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GENERAL

CHITOSAN

Brunel, F. et al. 2013. Complexation of copper(II) with **chitosan** nanogels: toward control of microbial growth. Carbohydrate Polymers 92: 1348– 1356.

Abstract

Pure chitosan nanogels were produced, used to adsorb copper (II), and their antimicrobial activities were assessed. The complexation of copper (II) with chitosan solutions and dispersions was studied using UV–vis spectrometry. The adsorption capacity of chitosan nanogels was comparable to that of chitosan solutions, but copper(II)-loaded nanogels were more stable (i.e. no flocculation was observed while chitosan solutions showed macroscopic gelation at high copper concentration) and were easier to handle (i.e. no increase in viscosity). Adsorption isotherms of copper(II) onto chitosan were established and the impact of the pH on copper(II) release was investigated. The formation of a copper(II)–chitosan complex strongly depended on pH. Hence, release of copper(II) can be triggered by a decrease in pH (i.e. the protonation of chitosan amino groups). Furthermore, chitosan nanohydrogels were shown to be a suitable substrate for chitosan hydrolytic enzymes. Finally, a strong synergistic effect between chitosan and copper in inhibiting *Fusarium graminearum* growth was observed. The suitability of these copper(II)–chitosan colloids as a new generation of copper-based bio-pesticides, i.e. as a bio-compatible, bio-active and pH-sensitive delivery system, is discussed.

Keywords: /Microbial Control/ /Agricultural Crops/ /Chitosan/

FOOD QUALITY

Di Wu & Da-Wen Sun. 2013. Colour measurements by computer vision for **food quality** control - A review. Trends in Food Sci. & Technol. 29 (1): 5 – 20.

Abstract

Colour is the first quality attribute of food evaluated by consumers, and is therefore an important component of food quality relevant to market acceptance. Rapid and objective measurement of food colour is required in quality control for the commercial grading of products. Computer vision is a promising technique currently investigated for food colour measurement, especially with the ability of providing a detailed characterization of colour uniformity at pixel-based level. This paper reviews the fundamentals and applications of computer vision for food colour measurement. Introduction of colour space and traditional colour measurements is also given. At last, advantages and disadvantages of computer vision for colour measurement are analyzed and its future trends are proposed.

Keywords: /Food Quality/

Jackman, P. and D.W. Sun. 2013. Recent advances in image processing using image texture features for **food quality** assessment. Trends in Food Sci. & Technol. 29: 35 – 43.

Abstract

The use of computer vision technology has been highly successful in food classification problems in the past and it has continued this success in recent times. There does however exist a number of opportunities to progress computer vision technology further, these opportunities are critically examined based on cost and feasibility. A range of hardware options are considered along with a range of software options. The economic cost of implementing new hardware continues to prove a major impediment. Thus future efforts need to be focused on maximising the potential benefits of the existing hardware framework and instead concentrate on developing improved software. Of the improved software available the aspect that offers the greatest promise is more efficient analysis of food surface texture attributes which will lead to more powerful understanding of the relationships between quality factors and experimentally measured food quality.

Keywords: /Food Quality/

FOOD SAFETY

Pitt, J.I. et al. 2013. Mycotoxin production in major crops as influenced by growing, harvesting, storage and processing, with emphasis on the achievement of **food safety** objectives. Food Control 32: 205 – 215.

Abstract

The concept of Food Safety Objective (FSO) has mostly been applied to understanding the effects of handling and processing on levels of bacterial pathogens in foods, but it is also applicable to the formation and removal of mycotoxins. This paper provides a general overview of how the concept of FSO can be used to understand increases and decreases in mycotoxin levels in foods, on the basis that international regulatory limits are equivalent to an FSO. Detailed information is provided on the ecology of the formation of aflatoxins, fumonisins, ochratoxin A and deoxynivalenol in major commodities. Methods in use to reduce levels of these mycotoxins, to meet an FSO, are then detailed. Each of the major mycotoxin e food combinations is visualised using a novel graphical method.

Keywords: / Food Safety/ /Harvesting/ /Storage/

Srey, S. et al. 2013. Biofilm formation in food industries: A **food safety** concern. Food Control 31: 572 – 585.

Abstract

Foodborne diseases have always been a threat to human health. They are considered an emergent public health concern throughout the world. Many outbreaks have been found to be associated with biofilm. It is well documented that biofilm has become a problem in food industries as it renders its inhabitants resistant to antimicrobial agents and cleaning. In this review, biofilm formation in dairy, fish processing, poultry, meat, and Ready-To-Eat foods industries are discussed, as well as the

biofilm forming abilities' of various microorganisms and the influence of food contact surface materials on biofilm formation. In addition, the conventional and emergent control strategies used to gain more proximity to efficiently maintain good hygiene throughout food industries is discussed.

Keywords: /Food Safety/ /Biofilm/

FRESH CUT

Scollard, J. et al. 2013. Some conventional and latent anti-listerial effects of essential oils, herbs, carrot and cabbage in **fresh-cut** vegetable systems. *Postharvest Biol. & Technol.* 77: 87–93.

