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**GENERAL**

**ACTIVE FOOD PACKAGING**

Burgos N., et.al. 2017. Functional properties of plasticized bio-based poly (lactic acid) poly (hydroxybutyrate) (PLA\_PHB) films for **active food packaging**. Food Bioprocess Technol. 10: 770 – 780.

**Abstract**

Fully bio-based and biodegradable active films based on poly(lactic acid) (PLA) blended with poly(3-hydroxybutyrate) (PHB) and incorporating lactic acid oligomers (OLA) as plasticizers and carvacrol as active agent were extruded and fully characterized in their functional properties for antimicrobial active packaging. PLA\_PHB films showed good barrier to water vapor, while the resistance to oxygen diffusion decreased with the addition of OLA and carvacrol. Their overall migration in aqueous food simulants was determined and no significant changes were observed by the addition of carvacrol and OLA to the PLA\_PHB formulations. However, the effect of both additives in fatty food simulants can be considered a positive feature for the potential protection of foodstuff with high fat content. Moreover, the antioxidant and antimicrobial activities of the proposed formulations increased by the presence of carvacrol, with enhanced activity against *Staphylococcus aureus* if compared to *Escherichia coli* at short and long incubation times. These results underlined the specific antimicrobial properties of these bio-films suggesting their applicability in active food packaging.

**Keywords:** /Active Packaging/ /Biofilms/

Krepker, M., et.al. 2017. **Active food packaging** films with synergistic antimicrobial activity. Food Control 76: 117 - 126.

**Abstract**

High-quality polymer nano composites containing a synergistic antimicrobial combination of essential oils (carvacrol and thymol mixtures) are produced and their outstanding performance as an active packaging for hummus is demonstrated. The interactive properties of carvacrol and thymol against *E. coli* are studied *in vitro*, as the combination of these essential oils (EOs), which provides a synergistic antimicrobial action, is loaded into halloysite nanotubes (HNTs) for the first time. The latter nano-scale carriers minimize the loss of the highly volatile EOs during the high-temperature polymer processing, enabling melt compounding and subsequent film production on a semi-industrial scale. The resulting films exhibit a synergistic antimicrobial activity against *E. coli*, outperforming films containing the individual EOs by both potency and shelf life. The films are also integrated into real food packaging, and their effect on *E. coli* growth in inoculated hummus is studied. Bacterial growth is reduced by seven orders of magnitude, leading to their complete eradication, while the antimicrobial performance of the control films was significantly weaker. These results demonstrate the immense potential of these films as food packaging materials to efficiently control bacteria growth in complex food systems.

**Keywords:** /Packaging/

## **BIOCONTROL**

Calvo, H, et.al. 2017. Potential of a new strain of *Bacillus amyloliquefaciens* BUZ-14 as a **biocontrol** agent of postharvest fruit diseases. Food Microbiol. 63: 101 - 110.

### **Abstract**

The biocontrol potential of the *Bacillus amyloliquefaciens* strain BUZ-14 was tested against the main postharvest diseases of orange, apple, grape and stone fruit. After characterizing the temperature and pH growth curves of strain BUZ-14, its *in vitro* antifungal activity was determined against *Botrytis cinerea*, *Monilinia fructicola*, *M. laxa*, *Penicillium digitatum*, *P. expansum* and *P. italicum*. Subsequently, *in vivo* activity was tested against these pathogens by treating fruit with cells, endospores and cell-free supernatants. The *in vitro* results showed that BUZ-14 inhibited the growth of all the pathogens tested corresponding to the least susceptible species, *P. italicum*, and the most susceptible, *M. laxa*. *In vivo* tests corroborated these results as most of the treatments decreased the incidence of brown rot in stone fruit from 100% to 0%, establishing  $10^7$  CFU mL<sup>-1</sup> as the minimum inhibitory concentration. For the *Penicillium* species a preventive treatment inhibited *P. digitatum* and *P. italicum* growth in oranges and reduced *P. expansum* incidence in apples from 100% to 20%. Finally, it has been demonstrated that BUZ-14 was able to survive and to control brown rot in peaches stored at cool temperatures, making it a very suitable biocontrol agent for application during the post-harvest storage and marketing of horticultural products.

**Keywords:** /Biocontrol/ /*Botrytis cinerea*/ /*Monilinia* spp./ /*Penicillium* spp/

## **EDIBLE FILM**

Cozmuta, A.M., et.al. 2017. Assessment of the effective antioxidant activity of **edible film** staking into account films–food simulants and films–environment interactions. Packag. Technol. Sci. 30: 3 – 20.

### **Abstract**

Six gelatin films incorporating different ratios of sage oil (SO) and hemp oil (HO) were subjected to contact with food simulants and environmental exposure, respectively, for 3 months, at 15 000 lx light intensity, 40°C and 65% relative humidity. The migration and degradation, respectively, of the antioxidants into the simulants as well as their loss in the environment were mathematically modelled. The fastest release rate of antioxidants was noticed in the case of SO: HO 0 : 2 in 85% ethanol while the highest degradation rates were achieved after 18 days in the case of SO :HO 0 : 2 in water and 3% acetic acid and after 22 days in 85% ethanol. The antioxidants from SO:HO 0 : 2 were lost to the largest extent (5.37%) while those from SO : HO 1 : 1 to the lowest extent (3.49%). SO: HO 1: 1 was selected as the most efficient film, by optimizing the amount of antioxidants available solely for food protection with the longest stability in the simulants. From industrial point of view, the mathematical modelling of the previously mentioned processes allows for the selection of the most effective film from a group with comparable physical–chemical–microbiological properties.

**Keywords:** /Active packaging/

## **MINIMALLY PROCESSED**

Rodgers, Svetlana. 2017. Minimally processed functional foods: technological and operational ways. J. Food Sci. 81 (10): R2309 - R2319.

### **ABSTRACT**

This paper offers a concise review of technical and operational concepts underpinning commercialization of minimally processed functional foods (FFs), foods with fresh-like qualities commanding premium prices. The growing number of permitted nutritional content/health claims, many of which relate to well-being, coupled with emerging extraction and food processing technologies offers new exciting opportunities for small and medium size enterprises (SMEs) specializing in fresh produce to play an active role in the health market. Supporting SMEs, governments could benefit from savings in healthcare costs and value creation in the economy. Consumers could benefit from novel FF formats such as refrigerated RTE (ready-to-eat) meals, a variety of fresh-like meat-, fish-, and egg-based products, fresh-cut fruits and vegetables, cereal-based fermented foods and beverages. To preserve these valuable commodities, mild biological (enzymatic treatment, fermentation and, bio-preservation) and engineering solutions are needed. The latter include nonthermal techniques such as high-pressure treatment, cook-chill, sous-vide, micro-encapsulation, vacuum impregnation and others. “De-constructive” culinary techniques such as 3D food printing and molecular gastronomy as well as developments in nutrigenomics and digital technologies facilitate novel product formats, personalization and access to niche markets. In the operational sense, moving from nourishment to health improvement demands a shift from defensive market-oriented to offensive market-developing strategies including collaborative networks with research organizations.

**KEYWORDS:** /Minimally Processed/ /Freshness/ /Ready-To-Eat/

## **POSTHARVEST DECAYS**

Parafati, L., et.al. 2017. Performance evaluation of volatile organic compounds by antagonistic yeasts immobilized on hydrogel spheres against gray, green and blue postharvest decays. Food Microbiol. 63: 191 - 198.

### **Abstract**

*Wickerhamomyces anomalus*, *Metschnikowia pulcherrima*, *Aureobasidium pullulans* and *Saccharomyces cerevisiae* yeasts were tested for their ability to survive and synthesize antifungal volatile organic compounds (VOCs) both in vitro and in vivo conditions when immobilized on commercial hydrogel spheres. The results showed a good survival of all yeasts on hydrogel spheres up to 10 days of incubation. Moreover, VOCs produced in vitro by tested yeasts inhibited *Botrytis cinerea*, *Penicillium digitatum* and *P. italicum* radial growth and conidial germination, with the highest antagonistic activity reported for *W. anomalus* and *A. pullulans* strains.

Experimental in vivo trials performed on strawberry and mandarin fruits proved the ability of VOCs to reduce significantly postharvest decays on artificially wounded tissues. Comprehensively, the best efficacy was detected for *W. anomalus*, which totally inhibited gray mold decay on strawberry fruits

and significantly reduced green mold infections on mandarin fruits. On the other hand, blue mold decay on mandarin fruits was more effectively managed by *A. pullulans* VOCs.

Accordingly, hydrogel spheres used as a support for VOC-generating yeasts could open a new way for the employment of this polymeric material as a bio-emitter in postharvest packaging.

**Keywords:** /Postharvest Decays/ /Mandarins/ /Strawberry/

## POSTHARVEST ROTS

Gatto, M.A., A.Ippolito, L. Sergio and D. Di Venere. 2016. Extracts from wild edible herbs for controlling **postharvest rots** of fruit and vegetables. *Acta Hort.* 1144: 349 - 354.

