

SELECTIVE DISSEMINATION OF INFORMATION
As of June 2019

Annona FRUITS

David, C.T., Sherrie, J.D., Jeyalyn, D.S. and Prasad, S.M. (2019). Value added products from certain fruit species of annona fruit. Acta Hort. 1241, 683-690 DOI: 10.17660/ActaHortic.2019.1241.99 <https://doi.org/10.17660/ActaHortic.2019.1241.99>

Abstract

Nutritional security for the burgeoning Indian population cannot be met by focusing on the staple and major horticultural crops alone. Food security can be achieved locally not globally, considering that though there is enough food produced to supply the calorie needs of a growing global population there are 830 million people worldwide who are undernourished. There is a vast production of underutilized and underexploited minor horticultural crops which could be used as the future crops to supplement our nutritional needs. There is a scattered but significant production of these minor fruits which are rich in nutrient and medicinal value. But a major percent of the production is lost due to poor harvesting and postharvest handling, lack of storage and processing facilities. Hence, there is an urgent need to explore the potential for postharvest management and processing of these fruits. This piece of work delivers health obvious benefits to the society, economic potential for farmers, entrepreneurs and consumers to meet the growing global demand, retain market share and stay ahead of the rapidly emerging competition in the world market. It is quite unfortunate that the country is wasting such excellent fruits, causing economic loss to the farmers and the country. Hence a package of practices should have been started off to curtail these postharvest losses through value addition. Hence an attempt was made to produce certain value enhanced products from bullock's heart, dragon fruit and Singapore cherry employing certain processing technologies paving way for the availability of the product round the year, reducing postharvest loss and better remunerative returns to the farmers.

Keywords: /Minor Fruits/ /Underutilized Fruits/ /Processing/ /Nutritional Security/

BAMBOO SHOOT

Wen, B., Cheng, Z., Hu, Y., Boon-Ek, Y., Wongs-Aree, C., & Supapanich, S. (2019). Ultraviolet-C treatment maintains physicochemical quality of water bamboo (*Zizania latifolia*) shoots during postharvest storage. Postharvest Biology and Technology, 152, 65–72. DOI: 10.1016/j.postharvbio.2019.02.017

Abstract

Ultraviolet-C (UV-C) treatment has been used as a method to maintain postharvest quality for many kinds of fruits and vegetables. In this study, we investigated the effects of UV-C treatment on physicochemical changes in water bamboo shoots (WBS) during storage. WBS were treated with UV-C at the doses of 0 (control), 1.06, 2.12, 3.18, 4.24, 5.30, and 6.36 kJ m⁻² at 20 °C ± 2 °C for 2 d. The increase in greenness of WBS was inhibited by all UV-C treatments, but the 4.24 kJ m⁻² UV-C treatment maintained lightness and whiteness index values of WBS better than other treatments. Thus, the 4.24 kJ m⁻² UV-C treatment was selected for use to determine the physicochemical quality of WBS during refrigeration at 10 °C. The UV-C treatment retarded the increases in greenness, chlorophyll a, chlorophyll b, and total chlorophyll content, resulting in maintenance of the whiteness index and colour attributes. It also prevented toughness by retarding lignin increase during storage. Moreover, it induced antioxidant activities and bioactive compounds, especially total phenol, and maintained the activities of antioxidant enzymes such as phenylalanine ammonia lyase and catalase during storage. However, the UV-C

treatment did not affect ascorbic acid content and the activities of ascorbic acid peroxidase and guaiacol-peroxidase. These results indicated that UV-C treatment at the dose of 4.24 kJ m⁻² is a potential alternative for maintaining physicochemical quality and improving the nutritional quality of WBS during storage.

Keywords: /Water Bamboo Shoots/ /Ultraviolet-C/ /Greenness/ /Chlorophyll/ /Antioxidants/ /Bioactive Compounds/

BANANA

Filho, F.O., De Almeida Lopes, M.M., Matias, M.L., Braga, T.R., De Aragao, F.A.S., Da Silvaria, M.R.S., De Oliveira, M.M.M., De Oliveira Silva, E. (2019). Shelf-life estimation and quality of resistant bananas to black leaf streak disease during ripening. Scientia Horticulturae. 251, 267-275 <https://doi.org/10.1016/j.scienta.2019.03.029>

Abstract

Black Leaf Streak Disease (BLSD), also known as Black Sigatoka, is considered the most important banana leaf disease worldwide, because it reduces, in average (↓), both yield (↓ 38%) and postharvest banana green-life (↓ 40%). The control of this disease requires weekly applications of fungicides, which increase the economic and environmental costs for banana production, especially in a few countries in Latin American, which account for over 80% of total banana traded internationally. However, frequent fungicide spraying leads to rapid evolution of fungicide-resistance fungal strains that cause disease-control failures. This work aimed to evaluate the shelf-life and postharvest quality of three genotypes of banana (*Musa* spp.) resistant to BLSD. Survival analysis methodology was used to estimate shelf-life using the Log-Rank test. Postharvest quality included variables such as peel weight, pulp weight, soluble solids, total sugar, starch, total chlorophyll and total carotenoids. The best results were highlighted by BRS Tropical including a high shelf-life for green life (GL) phase of 22.28 days, followed by BRS Vitória (13.45 days). BRS Platina presented the lowest GL phase (11.23 days). BRS Tropical presented a highest yellow life (YL), including good postharvest quality at the end of ripening as soluble solids (25.53°Brix), total sugars (13.73 g 100 g⁻¹) and starch (1.32 g 100 g⁻¹). Results suggest that BRS Tropical, which presented a longer shelf-life (27.85 days), may be indicated for exports purposes as well as in natura consumption. Due to the short shelf-life, BRS Vitória and BRS Platina were more suitable for processing industry.

Keywords: /*Musa sp.*/ /*Mycosphaerella fijiensis* Morelet/ /Green Life Phase/ /Survival Resistance/

Fu, X., Cheng, S., Feng, C., Kang, M., Huang, B., Jiang, Y., Duan, X., Grierson, D., Yang, Z. (2019). Lycopene cyclases determine high α - β -carotene ratio and increased carotenoids in bananas ripening at high temperatures. Food Chemistry 283, 131-140. <https://doi.org/10.1016/j.foodchem.2018.12.121>

Abstract

Bananas are a recommended food source to alleviate vitamin A deficiency because they contain a high ratio of provitamin A precursors. The objective of this study was to investigate carotenoid accumulation pattern in banana fruits during postharvest ripening and the mechanisms regulating this process. Ripe banana pulp had an unusually high α - β -carotene ratio (1.05), and the carotenoid contents increased ($p \leq 0.05$) under light and high temperature. We analyzed the sequences, transcript levels, and functions of genes involved in carotenoid synthesis. The high ratio of α - β -carotene in ripe banana fruit was explained by the high flux to the α -carotene biosynthetic pathway, as reflected by high transcript levels of LCYE, and the weak flux to the β -carotene branch of the biosynthetic pathway due to inactive

MaLCYB1.2. High temperature during ripening up-regulated the transcript levels of genes involved in the α - and β -carotene biosynthesis pathways and the activities of their encoded enzymes.

Keywords: /Banana Pulp/ /Carotenoid/ /High α - β -carotene Ratio/ /Light Stimulation/ /Lycopene Cyclase/ /Temperature-dependent/

BROCCOLI

Jiang, A., Zuo, J., Zheng, Q., Guo, L., Gao, L., Zhao, S., Hu, W. (2019). Red LED irradiation maintains the postharvest quality of broccoli by elevating antioxidant enzyme activity and reducing the expression of senescence-related genes. *Scientia Horticulturae*, 251, 73–79. DOI: 10.1016/j.scienta.2019.03.016

Abstract

The quality of broccoli stored at ambient temperatures deteriorates rapidly as tissues begin to senesce. The effect of red light-emitting-diode (LED) light irradiation ($50 \mu\text{mol m}^{-2} \text{s}^{-1}$) on the quality of harvested broccoli stored at 20°C for 5 d was investigated. Sensory quality and physiological function, including the activity of antioxidant enzymes and the expression of genes associated with chlorophyll degradation, were analyzed. Results indicated that red LED irradiation maintained the sensory appearance of broccoli, inhibited yellowing and the degradation of chlorophyll, and decreased weight loss and malondialdehyde (MDA) content. The activity of the antioxidant enzymes, peroxidase (POD), catalase (CAT), and ascorbate peroxidase (APX) were enhanced in LED-treated broccoli, while the expression of the chlorophyll degrading genes, chlorophyllase II (BoCLH2), chlorophyllase III (BoCLH3), and pheophorbide a oxygenase (BoPAO) was suppressed in the early stages of storage. In contrast, no effect on chlorophyllase I (BoCLH1) was observed. These results demonstrated that irradiation of broccoli with red LED induced a series of physiological and molecular responses that extended postharvest quality and could be used to prolong the shelf-life of commercially produced broccoli.

