Technology*, 167, 111248. doi: 10.1016/j.postharvbio.2020.111248**

### Abstract

Chitosan has a broad-spectrum antimicrobial activity and has been used to control or delay postharvest decay of fruit. In this study, transcriptomic and metabolomics analyses were used to evaluate the effect of chitosan treatment on the resistance to *Botrytis cinerea* of two grape varieties ('Kyoho' and 'Shine Muscat') that differ in their resistance to this pathogen. Meantime, the effect of chitosan treatment on *B. cinerea* mycelium growth was analyzed by scanning electron microscopes. The physiological indicators of disease and antioxidant enzyme activities of grape fruit after chitosan treatment were also measured. The results showed that chitosan treatment inhibited the damage of *B. cinerea* to grapefruit. At same time, chitosan could destroy the mycelium of *B. cinerea* and increase the antioxidant enzyme activities of grapefruit. The differentially expressed genes (DEGs) from treated or non-treated samples with chitosan were mainly enriched in the recognition of fungal diseases, plant hormone biosynthesis and signal transduction, and secondary metabolism. We detected a large number of secondary metabolites using the metabolome that were different in 'Kyoho' and 'Shine Muscat', such as epigallocatechin gallate, catechin, resveratrol etc. In conclusion, chitosan treatment improved disease resistance of grapefruit, and we established a possible model for chitosan regulating disease resistance of 'Kyoho' and 'Shine Muscat'. We found that the expression of DEGs in disease perception, plant hormone biosynthesis and signal transduction, and secondary metabolism differ between 'Kyoho' and 'Shine Muscat' after chitosan treatment, which helps to clarify the possible mechanism of chitosan providing tolerance to *B. cinerea*.

Keywords: /Chitosan/ /*Botrytis cinerea*/ /RNA-seq/ /Metabolome/ /Table grape/

## **GUAVA**

**Sharma, R., Nagaraja, A., Goswami, A., Thakre, M., Kumar, R., & Varghese, E. (2020). Influence of on-the-tree fruit bagging on biotic stresses and postharvest quality of rainy-season crop of 'Allahabad Safeda' guava (*Psidium guajava* L.). *Crop Protection*, 135, 105216. doi: 10.1016/j.cropro.2020.105216**

### **Abstract**

In India, guava trees produce two crops per year, one in the rainy-season and another in the winter. The rainy-season crop is severely infested by fruit fly, anthracnose disease and birds. Because of low quality, the rainy-season crop is usually discarded by farmers. In recent years, on-the-tree fruit bagging has emerged as one of the most effective approaches for controlling pests and diseases and quality improvement in fruits. Hence, we attempted to observe the effects of five different types of bags on the rainy-season crop of 'Allahabad Safeda' guava. For this, fruits were covered with either of four types of bags (nylon nets, polypropylene (PP) non-woven, butter paper and brown paper) at marble stage of development during the rainy-season crop for two consecutive years. All bags significantly advanced fruit maturity and improved fruit weight, texture, visual appeal, quality, and functional attributes over unbagged (control) fruits. Interestingly, fruit bagging with PP non-woven bags significantly reduced fruit drop and provided complete control of fruit fly, anthracnose and bird damage compared to unbagged fruits that suffered high incidence of fruit fly ( $56.6 \pm 1.08\%$ ), anthracnose ( $6.6 \pm 0.27\%$ ) and bird damage ( $14.6 \pm 0.23\%$ ). Thus, it can be concluded that on-the-tree fruit bagging with PP non-woven bags is useful for controlling major pests and/or disease and improving fruit quality of the rainy-season guava crop.

Keywords: /Anthracnose/ /Bird damage/ /Fruit fly/ /Functional attributes/ /Postharvest quality/

## **GRAPES**

**Gorrasi, G., Bugatti, V., Vertuccio, L., Vittoria, V., Pace, B., Cefola, M., ... Clarizia, G. (2020). Active packaging for table grapes: Evaluation of antimicrobial performances of packaging for shelf life of the grapes under thermal stress. *Food Packaging and Shelf Life*, 25, 100545. doi: 10.1016/j.fpsl.2020.100545**

### **Abstract**

The paper reports the formulation of an active packaging based on PET coated with a Layered Double Hydroxide (LDH) hosting 2-acetoxybenzoic anion (salicylate) as an antimicrobial molecule. The release of the molecule anchored to the LDH, compared to the molecule free dispersed into the coating, appeared much slower. Permeability of carbon dioxide and oxygen through the packaging at different temperatures was evaluated, as well as the capability of the active material to inhibit *Pseudomonas*, *Listeria* and *Lactobacillus*. Table grapes were stored in thermal stress conditions (*i.e.* 10 °C) into the active packaging and the total mesophilic aerobic count and yeasts and moulds population was evaluated up to 14 days of storage. The experimental results were used for a theoretical prediction of shelf life of the packed grapes

and compared with the same fruit packed into untreated material. Global and specific migration of salicylic acid from the active packaging demonstrated, in compliance with the migration limits of the EU regulation, the suitability of the considered material for food contact.

Keywords: /Layered double hydroxides/ /Active coating/ /Antimicrobial/ /Table grapes/

## KIWI

**Ge, M., Zhang, L., Ai, J., Ji, R., He, L., & Liu, C. (2020). Effect of heat shock and potassium sorbate treatments on gray mold and postharvest quality of 'XuXiang' kiwifruit. *Food Chemistry*, 324, 126891. doi: 10.1016/j.foodchem.2020.126891**

### Abstract

We determined whether heat and chemical treatments could reduce the decay of kiwifruit caused by *Botrytis cinerea* during postharvest storage. Kiwifruits were treated with 5 g/L (w/v) potassium sorbate (PS), with a 48 °C hot water treatment (HT), and with a combined treatment (HT + PS). Mycelial growth of *B. cinerea* and the postharvest quality of 'XuXiang' kiwifruits were evaluated. HT + PS significantly inhibited mycelial growth, germ tube growth, and spore germination of *B. cinerea*. This treatment also reduced the incidence of gray mold in kiwifruit postharvest, and enhanced activities of defense-related enzymes in kiwifruit tissues. Compared with the control, all treatments resulted in lower malondialdehyde (MDA) contents and higher total phenolic contents in kiwifruits. HT + PS also increased the activities of chitinase and  $\beta$ -1,3-glucanase and the transcript levels of their encoding genes. HT + PS can improve kiwifruit quality and reduce decay during postharvest storage.