### Abstract

The use of natural compounds with antimicrobial activity may be a viable alternative to the use of synthetic fungicides to control pathogens attacking fresh fruit and vegetables during postharvest storage. This paper reports results on the *in vitro* and *in vivo* antifungal activity of total and fractionated phenolic extracts obtained from wild edible herbs (*Borago officinalis*, *Orobancha crenata*, *Plantago coronopus*, *P. lanceolata*, *Sanguisorba minor*, *Silene vulgaris*, *Sonchus asper*, *S. oleraceus*, and *Taraxacum officinale*) against some of the most important postharvest diseases: gray mold (*Botrytis cinerea*), brown rot (*Monilinia laxa*), blue mold (*Penicillium italicum*, *P. expansum*), green mold (*P. digitatum*), and black mold (*Aspergillus carbonarius*, *A. niger*). The extracts obtained from *S. minor* and *O. crenata* completely inhibited conidial germination of *M. laxa*, *P. digitatum*, *P. italicum*, and *A. niger* and greatly reduced that of *B. cinerea* and *P. expansum*. The same extracts were tested *in vivo* on stone fruits (apricots, nectarines, and sweet cherries), oranges, and grapes with good results. Some phenolic compounds present in the extracts were identified as potential active components.

**Keywords:** /Postharvest Rots/ /Storage/ /Edible Herbs/

## FRUITS

### BLUEBERRY

Umagiliyage, A.L., et.al. 2017. Antimicrobial efficacy of liposomes containing D-limonene and its effect on the storage life of **blueberries**. *Postharvest Biol. & Technol.* 128: 130 – 137.

### Abstract

The purpose of this study was to investigate the antimicrobial activity of unilamellar nano vesicles (liposome) containing D-limonene against selected fruit rotting fungi (*Botrytis cinerea* and *Penicillium chrysogenum*) and food borne illness causing bacteria (*Escherichia coli* and *Listeria monocytogenes*). Furthermore, the research evaluated the extended shelf life and enhanced food safety of blueberries treated with D-limonene and liposomes. Liposomal nanoparticles were created by thin lipid film hydration followed by sonication. Mean liposome radius was  $100.2 \pm 3.1$  nm. The antibacterial activity against *E. coli* showed 0.99 and 1.6 log<sub>10</sub> reductions in CFU mL<sup>-1</sup> at 10 mM and 50 mM, respectively, within 48 h. The log<sub>10</sub> reduction was 1.6 at 10 mM and 3.4 at 50 mM for *L. monocytogenes*.

Germination of *B. cinerea* conidia was completely suppressed over 48 h by a 50 mM concentration of limonene. Liposomes exhibited 2.2 and 2.8 log<sub>10</sub> reductions for *P. chrysogenum*, whereas 3.7 and 4.6

log<sub>10</sub> reductions were observed for *B. cinerea* with 10 mM and 50 mM limonene, respectively. The in vivo study of liposome coatings on blueberries also revealed protection against microbial growth even after nine weeks of storage at 4 °C with liposomes reducing blueberry spoilage by more than 60% at the end of nine weeks. The results of this study can benefit the produce industry through both enhancement of food safety and extending the shelf life of blueberries, further highlighting the commercial applications of liposomes.

**Keywords:** /Blueberries/ /Edible Coatings/ /Postharvest Decay/

## CITRUS

Mditshwa, A., et.al. 2017. Postharvest factors affecting vitamin C content of **citrus** fruits: a review. *Scientia Hort.* 218: 95 – 104.

### Abstract

Vitamin C is widely regarded as one of the most important antioxidants in citrus fruits. The rapidly growing demand for fresh citrus fruits and their derivative products has prompted researchers to study factors affecting the vitamin C content. This review discusses postharvest factors influencing vitamin C content of citrus fruits. Vitamin C content in citrus fruits can be influenced by several factors such as postharvest treatment, storage conditions as well as oxidative stress. Postharvest treatments such as surface coating, heat treatments, irradiation, and ethylene degreening lead to better vitamin C retention. Additionally, improper temperature management may negatively affect the nutritional quality of the stored produce; vitamin C loss is intensified at higher storage temperatures. Although storage conditions favorable to water loss are known to accelerate vitamin C loss, the effect of low relative humidity (RH) on vitamin C content of citrus fruits has not yet been fully elucidated. Vitamin C retention is also improved when citrus fruits are stored in modified atmosphere packaging and controlled atmosphere (CA). Although the effect of postharvest treatments on vitamin C content has been intensively studied, the influence of chemical treatments warrants more research.

**Keywords:** /Citrus/ /Postharvest/ /Quality/ /Storage/

## DURIAN

Azlin, R.N., et.al. 2016. Simulation studies for export of minimally processed **durian** by air shipment to Hong Kong. *Acta Hort.* 1141: 283 - 288.

### Abstract

A simulation study for export of minimally processed durian by air shipment to Hong Kong was conducted using newly dropped 'Mousang King' durian. Two packing systems were evaluated, using (A) square polypropylene (PP) containers (110×110 mm) with seal packing at 200 g pack<sup>-1</sup> and (B) rectangular PP containers (185×125 mm) with shrink wrapping at 400 g pack<sup>-1</sup>. All samples were stored at -18°C for 5 weeks. Following that, samples were transferred to 2°C for 7 days to simulate retail conditions in Hong Kong. Physical changes (colour and visual appearance), chemical changes (total soluble solids) and sensory acceptance were observed daily. Microbial counts (yeasts and moulds, total coliforms, mesophilic aerobes) were also monitored to relate to product safety. Minimally processed durian in both packing systems (A and B) maintained its quality until the end of the 7 days of storage, as

noted by only slight variations in chemical and physical data. However, there were significant differences in microbial counts, as minimally processed durian packed in square PP containers with seal packing (A) showed lowered counts of microbial aerobes as compared with packing using shrink wrap (B). Total coliforms, yeasts and moulds also showed similar findings. Thus, the results revealed that the smaller packing system using seal packing was more suitable for packing minimally processed durian for export by air shipment to Hong Kong.

**Keywords:** /Durian/ /Minimally Processed/ /Packaging/ /Quality/

## GRAPES

Henriquez, J.L. and S. Pinochet. 2016. Impact of ventilation area of the liner bag, in the performance of SO<sub>2</sub> generator pads in boxed table grapes. Acta Hort. 1144: 267 - 272.

### Abstract

SO<sub>2</sub> generator pads are an important tool to prevent rotting of table grapes, caused by fungal pathogens, mainly *Botrytis cinerea*, during storage and shipping. Sodium metabisulfite salt contained in the pad reacts with water vapor and releases SO<sub>2</sub>. Due to market regulations, the liner bag used in the table grape packaging can have 0.3, 0.9 or 2.7% ventilated area. Switching to higher ventilated areas has been associated with higher decay. The objective of the study was to determine the dynamic of SO<sub>2</sub> concentration inside the boxes, during cold storage, and relate it with rotting and bleaching of table grapes. Different experiments were conducted from 2011 to 2015; in general, grapes were packed in boxes with liners of different ventilation areas, silicon hoses were set for weekly measurements of the gas concentration inside the box, then they were cold stored for 35 to 94 days, and after a period of three days at room temperature, simulating shelf life, the percentage of rotting and bleaching was determined. In a first experiment, rotting of 'Red Globe' grapes due to *B. cinerea* averaged 32.7 and 4.6% in control boxes (without generator pads) with 0.3 and 0.9% of ventilation, respectively. Similarly, boxes with 0.9% ventilation had 76.1% of rotting compared to a 24.3% in boxes with 2.7% ventilation. Differences in grey mold incidence were also observed in boxes packed with generator pads, where 16.8% rotting was significantly different to 5.0% rotting in boxes with 2.7 and 0.9% ventilation area, respectively. Bleaching of grapes was affected negatively with increasing ventilation reaching 10.3, 1.9 and 0.5% in boxes with 0.3, 0.9 and 2.7% ventilated area, respectively. SO<sub>2</sub> concentration inside the boxes was lower throughout the storage period, as the ventilation area of the liner increased.

**Keywords:** /Grapes/ /*Botrytis cinerea*/ /Postharvest/ /Box Liners/

Mao, J., et.al. 2017. Effect of vacuum impregnation combined with calcium lactate on the firmness and polysaccharide morphology of Kyoho grapes (*Vitis vinifera* x *V. labrusca*). Food Bioprocess Technol 10: 699 – 709.

### Abstract

The effects of vacuum impregnation (VI) with 2% calcium lactate treatment on the VI properties (obtained from hydrodynamic mechanism and deformation–relaxation phenomena models), firmness, and pectin of Kyoho grapes were investigated. Fruit pectin was analysed by atomic force microscopy (AFM). VI was applied for 10–35 min at 25–45 °C and 5 kPa. The maximum values of effective porosity,  $\epsilon_e$  (0.606%), and volume fraction, X (0.588%), occurred at 35 °C when the VI time was 15 min. No

change was observed in the volumetric deformation ( $\gamma \approx 0$ ) of the grapes after the impregnation. The firmness significantly increased at 35 °C VI (from 12.93 to 14.47 N). According to the AFM results, calcium mainly inhibited the degradation of chelate-soluble pectin and sodium carbonate-soluble pectin short branches during the VI. Under the studied conditions, the validity of VI to incorporate calcium into fruit to improve the quality of grapes was verified, and a final corresponding product was obtained by VI.

**Keywords:** /Grapes/ /Firmness/ /Pectin/

## KIWIFRUIT

Ugolini, L., et.al. 2017. Postharvest application of brassica meal-derived allyl-isothiocyanate to **kiwifruit**: effect on fruit quality, nutraceutical parameters and physiological response. Food Sci. Technol. 54(3): 751 – 760.