Abstract

The anti-listerial effectiveness of selected essential oils (EOs) and shredded fresh herbs (thyme, oregano and rosemary) was examined on a range of modified atmosphere packaged fresh-cut vegetables (lettuce, carrot discs, cabbage and dry coleslaw mix). Anti-listerial effects were in the order: thyme EO > oregano EO > rosemary herb > rosemary EO. While thyme EO demonstrated the best anti-listerial effect, direct application of all the EOs damaged product appearance. Shredded fresh rosemary herb appeared to have a major anti-listerial effect, but shredded fresh thyme and oregano showed no anti-listerial effects. However, fresh rosemary herb was only effective in fresh-cut products when it was stomached with the product prior to microbial analysis. The effectiveness of these antimicrobials varied depending on the product type. Greater anti-listerial effects were recorded on carrot discs and shredded cabbage than on shredded lettuce. Adding shredded carrot to packages enhanced the apparent anti-listerial effects, suggesting a synergistic effect between carrot and rosemary.

Keywords: /Fresh-cut/ /Vegetables/

FRESH PRODUCE

Hida, K. et al. 2013. Development of a rapid total nucleic acid extraction method for the isolation of hepatitis A virus from **fresh produce**. *Int'l J. Food Microbiol.* 161: 143 – 150.

Abstract

Recently, there have been increasing reports of foodborne illnesses associated with the consumption of fresh produce. Among these, hepatitis A virus (HAV) remains epidemiologically important and has been continually implicated in several outbreaks. We describe a rapid method (b8 h) for the isolation and subsequent detection with real-time quantitative PCR (RT-qPCR) of the HAV HM-175 cytopathic strain seeded onto baby spinach and sliced tomatoes using a total RNA extraction method, utilizing a high concentration (4 M) guanidine thiocyanate buffer. Consistent detection of HAV genome from both produce items was achieved at an inoculation level of 3×10^3 PFU/25 g of food, with less consistent detection achieved at 3×10^2 PFU/25 g. Initial studies revealed that a final precipitation of recovered RNA with potassium acetate to reduce carryover of polysaccharides and the addition of polyvinylpyrrolidone to remove polyphenolics in spinach were essential. For tomatoes, virus isolation was achieved with the incorporation of either an elution step with a high pH Tris-glycine-beef extract (TGBE) buffer or with an enzymatic digestion with pectinase. We also describe the development of a

protocol for the detection of HAV from tomatoes utilizing a Luminex® microbeadbased suspension array. The results correlated well with the RT-qPCR assay suggesting the feasibility of the Bioplex® as a detection platform for viruses isolated from foods.

Keywords: /Fresh Produce/ /Spinach/ /Tomatoes/

1- METHYLCYCLOPROPENE

Dong, X. et al. Diffusivity of **1-methylcyclopropene** in spinach and bok choy leaf tissue, disks of tomato and avocado fruit tissue, and whole tomato fruit. *Postharvest Biol. & Technol.* 78: 40–47.

Abstract

Gaseous 1-methylcyclopropene (1-MCP) has been widely employed for delaying ripening and senescence of harvested fruit and vegetables; however, details on ingress of gaseous 1-MCP in plant tissues, which might contribute to differences in responsiveness of different horticultural commodities to 1-MCP, have not been reported. In this study, we used spinach and bok choy leaves, disks from tomato epidermis, stem-scar and avocado-exocarp tissues, and whole tomato fruit to examine ingress of gaseous 1-MCP. Using a dual-flask system, equilibration of 20 L L⁻¹ (831 mol m⁻³) 1-MCP through leaf tissue was reached within 1–2 h, and paralleled 1-MCP transfer through glass-fiber filter paper. For disks derived from fruit tissues, changes in 1-MCP concentrations in the dual-flask system showed anomalous patterns, declining as much as 70% in source flasks with negligible accumulation in sink flasks. The pattern of 1-MCP distribution was markedly different from that of ethylene, which approached equal distribution with tomato stem-scar and avocado exocarp but not tomato epidermis tissues. 1-MCP ingress was further addressed by exposing whole tomato fruit to 20 L L⁻¹ 1-MCP followed by sampling of internal fruit atmosphere. Tomato fruit accumulated internal gaseous 1-MCP rapidly, reaching approximately 8–9 L L⁻¹ within 3–6 h at 20 °C. Internal 1-MCP concentration ([1-MCP]) declined around 74 and 94% at 1 and 3 h after exposure, respectively. Ingress was similar at all ripening stages and reduced by 45% in fruit coated with commercial wax. Blocking 1-MCP ingress through stem- and blossom-scar tissues reduced accumulation by around 60%, indicating that ingress also occurs through epidermal tissue. Fruit preloaded with 1-MCP and immersed in water for 2 h retained about 45% of post-exposure gaseous [1-MCP], indicating that 1-MCP is not rapidly sorbed or metabolized by whole tomato fruit. Rapid ingress of gaseous 1-MCP was also observed in tomato fruit exposed to aqueous 1-MCP. Both accumulation and post-exposure decline in internal gaseous [1-MCP] are likely to vary among different fruit and vegetables in accordance with inherent sorption-capacity, surface properties (e.g., waxes, stoma), volume and continuity of gas-filled intercellular spaces, and tissue hydration.