Keywords: /Heat/ /Potassium sorbate/ /Kiwifruit/ /Gray mold/ /Postharvest quality/

## LITCHI

**Li, T., He, M., Zeng, J., Chen, Z., Hongxia, Q., Duan, X., & Jiang, Y. (2020). Choline chloride alleviates the pericarp browning of harvested litchi fruit by inhibiting energy deficiency mediated programmed cell death. *Postharvest Biology and Technology*, 167, 111224. doi: 10.1016/j.postharvbio.2020.111224**

### Abstract

The effect of choline chloride (ChCl) on litchi pericarp browning and the potential regulating mechanism was investigated in this study. Results showed that 1 g L<sup>-1</sup> ChCl significantly inhibited the development of pericarp browning and reduced respiration rate of litchi fruit. Meanwhile, choline chloride treatment delayed the programmed cell death (PCD) indicated by lower DNA laddering, inhibition of programmed cell death-related genes expression and higher soluble protein content. Additionally, ChCl treatment maintained higher ATP content and energy charge due to higher level of glycine betaine and regulation of energy metabolism related genes and ATPase activities by ChCl treatment. Finally, higher ATP status in ChCl treated fruit resulted in lower accumulation of reactive oxygen species via enhancing the activities of

superoxide dismutase, catalase and ascorbate peroxidase. Taken together, the results obtained in this study suggested that choline chloride reduced pericarp browning of litchi fruit possibly through inhibiting energy deficiency mediated PCD.

Keywords: /Litchi fruit/ /Energy metabolism/ /Pericarp browning/ /Programmed cell death/ /Choline chloride/

**Luo, S., Hu, H., Wang, Y., Zhou, H., Zhang, Y., Zhang, L., & Li, P. (2020). The role of melatonin in alleviating the postharvest browning of lotus seeds through energy metabolism and membrane lipid metabolism. *Postharvest Biology and Technology*, 167, 111243. doi: /10.1016/j.postharvbio.2020.111243**

Abstract

To investigate the underlying mechanism of melatonin (MT) involvement in the browning of lotus pods and seeds, the samples were immersed in 100  $\mu\text{mol L}^{-1}$  MT and 10  $\mu\text{mol L}^{-1}$  luzindole, a nonselective MT1/MT2 receptor antagonist. The energy and membrane lipid metabolisms of lotus seeds during 8 d at  $25 \pm 1$  °C were evaluated. The results indicated that MT treatment suppressed the browning of lotus seeds through enhancing the endogenous MT content, while luzindole demonstrated an opposite effect. Compared with the control, the MT treatment ensured the energy status of lotus seeds, as the ATP content and energy charge were promoted. The activities of cytochrome C oxidase (CCO), succinate dehydrogenase (SDH), and ATPases were enhanced by the treatment, which might contribute to the ATP production. Additionally, the cell membrane integrity of lotus seeds was maintained by MT treatment through reducing the cell membrane permeability,  $\text{O}_2^-$  production rate, and malondialdehyde and  $\text{H}_2\text{O}_2$  contents, as well as enhancing the unsaturated-to-saturated fatty acids ratio, which could be explained by inhibited lipoxygenase (LOX), lipase (LPS) and phospholipase D (PLD) activities. Thus, the sufficient energy supply and normal cell membrane function may be responsible for the attenuated browning of lotus pods and seeds by MT treatment.

Keywords: /Lotus pods/ /Lotus seeds/ /Melatonin/ /Energy status/ /Cell membrane integrity/ /Storage/

**Mphahlele, R. R., Caleb, O. J., & Ngcobo, M. E. K. (2020). Effects of packaging and duration on quality of minimally processed and unpitted litchi cv. 'Mauritius' under low storage temperature. *Heliyon*, 6(1). Doi: 10.1016/j.heliyon.2020.e03229**

Abstract

Pericarp drying is a major postharvest challenge affecting the shelf life of litchi fruit resulting in loss of market value and consumer rejection. Sulphur dioxide ( $\text{SO}_2$ ) is considered an allergen due to its ability to cause irritation in people, particularly those vulnerable to asthma. Thus, the objective of this study was to investigate the effects of packaging and storage duration without  $\text{SO}_2$  on the quality attributes of minimally processed litchi fruit cv. 'Mauritius'. Minimally processed litchi cv. 'Mauritius' were packed inside clamshell trays with different perforation sizes: 0 (P-0), 1.1 mm (P-1), and 5.4 mm (P-2) and stored at 1 °C for 15 days, and then held at

12 °C for 2 days for shelf life study (mimicking retail practices). The least mass loss % was observed in fruit packaged under P-0 followed by P-1 and P-2 until the end of storage. Fruit packed in P-2 (5.4 mm perforation) had the highest firmness compared to samples from other packages, but they also had the highest decay incidences at day 9. The TSS (°Brix) was highest in fruit packed under P-0 followed by P-2 than P-1 at the end of storage. The TSS:TA increased significantly with storage duration with the highest value obtained on day 9 in P-0 (121.63) in comparison to P-1 (108.44) and P-2 (103.35). Ascorbic acid and radical scavenging activity declined with prolonged storage irrespective of package type. Overall litchi fruit were better maintained in non-perforated and 1.1 mm perforated clamshell trays up to 9 days, without decay incidences.

Keywords: /Food science/ /Food packaging/ /Food quality/ /Agricultural science/ /Horticulture/ /Litchi/ /Allergen/ /Total soluble solids/ /Radical scavenging activity/ /Ascorbic acid/ /Decay/

**Zou, J., & Li, P. (2020). Modelling of litchi shelf life based on the entropy weight method. *Food Packaging and Shelf Life*, 25. Doi: 10.1016/j.fpsl.2020.100509**

Abstract

The shelf life of litchi is difficult to predict because multiple quality indices should be considered; thus, the aim of this study is to introduce a new method by simultaneously considering several sensorial, physical and chemical attributes of litchi based on the entropy weight method (EWM). The objective weight of each litchi quality index was obtained by the EWM, and the comprehensive evaluation indices that reflected the overall changes in litchi quality were calculated by the linear weighted sum. Then, the comprehensive evaluation indices were used in the accelerated shelf life testing (ASLT) method to predict the shelf life of litchi. The results showed that the kinetics of the litchi comprehensive evaluation indices were described by the zero-order reaction, and the regression coefficients  $r^2$  were greater than 0.92. The activation energy  $E_a$  was 43.927 kJ mol<sup>-1</sup>, the predicted shelf life of litchi was 20.30 d at 278 K, and the relative error between the experimental and predicted shelf life was only 1.50%. In summary, the approach presented in this paper can integrate litchi information from multiple quality indices simultaneously to avoid the overestimation or underestimation of shelf life predictions.