### Abstract

The use of natural compounds to preserve fruit quality and develop high value functional products deserves attention especially in the growing industry of processing and packaging ready-to-eat fresh-cut fruit. In this work, potential mechanisms underlying the effects of postharvest biofumigation with brassica meal-derived allyl-isothiocyanate on the physiological responses and quality of 'Hayward' kiwifruits were studied. Fruits were treated with 0.15 mg L<sup>-1</sup> of allyl-isothiocyanate vapours for 5 h and then stored in controlled atmosphere (2% O<sub>2</sub>, 4.5% CO<sub>2</sub>) at 0 °C and 95% relative humidity, maintaining an ethylene concentration \0.02 IL L<sup>-1</sup>. The short- and long-term effects of allyl-isothiocyanate on fruit quality traits, nutraceutical attributes, glutathione content, antiradical capacity and the activity of antioxidant enzymes were investigated. The treatment did not influence the overall fruit quality after 120 days of storage, but interestingly it enhanced the ascorbic acid, polyphenols and flavan-3-ol content, improving the antioxidant potential of kiwifruit. The short-term effect of allyl-isothiocyanate was evidenced by an increase of superoxide dismutase activity and of oxidative glutathione redox state, which were restored 24 h after the treatment. The expression levels of genes involved in detoxification functions, ethylene, ascorbate and phenyl-propanoid biosynthesis, were also significantly affected upon allyl-isothiocyanate application. These results suggest that allyl-isothiocyanate treatment probably triggered an initial oxidative burst, followed by an induction of protective mechanisms, which finally increased the nutraceutical and technological value of treated kiwifruits.

**Keywords:** /Kiwifruit/ /Postharvest/ /Fruit Quality/

## MANGO

Karunanayake, L.C., et.al. 2016. Alternatives to synthetic fungicides in controlling postharvest anthracnose and stem-end rot in **mango**. Acta Hort. 1144: 453 - 460.

### Abstract

Control of postharvest diseases anthracnose and stem-end rot (SER) in mango cultivar 'Karuthacolomban' was attempted using means other than fungicides. The synthetic elicitors Bion<sup>®</sup>, salicylic acid (SA) and Kasil<sup>®</sup> were applied as postharvest treatments. All three products reduced anthracnose development. Bion<sup>®</sup> being most effective at 50 mg L<sup>-1</sup> with over 80% reduction in

anthracnose lesion area, SA being effective at 500 mg L<sup>-1</sup> and Kasil® at 1000 mg L<sup>-1</sup>. The most effective concentrations of Kasil® and SA were applied preharvest as soil drenches or fruit sprays, respectively. Both treatments were effective in reducing anthracnose in harvested fruit. SA sprays were more effective at 500 mg L<sup>-1</sup> on fruit at mid-fill, while 100 mg L<sup>-1</sup> sprays were more effective on mature fruit. Overall, spraying of SA was more effective on fruit at mid-fill, with over 66% reduction in lesion area. A potassium fertilizer was also applied in the field as a separate experiment. Results indicate that all elicitors tested were effective in controlling anthracnose of mango. The most effective being Bion®. SER was effectively controlled with 45-28% reduction in lesion area by an higher (three times recommended) dose (2055×3 g tree<sup>-1</sup> year<sup>-1</sup>) of potassium fertilizer. Total soluble phenols, cell wall bound phenolics and chitinases were induced by SA treatment, while antifungal compounds were increased by Kasil® treatment.

**Keywords:** /Mango/ /Anthracnose/ /Stem-End Rot/

Kim, M.J., et.al. 2017. Antibacterial effect of 405 ± 5 nm light emitting diode illumination against *Escherichia coli* O157:H7, *Listeria monocytogenes*, and *Salmonella* on the surface of fresh-cut **mango** and its influence on fruit quality. Int'l. J. Food Microbiol. 244: 82 – 89.

#### **Abstract**

To investigate a potential of 405 ± 5 nm light emitting diode (LED) as a novel technology for food preservation, the antibacterial effect of 405 ± 5 nm LED on *Escherichia coli* O157:H7, *Listeria monocytogenes*, and *Salmonella* spp. on the surface of fresh-cut mango and its influence on fruit quality were evaluated at different storage temperatures. LED-illumination inactivated 1.0–1.6 log CFU/cm<sup>2</sup> of populations at 4 and 10 °C for 36–48 h (total dose, 2.6–3.5 kJ/cm<sup>2</sup>) regardless of bacterial species, while those on non-illuminated mango remained unchanged or slightly increased during storage. At 20 °C for 24 h (total dose, 1.7 kJ/cm<sup>2</sup>), non-illuminated *E. coli* O157:H7 and *Salmonella* gradually grew, whereas LED-illumination reduced 1.2 log of *Salmonella* and inhibited the growth of *E. coli* O157:H7. Unlike these, non-illuminated *L. monocytogenes* cells rapidly increased to 7.3 log, while illuminated cells reached 4.6 log, revealing that LED-illumination delayed their growth. There were no significant (P >0.05) differences in color, antioxidant capacity, ascorbic acid, β-carotene, and flavonoid between non-illuminated and illuminated cut mangoes, regardless of storage temperature. These results suggest that 405 ± 5 nm LEDs in combination with chilling temperatures could be applied to preserve fresh-cut fruits without deterioration of physicochemical quality of fruits at food establishments, minimizing the risk of foodborne disease.

**Keywords:** /Mango/ /Foodborne Pathogens/ /Mango/ /Quality/

#### **ORANGE**

Aborisade, A.T. and O.M. Akomolafe. 2016. Investigating the control of the green mould *Penicillium digitatum* on sweet **oranges** subjected to steam treatment. Acta Hort. 1144: 303 - 308.

#### **Abstract**

Steam treatment of 'Amber' sweet orange (*Citrus sinensis*) fruit prior to storage at tropical ambient temperature controlled *Penicillium digitatum* infection. To investigate the basis of decay control by steam in this cultivar, an equal number of fruit was treated as follows: wound-inoculated with

the pathogen and exposed to steam at 50°C; unwounded, uninoculated but heated by steam; unwounded, uninoculated and unheated; wounded and steam treated; wounded and unheated. Control fruit were wound-inoculated but not exposed to steam. All fruit were stored at 28°C and 95% relative humidity. All control fruit decayed. Dichloromethane extracts of flavedo tissue from fruit that remained healthy were fractionated and tested for biological activity. Fractions from all treatments showed inhibition of fungal spore germination, indicating the presence of antifungal compounds. Gas chromatography-mass spectrometry analysis of the active fractions revealed that hydrocarbons (substituted and unsubstituted aliphatic, aromatic and alicyclic), esters and terpenes were some of the components common to all fruit. Several of them are known for antioxidant, antibacterial or antifungal action: carveol, an oxidation product of limonene; trans-p-mentha-1(7), 8-dien-2-ol, an oxygenated monoterpene; and 9, 12, 15-octadecatrienoic acid, 2-(acetyloxy)-1-[(acetyloxy) methyl] ethyl ester, (Z,Z,Z)-. However, they were present only in the wound-inoculated steam treated fruit, suggesting that they were produced in response to infection. Carveol, being antifungal itself, possibly synergized other components of the essential oil to further antifungal action in addition to the spore killing effect of steam treatment. The results suggest the presence of both preformed and induced antifungal compounds in inoculated fruit.

**Keywords:** /Orange/ /Green Mould/

Soto-Muñoz, L., et.al. 2016. DNA-based methodologies to detect and quantify the postharvest biocontrol agent *Pantoea agglomerans* CPA-2 applied on oranges. Acta Hort. 1144: 71 - 76.

## **Abstract**

*Pantoea agglomerans* strain CPA-2 is an effective biocontrol agent (BCA) for postharvest diseases of citrus and pome fruits. However, for registration purposes and to implement their use as effective control strategy, it is necessary to study the traceability and survival of BCAs in their target application sites. The main objective of this work was to evaluate the persistence and quantify the population of CPA-2 after its postharvest application on orange cultivar 'Valencia Late' by molecular techniques. After application, the persistence of CPA-2 was evaluated by sampling the packing line and storage chambers, as well as on clothing of the workers by conventional PCR. The results showed that the maximum persistence of CPA-2 was lower than 3 days in surfaces of packing line. Furthermore, CPA-2 did not survive more than 1 day on working clothes, while in the environment or on different storage chamber surfaces it was not detected. In addition, the CPA-2 populations were quantified by quantitative PCR (qPCR) combined with a DNA intercalating reagent, propidium monoazide dye (qPCR-PMA) to quantify the CPA-2 viable cells on fruit surface. The qPCR-PMA method was compared with qPCR and dilution plating method. Results showed that CPA-2 populations quantified by qPCR-PMA were significantly different compared with those obtained by qPCR during the time-course of the assay; however, no significant differences were observed between qPCR-PMA and dilution plating. In conclusion, the persistence of CPA-2 was low at different sampling areas, suggesting that it cannot grow and survive on the surfaced sampled. Furthermore, qPCR-PMA method can be a quick and specific tool to monitor the viable population of CPA-2 on fruit surface.