Keywords; /1- MCP/ / Spinach/ / Bok Choi/ / Tomato/ / Avocado/

PLASTIC FILM PACKAGING

Linke, M. and M. Geyer. 2013. Condensation dynamics in **plastic film packaging** of fruit and vegetables. *J. Food Eng.* 116: 144 – 154.

Abstract

Water condensation on the surface of fruit and vegetables causes defects of the external appearance, promotes both the forming of spores and the growth of micro-organisms, and thus

accelerates deterioration. Even at low temperature fluctuations of ambient air, condensation on relevant surfaces can be observed due to comparatively high air humidity inside the film packaging. The objective of the present study was to determine condensation dynamics and intensity within plastic film packaging for fruit under changing environmental conditions. Using packages of plums as a test case, it could be shown that water condensation processes occur time-delayed and superimposed with varying intensities on the surface of the fruit, on the inner film surface, and on the inner tray walls. Retention time and intensity of condensation were identified as the substantial components of condensation. In addition to the external temperature cycle the external mass transfer and the air volume within the packaging were taken into consideration. The condensation on the inner film surface was especially influenced by the flow conditions, the external temperature amplitude and the inner air volume. In contrast, condensation processes on fruit surfaces were caused primarily by temperature amplitude and cycle time.

Keywords: /Plastic Film Packaging/ /Fruits/ /Vegetables/

POSTHARVEST

Amaro, A.L. & D.P.F. Almeida. 2013. Lysophosphatidyl ethanolamine effects on horticultural commodities: A review. *Postharvest Biol. & Technol.* 78: 92–102.

Abstract

Lysophosphatidylethanolamine (LPE) is a naturally occurring lipid with regulatory effects in senescence and ripening. When applied exogenously to horticultural crops, LPE affects growth, development, and postharvest longevity. The effects of exogenously applied LPE have been studied in a range of plant organs in more than a dozen horticultural species. The claimed horticultural benefits include delayed leaf senescence, stimulation of ripening in table grape, acceleration of color development and extension of shelf-life in cranberry and tomato, and increased vase life of cut flowers. Responses to LPE application are found to vary dramatically within horticultural commodity, developmental stage, and organ type. Effects on ethylene responses are contradictory. LPE inhibits phospholipase D and is reported to affect the activity of enzymes relevant for produce quality, such as phenylalanine ammonia lyase and acid invertase. The biochemical mode of action of LPE is poorly understood. In particular, a mechanism by which a plant growth regulator might delay senescence of plant organs and accelerate ripening-related changes is not obvious. The horticultural, physiological and biochemical effects of LPE are reviewed in an attempt to highlight the knowledge gaps regarding the putative regulatory role of exogenously applied LPE.

Keywords: /LPE/ / Postharvest Longevity/ / Senescence/ Horticulture Crops/

FRUITS

BANANA

Castellanos, D.A. and N.A. Algerica. 2012. Modelling change in color and firmness of baby **banana** (*Musa acuminata* AA) in modified atmosphere packaging. *Agronomía Colombiana* . 30(1): 84 - 94.

Abstract

To determine the change in the ripening stage and quality through associated variables such as firmness and peel color is a useful tool for predicting the behavior and involvement of the product stored at different changing conditions. The change in O₂ and CO₂ concentration, pulp firmness and peel color were measured in a test of modified atmosphere packaging for baby banana to develop a mathematical model to represent the change in firmness and color as a function of temperature, mixture of gas and time. The fruits were packaged at three temperatures (11, 13 and 17°C) and a range of combinations of steady state concentrations of modified atmospheres (5.3 to 15.7 kPa O₂ and 0 to 11.0 kPa for CO₂), local atmospheric pressure of 74.9 kPa (0.74 atm) and 80 % relative humidity constant in polyethylene bags (HDPE) micro-perforated for a period of 30 days. The model considers the product respiration rate by an Michaelis-Menten equation of noncompetitive inhibition, and takes into account the transfer of gases through packaging film and through micro-perforations of this; the change of firmness is considered through a first-order model, and depending on the concentration of both O₂ and CO₂ by Michaelis-Menten equations; color change (in Hunter Lab coordinates) was considered separately for each color coordinate, representing the coordinate L* using an increase-logistic model, a* by a zero-order model and b* by first-order model, all temperature dependent by Arrhenius functions. The predictive capability of the developed model is appropriate, explaining 97.0% of the modified atmosphere effect on the loss of firmness, 90.6% of the change in the coordinate L*, 88.9% of the change in a* and 96.7 % of the change in b*.

Keywords: /Banana/ / Modified Atmosphere Packaging/

Gomes, J.F.S. et al. 2013. Colorimetric indicator for classification of **bananas** during ripening. *Scientia Hort.* 150: 201–205.