Keywords: /Broccoli/ /Sensory Quality/ /Antioxidant Enzymes/ /Gene Expression/

Zheng, Q., Zuo, J., Gu, S., Gao, L., Hu, W., Wang, Q., & Jiang, A. (2019). Putrescine treatment reduces yellowing during senescence of broccoli (*Brassica oleracea* L. var. *italica*). *Postharvest Biology and Technology*, 152, 29–35. DOI: 10.1016/j.postharvbio.2019.02.014

Abstract

Broccoli undergoes yellowing very quickly in storage, which impacts its' quality and economic value. The current study examined the ability of putrescine to inhibit postharvest yellowing of broccoli florets. Broccoli heads were dipped in a 0.25 mmol L^{-1} solution of putrescine for 10 min, air dried, and then stored at 20°C in the dark. Results indicated that, relative to the untreated control, putrescine treatment effectively suppressed changes in fruit color from green to yellow, reduced the degradation of chlorophyll, decreased electrolyte leakage, inhibited the accumulation of malondialdehyde, and maintained the enzyme activity and gene expression of peroxidase, catalase, and ascorbate peroxidase. The relative expression of chlorophyllase I (BoCLH1) and chlorophyllase III (BoCLH3) was enhanced while the relative expression of chlorophyllase II (BoCLH2), pheophorbide a oxygenase (BoPAO), and pheophytinase (BoPPH) was reduced by putrescine. The data clearly indicate that putrescine reduces the yellowing of broccoli florets and may represent an effective approach for reducing postharvest losses in broccoli.

Keywords: /Broccoli/ /Yellowing/ /Chlorophyll-degradation Relative Gene Expression/ /Antioxidant Enzymes/

CUCUMBER

Fan, K., Zhang, M., & Jiang, F. (2019). Ultrasound treatment to modified atmospheric packaged fresh-cut cucumber: Influence on microbial inhibition and storage quality. *Ultrasonics Sonochemistry*, 54, 162–170. DOI: doi.org/10.1016/j.ultsonch.2019.02.003

Abstract

Influence of ultrasound treatment on microorganisms and the quality of modified atmospheric packaged fresh-cut cucumber during storage were investigated. Fresh-cut cucumber was treated with ultrasound (US, 20 kHz) in different time (5, 10 and 15 min) and then modified atmospheric packaged as well as stored at 4 °C for 15 d. The results showed that US treatment inhibited the growth of total number of colonies, mold and yeast in modified atmospheric packaged fresh-cut cucumber during storage. US treatment for 10 min effectively reduced the loss of weight, firmness, total soluble solids and total color change (ΔE), the increase of MDA content and the degradation of ascorbic acid content and flavor, as well as decreased water mobility and maintained cell wall integrity in fresh-cut cucumber during storage. Therefore, these results demonstrated that US treatment was helpful for inhibiting microorganisms and improving storage quality, and could be an effective method to enhance the preservative effect of modified atmospheric packaged fresh-cut cucumber.

Keywords: /Ultrasound/ /Modified Atmosphere Packaging/ /Microorganisms/ /Quality/ /Fresh-cut Cucumber/

CUSTARD APPLE

Suresh, G.J. and Jagadeesh, S.L. (2019). Effect of postharvest dip treatment of calcium chloride and wax on postharvest behavior of custard apple fruits. *Acta Hort.* 1241, 541-548 DOI: [10.17660/ActaHortic.2019.1241.80](https://doi.org/10.17660/ActaHortic.2019.1241.80) <https://doi.org/10.17660/ActaHortic.2019.1241.80>

Abstract

Custard apple is one of the most popular tropical underutilized fruit crops of the world appreciated for delicate flavour. Custard apple fruits are seasonal and possess very short shelf life at ambient storage hence, pre-storage treatments coupled with cold storage is highly beneficial to improve their storability. The main problem of postharvest losses associated with custard apples is rapid loss of firmness. To combat the problem, custard apple fruits were exposed to pre-storage treatments involving CaCl_2 (4%) and wax (1:10) and combination of two. The treatment time is maintained for 5 min. The fruits were stored in cold storage ($10 \pm 1^\circ\text{C}$) for 12 days. Observations on various physico-chemical parameters were recorded at four-days interval. The results indicated that the minimum physiological loss in weight (16.57%), respiration rate (24.24 mL CO_2 kg^{-1} h^{-1}), total soluble solids (22.25 °B), titratable acidity (0.27%) and minimum change in instrumental color values viz., peel L^* (52.51), a^* (-2.02), b^* (30.12), C^* (29.24) and h° angle (93.93) and maximum firmness (2.49 N) were noticed in combination treatment as compared to fruits received no treatments. In conclusion, combined pre-storage treatment of CaCl_2 (4%) and wax (1:10) for 5 min effectively delay the ripening changes in custard apple.

Keywords: /Annona squamosa/ / CaCl_2 / /Wax Coating/ /Respiration Rate/ /Firmness/ /Quality/ /Storage/

FIGS

Ma, J., Li, D., Yang, D., Xu, W., Fu, Y., Liao, R., ... He, X. (2019). Effects of packaging designs with multiple pieces of function films on the quality of figs stored at ambient temperature. *Scientia Horticulturae*, 251, 32–38. DOI: 10.1016/j.scienta.2019.03.004

Abstract

To extend the shelf life of figs (*Ficus carica*, 'Blanrick') stored at ambient temperature (25 °C), we designed two new types of modified atmosphere packaging (MAP), namely, DMAP and TMAP. DMAP comprised of O film and W film with an area ratio of 1:1. TMAP comprised of B film, W film and M film with an area ratio of 1:2:1. O and B film primarily supplies O₂. W film is mainly responsible for discharging water vapor. M film is a piece of 1-methylcyclopropene (1-MCP) releasing film. Gas composition in the head space of the packaging, water loss, firmness, rate of decay, total soluble solids (TSS) content, titratable acidity (TA) content, vitamin C content, and sensory quality of figs were monitored during storage for 6 days at 25 °C to evaluate the efficacy of this design. Results corroborate that DMAP and TMAP can prolong the shelf life of figs from 2 days to 4 days and up to 6 days at 25 °C. Compared with the control group, figs packed in DMAP and TMAP maintained a lower loss of water, firmness, rate of decay, TA content, vitamin C content, and high sensory quality during storage. The change in the content of fig's TSS of TMAP and DMAP was smaller than that of the control group. TMAP had the best preservation effect on figs.

Keywords: /Figs/ /Modified Atmosphere Packaging (MAP)/ /1-Methylcyclopropene (1-MCP)/ /Shelf Life/ /Commercial Value/

GRAPE

Chen, R., Wu, P., Cao, D., Tian, H., Chen, C., & Zhu, B. (2019). Edible coatings inhibit the postharvest berry abscission of table grapes caused by sulfur dioxide during storage. *Postharvest Biology and Technology*, 152, 1–8. DOI:10.1016/j.postharvbio.2019.02.012

Abstract

Table grape (*Vitis vinifera* L.) is one of the most popular berries in the world but easy to decay due to gray mold infiltration during storage. Sulfur dioxide (SO₂) treatment is by far the most efficient way of for controlling gray mold development and long-term preserving table grape fruit. However, SO₂ treatment causes severe abscission of berry from fruit cluster. In this study, two edible coatings (1.5% chitosan and 1.0% poly-ε-lysine) were selected to prevent the berry from SO₂-induced abscission in 'Kyoho' table grapes (*Vitis vinifera* L. x *V. Labrusca*) during room temperature (20 °C) storage. Results indicated that both 1.5% chitosan and 1.0% poly-ε-lysine treatments remarkably inhibited the SO₂-induced abscission in 'Kyoho' fruits, and the abscission rates of both coating treated-groups were significantly lower even than the blank control (without SO₂ treatment) after 6 d of storage. Meanwhile, both edible coating treatments significantly decreased fruit weight loss and inhibited the increase of the cell-wall-degrading enzyme activities. Overall, these two edible coating treatments maintained other fruit qualities such as, total soluble solids (TSS), titratable acids (TA), and content of vitamin C. Thus, the edible coating 1.5% chitosan or 1.0% poly-ε-lysine provide potential effective ways to control SO₂-induced fruit abscission and quality deterioration in table grape, and they may be of great commercial value during postharvest handling of table grape.