Keywords: /Shelf life/ /Litchi/ /Entropy weight method/ /Quality index/

## MANGO

**Mogollón, R., Contreras, C., da Silva Neta, M. L., Marques, E. J. N., Zoffoli, J. P., & de Freitas, S. T. (2020). Non-destructive prediction and detection of internal physiological disorders in “Keitt” mango using a hand-held Vis-NIR spectrometer. *Postharvest Biology and Technology*, 167, 111251. doi: 10.1016/j.postharvbio.2020.111251**

Abstract

Mango (*Mangifera indica* L.) is a major tropical fruit that can develop internal physiological disorders at late ripening stages. These include jelly seed characterized by a transparent and

jelly tissue around the seed that eventually becomes a brown ring enclosing the seed, and black flesh characterized by a diffuse brown discoloration that covers the seed. Both disorders can result in high postharvest losses due to the fact that little information is available about mechanisms involved and efficient control approaches. The objective of this study was to establish the feasibility of using a visible and near-infrared (Vis-NIR) portable spectrometer for predicting at harvest and detecting mangoes with internal disorders, such as jelly seed and black flesh after storage. A total of 141 'Keitt' mangoes from two commercial harvests were measured spectrally between 400–1100 nm on two opposite cheeks, at harvest and after 30 d at 12 °C. Spectra data and the incidence of jelly seed and black flesh after storage were used to develop classification models using logistic, linear discriminative analysis (LDA), supporting vector machine, functional data and random forest modeling approaches. The results show that wavelengths between 550 and 650 nm can be used to predict at harvest and detect after storage, fruit with internal physiological disorders, such as jelly seed and black flesh. However, it was not possible to differentiate internal disorders from each other. The spectral data show that healthy fruit have higher reflectance intensity than jelly seed and black flesh ones, both at harvest and after storage. The best classification models were obtained with Logistic and LDA model development approaches. In the validation process for internal disorder prediction at harvest, the Logistic model showed accuracy of 65 %, sensitivity of 78 % and specificity of 49 %, whereas the LDA model showed accuracy of 63 %, sensitivity of 76 % and specificity of 46 %. In the validation process for detecting internal disorders after storage, the Logistic model showed accuracy of 71 %, sensitivity of 75 % and specificity of 67 %, whereas the LDA model showed accuracy of 76 %, sensitivity of 78 % and specificity of 73 %. In conclusion, Vis-NIR technology associated with Logistic and LDA modeling approaches can be used to predict at harvest and detect after storage the incidence of jelly seed and black flesh in mangoes.

Keywords: /*Mangifera indica*/ /Near-infrared spectroscopy/ /Classification models/ /Jelly seed/ /Black flesh/

## MUSHROOM

**Niu, Y., Yun, J., Bi, Y., Wang, T., Zhang, Y., Liu, H., & Zhao, F. (2020). Predicting the shelf life of postharvest *Flammulina velutipes* at various temperatures based on mushroom quality and specific spoilage organisms. *Postharvest Biology and Technology*, 167, 111235. doi: 10.1016/j.postharvbio.2020.111235**

### Abstract

Rapid senescence and microbial infection lead to a short shelf life for postharvest *Flammulina velutipes*. Therefore, a model for predicting the shelf life for this product would be meaningful and enable necessary steps to be taken to reduce losses. We simulated shelf storage of *F. velutipes* at three temperatures (4, 15 and 25 °C). Sensory, biochemical and microbial evaluations of the samples were carried out at frequent intervals. The kinetic models combined with the Arrhenius equation were used to establish shelf life prediction models based on quality indexes; whereas, the Gompertz model combined with the Belehradek equation were used to establish a growth trend and shelf life prediction model for *F. velutipes* based on the presence of *Pseudomonas* spp. Moreover, the microbial growth model was verified by several indices including the correlation coefficient  $R^2$ , accuracy factor  $A_f$  and bias factor  $B_f$ . The results

showed that the shelf-life kinetic models established according to four quality indicators were highly accurate, the  $R^2$  was  $>0.90$  and the relative error between the measured and the predicted values were less than  $\pm 10\%$ . In particular, the shelf-life prediction model established using the whiteness value was best. The mathematical model at different temperatures fitted the modified Gompertz model with a high correlation coefficient ( $R^2 > 0.95$ ). The  $A_f$  and  $B_f$  of the Belehradek model were all between 0.9 and 1.05. The residual value between the predicted value and measured values was less than  $\pm 0.1$ . Using these validated models, the shelf life of *F. velutipes* can be estimated at any point in the cold chain if the temperature history is known. These models can serve as effective tools for predicting shelf life and developing new products for the fresh produce food sector.

Keywords: *F. velutipes*/ Kinetic model/ Shelf life prediction/ Gompertz model/

**Zan, X. Y., Jia, W., Zhuang, H. N., Cui, F. J., Li, N., Zhang, J. S., ... Zhao, X. (2020). Energy Status and mitochondrial metabolism of *Volvariella volvacea* with controlled ultrasound treatment and relative humidity. *Postharvest Biology and Technology*, 167, 111250. doi: 10.1016/j.postharvbio.2020.111250**

Abstract

The short-term postharvest of *Volvariella volvacea* (straw mushroom) is still a major challenge hampering its long-distance distribution due to chilling injuries at less  $10\text{ }^\circ\text{C}$  and rapid senescence at over  $20\text{ }^\circ\text{C}$ . Our previous study has developed a synergistic control of ultrasound and relative humidity (sCURH) to effectively delay the decay and senescence development of straw mushroom. The present study aimed to explore the possible mitochondria-related mechanism of sCURH to retain the postharvest quality of straw mushroom. Results showed that 10-minute ultrasound pretreatment and  $15\text{ }^\circ\text{C}$  high RH (95 %) could effectively maintain sensory quality and mitochondrial integrity, and down-regulate the activities and gene transcriptions of respiration-related enzymes (PGI, SDH, and CCO). Ultrasound pretreatment combined with  $15\text{ }^\circ\text{C} + 95\text{ } \%$  RH remained the higher contents of ATP ( $>61.36\text{ }\mu\text{g g}^{-1}$ ), ADP ( $> 28.22\text{ }\mu\text{g g}^{-1}$ ), and energy charge ( $> 0.56$ ), and a lower AMP content ( $<49.18\text{ }\mu\text{g g}^{-1}$ ) compared to those in at  $4\text{ }^\circ\text{C}$  and  $15\text{ }^\circ\text{C}$  low RH (75 %). Our finding indicated that the proposed sCURH method could significantly retain postharvest quality of straw mushroom by maintaining proper respiration rates, reducing the mitochondrial dysfunction and supplying sufficient energy.