Abstract

Considering the rise in exports of fruits, the standardization and the improvement of fruit quality are becoming an important requirement. Several countries use rules for grading, labelling and packing, with the aim of standardizing the quality of commercial products and in order to meet consumer demands. Studies have been conducted aiming to define parameters for the characterization of the ripening stages of fruits and to standardize classification during packing. In the case of bananas, their classification involve besides ripening stage, quantity and size. This paper presents a new indicator of the ripening stages of bananas on the basis of colorimetric analyses, bringing standardization to the grading process. The results from the daily monitoring of the evolution of color and spectral radiance of the Brazilian 'Prata' banana peel (*Musa sapientum* AAB) are presented. The banana peel was classified according to the seven subclasses of the Von Loesecke ripening scale. On the basis of these analyses, the RCI (Ripening Color Index) was proposed as a practical index for the grading of bananas, based on the CIELAB system. The RCI index for banana 'Prata' varies from 140 to 300 and each ripening subclass have their limits defined, allowing a direct correlation to Von Loesecke classification. The results show that a scientific index is a feasible alternative to be used as a practical measurement system in the packing, avoiding eventual human errors. The same approach can be developed to other cultivars and fruits.

Keywords: /Banana/ / Ripening/

Hashim, Norhashila, et.al. 2013. An approach for monitoring the chilling injury appearance in **bananas** by means of backscattering imaging. *J. Food Eng.* 116. 28 – 36.

Abstract

The non-invasive detection of chilling injury (CI) symptoms in banana may potentially be approached by means of monitoring changes in the pigment contents and texture of the exocarp. In the present study, laser diodes emitting at 660 and 785 nm were applied to acquire images of backscattered light from intact banana fruits. The idea was to monitor chlorophyll and texture changes by means of relevant wavelengths, respectively. Bananas were stored for 2 days at 13 °C (control), 6 °C (chilling temperature), and subsequently 1 day at ambient temperature to allow the symptom development. Parameters obtained from the backscattering images and their combinations were applied for detecting chilling injury. Significant ($P < 0.05$) interaction of backscattering properties and treatment factors (temperature, ripening stage, and treatment time) were found. Classification of control and chill-injured samples in ripe fruits measured at 660 nm and 785 nm resulted in misclassification error as low as 6% and 8% for early detection, and 0.67% and 1.33% for detection after storage, respectively. The physiological relevance of the variation measured at the two wavelengths was pointed out by means of destructive pigment and water analyses.

Keywords: /Banana/ /Chilling Injury/

Imahori, Y. et al. 2013. Residual effects of low oxygen storage of mature green fruit on ripening processes and ester biosynthesis during ripening in **bananas**. *Postharvest Biol. & Technol.* 77: 19–27.

Abstract

Mature green banana (*Musa sapientum* L. cv. Cavendish) fruit were stored in 0.5%, 2%, or 21% O₂ for 7 days at 20 °C before ripening was initiated by ethylene. Residual effects of low O₂ storage in mature green fruit on ripening and ester biosynthesis in fruit were investigated during ripening for up to 6 d at 20 °C. Concentrations of ethanol in mature green fruit did not change during storage in both 21% and 2% O₂ atmospheres, but increased in fruit stored in 0.5% O₂. The activities of alcohol dehydrogenase (ADH) in 2% and 21% O₂ atmospheres remained very low throughout the storage period, but significantly increased with 0.5% O₂. After transferring fruit to regular air and triggering ripening with ethylene, yellowing of peel, fruit softening and hydrolysis of starch in fruit stored in low O₂ atmospheres were slower than in the control. Fruit stored in low O₂ also showed a delayed onset of the climacteric peak. The activities of ADH were lower in the low O₂ stored fruit than in the control fruit. Productions of ethyl acetate, isoamyl acetate, and isobutyl acetate were remarkably suppressed by low O₂ storage. Alcohol acetyl transferase activity increased gradually with storage time in all treatments, being significantly lower in fruit with low O₂ pre-treatment's. The results indicate that low O₂ plus room temperature storage can extend storage life of bananas with the sacrifice of a low production of ester volatiles.

Keywords: / Banana/ /Low Oxygen Storage/ / Ripening/

Sangeetha, G. et al. 2013. Antimicrobial activity of medicinal plants and induction of defense related compounds in **banana** fruits cv. Robusta against crown rot pathogens. *Biological Control* 64 : 16–25.

Abstract

A total of 72 plant extracts were tested in vitro for their ability to inhibit the mycelial growth of *Lasiodiplodia theobromae* and *Colletotrichum musae* the causal agents of crown rot disease of banana. The results showed that the leaf extract of Zimmu (an interspecific hybrid of *Allium cepa* L., *Allium sativum* L.) and tuber extract of *Zehneria scabra* recorded maximum inhibition of mycelial growth and spore germination of both the test pathogens. The dipping of banana fruits in Zimmu leaf extract at 25% conc. exhibited 100% inhibition of crown rot disease in cold storage (14 °C) up to 35 days and increased the shelf life to 64 days. However, at room storage (28 ± 2 °C), the same treatment exhibited 86% inhibition of crown rot disease up to 12 days. It was found that the treatment of banana fruits with Zimmu leaf extract did not alter the organoleptic properties of banana. The biochemical analysis of banana fruits treated with Zimmu leaf extract showed significant increase in phenylalanine ammonia-lyase (PAL), chitinase and b-1,3-glucanase activities and enhanced accumulation of phenolic compounds compared to other treatments. These findings suggest that the effect of Zimmu leaf extract on crown rot disease may be associated with the direct fungi toxic property against the test pathogens and elicitation of defence related compounds in banana fruits.