Keywords: Abscission/ /SO₂/ /Chitosan/ /Poly-ε-lysine/ 'Kyoho' Table Grape/

Giacosa, S., Gabrielli, M., Torchio, F., Río Segade, S., Moar Grobas, A. M., Ricauda Aimonino, D., Rolle, L. (2019). Relationships among electrolyzed water postharvest treatments on winegrapes and chloroanisoles occurrence in wine. Food Research International, 120, 235–243. DOI: 10.1016/j.foodres.2019.02.034

Abstract

Electrolyzed water (EW) has attracted much recent attention as a high-performance, new technology for its potential use in the food industry. However, the risk of postharvest EW treatments of winegrapes destined for winemaking is the chloroanisoles formation in the final product. In the present study, we investigated the impact of postharvest grape EW and storage treatments on the occurrence of these compounds in wine, 2,4,6-trichloroanisole (TCA) being the main compound responsible for the cork taint off-flavor due to its extremely low perception threshold. The results revealed that the presence of TCA in the wines depended on the concentration of residual free chlorine in the must from the EW treatment. Particularly, TCA was not detected in wine when active chlorine concentrations higher than 0.005 mg/L were present in the must. Chloroanisole and chlorophenol levels in wine were strongly affected not only by EW but also by grape storage conditions (temperature, time, sunlight exposition). The results showed that the 24-hours grape storage at a controlled temperature of 20 °C in the dark, after EW treatment, resulted in the highest TCA concentrations in wines (7.3 ± 2.7 ng/L), while storage and withering in sunlight seemed to mitigate its presence in wine. This could suggest that microbiological formation of chloroanisoles may have been influenced by the storage temperature and germicidal effect of UV light. Biochemical mechanism of chloroanisoles production in grapes and wine is unknown, but the combination of residual free chlorine on the grape surface and the controlled storage conditions in the dark may have positively influenced the bio-formation of chloroanisoles and therefore their presence in wine.

Keywords: /Grapes/ /Electrolyzed Water/ /Cork Taint/ /Chloroanisoles/ /Postharvest Treatments/ /Storage Conditions/

Zhang, Z., Xu, J., Chen, Y., Wei, J., WU, B. (2019). Nitric oxide treatment maintains postharvest quality of table grapes by mitigation of oxidative damage. Postharvest Biology and Technology. 152, 9-18 <https://doi.org/10.1016/j.postharvbio.2019.01.015>

Abstract

The senescence of table grape is closely related to reactive oxygen species (ROS) damage. In this study, the mechanism of NO on mitigating the oxidative damage of table grape (*Vitis vinifera* L.) during storage at 0 °C for 60 days was explored by quality, antioxidant enzyme activity and related gene expression. Our result showed that fruit quality was maintained by NO with the concentration of 300 $\mu\text{L L}^{-1}$. NO treatment alleviated ROS accumulation and membrane lipid peroxidation by activated superoxide dismutase (SOD), ascorbic acid peroxidase (APX), catalase (CAT), peroxidase (POD) and glutathione reductase (GR) activities in peel and pulp. The accumulation of superoxide anion ($\text{O}_2^{\cdot-}$) and hydrogen peroxide (H_2O_2), as well as the activities of some antioxidant enzymes were different in peel and pulp. The results of q-PCR showed that NO treatment induced VvSOD, VvCAT, VvPOD2 and VvGR expression and VvSOD and VvCAT were the main genes expressed in peel and pulp. Therefore, NO regulated the ROS metabolism in peel and pulp was a possible mechanism for mitigating the oxidative damage of table grape.

Keywords: /Table Grape/ /Nitric Oxide/ /Oxidative Damage/

GRAPEFRUIT

Shi, Z., Yang, H., Jiao, J., Wang, F., Lu, Y., Deng, J. (2019). Effects of graft copolymer of chitosan and salicylic acid on reducing rot of postharvest fruit and retarding cell wall degradation in grapefruit during storage. Food Chemistry. 283, 92-100
<https://doi.org/10.1016/j.foodchem.2018.12.078>

Abstract

This study was to evaluate the effect of graft copolymer (CTS-g-SA) of chitosan (CTS) and salicylic acid (SA) on the storability of grapefruit fruits during postharvest storage. Results indicate that the graft copolymer treatment significantly depressed green mold caused by *Penicillium digitatum*. The graft copolymer application kept fruit firmness without impairing the fruit quality. Moreover, the graft copolymer treatment inhibited the activity and gene expression of cell wall-modifying enzymes such as polygalacturonase, cellulase, pectin methylesterase, α -l-arabinofuranosidase, β -galactosidase, and suppressed the modification of cell wall components including covalently bound polysaccharide (sodium carbonate soluble pectin, 24% KOH-soluble fraction), which were associated with fruit softening. These results suggested that graft copolymer application can be recognized as a postharvest technique to suppress rotting and delay softening through inhibiting solubilization of cell wall polysaccharides.

Keywords: /Grapefruit/ /Graft Copolymer/ /Cell Wall Degradation/ /Softening/ /Storage/

JAMUN (*Syzygium cumini* Skeels)

Archana, T.J., Suresha, G.J., Vandana, A.K. and Swamy, G.S.K. (2019). Effect of exogenous application of putrescine on storage behaviour of jamun (*Syzygium cumini* Skeels) fruits. Acta Hort. 1241, 577-582 DOI: 10.17660/ActaHortic.2019.1241.85
<https://doi.org/10.17660/ActaHortic.2019.1241.85>

Abstract

Jamun is an important underutilized minor fruit of the tropics rich in antioxidants and having neutral pH values. Fruits are highly seasonal and possess very short shelf life. With intent to increase the useful life of fruits, they were treated with 1 mM putrescine (PUT) for 5 min. Various physico-chemical parameters like physiological loss in weight (PLW), firmness, respiration rate and TSS were recorded daily up to 4 days period under ambient condition. Fruits treated with PUT recorded minimum PLW of 4.58% as compared to the control (5.80%) at the 4th day of storage. Fruits treated with 1 mM PUT maintained higher firmness (145.2, 131.4, 128.06, 120.16 at the 1st, 2nd, 3rd and 4th day, respectively) while, untreated fruits recorded rapid loss of firmness during the storage. There was significant difference with respect to respiration rate, fruits treated with 1 mM PUT registered lower respiration rates (127.87 mL CO₂ kg⁻¹ h⁻¹) while, untreated fruits recorded higher (186.59 mL CO₂ kg⁻¹ h⁻¹) respiration rates. Untreated jamun fruits registered maximum changes in TSS (18.33 °B) at the 1st day to 12.25 °B at the 4th day. However, postharvest treatment of 1 mM PUT for 5 min recorded significantly minimum changes in TSS (18.30 at the 1st to 13.66 °B at the 4th day). In conclusion, postharvest dip treatment of 1 mM PUT for 5 min effectively delayed the physico-chemical and physiological changes in jamun fruits under ambient storage.

Keywords: /Putrescine/ /Jamun Fruits/ /Shelf Life/ /Respiration Rate/ /Physico-Chemical Changes/

Vandana, A.K., Suresha, G.J., Archana, T.J. and Swamy, G.S.K. (2019). Influence of environment friendly bio-preservative Aloe vera gel coating on quality parameters of jamun fruits. Acta Hort. 1241, 699-704 DOI: 10.17660/ActaHortic.2019.1241.101 <https://doi.org/10.17660/ActaHortic.2019.1241.101>

Abstract

Jamun (*Syzygium cumini* L.) is an underutilized fruit crop of the tropics but attained a status of being rich in antioxidants. Jamun possesses a very short shelf life and readily becomes soft rendering the fruit less marketable. Aloe vera gel is known to have a bio-preservative effect. In the present study the Aloe vera gel is applied on jamun fruits in order to extend the shelf life. Jamun fruits were harvested and washed with NaHCl3 at 0.5 mL L⁻¹ and surface air-dried jamun fruits were treated with 10 and 15% Aloe vera gel, keeping untreated fruits as control and they were stored at 13°C and 85% RH for 15 days. The physico-chemical parameters viz., physiological loss in weight (%), firmness (N), TSS (°Brix), and titratable acidity (%) were recorded at 3-day interval up to 15 days. Fruits treated with Aloe vera gel at 15% maintained lower PLW and higher firmness up to the 15th day of storage. Total soluble solids increased from the 6th to 15th day of storage. Fruits treated with 10% Aloe vera gel recorded lower TSS and higher TA indicating delayed biochemical changes whereas untreated fruits recorded progressive and sharp increase in TSS throughout the storage period. In conclusion, jamun fruits coated with Aloe gel retarded the quality changes under cold storage.