Keywords: *Volvariella volvacea*/ Ultrasound/ Relative humidity/ Energy status/ Mitochondrial metabolism/ Quality retention/

## PAPAYA

**Ahenkorah, C. K., Zaitoon, A., Apalangya, V. A., Afrane, G., & Lim, L. T. (2020). Moisture-activated release of hexanal from imidazolidine precursor encapsulated in ethylcellulose/poly(ethylene oxide) nonwoven for shelf-life extension of papaya. *Food Packaging and Shelf Life*, 25, 100532. doi: 10.1016/j.fpsl.2020.100532**

## Abstract

Hexanal extends the shelf life of fresh produce. Due to its high volatility and spontaneous oxidation, control release of hexanal is a challenge. The objective of the study was to stabilize and encapsulate hexanal as an acid labile precursor in polymeric nonwovens and trigger its release in moisture environments in packaged fresh produce. Bilayer nonwovens were prepared by encapsulating hexanal precursor and citric acid (CA) (1, 5, 10 % (w/w)) in a mixture of ethylcellulose/poly(ethylene oxide) polymers. The hexanal (10 % (w/w)) was stabilized by forming a precursor compound via condensation with N,N'-dibenzylethane-1,2-diamine through a Schiff base reaction. The release of the hexanal from the nonwovens was studied at 0, 75 and 100 % relative humidity (RH) using gas chromatography. Fourier transform infrared spectroscopy and scanning electron microscopy confirmed the presence of CA and hexanal in the nonwovens. The highest hexanal release was attained in the 10 % (w/w) CA nonwovens under 75 % RH after 6 h of study. The efficacy of the encapsulated hexanal precursor nonwovens containing 10 % (w/w) CA to delay the ripening of papaya fruits stored at  $22 \pm 1.5$  °C was assessed during a 14-day storage period. The shelf life of papaya fruits was extended for 4 days relative to the control samples. The hexanal treated samples significantly ( $p < 0.05$ ) maintained their firmness and reduced weight loss compared to the untreated control samples. The produced nonwovens can serve as active materials for extension of shelf life of fruits within the food distribution chain.

Keywords: /Shelf life extension/ /Activated release/ /Hexanal/ /Electrospun nonwoven/ /Citric acid/ /Relative humidity/

## PEACH

**Lin, M., Chen, J., Chen, F., Zhu, C., Wu, D., Wang, J., & Chen, K. (2020). Effects of cushioning materials and temperature on quality damage of ripe peaches according to the vibration test. *Food Packaging and Shelf Life*, 25, 100518. doi: 10.1016/j.fpsl.2020.100518**

## Abstract

Ripe peaches offer better flavor and taste but are more susceptible to mechanical damage than mature peaches. This study evaluated the protective performance of three cushioning materials (polyurethane (PU)+corrugated fiberboard boxes (CFB), expandable polyethylene (EPE)+CFB and CFB) and their packaging formats against mechanical damage to ripe peaches under simulated transportation at different vibration temperatures. In the first test, a 3-compartment tray was designed to study the isolated effect of only vibration force on an individual peach. The second test was conducted to verify the results of the first test and showed that the packaging format of PU + CFB performed better than the EPE + CFB and CFB formats. Moreover, ripe peaches vibrated at 10 °C had less damage than those vibrated at 20 and 30 °C. In addition, the bruise area, decay rate, and total phenolic contents of ripe peaches had significant linear correlations with each other on the first day after vibration.

Keywords: /Ripe peaches/ /Fresh fruit e-commerce/ /Vibration test/ /Temperatures/ /Polyurethane foam/ /Quality damage/

**Zhou, D., Liu, Q., Peng, J., Tu, S., Pan, L., & Tu, K. (2020). Metabolic analysis of phenolic profiles reveals the enhancements of anthocyanins and procyanidins in postharvest**

peach as affected by hot air and ultraviolet C. *Postharvest Biology and Technology*, 167, 111227. doi: 10.1016/j.postharvbio.2020.111227

#### Abstract

Anthocyanins are one of the most critical components in peach fruit and are responsible for their visual appearance and nutritional value. In this study, hot air (HA) and UV-C treatments were applied to induce colour development. Peach fruit were treated with HA (40 °C, 4 h) or UV-C (1.5 kJ m<sup>-2</sup>, 20 min for each side) and then stored at 1 °C for 35 d plus another 3 d at 20 °C. The results showed that anthocyanins, procyanidins (PAs) and cyanidin-3-glucoside (Cya-3-G) increased in response to HA and UV-C during the storage period. LC–MS/MS analysis indicated that most of the individual phenols increased in response to the two treatments. However, L-phenylalanine significantly decreased. HA and UV-C significantly upregulated the enzyme activity and gene expression of phenylalanine ammonia lyase to promote the conversion of phenylalanine into downstream compounds. The activities of leucoanthocyanidin reductase and anthocyanidin reductase were enhanced by HA and UV-C, which led to the accumulation of PAs. Besides, the activities of dihydroflavonol reductase, anthocyanidin synthase and UDP-glucose: flavonoid 3-o-glucosyltransferase increased in response to the two treatments, with increased contents of Cya-3-G, leucopelargonidin and pelargonidin-3-G occurring in treated fruit. In summary, HA and UV-C promoted the synthesis of anthocyanins and PAs by enhancing the activities and expressions of enzymes involved in phenylpropanoid metabolism.

Keywords: /Anthocyanin/ /Gene expression/ /Hot air/ /LC–MS/MS/ /Procyanidin/ /UV-C/

#### PEARS

Ortega-Hernández, E., Nair, V., Serrano-Sandoval, S. N., Welte-Chanes, J., Cisneros-Zevallos, L., & Jacobo-Velázquez, D. A. (2020). Wounding and UVB light synergistically induce the postharvest biosynthesis of indicaxanthin and betanin in red prickly pears. *Postharvest Biology and Technology*, 167, 111247. doi: 10.1016/j.postharvbio.2020.111247

#### Abstract

Indicaxanthin and betanin, the main betalains in red prickly pear (*Opuntia ficus-indica* cv. Rojo vigor), possess important applications as colorants and health-promoting biomolecules. Therefore, it is relevant to explore treatments that induce their postharvest biosynthesis in the fruit. In this study, the effect of ultraviolet B (UVB) radiation and wounding on the biosynthesis of indicaxanthin and betanin in red prickly pear was evaluated. Whole and wounded-fruit (cut in four even pieces with a cross and a longitudinal section) were UVB radiated (6.4 W m<sup>-2</sup>) for 15 min, and stored for 24 h at 16 °C. UVB radiation applied in the whole tissue induced an immediate accumulation of indicaxanthin after treatment, obtaining increases of 325.8% and 106.5% in the pulp and peel, respectively. The application of UVB radiation and wounding before storage induced a synergistic effect on the accumulation of indicaxanthin in the pulp (447.0%) and betanin in the peel (315.0%) after storage. Tyrosine hydroxylase and L-dopa oxidase activities of tyrosinase, as well as the spontaneous formation of Cyclo-dopa, which are key steps on betalain biosynthesis, were also synergistically activated by wounding and UVB

light. Results allowed the generation of a physiological model explaining the synergistic effect of wounding and UVB on the postharvest biosynthesis of indicaxanthin and betanin in red prickly pear.