Keywords: /Banana/ /Crown Rot Pathogens/ /Medicinal Plants/

BLUEBERRY

Paniagua, A.C. et al. 2013. Moisture loss is the major cause of firmness change during postharvest storage of blueberry. Postharvest Biol. & Technol. 79 : 13–19.

Abstract

Blueberry softening is known to be influenced by cell wall modifications accompanying ripening but these changes appear to be largely complete by the time of harvest. In this study postharvest storage conditions were controlled so only the extent of water loss varied between treatments. A linear relationship between weight loss and loss of firmness (as assessed by a non-destructive compression test) was demonstrated. This relationship did not hold at very low weight loss, where instead, firming of blueberries during storage was found. Magnetic resonance imaging of berries confirmed significant shrinkage and loss of water in berries which had high weight loss, compared with more subtle effects on sub-epidermal water content in berries with very low weight loss. Treatments which restrict blueberry water loss to below 8% are likely to be beneficial in retaining acceptable berry firmness for up to three weeks' storage.

Keywords: /Blueberry/ /Moisture Loss/ /Postharvest/ /Storage/

CANTALOUPE

Fang, Ting, Yanhong Liu, Lihan Huang. 2013. Growth kinetics of *Listeria monocytogenes* and spoilage microorganisms in fresh-cut cantaloupe. Food Microbiol. 34: 174 – 181.

Abstract

The main objective of this study was to investigate the growth kinetics of *Listeria monocytogenes* and background microorganisms in fresh-cut cantaloupe. Fresh-cut cantaloupe samples, inoculated with three main serotypes (1/2a, 1/2b, and 4b) of *L. monocytogenes*, were incubated at different temperatures, ranging from 4 to 43 °C, to develop kinetic growth models. During storage studies, the

population of both background microorganisms and *L. monocytogenes* began to increase almost immediately, with little or no lag phase for most growth curves. All growth curves, except for two growth curves of *L. monocytogenes* 1/2a at 4 °C, developed to full curves (containing exponential and stationary phases), and can be described by a 3-parameter logistic model. There was no significant difference ($P \geq 0.28$) in the growth behaviors and the specific growth rates of three different serotypes of *L. monocytogenes* inoculated to fresh-cut cantaloupe. The effect of temperature on the growth of *L. monocytogenes* and spoilage microorganisms was evaluated using three secondary models. For *L. monocytogenes*, the minimum and maximum growth temperatures were estimated by both the Ratkowsky square-root and Cardinal parameter models, and the optimum temperature and the optimum specific growth rate by the Cardinal parameter model. An Arrhenius-type model provided more accurate estimation of the specific growth rate of *L. monocytogenes* at temperatures <4 °C. The kinetic models developed in this study can be used by regulatory agencies and food processors for conducting risk assessment of *L. monocytogenes* in fresh-cut cantaloupe, and for estimating the shelf-life of fresh-cut products

Keywords: /Cantaloupe/ /Fresh cut/

CITRUS

Njombolwana, Ncumisa, Arno Erasmus, Paul H. Fouriea. 2013. Evaluation of curative and protective control of *Penicillium digitatum* following imazalil application in wax coating. *Postharvest Biol. & Technol.* 77: 102 – 110.

Abstract

Imazalil (IMZ) is widely used in citrus packhouses to manage green mould, caused by *Penicillium digitatum*. The aim of this study was to investigate green mould control efficacy of IMZ applied in a wax coating, and the combination of aqueous dip and coating IMZ applications. Single application of IMZ at 3000 µg mL⁻¹ in carnauba wax coating at rates of 0.6, 1.2 and 1.8 L tonne⁻¹ of fruit gave better protective (mean 13% infection) than curative (mean 70% infection) control of the sensitive isolate. Imazalil residue levels increased (0.85 to 1.75 µg g⁻¹) with increasing coating load. However, the resistant isolate could not be controlled (>74% infection). Dip only treatment (IMZ sulphate at 500 µg mL⁻¹ for 45 s and 90 s) gave good curative control (≈77%) of the sensitive isolate at residue loading of 0.12–0.73 µg g⁻¹. Wax coating only treatment (IMZ at 3000 µg mL⁻¹ at 1.8 L wax tonne⁻¹) gave good protective control and improved sporulation inhibition (≈80%) at residue loading of 1.32–7.09 µg g⁻¹. The MRL of 5 µg g⁻¹ was exceeded at higher wax loads on navels and clementines. Double application with dip (45 s in IMZ sulphate at 500 µg mL⁻¹) followed by 2000 µg mL⁻¹ IMZ in wax coating at 0.6, 1.2 and 1.8 L wax tonne⁻¹ resulted in residue loading of 1.42 to 2.83 µg g⁻¹, increased protective control (≈69%) as well as curative control (≈83%). In all treatments, poor curative and protective control of the resistant isolate was observed (<46% and <55%, respectively). Double application demonstrated superior green mould control by giving good curative and protective control and sporulation inhibition.