Keywords: /Jamun Fruit/ /Bio-preservative/ /Gel coating/

KIWIFRUIT

Du, D., Wang, B., Wang, J., Yao, F., & Hong, X. (2019). Prediction of bruise susceptibility of harvested kiwifruit (*Actinidia chinensis*) using finite element method. Postharvest Biology and Technology, 152, 36–44. DOI: 10.1016/j.postharvbio.2019.02.013

Abstract

Bruising is one of the most common mechanical damages of fruit, but it is difficult to detect quantitatively. In this study, the finite element method (FEM) was utilized to predict the bruise susceptibility of harvested kiwifruit. The elastic-plastic material properties of fruit flesh at different ripening times, including Young's modulus, bio-yield stress and tangent modulus, were measured using the compression test. Then the fruit were modeled as a multiscale body of flesh and skin, and a finite element model was developed for dropped fruit. The drop scenarios were successfully simulated by FEM, and the results showed simultaneous activities of the simulation and high speed camera recordings. Results of FEM-based simulation showed that the bruise susceptibility increased with ripening time, but that different drop heights resulted in similar levels of bruise susceptibility. In addition, the horizontal orientation would cause higher bruise susceptibility than the vertical orientation. Results of accuracy analysis showed that the hourglass energy in any of the simulation scenarios kept in a very low level (<5%). The maximum errors between simulation and high speed camera recordings were 5.0%, 19.0% and 11.9% for initial velocity, maximum deformed length and contact time, respectively. Compared with experimental measurement, the maximum errors of simulation were 17.1% for bruise volume and 18.3% for bruise susceptibility. The results confirmed the FEM was reliable for prediction of bruise susceptibility of the fruit, and would be an effective approach to further investigate the bruise damage.

Keywords: /Kiwifruit/ /Finite Element Method/ /Bruise Susceptibility/ /High Speed Camera/ /Experimental Measurement/

Ozturk, B., Uzun, S., & Karakaya, O. (2019). Combined effects of aminoethoxyvinylglycine and MAP on the fruit quality of kiwifruit during cold storage and shelf life. *Scientia Horticulturae*, 251, 209–214. DOI: 10.1016/j.scienta.2019.03.034

Abstract

This study was conducted to investigate the effects of postharvest aminoethoxyvinylglycine (AVG) and modified atmosphere packaging (MAP) treatments on quality traits and bioactive compounds of kiwifruit (*Actinidia deliciosa* cv. 'Hayward') during cold storage and shelf life periods. In the study, treatments were selected as control, AVG (225 mg L⁻¹ as dipping for 2 min), MAP and AVG + MAP. Kiwifruit were stored at 0 ± 0.5 °C and 90 ± 5% relative humidity (RH) for 180 days. Fruit were kept at 21 ± 1 °C and 70 ± 5% for shelf life (5 d). MAP significantly delayed the weight loss during cold storage. In measurement of last cold storage and shelf life, MAP-treated fruit had higher firmness compared to the control and AVG, but had lower respiration rate. On 180th day of cold storage, MAP-treated fruit was higher than the control in terms of vitamin C content, whereas at the shelf life all treatments were higher values than control. In measurement of last cold storage and shelf life, the highest total phenolic was found in AVG treatment. Also all treatments significantly delayed the losses of the total flavonoid and antioxidant activity compared to the control. It was revealed that MAP could be used as an efficient tool for delaying the losses which occurred the fruit quality and bioactive components of kiwifruit during cold storage and shelf life.

Keywords: /*Actinidia deliciosa*/ /Antioxidant/ /Flavonoids/ /Respiration Rate/ /Vitamin C/ /Weight Loss/

LETTUCE

Ripoll, J., Charles, F., Vidal, V., Laurent, S., Klopp, C., Lauri, F., ... Roux, D. (2019). Transcriptomic view of detached lettuce leaves during storage: A crosstalk between wounding, dehydration and senescence. *Postharvest Biology and Technology*, 152, 73–88. DOI: 10.1016/j.postharvbio.2019.02.004

Abstract

Many methods of storage are currently used to delay the postharvest senescence and the ensuing quality losses of detached lettuce leaves. This transcriptome study explores the senescence mechanisms of packaged lettuce leaves over 7 d of cold storage in darkness. At the end of the storage, the detached lettuce leaves showed a 10% water loss and 24% cut-edge discoloration. No chlorophyll fluorescence variation was observed. A total of 1048 and 1846 genes were differentially expressed (DE) after 2 and 7 d of storage, respectively. In terms of gene expression modulation, the data showed a global shutdown of primary-metabolism but no obvious chlorophyll breakdown. Although an early stress-response clearly takes place, the cold storage under darkness appeared to delay senescence by protecting chloroplasts from degradation and enhancing an antioxidative response. Then, a progressive global expression shutdown appeared, concomitantly with the dehydration stress. Among the transcripts that showed an early high expression, the data highlighted many stress-related genes (PIN, bzip TF, Heat-shock, stress A-like), 30 redox-regulation associated transcripts, the majority of the phenylpropanoid pathway markers and ethylene and auxin-related genes. Later (day 7), many dehydration-responsive markers showed an increased expression, as did some abscisic acid related markers. Phytohormones (cytokinins) and transcription factors (WRKYs) appeared to play complex roles as senescence progressed. No simple link between cut-edge discoloration and PPO-related genes expression was made. The main known process of senescence induction through the pheophorbide a oxygenase and phospholipase D pathways were not highlighted in this study. To the best of our knowledge, this study is the first to explore the transcriptional response of postharvest senescence in detached lettuce leaves. Deeper analysis of several markers will help to dissect the crosstalk between wounding, dehydration and senescence mechanisms. In addition, post-transcriptional studies are needed to conclude about the described patterns.

Keywords: /*Lactuca sativa* L./ /Postharvest/ /Storage/ /Wounding/ /Senescence/ /Transcriptome/

LITCHI (*Litchi chinensis*)

Fahima, A., Levinkron, S., Maytal, Y., Hugger, A., Lax, I., Huang, X., Eyal, Y., Lichter, A., Goren, M., Stern, R.A., Harpaz-Saad, S. (2019). Cytokinin treatment modifies litchi fruit pericarp anatomy leading to reduced susceptibility to post-harvest pericarp browning. *Plant Science*. 283, 41-50 <https://doi.org/10.1016/j.plantsci.2019.02.006>

Abstract

Litchi (*Litchi chinensis* Sonn.) is a subtropical fruit known for its attractive red pericarp color, semi-translucent white aril and unique flavor and aroma. Rapid post-harvest pericarp browning strictly limits litchi fruit marketing. In the current research, we hypothesized that modification of litchi fruit pericarp anatomy by hormone application may reduce fruit susceptibility to post-harvest pericarp browning. In this context, we hypothesized that cytokinin treatment, known to induce cell division, may yield fruit with thicker pericarp and reduced susceptibility for fruit surface micro-crack formation, water loss and post-harvest pericarp browning. Exogenous cytokinin treatment was applied at different stages along the course of litchi fruit development and the effect on fruit pericarp anatomy, fruit maturation and postharvest pericarp browning was investigated. Interestingly, cytokinin treatment, applied 4 weeks after full female bloom (WFB), during the phase of pericarp cell division, led to mature fruit with thicker pericarp, reduced rate of post-harvest water loss and reduced susceptibility to post-harvest pericarp browning, as compared to non-treated control fruit. Histological sections ascribe the difference in pericarp anatomy to increased cell proliferation in the parenchymatic tissue and the highly-lignified brachysclereid cell layer. In contrast, exogenous cytokinin treatment applied 7 WFB, following the phase of pericarp cell division, significantly increased epidermal-cell proliferation but had no significant effect on overall fruit pericarp thickness and only minor affect on post-harvest water loss or pericarp browning. Interestingly, the late cytokinin treatment also significantly postponed fruit maturation-associated anthocyanin accumulation and chlorophyll degradation, as previously reported, but had no effect on other parameters of fruit maturation, like total soluble sugars and total titratable acids typically modified during aril maturation. In conclusion, exogenous cytokinin treatment at different stages in fruit development differentially modifies litchi fruit pericarp anatomy by induction of cell-type specific cell proliferation. Early cytokinin treatment during the phase of pericarp cell division may prolong litchi fruit storage by reducing fruit susceptibility to post-harvest water loss and pericarp

Keywords: /*Litchi chinensis* Sonn./ /Pericarp Anatomy/ /Pericarp Browning/ /Cytokinin/ /Micro-Crack Formation/ /Fruit Development/ /Fruit Ripening/

MACADAMIA NUTS

Buthelezi, N.M.D., Magwaza, L.S., Tesfay, S.J. (2019). Postharvest pre-storage processing improves antioxidants, nutritional and sensory quality of macadamia nuts. *Scientia Horticulturae*. 251, 197-208 <https://doi.org/10.1016/j.scienta.2019.03.026>

Abstract

Macadamia nut is rich in monounsaturated fatty acids, which are known to reduce the risk of cardiovascular diseases when included as part of a healthy human diet. On the negative side, high concentrations of unsaturated fatty acids lead to oxidative reactions, which result in rancidity thus decreases the quality of the nut. Drying and roasting are, therefore, needed to reduce moisture content and hence alleviate the above-mentioned problems. This research was conducted to evaluate and compare the quality properties of raw and roasted macadamia nuts during the accelerated storage of 70

days. Two commercially important macadamia cultivars, namely, 'A4' and 'Beaumont' were used as model cultivars. Nuts were roasted at 125 °C for 15 min using a hot air oven dryer. Roasted kernels of 'A4' and 'Beaumont' cultivars had significantly lower concentration of peroxide value (PV), high concentration of flavonoids, phenols and antioxidants activity and good sensory quality compared to raw kernels which had a higher concentration of polyphenol oxidase activity, PV, low concentration of flavonoids, phenols and antioxidant activity and poor sensory quality during the accelerated storage of 70 days. These results indicated that roasting significantly improved kernel quality and shelf life of 'A4' and 'Beaumont' macadamia cultivars.