Keywords: /Betalain biosynthesis/ /Abiotic stress/ /Natural colorants/ /Nutraceuticals/ /Functional foods/ /*Opuntia ficus-indica* cv. Rojo vigor/

## POMEGRANATE

**Belay, Z. A., Caleb, O. J., Vorster, A., Heerden, C. V., & Opara, U. L. (2020). Transcriptomic changes associated with husk scald incidence on pomegranate fruit peel during cold storage. *Food Research International*, 135, 109285. doi: 10.1016/j.foodres.2020.109285**

### Abstract

Pomegranate fruit is valued for its social, economic, aesthetic and health benefits. The fruit rapidly loses quality after harvest due to continued metabolic responses and physiological disorders under suboptimal conditions. The incidence of physiological disorders such as husk scald manifests during storage and commercial shipping, which affects the appearance and limits marketability. Despite the importance of pomegranate husk scald, little information is available about the origin and molecular mechanisms. Therefore, the aim of this study was to investigate the scald incidence of pomegranate fruit at molecular level using RNA-Seq (Ion Proton™ Next Generation Sequencing) by analyzing peel transcriptomic changes. The RNA-seq analysis generated 98,441,278 raw reads. 652 Differentially Expressed Genes (DEGs) with a fold change of  $> |2|$ , a p value  $\leq 0.05$  and a false discovery rate (FDR) of  $<0.05$  were identified between healthy and scald fruit peels. An analysis of the gene ontologies of these DEGs revealed the 432 genes were assigned with molecular functions, 272 as cellular components and 205 as part of biological processes. In this analysis, genes (*Pgr023188* and *Pgr025081*) that encode uncharacterized protein and gene (*Pgr007593*) that encodes glycosyltransferase showed significantly highest fold changes. Genes (*Pgr003448*, *Pgr006024* and *Pgr023696*) involved in various iron binding and oxidoreductase activities were significantly suppressed. This is the first transcriptome analysis of pomegranate fruit peel related to husk scald development. Results obtained from this study will add valuable information on husk scald related changes on pomegranate fruit at genomic level and provide insight on other related physiological disorders.

Keywords: /RNA-Seq/ /Physiological disorder/ /Gene expression/ /Enzyme classes/ /*Punica granatum*/ /Postharvest biotechnology/ /Postharvest handling/

**García-Pastor, M. E., Serrano, M., Guillén, F., Zapata, P. J., & Valero, D. (2020). Preharvest or a combination of preharvest and postharvest treatments with methyl jasmonate reduced chilling injury, by maintaining higher unsaturated fatty acids, and increased aril colour and phenolics content in pomegranate. *Postharvest Biology and Technology*, 167, 111226. doi: 10.1016/j.postharvbio.2020.111226**

### Abstract

In the present research the effects of preharvest 5 mM methyl jasmonate (MeJa) treatments, alone (Pre) or in combination with postharvest 5 mM MeJa treatment (Pre + Post), on reducing chilling injury (CI) of pomegranate during 90 d of storage at 2 °C plus 3 d at 20 °C and its relationship with changes in fatty acid composition of cell membranes were assayed. In addition, fruit and aril quality traits, total content in phenolics and anthocyanins and antioxidant activity of the arils were evaluated. Both external and internal CI symptoms and the increase in ion leakage (IL) were reduced by Pre and Pre + Post MeJa treatments. The major fatty acids in pomegranate husk were palmitic, oleic, linoleic and linolenic acids. MeJa treatments led to higher concentration of unsaturated fatty acids (UFA) at harvest, which was maintained at higher levels during storage, while saturated fatty acid (SFA) concentration was lower in treated fruit than in controls. The concentration of total phenolics and anthocyanins were lower in the arils from control fruit than in the arils of Pre and Pre + Post treated fruit during the whole storage period. In general, there were no significant differences between Pre and Pre + Post MeJa treatments on their effects on reducing CI, maintaining membrane stability and bioactive compounds with antioxidant activity. Thus, preharvest MeJa treatments may be sufficient to increase the cold storage potential of pomegranate fruit by reducing CI symptoms and enhancing the content bioactive compounds with antioxidant activity.

Keywords: /Antioxidants/ /Anthocyanins/ /Fatty acids/ /Ion leakage/ /*Punica granatum* L./ /Quality/

**Naeini, M. M., Jafari, A., Gholamnejad, J., & Vazifeshenas, M. (2019). Optimizing shelf life of pomegranate fruits during traditional storage by Tragacanth gum coating. *Journal of Horticulture and Postharvest Research*, 3(1), 49–60. doi: 10.22077/jhpr.2019.2690.1081**

#### Abstract

**Purpose:** One of the primary methods in increasing shelf life and maintaining the horticultural product quality is the application of edible coatings at the product surface. In this regard, this experiment was conducted to investigate the effect of tragacanth gum on some characteristics of pomegranate fruits such as weight loss, appearance quality, decay index, pH, soluble solid contents (SSC), titratable acidity (TA), maturity index, total phenol, vitamin C and anthocyanin content. **Research Method:** Fruits of two cultivars ('Malase Yazdi' and 'Malase Daneh Siah') were harvested and immersed in the tragacanth gum (0, 2.5, 5, 7.5, and 10 g l<sup>-1</sup>) solution for one minute. After applying treatments, fruits were air-dried, weighed, put in plastic baskets, and kept in the conventional storage in a completely randomized design for three months. Some quantitative and qualitative traits were measured and compared with the non-treated samples. **Findings:** Results revealed using tragacanth gum had a different effect according to cultivar type. The results also showed that tragacanth gum coatings could control the reduction of fruit appearance quality, and reduce the number of fruit decay in the "Malase Yazdi". In "Malase Daneh Siah", coating with tragacanth gum could improve pH, SSC, TA, and total anthocyanin content. Phenol content in both cultivars increased at the highest concentration (10 g l<sup>-1</sup>) of this edible coating. **Research limitations:** No limitations were founded. **Originality/Value:** Tragacanth gum coating could improve fruit quality of pomegranate during traditional storage and can be recommended to traditional pomegranate gardeners who still have large-scale traditional pomegranate storage.