Keywords: /Citrus/ /Green Mould/ /Wax Coating/

Pedro A. Moscoso-Ramírez, Pedro A. Clara Montesinos-Herreroa, Lluís Paloua. 2013. Characterization of postharvest treatments with sodium methylparaben to control **citrus** green and blue molds. *Postharvest Biol. & Technol.* 77: 128 – 137.

Abstract

The curative antifungal activity of postharvest sodium methylparaben (SMP) treatments against citrus green (GM) and blue (BM) molds was characterized on different citrus species and cultivars artificially inoculated with *Penicillium digitatum* or *Penicillium italicum* and incubated at 20 °C and 90% RH for 7 d or stored at 5 °C and 90% RH for 8 weeks plus 7 d of shelf-life at 20 °C. Effective concentrations were selected in in vivo primary screenings with 'Valencia' oranges. SMP at 200 mM was tested at 20, 50 or 62 °C for 30, 60 or 150 s in small-scale trials to determine the best dip treatment conditions. Dips of 200 mM SMP at 20 °C for 60 s were selected and applied alone or in combination with 25 μ L L⁻¹ of the conventional fungicide imazalil (SMP + IMZ 25). Imazalil at the very low concentrations of 25 (IMZ 25) or 50 μ L L⁻¹ (IMZ 50) were also tested. Effectiveness of SMP alone at 20 °C for 60 s was significantly higher on oranges (cvs. 'Valencia' and 'Lanelate') than on mandarins (cvs. 'Clemenules', 'Nadorcott' and 'Ortanique'), with GM and BM incidence reductions of up to 88% after 7 d at 20 °C. SMP was compatible with IMZ 25 and consistently improved its performance, irrespective of citrus cultivars and storage conditions. All treatments were less effective on 'Clemenules' mandarins. On 'Valencia' oranges stored for 8 weeks at 5 °C and 7 d at 20 °C, the combined treatment was significantly more effective than the single treatments (reductions of GM and BM incidence of about 50–60% and 90–95%, respectively). In additional tests, 200 mM SMP dips at 20 °C for 60 s did not prevent GM on 'Valencia' oranges wounded, treated, inoculated with *P. digitatum* 24 h later, and incubated at 20 °C for 7 d. In contrast, the treatments IMZ 25 and SMP + IMZ 25 showed significant preventive activity. It can be concluded from these results that SMP aqueous solutions, especially applied at room temperature, might be an interesting nonpolluting control alternative to be included in citrus postharvest disease control programs in the future.

Keywords: /Citrus/ / Postharvest Treatment/

Sukorini, H. , Sangchote, S. & N. Khewkhom. 2013. Control of postharvest green mold of **citrus** fruit with yeasts, medicinal plants, and their combination. *Postharvest Biol. & Technol.* 79: 24 – 31.

Abstract

The use of bio-fungicides and a plant extracts to control postharvest disease was investigated as an alternative to chemical control. The combination of a promising plant extract and yeast were selected through in vitro and in vivo techniques. A combination of *Candida utilis* TISTR 5001 and *Eugenia caryophyllata* crude extract was the best combination to attain a reduction in disease incidence and disease severity of *Penicillium digitatum* on citrus fruit. Colonization was the lowest on fruit treated with the combination of *E. caryophyllata* crude extract and *C. utilis* TISTR 5001, and survival of *C. utilis* TISTR 5001 was the highest. The combination of *E. caryophyllata* crude extract and *C. utilis* TISTR 5001 significantly reduced the natural development of green mold of citrus fruit, and had no effect to fruit quality. The active compound of *E. caryophyllata* was found to be eugenol, based on HPLC and NMR (1H and 13C). Hence, the results indicate that a combination of plant extracts and yeasts possess antifungal activity that can be exploited as an ideal treatment for future plant disease management.

Keywords: /Citrus/ /Green Mold/ /Postharvest/ /Green Mold/

Erasmus, A. et al. 2013. Imazalil residue loading and green mould control on **citrus** fruit as affected by formulation, solution pH and exposure time in aqueous dip treatments. *Postharvest Biol. & Technol.* 77: 43 – 49.

Abstract

Green mould, caused by *Penicillium digitatum*, is responsible for major postharvest fruit losses on the South African fresh citrus export market. Some of these losses as well as fungicide resistance development can be attributed to sub-optimal imazalil (IMZ) residue loading on citrus fruit (<2 g g⁻¹), which is commonly the case in South African packhouses. This will result in loss of control and sporulation inhibition on decayed fruit. IMZ formulation [IMZ sulphate and emulsifiable concentrate (EC)], solution pH (IMZ sulphate at 500 g mL⁻¹ buffered with NaHCO₃ or NaOH to pH 6 and 8) and exposure time (15–540 s) were investigated in order to improve IMZ residue loading and the green mould control on Clementine mandarin, 'Eureka' lemon, and navel and Valencia orange fruit. Exposure time had no significant effect on residue loading in the unbuffered IMZ sulphate solution (pH 3). No differences were observed between the pH buffers used, but residue loading improved with increase in pH. The maximum residue limit (MRL) of 5.0 g g⁻¹ was exceeded following dip treatment in the IMZ EC (after 75 s exposure time), and IMZ sulphate at pH 8 using NaHCO₃ (77 s) or NaOH (89 s) as buffer. The MRL was exceeded after 161 s in IMZ sulphate solutions buffered at pH 6 with either NaHCO₃ or NaOH. An IMZ residue-loading curve was prepared from which residue levels can be predicted for the control of IMZ-sensitive and IMZ-resistant isolates of *P. digitatum*. From this model the benchmark residue level for 95% control of an IMZ-sensitive isolate and of an IMZ-resistant isolate were predicted to be 0.81 and 2.64 g g⁻¹, respectively. Residue loading can be improved by adjusting the pH level of an IMZ sulphate solution to 6 or by using the IMZ EC formulation, but exposure time should be restricted to 45 s so as not to exceed the MRL. Conversely, sufficient exposure time of ≈90 s in an unbuffered IMZ sulphate solution (pH 3) will result to improved green mould control, but with residue loading below 2 g g⁻¹. The resistant isolate could not be controlled adequately with residue levels below the MRL, therewith indicating the practical relevance of IMZ resistance.