Keywords: /Roasted Kernels/ /Raw Kernels/ /Polyphenol Oxidase/ /Peroxide Value/ /Antioxidant Activity/ /Sensory Evaluation/

MANGO

Gava, C.A.T., Alves, I.L.S., Duarte, N.C. (2019). Timing the application of *Bacillus subtilis* QST 713 in the integrated management of the postharvest decay of mango fruits. *Crop Protection*. 121, 51-56 <https://doi.org/10.1016/j.cropro.2019.03.013>

Abstract

This work evaluated the application of a commercial formulation of *B. subtilis* QST 713 (Serenade®, Bayer AgroSciences) at different times in the development of mango fruits for the control of postharvest diseases. Initially, two experiments were conducted to define the best fruit development stage for substitute synthetic fungicides by biocontrol. The experiments were made in commercial orchards with cv. 'Kent' and 'Palmer' with five treatments: 1. Conventional – fungicides were applied from pre-bloom until the maximal growth of fruits and in the postharvest processing; 2. *B. subtilis* QST 713 substitute fungicides from the 50% flowering stage onwards and in postharvest treatment; 3. *B. subtilis* from the fruit-setting (peanut size) up to egg size and in postharvest; 4. *B. subtilis* from the fruit growth (from egg size until harvest) and in postharvest; 5. Preharvest – three weeks before harvest and in postharvest. Application of *B. subtilis* from the fruit setting and fruit growth stages onwards resulted in significantly lowest fruit rot incidence. A third experiment was conducted in an orchard with cv. Tommy Atkins and *B. subtilis* application started in three fruit development stages: 1. Conventional; 2. Fruit growth; 3. Preharvest. There was a significant reduction of rot incidence, severity, and lesion development rate through the shelf life period for the application starting fruit growth onward. Our results showed that *B. subtilis* QST 713 applied after the mid-stage of fruit development can efficiently complement the application of fungicides in the initial stages of mango fruit production. It is an important finding showing a safe substitution of conventional fungicides by a biofungicide formulation for the management of postharvest rot of mango.

Keywords: /Biological Control/ /Fruit Rot/ /Integrated Management/ /Quiescent Pathogens/

MELON

Zainal, B., Ding, P., Ismail, I. S., & Saari, N. (2019). Physico-chemical and microstructural characteristics during postharvest storage of hydrocooled rockmelon (*Cucumis melo* L. *reticulatus* cv. Glamour). *Postharvest Biology and Technology*, 152, 89–99. DOI: [10.1016/j.postharvbio.2019.03.001](https://doi.org/10.1016/j.postharvbio.2019.03.001)

Abstract

The effects of hydrocooling time on maintaining the quality and increasing postharvest storage life of rockmelon fruit has not been studied. Thus, we investigated hydrocooling at ½ and ¾ cooling time (CT)

compared with no hydrocooling on the physico-chemical and microstructural properties of the fruit during storage at 13 °C and 85% relative humidity (RH). Hydrocooling with ½ CT slowed weight loss and increases in soluble solids concentration during storage, maintained higher chroma intensity of pulp colour and turgor pressure of rind and pulp firmness, and the citric acid content compared with the other treatments. Light microscopy images and scanning electron micrographs confirmed that weight loss in non-hydrocooled and ¾ CT hydrocooled fruit was associated with loss of cell turgor, thereby influencing cell wall rigidity in the pericarp tissue of fruit. The results suggest that hydrocooling at ½ CT can preserve cell wall structure of rockmelon fruit and maintain its quality during cold storage.

Keywords: /Hydrocooling/ /Physico-chemical/ /Pericarp/ /Cell Turgor/ /Cellular Structure/

MUSHROOM

Li, L., Kitazawa, H., Zhang, R., Wang, X., Zhang, L., Yu, S., & Li, Y. (2019). New insights into the chilling injury of postharvest white mushroom (*Agaricus bisporus*) related to mitochondria and electron transport pathway under high O₂/CO₂ controlled atmospheres. *Postharvest Biology and Technology*, 152, 45–53. DOI: 10.1016/j.postharvbio.2019.02.015

Abstract

Mitochondria and their electron transport pathway (ETP) might have a potential role in response to chilling stress. Notwithstanding, it is a novel area and the relative research is still in the early stages. In this study, we attempt to explore the explicit mechanisms of the 80% O₂ + 20% CO₂ treatment on alleviating chilling injury (CI) to white mushrooms based on the ETP and mitochondria, with natural air as the control. CI incidence, proportions of cytochrome pathway (CCP) and alternative pathway (AP), activities of key enzymes of CCP and AP, the relative gene expressions, mitochondrial structure and functions were investigated at 1 °C. The results reported that 80%O₂ + 20% CO₂ treatment prevented the occurrence of CI and retained the ATP yield. With regard to the ETP, the 80% O₂ + 20% CO₂ treatment restrained the decline in the proportion of CCP and boosted the proportion of AP through impacting the key enzymes and relative genes expressions. It also retarded mitochondria swelling and maintained higher levels of membrane fluidity and cytochrome c (Cyt c). Our results illustrated that 80% O₂ + 20% CO₂ dramatically alleviated the development of CI in white mushrooms, which could possibly be ascribed to the adjustment of ETP while retaining the structure and functions of the mitochondrion and the switching of its two conformations.

Keywords: /*Agaricus bisporus*/ /High O₂/ /Chilling Stress/ /Mitochondria/ /Electron TRansport Pathway/

Yang, W., Wu, Y., Hu, Q., Pei, F., & Mariga, A. M. (2019). Preharvest treatment of *Agaricus bisporus* with methyl jasmonate inhibits postharvest deterioration. *LWT- Food Science and Technology*. 106, 158–163. <https://doi.org/10.1016/j.lwt.2019.02.069>

Abstract

Rapid deterioration is a serious problem in postharvest storage of *Agaricus bisporus* (*A. bisporus*). Hence, measures to improve shelf-life of the mushroom are of great importance. This study analyzed the effect of preharvest treatment of *A. bisporus* with methyl jasmonate (MeJA) on the postharvest storage quality. Appearance and texture characteristics were determined during a 10-day storage period at 4 °C, and the results showed that MeJA improved the appearance of *A. bisporus* by inhibiting browning and color variation. Additionally, weight loss and cellulose content were inhibited in MeJA-treated groups. Consequently, MeJA maintained a dense microstructure and alleviated the decline of fracturability and springiness of the mushroom. Thus, MeJA inhibited deterioration and prolonged postharvest storage

period of *A. bisporus* by enhancing appearance and texture characteristics. These results provide important information on improving postharvest quality in the *A. bisporus* cultivation industry.

Keywords: /*Agaricus bisporus*/ /Methyl Jasmonate/ /Appearance/ /Texture Characteristics/ /Antioxidant Enzyme Activity/

Karimirad, R., Behnamian, M., Dezhsetan, S. (2019). Application of chitosan nanoparticles containing *Cuminum cyminum* oil as a delivery system for shelf life extension of *Agaricus bisporus*. LWT- Food Science and Technology, 106, 218-228 <https://doi.org/10.1016/j.lwt.2019.02.062>

Abstract

The present study was conducted to investigate the effect of *Cuminum cyminum* essential oil loaded chitosan nanoparticles (CEO-CSNPs) on the shelf life of button mushroom during 20 days of cold storage. CEO-CSNPs were prepared by ionic gelation technique. The size and morphology of nanoparticles were analyzed by transmission electron microscopy (TEM) and dynamic light scattering (DLS). The size of CEO-CSNPs ranged from 30 to 80 nm. CEO and CEO-CSNPs were spotted onto the whatman filter paper inside containers. CEO-CSNPs treatment was effective in maintaining color, firmness and overall acceptability of mushrooms and inhibiting the investigated bacteria and mold and yeast growth, resulted to significantly higher SOD and APX activity, antioxidant capacity and total phenolic content and lower PPO activity throughout the storage period. In general, treated samples stored for 15 days at 4 °C indicated overall acceptable quality compared to the control samples which lost their quality after 10 days of storage.