Keywords: /Appearance Quality/ /Decay Index/ /Edible Coating/ /Phenol Content/ /Postharvest/

## POSTHARVEST TECHNOLOGY

**Song, L., Zhang, F., Yu, J., Wei, C., Han, Q., & Meng, X. (2020). Antifungal effect and possible mechanism of curcumin mediated photodynamic technology against *Penicillium expansum*. *Postharvest Biology and Technology*, 167, 111234. doi: 10.1016/j.postharvbio.2020.111234**

### Abstract

Contamination of *Penicillium expansum* has dramatic impacts on the development of the fruit and vegetable industry. In this study, the antifungal effect and its mechanism of curcumin mediated photodynamic technology (PDT) against *P. expansum* spores was investigated. Results indicated that PDT inactivated 99.7 % spores and inhibited spore germination, mycelial growth and disease severity of the blue mold rot on apple fruit. PDT induced the generation of reactive oxygen species (ROS), which caused oxidative damage of spores and further disrupted cellular structure. In addition, excessive ROS triggered the antioxidant defense systems of spores. Moreover, the ultimate result of cell death induced by PDT was apoptosis for short time illumination, and necrosis for a long time. These results can be an asset to exploit PDT for further application in controlling harvest diseases of the fruit and vegetable.

Keywords: /*Penicillium expansum*/ /photodynamic technology/ /curcumin/ /antifungal/ /effect mechanism/

## POTATO

**Yang, R., Han, Y., Han, Z., Ackah, S., Li, Z., Bi, Y., ... Prusky, D. (2020). Hot water dipping stimulated wound healing of potato tubers. *Postharvest Biology and Technology*, 167, 111245. doi: 10.1016/j.postharvbio.2020.111245**

### Abstract

This study examines the effects of hot water dipping on wound healing of harvested potato tubers and to explore partial mechanisms. The potato 'cv. Longshu No. 7' was used as materials, which were artificially wounded and then dipped into 45 °C hot water for 10 min. The wounded tubers were stored at ambient temperature (20–25 °C, RH 70–80%) in dark for wound healing. The weight loss of wounded tubers and the disease index of wounded tubers inoculated with *Fusarium sulphureum* were determined. The accumulation of suberin poly phenolic, suberin poly aliphatic and lignin at wound sites were observed. The activity of phenylalanine ammonia lyase, peroxidase activity, the content of H<sub>2</sub>O<sub>2</sub>, total phenols, flavonoids and lignin were also measured. We found that hot water dipping effectively reduced the weight loss and the disease index of wounded potato tubers. The weight loss of treated tubers was 45.1% lower than the control on the 14 d of healing, and the disease index of treated

tubers was 18.2% lower than the control on the 21 d of healing. Hot water dipping significantly stimulated the accumulation of suberin poly phenolic, suberin poly aliphatic and lignin at wound sites. The thickness of suberin poly phenolic, suberin poly aliphatic and lignin cell layers of treated tubers were 28.9%, 23.2% and 18.9% higher than the control on the 21 d of healing, respectively. Moreover, hot water dipping significantly enhanced the activity of phenylalanine ammonia lyase and peroxidase. Meanwhile, the H<sub>2</sub>O<sub>2</sub> content, total phenols, flavonoids and lignin were also significantly promoted at wound sites by hot water dipping treatment during healing. These results suggested that hot water dipping promotes wound healing of potato tubers by activating phenylpropanoid metabolism, increasing H<sub>2</sub>O<sub>2</sub> content and peroxidase activity, promoting the suberin and lignin accumulation at wound sites and decreasing the weight loss and the disease index of tubers during healing.

Keywords: /Potato/ /Hot water dipping/ /Postharvest/ /Wound healing/ /Phenylpropanoid metabolism/

## ROCKET

**Raffo, A., Moneta, E., Ferrari Nicoli, S., & Paoletti, F. (2020). GC-olfactometric characterisation of off-odours in commercially packaged rocket leaves. *Food Packaging and Shelf Life*, 25, 100540. doi: 10.1016/j.fpsl.2020.100540**

### Abstract

A non-destructive analytical method based on Headspace-Solid Phase MicroExtraction/GC-Olfactometry-MS (HS-SPME/GC-O-MS) for characterisation of odour-active compounds released within packages of rocket leaves was developed. Then it was applied, along with sensory olfactory evaluation, to ten commercial products, close to the expiration date, to identify the volatiles responsible for the off-odour perception upon the opening of the bag. Twenty-nine volatiles were detected by GC-MS within the packages, whereas only eleven odour-active regions were detected by GC-O in at least three of the commercial products. Besides dimethyl sulfide and dimethyl disulfide, also methanethiol was identified as a major odour-active compound associated with off-odour notes, such as rotten leaves and faecal. Acetic acid and 2,4-dithiapentane were also tentatively identified as major off-odorants. Four structurally related volatile compounds, characterised by a solvent-like note and still unidentified, were clearly detected as odour-active but their role in off-odour perception remained to be elucidated. Among the different classes of volatiles detected in the headspace of rockets stored under modified atmosphere packaging, in the present and in previous studies, only the group of sulfur compounds consistently appeared to be related to off-odour perception and thus may be considered the best candidate as indicator of off-odour formation.

Keywords: /Fresh-cut/ /Minimally processed/ /Modified atmosphere packaging (MAP)/ /Shelf-life/ /Off-flavour/

## ROSE

**Hamidi, E., Roein, Z., & Karimi, M. (2020). Extending the vase life of rose cut flower cv . Bakara using inhibitors of physiological vascular occlusion stem. *Journal of Horticulture and Postharvest Research* 3(1), 35–48. doi: 10.22077/jhpr.2019.2594.1072**

## Abstract

**Purpose:** Rose cut flowers have a short postharvest life, which can be increased using different treatments. Thus, an experiment was designed to determine the effect of hot water (one min) and chemical solutions (pulse treatment for 20 h) on the postharvest quality of cut rose flowers cv. Baraka. **Research Method:** Hot water treatments contain 50, 55, and 60 °C, chemical treatments consist of catechol (5 and 10 mM), sodium azide (0.05 and 0.1 mM) and sodium metabisulfite (5 and 10 mM). Afterward, for the evaluation of associated traits with longevity, the flowers were kept in a vase solution containing sucrose (3%) and hydroxyquinoline (8-HQ at 200 mg. L<sup>-1</sup>). **Findings:** The results showed that the vase life of cut flowers extended about four days by the application of chemical treatments as compared with control. The maximum vase life (9.9 days) observed in 0.05 mM sodium azide and 10 mM catechol (9.7 days). Also, the vase life of cut flowers increased 3.7 days by hot water treatments (at 50 and 55 °C) in comparison to the control. Moreover, the results revealed that the catechol, sodium azide and sodium metabisulphite treatments delayed flower senescence and maintained leaf chlorophyll and petal anthocyanin content. The lowest content of lignin was obtained in 10 mM catechol, and 0.1 mM sodium azide. **Research limitations:** There was no significant limitation to the report. **Originality/Value:** Overall, the results showed that catechol and sodium azide were the most effective treatments to increase the vase life of rose cut flowers.