**Keywords:** /Orange/ /Postharvest Biocontrol/

## PEAR

Celik, H. Kursat. 2017. Determination of bruise susceptibility of pears (Ankara variety) to impact load by means of FEM-based explicit dynamics simulation. *Postharvest Biol. & Technol.* 128: 83 – 97.

### Abstract

This study focuses on determining bruise susceptibility and the realistic representation of time-dependent nonlinear deformation behaviour of pears (Ankara variety) under various impact cases. A reverse engineering approach, physical material tests and finite element method (FEM)-based explicit dynamics simulations were utilised to investigate impact deformation characteristics of the fruit. Three impact heights (0.25, 0.5 and 1 m), three impact surfaces (steel, wood and rubber-based materials) and three impact orientations of the fruit (vertical, horizontal and at a 45° angle) were considered in the impact simulation scenarios. Useful numerical data and deformation visuals were obtained from the simulation results. These results revealed that maximum bruise susceptibility magnitude on the fruit was experienced for the case of impact on the wood-based platform (impact height: 1 m; impact orientation: 0°) and minimum bruise susceptibility magnitude was calculated for the case of impact on the rubber-based impact platform (impact height: 1 m; impact orientation: 45°). In addition to this, numerical results related to fruit bruising were analysed through response surface analysis approach and prediction models were successfully described with a reasonable coefficient of determination (R<sup>2</sup>) values. Verification checks of the prediction models also indicated that the relative differences between the results of simulation and the empirical model were in agreement (max. 7.03%). These models can describe the bruise susceptibility magnitudes of the fruit for various impact cases on specific impact platforms. This study contributes to further research on the usage of numerical-methods-based nonlinear explicit dynamics simulation techniques in complicated deformation and bruising investigations and industrial applications related to agricultural and food products.

**Keywords:** /Pear/

Goliáš, J., et.al. 2016. Effect of controlled atmosphere storage on production of volatiles and ethylene from cv. Zaosuli pears. *Hort. Sci.* 43(3): 117 – 125.

### Abstract

Harvest-mature fruits of the pear cv. Zaosuli (*Pyrus bretschneideri* Rehd.) were stored at 1.0–1.5°C under two different experimental atmospheres. The controlled atmosphere (CA) had low oxygen (2.0%) and high CO<sub>2</sub> (7%), while the regular atmosphere (RA) had 20.9% O<sub>2</sub> and 0.1% CO<sub>2</sub>. Sixty-four volatile compounds were subsequently detected and quantified by solid phase micro-extraction (SPME) including 1 hydrocarbon, 16 alcohols, 15 aldehydes, 4 ketones, 15 esters, 8 terpenes, 2 lactones and 2 fatty acids. The principal component analysis of data was carried out to assess the effects of these post-harvest storage conditions in comparison to fruit stored in air at room temperature for 5 days. Thirteen compounds were found to be sufficient to differentiate the two different pear treatments, which were followed by subsequent warming to 20°C. The observed differences in the production of volatiles between the start of storage and 40 days later (RA), or 40 days later (CA), are principally due to just four compounds, namely n-hexanol, 2-furaldehyde, cis-geraniol and α-damascenone. Ethylene production is also lower in the CA treatment. The higher concentration of CO<sub>2</sub> in the CA treatment causes a rise in respiration rates due to anaerobic respiration.

**Keywords:** /Pears/ /Ethylene/

Scholtz, I., N. Siyoum and L. Korsten. 2017. *Penicillium* air mycoflora in postharvest fruit handling environments associated with the **pear** export chain. *Postharvest Biol. & Technol.* 128: 153 – 160.

### **Abstract**

*Penicillium* is a well-known airborne fungal contaminant that is prevalent in indoor air. In this study, the total air mycoflora was determined in postharvest fruit handling environments. The study included eleven indoor environments from the packhouse to the final retail outlet. Standard active and passive air sampling methods were used over a period of three years to obtain a profile of air quality. A total of 6047 and 5849 *Penicillium* colonies were counted of which 1123 and 508 isolates were obtained using active and passive sampling methods respectively. Ultimately, 25 dominant *Penicillium* spp. were identified from active air samples. The five most prevalent species isolated were: *P. glabrum* (31.88%); *P. expansum* (14.18%); *P. crustosum* (13.42%); *P. chrysogenum* (10.35%) and *P. brevicompactum* (10.25%). Furthermore, a total of 22 *Penicillium* spp. were isolated from passive air samples with *P. glabrum* (23.72%); *P. italicum* (16.45%); *P. brevicompactum* (14.22%); *P. crustosum* (13.80%) and *P. chrysogenum* (11.76%) being most prevalent. The presence of pathogenic *Penicillium* spp. in the air of fruit handling environments was profiled. Counts of total air mycoflora were significantly higher in the re-pack facilities than in all other environments sampled and are significantly higher than the proposed baseline threshold value. This study clearly shows the importance of air quality in facilities that regularly handle different fruit types. Re-pack and retail facilities should therefore be cleaned more effectively to reduce the potential air inoculum that can induce decay of fruit at the market-end. Finally we propose an air quality standard for fresh produce environments.

**Keywords:** /Pear/ /Postharvest/ /Handling/

### **PERSIMMON**

Sanchis, E., et.al. 2016. Browning inhibition and microbial control in fresh-cut **persimmon** (*Diospyros kaki* 'Rojo Brillante') by applepectin-based edible coating and modified atmosphere packaging. *Acta Hort.* 1141: 305 - 310.

### **Abstract**

The aim of this work was to study the ability of a pectin-based edible coating and modified atmosphere packaging (MAP) to control enzymatic browning and microbial growth of fresh-cut 'Rojo Brillante' persimmon. The pectin-based coating was amended with 1% (w/v) citric acid and 1% (w/v) calcium chloride as antioxidants and nisin at 500 IU mL<sup>-1</sup> as antimicrobial. Persimmon slices were dipped in the coating or in water (control), packed under MAP (5 kPa O<sub>2</sub>, balance N<sub>2</sub>) or ambient atmosphere and stored at 5°C for up to 9 days. Microbial growth, package gas composition, color, firmness, polyphenol oxidase (PPO) activity, visual quality and overall sensory flavor were measured during storage. The coating significantly reduced the CO<sub>2</sub> emission and O<sub>2</sub> consumption in the headspace of MAP samples, and the PPO activity of persimmon slices. MAP reduced firmness loss of control samples. The coated-MAP samples showed the lowest a\* and the highest hue values, and maintained a good visual quality up to day 9 of storage. At the end of the storage period, the overall fruit flavor was ranked above the limit of acceptability. The coating inhibited the growth of mesophilic aerobic bacteria. No

growth of molds, yeasts or psychrophilic aerobic bacteria was observed during storage. Overall, the combination coating-MAP was the best treatment to maintain a good visual quality and control microbial growth of fresh-cut persimmons.

**Keywords:** /Shelf-life/ /Enzymatic browning/ /Fresh-Cut/

## **PINEAPPLE**

Techavuthiporn, C. Panida Boonyaritthongchai and Suriyan Supabvanich. 2017. Physicochemical changes of 'Phulae' pineapple fruit treated with short-term anoxia during ambient storage. Food Chem. 228: 388 – 393.

### **Abstract**

The effects of short-term anoxia exposure for 16 h on physicochemical changes of 'Phulae' pineapple fruit stored at ambient temperature ( $25 \pm 2$  °C) were investigated. The respiratory rate of the fruit was induced by the anoxia treatment. However, it retarded the increase in moisture loss and maintained both flesh and pulp colour by inhibiting polyphenol oxidase (PPO) activity of the both tissues. The anoxia exposure delayed the increase in total sugar content and enhanced total ascorbic acid content during storage. The half-cut pineapple fruit showed that the anoxia exposure completely inhibited internal transparency of the flesh tissue adjacent to core during the storage. In conclusion, the short-term anoxia exposure for 16 h maintained postharvest quality, retarded physiological disorder and enhanced nutritional values of the pineapple fruit stored at ambient temperature ( $25 \pm 2$  °C).

**Keywords:** /Pineapple/ /Internal Browning/

## **STRAWBERRY**

Peretto, G., et. al. 2017. Electrostatic and conventional spraying of alginate-based edible coating with natural antimicrobials for preserving fresh strawberry quality. Food Bioprocess Technol. 10: 165 – 174.

### **Abstract**

Microbial contamination and mold growth are common causes of strawberry deterioration during storage. The growing need for extending shelf-life while enhancing the overall quality of perishable fruits has generated increasing interest in the development of novel preservation technologies. This study used electrostatic spraying (ES) technology as an innovative and efficient technique for the application of edible alginate coating enriched with carvacrol and methyl cinnamate (natural antimicrobials) on fresh strawberries. The efficiency of the electrostatic technology was compared to non-electrostatic (conventional) spray (NES) technology in terms of transfer efficiency and coating evenness. Furthermore, physicochemical and textural parameters (such as weight loss, visible decay, firmness, surface color, total soluble phenolic content, and antioxidant capacity) of ES and NES coated fruits were studied and compared to uncoated controls. ES technology demonstrated higher transfer efficiency and evenness than NES, which led to a significant reduction of visible decay over uncoated controls. The delay in microbial spoilage by ES (11 days) was greater than by NES (10 days) and uncoated strawberries (7 days). ES coating significantly inhibited strawberry decay with only 5.6 % of infected fruits, compared to 16.6 and 8.3 % for control and NES fruits after 13 days of storage,

respectively. At the end of 13 days of storage, ES coating demonstrated superior performance on strawberry firmness, color retention, and weight loss reduction. Additionally, no differences were observed between uncoated and coated fruits with regard to their antioxidant and total soluble phenolics.