Keywords: /Antioxidant Capacity/ /Button Mushroom/ /Cumin Seed/ /Postharvest/

ONION

Wang, A., Islam, M. N., Johansen, A., Haapalainen, M., Latvala, S., & Edelenbos, M. (2019). Pathogenic *Fusarium oxysporum* f. sp. *cepae* growing inside onion bulbs emits volatile organic compounds that correlate with the extent of infection. *Postharvest Biology and Technology*, 152, 19–28. DOI: 10.1016/j.postharvbio.2019.02.010

Abstract

Diseases develop during the storage of onions. To minimize losses, new methods are needed to identify diseased bulbs early in storage. Volatile organic compounds (VOCs), the respiration rate, weight loss, and the dry matter content were investigated for 1–7 weeks post inoculation of bulbs with water (control) and two strains (Fox006 or Fox260) of *Fusarium oxysporum* f. sp. *cepae*. Photos, multispectral image analysis, and real-time polymerase chain reaction (PCR) showed no infection in the control onions, weak pathogenic infection in Fox006-onions, and strong pathogenic infection in Fox260-onions at week 7 post inoculation. Infected bulbs exhibited increased respiration rate, increased VOC emission rate, and increased weight loss. The control and Fox006-onions did not respond to inoculation and had similar reaction pattern. Forty-three different VOCs were measured, of which 17 compounds had sulfur in their chemical structure. 1-Propanethiol, methyl propyl sulfide, and styrene were emitted in high concentrations and were positively correlated with the extent of infection ($r = 0.82 - 0.89$). Therefore, these compounds were the most promising volatile markers of *Fusarium* basal rot infection. For the first time, we show that the extent of fungal infection determined by real-time PCR in onion bulbs is related with VOC emission.

Keywords: /*Allium cepa* L. / /Food Spoilage/ /SPME/ /Image Analysis/ /Real-time/ / PCR/ /Respiration Rate/

PAPAYA

Sigalingging, R., Nasution, H.A., Rindang, A., Ayu, P.C. (2019). Effect of Packaging Fillers Materials on the Quality of Papaya Fruit (*Carica papaya* L.). IOP Conference Series: Earth & Environmental Science, 260(1), 1. Retrieved from <http://search.ebscohost.com/login.aspx?direct=true&db=edb&AN=136872802&site=eds-live>. doi:10.1088/1755-1315/260/1/012036

Abstract

Papaya is classified as a high economic value commodities, however it is perishable, easy to lose weight due to its thin skin and soft flesh and has a short shelf-life. Generally, the papaya transportation process in Indonesia is only conducted using a simple packaging method such as using papers or baskets to avoid wound on the fruit. Therefore, packaging improvement would provide a great advantage for papaya trading. This study aimed to determine the effect on papaya quality while packaged in different packaging fillers materials during land transportation using simulation. The results showed that the highest percentage of weight loss, mechanical damage and hardness after simulation at frequency of 1.5 Hz and 3 Hz were 6.74%; 71.48%; 4.23 gr/mm and 7%; 97.16%, 4.17 gr/mm respectively in RST3 treatment (plastic basket of straw filler in 5 hours simulation), while the lowest percentage after simulation at frequency of 1.5 Hz and 3 Hz were 0.14%; 30.95%; 2.86 gr/mm and 0.17%; 26.18%; 2.56 gr/mm respectively in NPT1 treatment (newspaper filling material in 1 hour simulation). The best packaging to reduce quality degradation in papaya using transportation simulation at the frequency of 1.5 Hz and 3 Hz was the plastic basket with newspaper filler.

Keywords: /Papaya/ / Packaging fillers/

PEACH

Hashem, M., Alamri, S. A. M., Alqahtani, M. S. A., & Alshehri, S. R. Z. (2019). A multiple volatile oil blend prolongs the shelf life of peach fruit and suppresses postharvest spoilage. Scientia Horticulturae. 251, 48–58. DOI: 10.1016/j.scienta.2019.03.020

Abstract

Prolongation of the shelf life of delicate fruit such as peaches without the application of fungicides is a great challenge facing the horticulture sector. This study aimed to apply Thieves oil blend (six oils in one mixture) to protect peach fruit from spoilage during long-term cold storage. *Alternaria alternata*, *Fusarium oxysporum*, *Geotrichum candidum* and *Monilinia laxa* were isolated from naturally infected peach fruit showing symptoms of postharvest rot, and their pathogenicity was confirmed on the same fruit. Pathogens were identified by sequencing of their internal transcribed spacer (ITS). The results showed that Thieves oil blend at a concentration of 2.0 mL L⁻¹ completely suppressed fungal growth in vitro. This concentration reduced the disease incidence to 12.0% and the disease severity index to 1.2 after 7 d at 27 °C in vivo. The oil blend prolonged the shelf life of peach fruit up to 30 d under cold storage conditions (4 °C). Electron microscopy confirmed the fungitoxicity of Thieves oil blend, which resulted in complete death of the fungal mycelia. Gas chromatography–mass spectroscopy (GC–MS) analysis of the oil blend showed the presence of 25 effective constituents that work synergistically to suppress the disease and its causal pathogens. The study recommends the application of Thieves oil blend for the first time as a safe multiple preparation to protect peaches and other fruit during transportation and cold storage to reduce losses during the marketing process.

Keywords: /Volatile OilsBlend/ /Mode of Action/ /Shelf Life/ /Scan Electron Microscopy/ /GC-MS/

Zhang, S., Zheng, Q., Xu, B., & Liu, J. (2019). Identification of the Fungal Pathogens of Postharvest Disease on Peach Fruits and the Control Mechanisms of *Bacillus subtilis* JK-14. *Toxins*, 11(6), 322. DOI: 10.3390/toxins11060322

Abstract

Postharvest fungal disease is one of the significant factors that limits the storage period and marketing life of peaches, and even result in serious economic losses worldwide. Biological control using microbial antagonists has been explored as an alternative approach for the management of postharvest disease of fruits. However, there is little information available regarding to the identification the fungal pathogen species that cause the postharvest peach diseases and the potential and mechanisms of using the *Bacillus subtilis* JK-14 to control postharvest peach diseases. In the present study, a total of six fungal isolates were isolated from peach fruits, and the isolates of *Alternaria tenuis* and *Botrytis cinerea* exhibited the highest pathogenicity and virulence on the host of mature peaches. In the culture plates, the strain of *B. subtilis* JK-14 showed the significant antagonistic activity against the growth of *A. tenuis* and *B. cinerea* with the inhibitory rates of 81.32% and 83.45% at 5 days after incubation, respectively. Peach fruits treated with different formulations of *B. subtilis* JK-14 significantly reduced the mean disease incidences and lesion diameters of *A. tenuis* and *B. cinerea*. The greatest mean percent reduction of the disease incidences (81.99% and 71.34%) and lesion diameters (82.80% and 73.57%) of *A. tenuis* and *B. cinerea* were obtained at the concentration of 1×10^7 CFU mL⁻¹ (colony forming unit, CFU). Treatment with the strain of *B. subtilis* JK-14 effectively enhanced the activity of the antioxidant enzymes-superoxide dismutase (SOD), peroxidase (POD) and catalase (CAT) in *A. tenuis* and *B. cinerea* inoculated peach fruits. As such, the average activities of SOD, POD and CAT were increased by 36.56%, 17.63% and 20.35%, respectively, compared to the sterile water treatment. Our results indicate that the isolates of *A. tenuis* and *B. cinerea* are the main pathogens that cause the postharvest peach diseases, and the strain of *B. subtilis* JK-14 can be considered as an environmentally-safe biological control agent for the management of postharvest fruits diseases. We propose the possible mechanisms of the strain of *B. subtilis* JK-14 in controlling of postharvest peach diseases.

Keywords: /*Bacillus* spp./ /Peach Fruits/ /Postharvest Diseases/ /Antagonistic Activity/ /Antioxidative Defense System/

PEARS

Zhang, Q., Zhao, L., Li, Z., Li, C., Li, B., Gu, X., Zhang, H. (2019). Screening and identification of an antagonistic yeast controlling postharvest blue mold decay of pears and the possible mechanisms involved. *Biological Control*, 133, 26–33. DOI: 10.1016/j.biocontrol.2019.03.002

Abstract

Postharvest disease of pears caused by pathogens results in great economic losses. The aim of this research was to isolate a strain of potential antagonistic yeast from soil of orchards, and to test the control efficacy against postharvest blue mold decay of pears. By molecular biological identification based on comparative sequence analysis of 5.8S rDNA gene, the antagonistic strain was identified as *Wickerhamomyces anomalus*. The results showed that *W. anomalus* significantly reduced the disease incidence and lesion diameter of blue mold of pears compared with the control in vivo. The disease incidence caused by *Penicillium expansum* of pears was only 5.56%, when treated with 1×10^8 cells/mL *W. anomalus*, compared with 100% disease incidence of the control. In vitro test showed that *W. anomalus* reduced the spore germination rate and germ tube length of *P. expansum*. Meanwhile, polyphenoloxidase (PPO), peroxidase (POD), catalase (CAT) and chitinase (CHI) activities of the pears treated by *W. anomalus* were significantly higher than that of the control. And the expression levels of defense-related enzymes were significantly induced by *W. anomalus*. All these results indicated that *W. anomalus* has the potential to control postharvest diseases of pears, and the mechanisms involved in

inhibiting spore germination and germ tube length, induction of the activities of the defense-related enzymes of pears, and improvement of the expression levels of defense-related genes of pears.