Keywords: /Citrus/ / Fungicidal Resistance/ / Postharvest/Fruit Losses/

Moscoso–Ramirez, P.A. et al. 2013. Control of citrus postharvest penicillium molds with sodium ethylparaben. *Crop Protection* . 46: 44 – 51.

Abstract

The curative antifungal activity of postharvest sodium ethylparaben (SEP) treatments against citrus green mold (GM) and blue mold (BM) was determined on different citrus species and cultivars artificially inoculated with *Penicillium digitatum* or *Penicillium italicum* and incubated at 20 C and 90% RH for 7 d or stored at 5 C and 90% RH for 8 weeks plus 7 d of shelf-life at 20 C. The best concentration was selected in in vivo primary screenings with 'Valencia' oranges. SEP at 80 mM was tested at 20, 50 or 62 C for 30, 60 or 150 s in small-scale trials to determine the best dip treatment conditions. Dips of 80 mM SEP at 20 C for 60 s were selected and applied alone or in combination with 25 mL L⁻¹ of the conventional fungicide imazalil (SEP p IMZ 25). Imazalil at the very low concentrations of 25 (IMZ 25) or 50 mL L⁻¹ (IMZ 50) was also tested. Effectiveness of SEP alone at 20 C for 60 s was significantly higher on oranges (cvs. 'Valencia' and 'Lanelate') than on mandarins (cvs. 'Clemenules', 'Nadorcott' and 'Ortanique'), with GM and BM incidence reductions of up to 57e73% after 7 d at 20 C. SEP was compatible with IMZ 25 and consistently improved its performance, irrespective of citrus cultivars and storage conditions. All treatments were less effective on 'Clemenules' mandarins. On 'Valencia' oranges stored for 8 weeks at 5 C and 7 d at 20 C, the combined treatment was significantly more effective than the single treatments (reductions of GM and BM incidence of about 96e93% and 55e39%, respectively).

In additional tests, SEP, IMZ 25 and the combination applied at 20 C for 60 s prevented GM on 'Valencia' oranges treated, inoculated with *P. digitatum* 24 h later and incubated at 20 C for 7 d. It can be concluded from these results that SEP might be an integrating non μ pollutant control alternative to be included in citrus postharvest disease control programs in the future.

Keywords: /Citrus/ /Postharvest/

Njombolwana, N.S. et al. 2013. Evaluation of curative and protective control of *Penicillium digitatum* following imazalil application in wax coating. *Postharvest Biol. & Technol.* 77: 102 – 110.

Abstract

Imazalil (IMZ) is widely used in citrus pack houses to manage green mould, caused by *Penicillium digitatum*. The aim of this study was to investigate green mould control efficacy of IMZ applied in a wax coating, and the combination of aqueous dip and coating IMZ applications. Single application of IMZ at 3000 $\mu\text{g mL}^{-1}$ in carnauba wax coating at rates of 0.6, 1.2 and 1.8 L tonne $^{-1}$ of fruit gave better protective (mean 13% infection) than curative (mean 70% infection) control of the sensitive isolate. Imazalil residue levels increased (0.85 to 1.75 $\mu\text{g g}^{-1}$) with increasing coating load. However, the resistant isolate could not be controlled (>74% infection). Dip only treatment (IMZ sulphate at 500 $\mu\text{g mL}^{-1}$ for 45 s and 90 s) gave good curative control (\approx 77%) of the sensitive isolate at residue loading of 0.12–0.73 $\mu\text{g g}^{-1}$. Wax coating only treatment (IMZ at 3000 $\mu\text{g mL}^{-1}$ at 1.8 L wax tonne $^{-1}$) gave good protective control and improved sporulation inhibition (#80%) at residue loading of 1.32–7.09 $\mu\text{g g}^{-1}$. The MRL of 5 $\mu\text{g g}^{-1}$ was exceeded at higher wax loads on navels and clementines. Double application with dip (45 s in IMZ sulphate at 500 $\mu\text{g mL}^{-1}$) followed by 2000 $\mu\text{g mL}^{-1}$ IMZ in wax coating at 0.6, 1.2 and 1.8 L wax tonne $^{-1}$ resulted in residue loading of 1.42 to 2.83 $\mu\text{g g}^{-1}$, increased protective control (\approx 69%) as well as curative control (\approx 83%). In all treatments, poor curative and protective control of the resistant isolate was observed (<46% and <55%, respectively). Double application demonstrated superior green mould control by giving good curative and protective control and sporulation inhibition.