**Keywords:** /Strawberry/ /Edible Coating/ /Shelf-Life/

Qin, X., et.al. 2017. *Hanseniaspora uvarum* prolongs shelf life of **strawberry** via volatile production. Food Microbiol. 63: 205 - 212.

### **Abstract**

Gray mold caused by *Botrytis cinerea* led to severe postharvest losses for strawberry industry. In recent years, some studies have shown that postharvest diseases of strawberry can be controlled by using bacterial, fungal and yeast strains. The yeast strain *Hanseniaspora uvarum* was shown as an effective antagonist against *B. cinerea* growth. Here, we further investigated the volatile organic compounds (VOCs) production of *H. uvarum* and how this could impact on postharvest gray mold control of strawberry. A total of 28 VOCs were detected by GC-MS in the headspace of *H. uvarum* and strawberry with/without *B. cinerea* (SI and RSI  $\geq$  800). Among these VOCs, 15 VOCs were detected in both conditions, 4 VOCs were *H. uvarum* and strawberry without *B. cinerea* and the other 9 VOCs were only detected when *B. cinerea* was inoculated. Two VOCs, ethyl acetate and 1,3,5,7-cyclooctatetraene, enhanced by inoculation of *B. cinerea*. In in vitro assay, *H. uvarum* significantly inhibited mycelial growth and spore germination of *B. cinerea* via VOCs production. Moreover, in vivo assay showed that *H. uvarum* reduced *B. cinerea* infection of strawberry and maintained fruit appearance, firmness and total soluble solids via VOCs production. Collectively, our results showed that *H. uvarum* VOCs significantly controlled postharvest gray mold of strawberry and prolonged the storage time and shelf life.

**Keywords:** /Strawberry/ /*Botrytis cinerea*/ /Shelf Life/

## **VEGETABLES**

### **BROCCOLI**

Duarte-Sierra, A., et.al. 2017. Influence of hormetic heat treatment on quality and phytochemical compounds of **broccoli** florets during storage. Postharvest Biol. & Technol. 128: 44 – 53.

### **Abstract**

The effect of moist hot air treatment applied to broccoli florets was studied in order to maintain quality and phytochemical compounds during postharvest storage at 4 # C. Exposure to hormetic heat doses of 41 # C for 180 min (low temperature, LT) and 47 # C for 12 min (high temperature, HT) delayed yellowing for 21 d compared with non-heated florets that yellowed after 14 d. Chlorophyll content was also higher in florets treated with both the LT and HT heat treatments. The respiration rate of heat-treated broccoli was significantly higher immediately after heat treatments, being 10-times greater in LT-treated and 15-times greater in HT-treated florets on day 0 when compared with the control florets. However, after 7 d of storage differences were not significant, even though respiration rates were lower in treated broccoli after 21 d of storage compared with non-heated florets. Off-odors were also detected in HT-treated broccoli. Titrers of indole-type glucosinolates were significantly enhanced by both

heat treatments, while the glucoraphanin content of florets only increased with the HT treatment. A similar pattern was observed with gene expression, where overexpression of tryptophan N-hydroxylase (CYP79B3) was greater than the expression of dihomomethionine N-hydroxylase (CYP79F1) in heat-treated broccoli florets. Titrers of hydroxy-cinnamic acids of florets were increased by both heat treatments. The total antioxidant capacity was significantly enhanced by the HT treatment. Similarly, overexpression of coumarate ligase (CoL), chalcone synthase (CHS) and phenylalanine N-hydroxylase (CYP79A2) was triggered by the HT treatment. The results indicate hormetic heat treatments can enhance the content of phytochemicals in broccoli florets during storage. However, the application of heat at 41 °C (LT) was superior to the HT treatment in maintaining quality, although the enhancement of phytochemicals was less.

**Keywords:** /Broccoli/ /Heat treatment/

Liu, Q., et.al. 2017. Treatment with low-concentration acidic electrolysed water combined with mild heat to sanitise fresh organic **broccoli** (*Brassica oleracea*). LWT - Food Sci. & Technol. 79: 594-600.

### **Abstract**

The effects of low-concentration electrolysed water (LcEW) (4 mg/L free available chlorine) combined with mild heat on the safety and quality of fresh organic broccoli (*Brassica oleracea*) were evaluated. Treatment with LcEW combined with mild heat (50 °C) achieved the highest reduction in naturally occurring microorganisms and pathogens, including inoculated *Escherichia coli* O157:H7 and *Listeria monocytogenes* ( $P < 0.05$ ). In terms of the antioxidant content of the treated broccoli, the total phenolic levels and ferric reducing antioxidant power remained unchanged; however, the oxygen radical absorbance capacity of the treated broccoli was higher than that of the untreated control. In addition, mild heat treatment resulted in an increase in firmness. The increased firmness was attributed to changes in the pectin structure, including the assembly and dynamics of pectin. The results revealed that mild heat induced an antiparallel orientation and spontaneous aggregation of the pectin chains. This study demonstrated that LcEW combined with mild heat treatment was effective to reduce microbial counts on fresh organic broccoli without compromising the product quality.

**Keywords:** /Broccoli/

### **CABBAGE**

Sow, L.C., et.al. 2017. Carvacrol nanoemulsion combined with acid electrolysed water to inactivate bacteria, yeast in vitro and native microflora on shredded **cabbages**. Food Control. 76: 88 - 95.

### **Abstract**

Carvacrol is an effective antimicrobial agent originated from essential oils, this natural antimicrobial agent has higher consumer acceptance compared to chemical agents. Due to the low solubility of carvacrol in water, carvacrol was delivered as a nanoemulsion. A carvacrol nanoemulsion contained 3.5% (w/w) oil phase (1% carvacrol and 2.5% corn oil, w/w) and 3.5% (w/w) Tween 80 was produced by ultrasonification at 10 min using 100% amplitude; the median particle size was  $309 \pm 19$  nm. The nanoemulsion was shelf-life stable for 1 month without any significant changes in particle size. When applied against *Escherichia coli* ATCC 25922 and *Pichia pastoris* GS115 growth in nutrient broth,

carvacrol nanoemulsion (0.5% w/w carvacrol) achieved 3 log reductions of microorganisms. When microorganisms were fixed and dried on stainless steel coupon surface, the carvacrol nano emulsion treatment was more effective on *E. coli* than *P. pastoris* with about 5 and 0.3 log reduction of viable count, respectively. The native microflora on shredded cabbages was challenged by combining carvacrol nanoemulsion and acidic electrolysed water (AEW) that contained  $\leq 4$  mg/L free available chlorine (FAC). The treatment reduced about 0.5 log of aerobic mesophilic and psychrotropic bacteria counts and the antimicrobial activity of carvacrol nanoemulsion and AEW lasted up to 2 days. The results indicated that carvacrol nanoemulsion is promising in controlling the safety of fresh-cut vegetables.

**Keywords:** /Cabbage/ /Fresh Cut/ /Food Safety/

## LEAFY GREENS

Maffei, D.F., et.al. 2017. Quantitative assessment of the impact of cross-contamination during the washing step of ready-to-eat leafy greens on the risk of illness caused by *Salmonella*. Food Res. Int'l. 92: 106 – 112.

### Abstract

The aim of this study was to develop a quantitative microbial risk assessment (QMRA) model to estimate the risk of illness caused by *Salmonella* in ready-to-eat (RTE) leafy greens, based on common practices in Brazilian processing plants. The risk assessment model considered five modules: in field, washing step, retail storage, home storage and dose-response. Fifty thousand iterations of a @Risk model built in Excel were run for each of sixty scenarios. These scenarios considered different initial pathogen concentrations, fractions of contaminated produce and chlorine concentrations. For chlorine, seven pre-set concentrations (0, 5, 10, 25, 50, 150 and 250 mg/L) and three triangular distributions were considered [RiskTriang (0, 5, 10 mg/L), RiskTriang (0, 80, 250 mg/L) and RiskTriang (10, 120, 250 mg/L)]. The outputs were risk of infection, estimated number of illnesses and estimated percent of illnesses arising from cross-contamination. The QMRA model indicated quantitatively that higher chlorine concentrations resulted in lower risk of illness. When simulation was done with  $<5$  mg/L of chlorine, most ( $>96\%$ ) of the illnesses arose from cross-contamination, but when a triangular distribution with 10, 120 and 250mg/L of chlorine was simulated, no illnesses arising from cross-contamination were predicted. Proper control of the sanitizer in the washing step is essential to reduce initial contamination and avoid cross-contamination.

**Keywords:** /Leafy Greens/ /Ready to Eat/

## LETTUCE

Jung, Y., et.al. 2017. Sanitizer efficacy in preventing cross-contamination of heads of lettuce during retail crisping. Food Microbiol. 64: 179 - 185.