**Keywords:** /anthocyanin/ /lignin/ /postharvest/ /sodium azide/ /sodium metabisulfite/

## STRAWBERRY

**Jalali, A., Linke, M., Geyer, M., & Mahajan, P. V. (2020). Shelf life prediction model for strawberry based on respiration and transpiration processes. *Food Packaging and Shelf Life, 25*, 100525. doi: 10.1016/j.fpsl.2020.100525**

## Abstract

The physiological behaviour of fresh horticultural produce such as respiration and transpiration affects its quality and shelf life. Several studies have reported the models for shelf life prediction of packaged and non-packaged fruits and vegetables; however, while including a single quality parameter. Fluctuations in storage conditions add further complexity to the physiological processes. In this study, an integrated mathematical modelling for shelf life prediction of strawberry based on respiration and transpiration was developed and validated under realistic supply chain conditions. The model simultaneously considered three indices: microbial deterioration, mass loss and cumulative CO<sub>2</sub> production after harvest as a guide to predict shelf-life of packaged and non-packaged strawberries. The model was found to be useful to simulate the shelf life of strawberries under modified atmosphere packaging and open tray conditions under varying temperature and humidity as normally observed in the supply chain. Deterioration based shelf life for strawberry was 10.8 d under MAP condition as compared to 9.5 d in open tray. Mass loss based shelf life for strawberry was 8.0 d for MAP condition as compared to 2.3 d in open tray. The cumulative CO<sub>2</sub> produced up to the keeping quality was varying in a narrow range of 6.09 ± 0.21 g kg<sup>-1</sup>, in spite of different perforation diameters and storage temperatures. The proposed model will enable optimization of supply chain and making advice to all role players, including growers, traders and consumers.

**Keywords:** /Quality/ /Shelf-life/ /Physiological metabolism/ /Modified atmosphere / /packaging/

**Nguyen, H. V. H., & Nguyen, D. H. H. (2020). Effects of nano-chitosan and chitosan coating on the postharvest quality, polyphenol oxidase activity and malondialdehyde content of strawberry (*Fragaria x ananassa* Duch.). *Journal of Horticulture and Postharvest Research*, 3(1), 11–24. doi: 10.22077/jhpr.2019.2409.1053**

Abstract

**Purpose:**The aim of this study was to investigate the effects of nano-chitosan and chitosan coating on physico-chemical properties of strawberries during storage. **Research methods:** Fresh strawberries were coated with different concentrations of chitosan (1%, 1.5%, 2%) or nano-chitosan (0.2%, 0.4%, and 0.8%) and stored in 20C for 21 days. **Findings:** Coating strawberries with 0.2% and 0.4% nano-chitosan preserved the overall quality index of the fruit up to 21 days. The treatments reduced weight loss, retained firmness, titratable acidity and L-ascorbic acid, significantly retarded malondialdehyde production and inhibited polyphenol oxidase activity of the stored fruit. The 0.2% nano-chitosan treatment reserved total soluble solid and total anthocyanin content better than the 0.4% nano-chitosan. Although 2% chitosan coating showed the positive effects, the overall quality index of the coated fruit was reduced below the acceptable level after 18 days, shorter as compared to the others coated with the lower concentrations of nano-chitosan. **Research limitations:** Nano-chitosan, showing to be the effective coating material in this study, is not popularly traded in the industry. **Originality/Value:** The combination of 0.2 % nano-chitosan coating and storing fresh strawberry at 2°C preserved the quality of fruits up to 21 days. The much lower concentrations of nano-chitosan showed higher positive effects as compared to the higher concentrations of chitosan. This would help to reduce the cost of postharvest handlings for the strawberry industry.

**Keywords:** /Anthocyanin Content/ /Edible Coating/ /Post-Harvest Losses/ /Post-Harvest Quality/ /Total Phenolic Content/

**Samina Khalid, Maria Majeed, Muhammad Ullah, Muhammad Shahid, Abdur Rehman Riasat, Tahira Abbas, Hafiz Muhammad Aatif, & Amjad Farooq. (2020). Effect of storage conditions and packaging material on postharvest quality attributes of strawberry. *Journal of Horticulture and Postharvest Research*, 3(Issue 2), 195–208. doi: 10.22077/jhpr.2019.2826.1093**

Abstract

**Purpose:** Strawberry (*Fragaria x ananassa*) is highly perishable fruit with a limited postharvest life at room temperature and is vulnerable to postharvest decay due to its high respiration rate, environmental stresses and pathogenic attacks. **Research method:** To increase the postharvest life of strawberries, a combination of packaging material (polyethylene and perforated polyethylene) along with control and storage conditions {zero energy cool chamber (ZECC) and ambient conditions in laboratory} were tested. **Main findings:** Mass loss (1.59%) and internal temperature (22.24°C) were significantly reduced while shelf-life (more than 3 days) was enhanced in ZECC as compared to ambient conditions in laboratory with 6.46% mass loss, 23.04°C internal temperature and less than 3 days shelf-life. Packaging material significantly influenced mass loss (%) and electrical conductivity (S/m) of strawberry juice irrespective of its interaction with storage conditions and storage durations. Maximum mass loss (9.11%) and EC

(3.74 S/m) were recorded in control samples while, minimum mass loss (1.24%) and EC (3.52 S/m) was recorded in polyethylene enclosed fruit. Irrespective of storage conditions and packaging material pH, TSS, titratable acidity (%) and ascorbic acid (mg100 ml<sup>-1</sup>) decreased while electrical conductivity (S/m) increased during storage. Limitations: In future study storage duration should be extended by adding more removals to get clear difference in fruit quality and shelf-life under various treatments. Originality/Value: In conclusion ZECC can be used for short term storage of strawberries.