Keywords: /Postharvest Decay/ /Pears/ /Mechanism/ /Wickerhamomyces anomalus/ /Penicillium expansum/ /Biocontrol/

PINEAPPLE

Hong, K., Xian, J., Jia, Z., Hou, X., & Zhang, L. (2019). Genome-wide identification of Dof transcription factors possibly associated with internal browning of postharvest pineapple fruits. *Scientia Horticulturae*, 251, 80–87. DOI: 10.1016/j.scienta.2019.03.007

Abstract

DNA binding with one finger (Dof) proteins, which are a family of plant-specific transcription factors (TFs), play vital roles in diverse biotic and abiotic stress responses in plants. Dof TFs from the genome-wide analysis have performed in some species, but information on Dof TFs in pineapple (*Ananas comosus* L.) fruits during internal browning (IB), which is a postharvest physiological disorder, is lacking. In the present study, we identified 25 putative Dof TFs, that is, designated as AcDof1–AcDof25, which can be classified into seven out of the nine subgroups of the previously characterized Dof proteins, on the basis of the pineapple genome database. Their protein conserved domains displayed similarities to Dof TFs from other plant species. Gene expression profiles indicated that most AcDof genes were upregulated during IB. The further subcellular localizations of four Dof proteins (i.e., AcDof1, AcDof11, AcDof19, and AcDof23) were performed by the transient expression assays. To the best of our knowledge, this work is the first to characterize Dof TF family members and report on their possible role in pineapple fruit IB. Our findings should provide valuable information and novel insights into the Dof TF functions.

Keywords: /Dof/ /Gene Expression/ /Internal Browning/ /Pineapple Fruit/ /Subcellular Localization/

POMEGRANATE ARILS (BHAGWA)

Ramesh Naik, D., Manohar Prasad, D., Joshi, V., Padmavathamma, A.S., Syamraj Naik, C. and Venkatram, A. (2019). Effect of washing treatments on shelf life and quality of minimally processed 'Bhagwa' pomegranate arils. *Acta Hort.* 1241, 673-682 DOI: 10.17660/ActaHortic.2019.1241.98 <https://doi.org/10.17660/ActaHortic.2019.1241.98>

Abstract

Minimally processed 'Bhagwa' pomegranate arils were washed with antioxidants viz., sodium hypochlorite (SH) 200 ppm, ascorbic acid (AA) 5000 ppm and citric acid (CA) 5000 ppm packed in plastic cups then stored at 5°C to the best quality preservation. Arils washed with SH 200 ppm plus AA 5000 ppm recorded lowest PLW, spoilage and increased shelf life of 9 days, whereas non-washed arils recorded a shelf life of 4.33 days only. Hunter colour Lab values (L^* , a^* and b^*), TSS, Brix-acid ratio, sugars, ascorbic acid were also recorded significantly highest in arils washed with SH 200 ppm plus AA 5000 ppm. Arils treated with SH 200 ppm plus AA 5000 ppm were found superior for organoleptic attributes.

Keywords: /Minimally Processed Pomegranate Arils/ /Washing/ /Antioxidants/ /Shelf Life/ /Quality/

POTATO

Jia, G., Xu, L., Guan, W., Lin, Q., Brennan, C., Yan, R., Zhao, H. (2019). Effect of citronella essential oil fumigation on sprout suppression and quality of potato tubers during storage. Food Chemistry, 284, 254-258 <https://doi.org/10.1016/j.foodchem.2019.01.119>

Abstract

Effect of citronella essential oil (CEO) fumigation on sprout suppression and quality of potato tubers during storage was investigated. Potato tubers were treated under conditions of single-phase (30 $\mu\text{L L}^{-1}$, 0–10 d) and dual-phase (30 $\mu\text{L L}^{-1}$, 0–10 d; 30 $\mu\text{L L}^{-1}$, 35–90 d) fumigation. Changes in germination rate, weight loss, starch, reducing sugar, gibberellins (GA3), and α -solanine were measured. The results showed that CEO fumigation could control sprouting and improve the quality of potato tubers during storage compared to the non-treated tubers. CEO treatments inhibited the degradation of starch and the increase of reducing sugar content. The production of gibberellins (GA3) was suppressed, and the levels of α -solanine in the skin and flesh of potato tubers were decreased by CEO fumigation. Dual-phase CEO fumigation had a better effect on sprout suppression than single-phase fumigation, and possesses potential for postharvest application.

Keywords: /Potato/ /Citronella Essential Oil/ /Sprout Suppression/ /Storage/ / α -Solanine/

ROSE

Bayanati, M., Razavi, K., Tehranifar, A., Lohrasebi, T., Neamati, S. H., & Ahmadi, N. (2019). Isolation and expression patterns of two novel senescence-associated genes RhAA and RhCG in rose (*Rosa hybrida*). Postharvest Biology and Technology, 152, 60–64. DOI: 10.1016/j.postharvbio.2019.02.011

Abstract

The functional life and marketability of flowers is restricted by senescence and /or abscission. Many senescence-associated genes have been identified in the *Arabidopsis* plant. In this research, we isolated two full length clones of RhAA and RhCG in rose (*Rosa hybrida*) and compared the expression patterns of these genes in cultivars with short ('Cool Water') and long ('Marroussia') shelf lives. The RhAA gene is more similar to unknown proteins *Cucurbita maxima*, *Gossypium arboretum* and senescence-associated protein *Medicago truncatula*, while the RhCG is closer to the unknown proteins *Pisum sativum* and *Dendrobium catenatum*. The results of quantitative real-time polymerase chain reaction (qRT-PCR) analysis showed that the RhAA was expressed at higher levels in at the bud and open stages in most tissues of 'Cool water' compared with 'Marroussia' in response to the ethylene treatment. In gynoecia, the RhCG gene showed the highest level of expression in both cultivars at the second and seventh stages. It seems that the RhAA and RhCG were encoding a plant-specific protein of unknown function, which may relate to in the degradative and remobilization processes of senescence.

Keywords: /Cut Rose/ /Ethylene/ /Senescence-Associated genes/ /RT-PCR/ /RhAA/ /RhCG/

Spartium junceum

Darras, A. I., & Kargakou, V. (2019). Postharvest physiology and handling of cut *Spartium junceum* inflorescences. *Scientia Horticulturae*, 252, 130–137. DOI: 10.1016/j.scienta.2019.03.048

Abstract

Spartium junceum is a deciduous perennial shrub with extreme resistance to drought that develops spike inflorescences with yellow, delicate, lightly scented flowers. In series of experiments, we investigated *S. junceum* postharvest performance and recorded various quality parameters. Harvesting *S. junceum* inflorescences at different developmental stages did not affect vase life (VL) or inflorescence fresh weight. However, significant differences between harvest stages were recorded on flower open rate (FOR; %) and flower fall rate (FFR; %). Sucrose pulsing at 2 and 5% (w:v) for 24 h resulted in significant increases in FOR, but no changes in FFR, inflorescence fresh weight and solution uptake (SU) were recorded. Wet storage at 3 °C effectively increased VL and maintained quality of inflorescences for over 40 days. *S. junceum* showed a moderate sensitivity to exogenous ethylene. Exposure of inflorescences to 5 and 10 $\mu\text{L L}^{-1}$ for 12 h resulted in significant decrease in VL and FOR, and also increase in FFR. 1-MCP treatments at 10 $\mu\text{L L}^{-1}$ significantly increased VL by 2.2 d, FOR by up to 90% and maintained higher inflorescence fresh weight ($P < 0.05$) for 5 d (e.g. from day-3 to day-8), compared to the un-treated controls. The results of the present study suggest that *S. junceum* could, potentially, be cultivated commercially for specialty cut flower production.