### Abstract

This study was conducted to provide information regarding mitigation of cross-contamination through the use of sanitizer during crisping at retail outlets. Seven non-inoculated heads and one inoculated head ( $\approx 5$  log CFU/g) of lettuce were placed into commercial sink filled with 76 L of tap water (TW), electrolyzed water (EW, free chlorine:  $43 \pm 6$  ppm), lactic acid and phosphoric acid-based sanitizer

(LPA, pH 2.89), or citric acid-based sanitizer (CA, pH 2.78) and soaked for 5 min. Two subsequent batches (eight non-inoculated heads per batch) were soaked in the same solution. Soaking with EW significantly reduced the population of *S. enterica* ( $2.8 \pm 1.5$  log CFU/g), *E. coli* O157:H7 ( $3.4 \pm 1.1$  log CFU/g), and *L. monocytogenes* ( $2.6 \pm 0.7$  log CFU/g) inoculated on Romaine lettuce compared to TW, LPA, and CA ( $p < 0.05$ ). On Red leaf lettuce, EW significantly reduced populations of *S. enterica* and *E. coli* O157:H7, but not *L. monocytogenes* compared to other treatments. No significant difference was noted between TW, LPA, and CA in reducing foodborne pathogens ( $p > 0.05$ ) or preventing cross-contamination. Soaking with EW prevented cross-contamination among lettuce heads and controlled bacterial populations in crisping water for three consecutive batches. EW may be an effective option as a sanitizer to minimizing the cross-contamination of leafy greens during the retail crisping.

**Keywords:** /Lettuce/ /Foodborne Pathogens/

Mo, C., et.al. 2017. On-line fresh-cut **lettuce** quality measurement system using hyperspectral imaging. Biosystem Eng. 56: 38 - 50.

### Abstract

In this study, an online quality measurement system for detecting foreign substances on fresh-cut lettuce was developed using hyperspectral reflectance imaging. The online detection system with a single hyperspectral camera in the range of 400-1000 nm was able to detect contaminants on both surfaces of fresh-cut lettuce. Algorithms were developed for this system to detect contaminants such as slugs and worms. The optimal wavebands for discriminating between contaminants and sound lettuce as well as between contaminants and the conveyor belt were investigated using the one-way analysis of variance (ANOVA) method. The subtraction imaging (SI) algorithm to classify slugs resulted in a classification accuracy of 97.5%, sensitivity of 98.0%, and specificity of 97.0%. The ratio imaging (RI) algorithm to discriminate worms achieved classification accuracy, sensitivity, and specificity rates of 99.5%, 100.0%, and 99.0%, respectively. The overall results suggest that the online quality measurement system using hyperspectral reflectance imaging can potentially be used to simultaneously discriminate foreign substances on fresh-cut lettuces.

**Keywords:** /Lettuce/ /Fresh Cut/ /Quality/

Woltering, E.J., J.-F. Wang and Y.W. Seifu. 2016. Storage of fresh-cut **lettuce** at light levels below the light compensation point increases sugar levels and greatly prolongs the shelf-life. Acta Hort. 1141: 357 - 364.

### Abstract

The quality of fresh-cut butterhead lettuce held at 12°C was greatly improved when the product was stored under low levels of light, provided by either fluorescent tubes, or red, blue or green LEDs. Although the applied light level ( $5 \mu\text{mol m}^{-2} \text{s}^{-1}$  photosynthetically active radiation) was well below the light compensation point, significant accumulation of carbohydrates (sugars and starch) was observed. The level of carbohydrates positively correlated with the shelf-life. Photosynthetic activity was low and net photosynthesis during storage was negative and cannot account for the observed accumulation of carbohydrates. Treating the leaf pieces with an inhibitor of photosynthetic electron transport 3-(3,4-dichlorophenyl)-1, 1-dimethylurea (DCMU), diminished the light-induced sugar accumulation and the beneficial effect of light on fresh-cut quality. Currently, it is not clear which processes are

responsible for the sugar accumulation in light-stored samples. We hypothesize that, under low light conditions, sugars may be produced through the processing of chloroplast degradation products in the glyoxysome, subsequent production of malate and oxaloacetate and production of glucose through reversal of the glycolysis pathway (gluconeogenesis).

**Keywords:** /Lettuce/ /Quality/ /Shelf-life//Fresh-cut/  
**TOMATO**

Li. Ling, Xiaoguang Wang, Xinhua Zhang, Mei Guo and Tieling Liu. 2017. Unraveling the target genes of RIN transcription factor during **tomato** fruit ripening and softening. J. Sci. Food Agric. 97: 991 - 1000.

### **Abstract**

**BACKGROUND:** The RIN transcription factor is one of the MADS box family members and predominantly controls fruit ripening. In this study, effort was made to demonstrate the regulation network of RIN transcription factor during tomato fruit ripening and softening. Novel RIN target genes were identified by proteomics, electrophoresis mobility shift assay (EMSA) and chromatin immunoprecipitation (ChIP) analysis.

**RESULTS:** Over 700 protein spots were achieved by two-dimensional gel electrophoresis, and 42 proteins were successfully identified. Among them, 1-aminocyclopropane-1-carboxylate oxidase (LeACO4, ethylene synthesis, spot 3) and  $\alpha$ -galactosidase-like isoform 2 ( $\alpha$ -Gal, cell wall metabolism, spot 26) exhibited varied expression levels in different tomato fruits. Particularly high expression levels of LeACO4 and  $\alpha$ -Gal were observed in wild type but not in the rin mutant. Additionally, CArG box, a RIN-binding site, was discovered in the promoter regions of both LeACO4 and  $\alpha$ -Gal genes, suggesting that RIN possibly directly regulates their transcriptions, and this assumption was further confirmed by EMSA and ChIP assay.

**CONCLUSIONS:** Functional annotations of RIN target genes demonstrated the specific role of RIN in the process of fruit ripening and softening, especially in cell wall degradation and ethylene biosynthesis. This study will further illuminate the mechanism of tomato ripening and softening.

**Keywords:** /Tomato/ /Ripening/ /Fruit Ripening/

Macheka,L., E. Spelt, J. G.A.J. Van der Vorst and P.A.Luning. 2017. Exploration of logistics and quality control activities in view of context characteristics and postharvest losses in fresh produce chains: a case study for **tomatoes**. Food Control 77: 221 - 234.

### **Abstract**

Postharvest losses in fresh produce chains are a major threat to food security, especially in transition countries. To develop effective intervention strategies for postharvest losses reduction, it is important to first understand the core logistics and quality control activities that could affect postharvest losses in these chains. In this study, a diagnostic tool was developed and used to assess the implementation level of core logistics and quality control activities, the vulnerability of the system due to the context in which it operates, and the actual postharvest losses. Based upon a literature review, the context characteristics are divided into product, process, organisation, and supply chain environment characteristics to assess the context vulnerability to postharvest losses. The identified core logistics activities are planning on the amount of fresh produce to harvest and process, selecting issuing

policies, selecting mode of transportation and type of vehicle, and vehicle scheduling and routing. Maturity determination at harvest, deciding on harvest moment, harvesting, packing, and storage practices, use of grading standards, package material, temperature monitoring during storage and transportation, and equipment maintenance are the core quality control activities identified. The tool was applied to three groups of farmers operating in a tomato supply chain in Zimbabwe. The major findings are that commercial farmers recorded lower postharvest losses (1%) as compared to subsistence farmers (3%), the context for commercial farmers is less vulnerable to the generation of postharvest losses as compared to that for subsistence farmers, and logistics and quality control activities for commercial farmers are implemented at a more advanced level. The tool provides differentiated assessment that allows users to identify improvement opportunities to achieve higher performance for the activities and to reduce context vulnerability.

**Keywords:** /Tomato/ /Postharvest Losses/ /Quality Control/ /Fresh Produce/

Perini, M.A., et.al. 2017. Overexpression of the carbohydrate binding module from *Solanum lycopersicum* expansin 1 (*Sl-EXP1*) modifies **tomato** fruit firmness and *Botrytis cinerea* susceptibility. Plant Physiol. & Biochem. 113: 122 - 132.

### **Abstract**

Firmness, one of the major determinants of postharvest quality and shelf life of fruits is determined by the mechanical resistance imposed by the plant cell wall. Expansins (EXP) are involved in the nonhydrolytic metabolic disassembly of plant cell walls, particularly in processes where relaxation of the wall is necessary, such as fruit development and ripening. As many carbohydrate-associated proteins, expansins have a putative catalytic domain and a carbohydrate-binding module (CBM). Several strategies have been pursued to control the loss of fruit firmness during storage. Most of the approaches have been to suppress the expression of key enzymes involved in the cell wall metabolism, but this is the first time that a CBM was overexpressed in a fruit aimed to control cell wall degradation and fruit softening.

We report the constitutive overexpression of the CBM of *Solanum lycopersicum* expansin 1 (CBMSIExp1) in the cell wall of tomato plants, and its effects on plant and fruit phenotype.

Overexpression of CBM-SIExp1 increased the mechanical resistance of leaves, whereas it did not modify plant growth and general phenotype. However, transgenic plants showed delayed softening and firmer fruits. In addition, fruits were less susceptible to *Botrytis cinerea* infection, and the “in vitro” growth of the fungus on media containing AIR from the pericarp of transgenic fruits was lower than controls.

The possibility of overexpressing a CBM of a fruit-specific expansin to control cell wall degradation and fruit softening is discussed.

**Keywords:** /Tomato/ /Fruit Softening/ /Ripening/ /Postharvest/

Schneider, K.R., et.al. 2017. Microbial evaluation of pre- and post-processed **tomatoes** from Florida, New Jersey and Maryland packinghouses. Food Control. 73: 511 - 517.