Keywords: /evaporative cool chamber/ /mass loss/ /perforated polyethylene/ /postharvest life/ /strawberry/ /Agriculture/

**Varghese, S. A., Pulikkalparambil, H., Rangappa, S. M., Siengchin, S., & Parameswaranpillai, J. (2020). Novel biodegradable polymer films based on poly(3-hydroxybutyrate-co-3-hydroxyvalerate) and Ceiba pentandra natural fibers for packaging applications. *Food Packaging and Shelf Life*, 25, 100538. doi: 10.1016/j.fpsl.2020.100538**

Abstract

In this work novel poly(3-hydroxybutyrate-co-3-hydroxyvalerate) (PHBV) polymer composites were prepared by incorporating *Ceiba pentandra* bark fibers. The casting technique was used for the preparation of the composites. The effect of *Ceiba pentandra* bark fibers on the morphology, thermo-mechanical, hydrophilicity, transparency, biodegradability, antimicrobial, and packaging properties were studied. The scanning electron microscope was used for morphological characterization while Fourier transform infrared spectroscopy was used for structural analysis. The investigation was done on the mechanical properties, percentage crystallinity, and biodegradability of these composites. It was found that the incorporation of fibers enhanced the tensile properties, percentage crystallinity, and the biodegradability of the composite when compared to that of the virgin PHBV. Additionally, all the biocomposites show good thermal stability. Antimicrobial studies showed that the composite films of higher fiber loading showed antibacterial activity against *S.aureus* while no activity was shown against *E. coli*. Finally, these composite films were used for packaging of fresh strawberries which showed that the strawberries packed in films of fiber loading above 10 % have better preservation of freshness of the fruit than unpacked strawberries which showed mold attack after 7 days of packing.

Keywords: /Poly(3-hydroxybutyrate-co-3-hydroxyvalerate)/ /*Ceiba pentandra* fiber/ /Biocomposite/ /Packaging applications/

**Yoon, Y.-S., Ameer, K., Song, B.-S., Kim, J.-K., Park, H.-Y., Lee, K.-C., ... Park, J.-H. (2020). Effects of X-ray irradiation on the postharvest quality characteristics of 'Maehyang' strawberry (*Fragaria × ananassa*). *Food Chemistry*, 325, 126817. doi: 10.1016/j.foodchem.2020.126817**

Abstract

This study evaluated the effects of X-ray irradiation (0–1 kGy) on quality parameters of Korean strawberries during storage at 15 °C for 9 d. As compared to control, all irradiated samples exhibited dose-dependent decreases in microbial counts regardless of storage period. Irradiation significantly ( $p < 0.05$ ) reduced weight loss and decay incidence of fruits during storage. Fruit firmness decreased immediately after irradiation, but no significant changes

occurred after 3 d. Neither irradiation nor storage period significantly affected total soluble solids, pH, or titratable acidity. All treatments delayed color changes and pelargonidin accumulation during storage. The radical scavenging activities and total phenolic, ellagic acid, and catechin contents increased gradually during storage. Furthermore, irradiated fruits showed improved sensory characteristics throughout storage. Thus, X-ray irradiation ( $\leq 1$  kGy) was confirmed as an effective phytosanitary treatment for strawberries to delay decay and negative physicochemical changes and extend shelf life with acceptable sensory attributes.

Keywords: /Strawberry/ /Phytosanitary treatment/ /X-ray irradiation/ /Physicochemical change/ /Shelf life/

## TOMATO

**Boonsiriwit, A., Xiao, Y., Joung, J., Kim, M., Singh, S., & Lee, Y. S. (2020). Alkaline halloysite nanotubes/low density polyethylene nanocomposite films with increased ethylene absorption capacity: Applications in cherry tomato packaging. *Food Packaging and Shelf Life*, 25, 100533. doi: 10.1016/j.fpsl.2020.100533**

### Abstract

Halloysite nanotubes (HNTs) are hollow tubular clay nanoparticles used as nanofillers to remove or minimize the production of ethylene gas. The presence of ethylene gas leads to reduced shelf life in fruits and vegetables by accelerating postharvest softening and aging. Alkaline solution-treated HNTs have increased ethylene adsorption capacity due to an increased number of OH groups on the HNTs external surface. This study reports on the thermal, morphological, and mechanical properties of alkaline HNTs (ALK-HNTs) loaded into a low-density polyethylene (LDPE) matrix. Our results indicate that, although the mechanical properties of the LDPE matrix films were not improved with loading ALK-HNTs, the oxygen barrier properties were improved and ethylene gas adsorption increased by 220 %. Cherry tomatoes packaged in a 3% ALK-HNTs/LDPE nanocomposite film and stored at 8 °C for 21 days showed a reduction in loss of firmness and weight by 17.0 % and 36.7 %, respectively.

Keywords: /Alkaline halloysite nanotubes/ /Ethylene adsorption/ /Cherry tomato/ /Shelf life/ /Active packaging/

**Goisser, S., Wittmann, S., Fernandes, M., Mempel, H., & Ulrichs, C. (2020). Comparison of colorimeter and different portable food-scanners for non-destructive prediction of lycopene content in tomato fruit. *Postharvest Biology and Technology*, 167, 111232. doi: 10.1016/j.postharvbio.2020.111232**

### Abstract

Lycopene, the red colored carotenoid in tomatoes, has various health benefits for humans due to its capability of scavenging free radicals. Traditionally, the quantification of lycopene requires an elaborate extraction process combined with HPLC analysis within the laboratory. Recent studies focused on simpler methods for determining lycopene and utilized spectroscopic measurement methods. The aim of this study was to compare non-destructive methods for the prediction of lycopene by using color values from colorimeter measurements and Vis/NIR spectra recorded with three commercially available and portable Vis/NIR spectrometers, so

called food-scanners. Tomatoes of five different ripening stages (green to red) as well as tomatoes stored up to 22 days after harvest were used for modeling. After measurement of color values and collection of Vis/NIR spectra the corresponding lycopene content was analyzed spectrophotometrically. Applying exponential regression models yielded very good prediction of lycopene for color values  $L^*$ ,  $a^*$ ,  $a^*/b^*$  and the tomato color index of 0.94, 0.90, 0.90 and 0.91, respectively. Color value  $b^*$  was not a suitable predictor for lycopene content, whereas the  $(a^*/b^*)^2$  value had the best linear fit of 0.87. In comparison to color measurements, the cross-validated prediction models developed for all three food-scanners had coefficients of determination ( $r^2_{CV}$ ) ranging from 0.92 to 0.96. Food-scanners also can be used for additional measurements of internal fruit quality, and therefore have great potential for fruit quality assessment by measuring a multitude of important fruit traits in one single scan.

**Keywords:** /Tomato/ /*Solanum lycopersicum* L./ /Colorimeter/ /Portable near-infrared spectrometer/ /Lycopene content/ /Food-scanner/