Keywords: /Specialty Cut Flowers/ /Storage/ /Ethylene/ /1-MCP/ /Sucrose Pulsing/

STRAWBERRY

Luo, G., Xue, L., Xu, W., Zhao, J., Wang, J., Ding, Y., ... Lei, J. (2019). Breeding decaploid strawberry with improved cold resistance and fruit quality. *Scientia Horticulturae*, 251, 1–8. DOI: 10.1016/j.scienta.2019.03.001

Abstract

The reciprocal crosses of Akihime (8x) and YH15-10 (12x), Sagahonoka (8x) and YH15-10, and Tokun (10x) and AY175 (10x) were performed to select decaploid (10x) seedlings with improved cold resistance and fruit quality of strawberry. The hybrids were obtained from any other cross combinations except for YH15-10 \times Sagahonoka. All of the observed hybrids were decaploids except for one enneaploid (9x) from the cross of Akihime \times YH15-10. Some of the decaploid hybrids from the five cross combinations had obviously increased in cold resistance. For instance, 80.00% and 75.00% hybrids respectively from YH15-10 \times Akihime and AY175 \times Tokun showed higher cold resistance than their lower cold resistant parent 'Akihime' and 'Tokun'. The mean LT_{50} value of hybrids from YH15-10 \times Akihime was -16.6 °C, which was the highest among the five cross combinations. There was an obvious improvement in fruit quality, some of the hybrids exhibited larger fruit, higher contents of soluble solids, vitamin C, anthocyanin, total phenol and total antioxidant capacity compared to their parents and standard cultivar 'Sachinoka'. In summary, 18 advanced decaploid selections showed substantial improvement for cold resistance and fruit quality. These decaploid selections have potential values in commercial production and cultivar improvement.

Keywords: /Strawberry/ /Hybridization/ /Decaploid/ /ColdResistance/ /Fruit Quality/

Vendel, I., Hertog, M., & Nicolaï, B. (2019). Fast analysis of strawberry aroma using SIFT-MS: A new technique in postharvest research. *Postharvest Biology and Technology*, 152, 127–138. DOI: 10.1016/j.postharvbio.2019.03.007

Abstract

Aroma is an essential quality aspect of fresh produce and plays an important role in determining consumer liking and the volatile organic compounds (VOCs) can serve as markers for fermentation and postharvest storage disorders. This study suggests Selected Ion Flow Tube Mass Spectrometry (SIFT-MS) as a candidate technique for the rapid, non-destructive and quantitative measurement of VOCs in postharvest quality research. Strawberry was chosen as a model fruit since its aroma is one of its main quality traits. Combining SIFT-MS in full scan mode with multivariate statistics allowed for inter- and intra-cultivar discrimination of strawberry aroma profiles. Further, by combining SIFT-MS with GC-MS it is possible to tentatively identify volatiles. As compared to GC-MS based approaches total analysis time was reduced by a factor 11.

Keywords: /SIFT-MS/ /Strawberry aroma/ /Fragaria x ananassa/ /Strawberry cultivars/ /Ripening/

TOMATO

Panjai, L., Noga, G., Hunsche, M., & Fiebig, A. (2019). Optimal red light irradiation time to increase health-promoting compounds in tomato fruit postharvest. *Scientia Horticulturae*, 251, 189–196. DOI: 10.1016/j.scienta.2019.03.019

Abstract

The impact of postharvest red light irradiation via LED modules on the content of health promoting compounds was evaluated on green tomatoes stage 1 exposed to intermittent or continuous irradiation. The first experiment studied the overall effects of different duration periods of red light radiation (darkness, continuous red light for 10 d, continuous red light for 15 d and continuous red light for 20 d) while the second experiment focused on the effects of intermittent red light (darkness, red light for 30 min per day, red light for 6 h per day, red light for 12 h per day and continuous red light). In both experiments, tomatoes exposed to darkness served as control. Continuous red light irradiation accelerated ripening of green tomatoes. In addition, continuous red light also significantly increased lycopene, β -carotene, total phenolic content, total flavonoid concentration and antioxidant activity compared to all other treatments, suggesting that continuous red light exposure positively influences metabolic processes and contributes to a higher content of health promoting compounds in tomatoes.

Keywords: /Lycopene/ / β -carotene/ /Antioxidant activity/ /LED/ /Postharvest/ /Tomato/

Suzuki, Y., & Nagata, Y. (2019). Postharvest ethanol vapor treatment of tomato fruit stimulates gene expression of ethylene biosynthetic enzymes and ripening related transcription factors, although it suppresses ripening. *Postharvest Biology and Technology*, 152, 118–126. DOI: 10.1016/j.postharvbio.2019.03.006

Abstract

Postharvest ethanol vapor treatment suppresses tomato fruit ripening. The aim of this study was to clarify the mechanism of suppression at the molecular level. Tomato (*Solanum lycopersicum* cv. 'Micro Tom') fruit harvested at mature green and breaker stages was continuously treated with ethanol using an ethanol pad at 20 °C in the dark. Ethanol treatment stimulated ethylene production and increased gene expression of LeACS2 and LeACS4, which are related to ethylene-related ripening. The expression of

genes encoding ripening-specific transcription factors acting upstream of ethylene was also induced, when the fruit was treated with ethanol. In the ethylene-dependent ripening process, ethanol inhibited the expression of RIN-dependent and ethylene-dependent ripening-related genes, suggesting that ethanol could inhibit some processes downstream of ethylene perception. In the ethylene-independent ripening process, expression of RIN-dependent and ethylene-independent ripening related genes was inhibited by ethanol, suggesting that ethanol could inhibit some processes downstream of RIN. Inhibition of each process by ethanol could be a mechanism by which ethanol inhibits ripening, although it stimulates ethylene production and factors upstream of the ripening process.

Keywords: /Ethanol/ /Ethylene/ RIN/ /Ripening/ /Tomato fruit/

Zhu, J., Wu, H., & Sun, Q. (2019). Preparation of crosslinked active bilayer film based on chitosan and alginate for regulating ascorbate-glutathione cycle of postharvest cherry tomato (*Lycopersicon esculentum*). International Journal of Biological Macromolecules, 130, 584–594. DOI: 10.1016/j.ijbiomac.2019.03.006

Abstract

In the present study, a bilayer film composed of chitosan and alginate was produced by layer-by-layer casting and crosslinking by oxidized ferulic acid. The effects of different film components on mechanical, permeable and optical properties of the film were systematically investigated and the optimum concentrations were determined. The results of scanning electron microscopy and thermogravimetric analysis showed that the crosslinked bilayer film had a smoother and more uniform appearance than the uncrosslinked bilayer film, while the thermal stability was not significantly different. In addition, the infrared measurements confirmed the existence of crosslinking. Subsequently, citric acid was added as an active compound to the bilayer film, which endows the film with antioxidant capacity. Its optimum concentration was also determined by measuring the mechanical, permeable and optical properties of the film. Finally, the active bilayer film was applied to preserve the postharvest cherry tomatoes. The result found that it could well regulate the ascorbate-glutathione cycle in cherry tomatoes and alleviate the accumulation of oxidative damage during postharvest.

Keywords: /Active Bilayer Film/ /Cherry Tomato/ /Ascorbate-Glutathione cyc/

WATER HYACINTH

Imsabai, W. and Kam-lar, T. (2019). Study on pre- and postharvest physiology of water hyacinth [*Eichhornia crassipes* (Mart.) Solms] flowers. Acta Hort. 1240, 21-26 DOI: 10.17660/ActaHortic.2019.1240.3 <https://doi.org/10.17660/ActaHortic.2019.1240.3>

Abstract

Water hyacinth [*Eichhornia crassipes* (Mart.) Solms] is an aquatic plant with bluish-purple flowers that spreads rapidly. This research was carried out on the pre- and post-harvest physiology of water hyacinth flowers to evaluate the possibility of using the water hyacinth as a cut flower. Development of the flower, while still on the plant, was observed from flower initiation to senescence. The spikes appeared around 6 pm; all the flowers started to bloom at 8 am, and then wilted around 2 am the next day. The flower spikes were harvested at bud and flower-opening stages, and held in reverse osmosis (RO) water. It was found that their average vase life was 21 and 18 h, respectively. Water hyacinth flowers (opening stage) were fumigated with 0 (air) and 10 $\mu\text{L L}^{-1}$ ethylene for 3 h. The results showed that water uptake and fresh weight change of the ethylene-fumigated flowers and their vase life was not different from non-fumigated flowers. Flowers were also held in silver nitrate, 8-hydroxyquinoline sulfate, gibberellic acid, and thidiazuron solutions. It was found that none of the solutions extended the vase life of water hyacinth

flowers. It is concluded that water hyacinth flowers are not sensitive to ethylene, and their vase life is only 1 day. The different postharvest treatments tested did not improve flower vase life. Therefore, at this time, it is unlikely that water hyacinth can be commercialized as a cut flower.

Keywords: /Cut Flower/ /Ethylene/ /Flower Opening/ /Vase Life/ /Water Hyacinth/