### **Abstract**

Prevention of microbial cross-contamination during postharvest handling is an important step to minimize microbial food safety hazards. Dump tanks and flume systems are widely used in states like

Florida to transfer/wash tomatoes, and are one of the most critical points where cross-contamination may occur. Some processors in states such as New Jersey, New York and California utilize dry dump systems, with or without overhead spray bars, to process tomatoes, while others states such as Maryland field-pack tomatoes. This study was conducted in 2013 and 2014, from five growing regions in Florida and New Jersey each and from four growing regions in Maryland. A total of 1600 and 1597 composite samples were analyzed for aerobic plate count (APC), and total coliforms (TC) and generic *E. coli* (EC), respectively, from both pre- and post-processed tomatoes. Seventeen samples for APC and 72 for TC had counts outside the countable range and failed to provide any valid result, and were not included in the final data sets. The least square mean (LSM) value of APC for all samples (both pre- and post-processed) was 6.8 log<sub>10</sub> CFU/tomato (n = 1583), whereas the LSM for TC counts was 4.9 log<sub>10</sub> CFU/tomato (n = 1438). Ninety out of 1528 (5.9%) and 1498 out of 1597 (93.8%) samples had TC and EC counts below the detection limit of 1.3 log<sub>10</sub> CFU/tomato, respectively. APC and TC counts in post-processed samples were significantly lower (p < 0.0001) than those in the pre-processed samples. There was no significant difference (p = 0.1011) in the occurrence of generic EC pre- and post-process. There were significantly higher (p < 0.0001) APC and TC on samples collected in 2014 than 2013, while the EC levels showed no significant differences between years. TC counts varied significantly (p < 0.0001) by different growing seasons, with highest counts in summer, over a two-year period, while APC varied significantly (p < 0.0001) in summer and fall vs. winter and spring. APC and TC counts were positively correlated. Tomatoes from FL had significantly lower APC and TC (p < 0.0001) than those from NJ and MD. Despite the potential for increasing microbial contamination resulting from improperly maintained water systems, many packinghouses will continue using existing washing practices to prevent cross-contamination.

**Keywords:** /Tomato/ /Packinghouse/

Valdivia-Najar, C., et.al. 2017. Modeling the inactivation of *Listeria innocua* and *Escherichia coli* in fresh-cut tomato treated with pulsed light. Food Bioprocess Technol. 10: 266 – 274.

### **Abstract**

The effectiveness of pulsed light (PL) treatments to inhibit microorganisms on fresh-cut tomatoes (*Lycopersicon esculentum* Mill., cv. Daniela) was investigated. Tomato slices inoculated with *Escherichia coli* or *Listeria innocua* were exposed to PL treatments (4, 6, or 8 J cm<sup>-2</sup> fluence) and kept cold at 4 °C for 20 days. *L. innocua* and *E. coli* counts, gases in the headspace of the containers (O<sub>2</sub> and CO<sub>2</sub>), pH, titratable acidity, and soluble solid content were monitored throughout the cold storage. The PL treatments reduced significantly (p < 0.05) initial loads of both microbes. The effect of the PL fluence on the survival number of microorganisms was described by a log-linear model (R<sup>2</sup> = 0.849–0.999). At any fixed time within the cold storing, the microbial counts for untreated samples were always higher than those cut tomatoes that had been previously PL-treated. The behavior of *L. innocua* and *E. coli* during the storage were well adjusted (R<sup>2</sup> > 0.930) by Gompertzian models; the studied microorganisms exhibited different patterns during the storage period. On the other hand, O<sub>2</sub> and CO<sub>2</sub> partial pressures in containers with fresh-cut tomatoes were also significantly affected by PL treatments (p < 0.05). The highest PL fluence caused the greatest changes of O<sub>2</sub> and CO<sub>2</sub> contents. In addition, the application of PL triggered an acceleration of the O<sub>2</sub> consumption during the cold stage. PL treatments might be used to effectively extend the safety of fresh-cut tomatoes over 12 days of storage against *E. coli* and *L. innocua* growth.

**Keywords:** /Tomato/ /Fresh-Cut/

## VEGETABLE

Ju, Se-Young, et.al. 2017. Does electrolyzed water have different sanitizing effects than sodium hypochlorite on different vegetable types? *British Food J.* 119(2): 342 - 356.

### Abstract

**Purpose** – The purpose of this paper is to examine the efficacy of microbial elimination using different sanitizers in raw vegetables (cherry tomatoes, spring onions, Chinese chives, and chicory) and to analyze the efficacy of *Escherichia coli* O157:H7 reduction by type of sanitizer and vegetable.

**Design/methodology/approach** – To assess the sanitizing effects of microbial elimination by variety of vegetable, the samples were grouped into four different washing methods: control (no sanitizer), 100 ppm chlorine, 100 ppm electrolyzed water, and 200 ppm electrolyzed water after prewashing. Subsequently, quantitative microbiological experiments were conducted to assess aerobic mesophilic plate count (APC), coliform, *E. coli*, and *Bacillus cereus*, and sensory changes of the sanitized vegetables were tested. Thereafter, measurement of the sanitizing effects on bacterial reduction after inoculation with *E. coli* O157:H7 was conducted.

**Findings** – The microbial levels of four types of vegetables ranged from 3.37 to 5.24 log CFU/g for APC, 2.41 to 5.57 log CFU/g for *E. coli*, 0.25 to 5.40 log CFU/g for coliform, and 0.83 to 5.44 log CFU/g for *B. cereus*. After three types of sanitizing treatments, microbial reduction effects showed 0.94-1.84 log CFU/g for APC, 0.56-1.00 log CFU/g for *E. coli*, 0.18-1.26 log CFU/g for coliform, and 0.56-1.23 log CFU/g for *B. cereus* ( $p < 0.05$ ). In sensory evaluation, there were no significant differences in taste and flavor between with and without sanitizing treatments. Regarding bacterial reduction after inoculation with *E. coli* O157:H7, the microbial reduction on vegetables was shown to be in the range of 0.27-1.57 log CFU/g with 100 ppm sodium hypochlorite, 0.66-3.07 log CFU/g with 100 ppm electrolyzed water, and 0.79-2.55 log CFU/g with 200 ppm electrolyzed water. Chicory, cherry tomato, and spring onion showed significant reduction levels of *E. coli* O157:H7 after sanitation ( $p < 0.05$ ).

**Originality/value** – This study revealed that different sanitization methods are required for different types of vegetables. Electrolyzed water treatment (100 ppm) is a more effective and safe method of washing raw vegetables. Given that the main purpose of sanitizing fresh-cut produce is to maximally reduce microorganism levels, different methods of sanitizing fresh-cut produce with an adequate washing method should be used according to vegetable type.

**Keywords:** /Vegetables/ /Food Safety/ /Fresh-Cut/

## ZUCCHINI FLOWERS

Cefola, M, M.L. Amodio, and G. Colelli. 2016. Extending postharvest life of ready-to-use zucchini flowers: effects of the atmosphere composition. *Acta Hort.* 1141: 123 - 130.

### Abstract

Male zucchini flowers (*Cucurbita pepo* L.) are greatly appreciated by consumers although, because of their high perishability, they are destined only for local markets. The effects of four different atmosphere compositions (air, 3% O<sub>2</sub> in nitrogen, 3% O<sub>2</sub> + 10% CO<sub>2</sub> in air, and 10% CO<sub>2</sub> in air) on quality attributes of fresh zucchini flowers (color, weight loss, respiration, fermentative volatiles, and vitamin C) were studied. Storage in a controlled atmosphere significantly affected postharvest quality and

marketability. At 5°C, an atmosphere containing 3% O<sub>2</sub> in nitrogen resulted in a reduction in respiration rate and weight loss, preserved visual appearance, sensorial and nutritional quality, and maintained the vitamin C content during the entire storage period. Under these conditions, fresh zucchini flowers were scored marketable and with a good appearance after 9 days of storage. On the other hand, flowers stored in air deteriorated rapidly, resulting in a score just above the limit of marketability (score 3) after 5 days of storage, whereas adding CO<sub>2</sub> to air slightly increased flower shelf-life. Flowers stored in air (with or without CO<sub>2</sub>) showed the same spoilage symptoms, defined by water soaking, wilting and brightness loss, all symptoms that were reduced in a low-oxygen atmosphere. Based on these results, the correct atmosphere conditions for male zucchini flowers should attain low oxygen levels (3%) and avoid excessive accumulation of CO<sub>2</sub>. Further studies will be needed to investigate the possibility of introducing washing in the processing, due to the high sensitivity of this product to manipulation.

**Keywords:** /Zucchini Flowers/ /Postharvest/

## HERBS AND SPICES

### CELERY

Yan, Ling, et.al. 2017. Non-destructive determination and visualisation of insoluble and soluble dietary fibre contents in fresh-cut celerics during storage periods using hyperspectral imaging technique. Food Chem. 228: 249 – 256.

#### Abstract

The feasibility of using hyperspectral imaging technique to non-destructively determine insoluble dietary fibre (IDF) and soluble dietary fibre (SDF) contents in fresh-cut celerics and visualise their spatial distribution during 28-day storage periods was investigated. Genetic synergy interval partial least square (GA-Si-PLS) algorithm was developed to establish calibration model, which, superior to the PLS and Si-PLS developed models, achieved the prediction performance with R<sub>p</sub> of 0.9638 and 0.9756, and RMSEP of 1.180 and 0.336, respectively. The developed GA-Si-PLS models were then applied pixel-wise to visualise the spatial distribution of IDF and SDF contents during storage, which clearly showed that the IDF content increased with storage time, while the SDF content kept decreasing. The study provides the basis for further understanding of the spatial-temporal variation of IDF and SDF contents during storage, demonstrating that HSI could be useful in real-time IDF and SDF contents monitoring in vegetable research and industry.

**Keywords:** /Celery/ /Fresh-Cut/ /Storage/

### CORIANDER

Gao, H., et.al. 2017. Effect of alternatives to chlorine washing for sanitizing fresh coriander. J. Food Sci. Technol. 54(1): 260 – 266.

#### Abstract

Fresh coriander leaves are highly perishable in nature and their sensory quality and nutritional value decreases without proper processing or preservation. In the present study, three aqueous solutions of sodium hypochlorite (SH, 100 mg/L), chlorine dioxide (CD, 10 mg/L), and sodium butyl *p*-

hydroxybenzoate (SBPH, 12 mg/L), and tap water, were used to treat fresh coriander for 15 min. The treated samples were packed in PVC boxes with ambient air under packaged under passive modified atmosphere packaging conditions and stored at 4 °C for 10 days. Effects of washing treatments on color, total chlorophyll contents, ascorbic acid contents, total contents of phenolic compounds, and total aerobic bacterial counts (APC) were investigated. CD treatment has the least detrimental effects on color, total chlorophyll contents and ascorbic acid contents of fresh coriander, followed by SH treatment. In addition, CD treatment showed a greater reduction in APC and maintained the microbial load at lower levels than other treatments during the 10-day storage period.

**Keywords:** /Coriander/ /Fresh Produce/ /Quality/ /Shelf Life/

## ONIONS

Wang, A., et.al. 2016. Emission of volatile organic compounds from healthy and diseased **onions**. Acta Hortic. 1144: 333 - 340.

### Abstract

In this study, onions were selected from a sorting machine and divided into three groups, i.e., healthy onions, soft-rot onions, and *Penicillium*-infected onions, by visual and tactical judgement. For each of the groups, consumption of O<sub>2</sub> and emission of CO<sub>2</sub> were tested in closed jars. Besides, volatile organic compounds (VOCs) from healthy and diseased onions were sampled by solid-phase microextraction (SPME) and analyzed on GC-MS. The results showed that healthy and soft-rot onions had lower respiration rate than *Penicillium*-infected onions. Also the concentration of total VOCs was higher from soft-rot onions than from healthy onions and *Penicillium*-infected onions. Ten compounds were selected to describe differences in the VOC profiles between samples. These were ethanol, 1-propanol, 1-propanethiol, acetic acid, (E)-1-(methylthio)-1-propene, 1-(methylthio)-propane, dimethyl disulphide, 3-methyl-1-butanol, styrene, and methyl propyl disulphide. The levels of all ten compounds from the soft-rot onions and six from the *Penicillium*-infected onions were significantly different (P≤0.05) from the levels of the healthy onions. The soft-rot onions had high levels of ethanol, 1-propanol, 1-propanethiol, acetic acid and methyl propyl disulphide as compared to the healthy and *Penicillium*-infected onions. 3-methyl-1-butanol was specific to the soft-rot sample, while styrene was specific to soft-rot and *Penicillium*-infected onions.

**Keywords:** /Onions/ /*Allium cepa*/ /Storage Disease/

Zaulia, O., et.al. 2016. Effective combination treatments to maintain quality and extend the storage-life of minimally processed **onion**. Acta Hortic. 1141: 365 - 372.

### Abstract

Freshly peeled onion is convenient, ready to use and useful for food-service operations to expedite food preparation as well as optimize the use of labour. However, without proper processing technologies, peeled onion has a short storage-life (1-2 weeks) due to rooting, sprouting, microbial growth, discoloration and development of strong off-odours. Combination treatments produced high-quality peeled onions with a storage life of up to 8 weeks at 2°C. The studies reported here included evaluation of cut types, washing sanitizers, UV-C treatments, use of suitable packaging (polypropylene at retail, 0.04 mm low-density polyethylene for bulk packaging), active packaging materials (oxygen,

ethylene and water absorbers) and optimum storage temperature (2°C) and temperature control with gel packs. Active packaging materials, nanosilver packaging (1%) and UV-C treatment (240 nm, 5 or 10 min) provided additional benefits to temperature control in relation to browning, rooting, sprouting, fungal growth, colour and ascorbic acid content.

**Keywords:** /Onion/ / Minimal Processed/ /Active Packaging/ /Ethylene Absorber/

## **TUBERS AND ROOTCROPS**

### **POTATO**

Silveira, A.C., et.al. 2017. Effect of genotype, raw-material storage time and cut type on native **potato** suitability for fresh-cut elaboration. *Postharvest Biol. & Technol.* 128: 1 – 10.

#### **Abstract**

The suitability for fresh-cut processing of three native colored-fleshed potatoes (i.e., Bruja, Michuñe roja and Michuñe azul) and one commercial non-colored-fleshed potato (i.e., Asterix) was investigated. The impact of the storage time of the raw material and the type of cut (i.e., cube and chip) was also examined. Fresh-cut potato from raw material stored 2 months at 12 °C and 90% relative humidity (RH) displayed 1 to 2.5 times higher respiration activity than potatoes stored 4 months under the same conditions. Lower CO<sub>2</sub> emission was only observed when potatoes stored 4 months were used. Fresh-cut potato shelf life decreased (less than 23 d at 5 °C) due to microbial growth. Approximately 7 log cfu g<sup>-1</sup> for mesophilic and psychophilic bacteria and *Enterobacteriaceae* when potatoes stored 4 months were used. Microbial growth was higher in chips than cube. The native colored-fleshed potatoes were rich in polyphenols, and total antioxidant capacity is 1 to 2 times higher than that of commercial potato. Total polyphenol content was not affected by the storage time of the raw material and remained stable under storage at 5 °C. However, fresh-cut potato processed from raw material stored 2 months had 1.5 to 3 times more total antioxidant capacity than that processed from raw material stored 4 months. For both parameters, Bruja exhibited values approximately 60% higher. Although all the analyzed varieties were suitable for fresh-cut elaboration, Bruja and Michuñe roja displayed higher metabolic activity and susceptibility to microbial deterioration and browning. To guarantee fresh-cut potato quality, raw material should be maintained no longer than 4 months in storage. From this moment some quality parameters alterations, that limited the fresh-cut shelf life, begin to be observed.

**Keywords:** /Potato/

### **SUNCHOKE**

Wang, T., Q. Wang, F. Pupin and M.I. Cantwell. 2016. Control of red discoloration of fresh-cut **sunchoke** tubers. *Acta Hort.* 1141: 349-356.

#### **Abstract**

Sunchokes (*Helianthus tuberosus L.*) are inulin-accumulating tubers native to North America that are edible raw or cooked, and have good potential as a fresh-cut product. Sunchokes perform well as fresh-cut slices except for the development of a reddish discoloration on the cut surface. Dip treatments with ethanol (5%) provided effective control of discoloration. Untreated or ethanol-treated sliced tubers

(5% for 3 min) were stored in air at 0 and 5°C, with best quality of untreated slices (visual, color values) maintained at 0°C. Ethanol treatment retarded discoloration effectively at both temperatures. Ethanol treatment suppressed respiration, and reduced wound induced phenylalanine ammonia-lyase (PAL) activity and phenolic concentrations. Controlled atmospheres of 3% O<sub>2</sub> with 6 or 12% CO<sub>2</sub> at 5°C were less effective than ethanol dips, although high-CO<sub>2</sub> atmospheres also retarded PAL activity and increases in phenolics. Increased endogenous ethanol concentrations were developed by nitrogen-flushing of tubers at 10°C in closed containers, with accumulation of CO<sub>2</sub>. These pre-cutting atmosphere treatments were only partially effective in controlling slice discoloration. Pre-processing hot-water dips (50°C for 6 min plus 1 or 3 days at 20°C) or tuber-warming treatments (20°C for 7 or 14 days) were also partially effective in controlling red discoloration of sliced tubers.

**Keywords:** /Sunchokes/ /Discoloration/ /Fresh-Cut/

## **ORNAMENTALS**

### **CARNATION**

Boxriker, Maike, et.al. 2017. Efficient statistical design in two-phase experiments on vase life in carnations (*Dianthus caryophyllus* L.). *Postharvest Biol. & Technol.* 128:161 – 168.

#### **Abstract**

Good experimental design is necessary for the success of experiments. Many experiments on ornamentals comprise at least two phases, for example vase life trials in carnations. The first phase entails the cultivation in the greenhouse and the second the vase life assessment in the laboratory. In field or greenhouse experiments, it is common to use efficient experimental designs such as a-designs or row- column designs, while in the laboratory quite often no particular experimental designs are applied. We conducted vase life trials in carnations, using a randomized layout in both phases. We utilized the data from these trials to compare with competing designs based on the response to selection. This comparison revealed that the choice of design is crucial.

**Keywords:** /Carnation/ /Vase life/