Keywords: /Citrus/ /Green Mold/

Tu, Q., J. C and J. Guo. 2013. Screening and identification of antagonistic bacteria with potential for biological control of *Penicillium italicum* of citrus fruits. *Scientia Hort.* 150 : 125 – 129.

Abstract

A total of 81 bacterial isolates from the surface of mandarines, apples, lemons and kumquats were screened for antagonism against *Penicillium italicum* wehmer and used to control postharvest blue mold. Bacterial YS-1 was isolated from the surface of kumquat fruit and identified as *Paenibacillus brasilensis* by the Biological microbial identification system combined with 16S rDNA sequence analysis, biochemical and physiologic characteristics and rpoB sequence analysis. YS-1 showed obvious antifungal activity to four different fruit pathogens. Effect of different treatments with strain YS-1 against disease caused by *P. italicum* on inoculated Nanfeng oranges was also investigated. Results showed that citrus blue mold incidence of fruits treated by cell culture, cell-free filtrate and cell suspension of strain YS-1 were all less than 45% and the lesion diameter were all below 10 mm. Also the treatment of cell suspension showed significant comparing with other two treatments. Lesion diameter and disease incidence treated at 5 °C were higher than those at 25 °C. In this article, strain YS-1 is reported for the

first time as a biocontrol agent against blue mold of citrus. The research will provide a theoretical basis for research of postharvest antagonistic bacteria in citrus.

Keywords: /Citrus/ /Biological Control/

Sim, Li Hui, et.al. 2013. Behavior of Salmonella spp. and natural microbiota on fresh-cut **dragon fruits** at different storage temperatures. Int'l. J. Food Microbiol. 160: 230 – 244.

Abstract

The aim of this study was to determine survival or growth of unadapted, acid-adapted and cold-stressed Salmonella spp., and natural microbiota on fresh-cut dragon fruits at different storage temperatures. Dragon fruits were sliced and spot inoculated with five-strain cocktail of Salmonella spp. at two inoculum levels (2.5 or 5.5 log CFU/g). Inoculated fruits were stored at 28 °C for 48 h and at 4 °C and 12 °C for 96 h. Salmonella population significantly increased by 2.4 to 3.0 log CFU/g at low inoculum level, whereas the numbers increased by 0.4 to 0.7 log CFU/g at the high inoculum level on fruits held at 28 °C for 48 h. Only unadapted and acid-adapted cells grew with 0.7 to 0.9 log increase at the low inoculum level at 12 °C for 96 h. No significant growth was observed at both inoculum levels during storage at 4 °C. Overall, acid, starved and cold adaptation of Salmonella spp. did not show significant difference in survival or growth on fresh-cut dragon fruits during storage compared to unadapted control cells. For natural microbiota on the fruit, mesophilic bacterial counts reached to 5-log CFU/g at 28 and 12 °C by 9.9 and 52.9 h. Similar with Salmonella spp. there was no growth of natural microbiota at 4 °C. These results showed that Salmonella spp. could grow on fresh-cut dragon fruits under inappropriate storage conditions, indicating that fresh-cut dragon fruits could be a potential vehicle for salmonellosis. Thus, this study suggests that fresh-cut dragon fruits should be stored at 4 °C to ensure the safety as well as to extend the shelf life of fresh-cut dragon fruits.

Keywords: /Dragon Fruit/ /Storage/ /Fresh-Cut

DURIAN

Kuson, Pramote, Anupun Terdwongworakul. 2013. Minimally-destructive evaluation of **durian** maturity based on electrical impedance measurement. J. Food Eng. 116: 50 – 56.

Abstract

Electrical impedance spectroscopy was investigated to model the dry matter content of durian using partial least squares regression. Measurements of the impedance were taken on the stem and the rind of durian samples at various stages of maturity based on the number of days after anthesis. Plots of the relationship between resistance and reactance, and the change in impedance and capacitance with respect to frequency in a range of 1–200 kHz were explored to determine the optimal frequencies associated with variation in the number of days after anthesis. The impedance parameters at frequencies of 1, 41 and 200 kHz were employed to model the dry matter content of the pulp. The reactance of the cross section of the stem and the capacitance of the rind were found to predominantly contribute to the prediction of the dry matter content. Selected impedance parameters using a stepwise regression could be used to classify durian samples into an immature class and mature class with less accuracy of 83.3%.

Keywords: /Durian/ /Maturity/

MANGO

De los Santos-Villalobos, S. et al. 2013. Potential use of *Trichoderma asperellum* (Samuels, Liechfeldt et Nirenberg) T8a as a biological control agent against anthracnose in **mango** (*Mangifera indica* L.). *Biological Control* 64: 37 – 44.

Abstract

Twenty isolates of *Trichoderma* were obtained from orchards located in three main mango-producing States in Mexico: Chiapas, Oaxaca, and Michoacan, which represent different agronomical management practices and levels of soil fertility. Phylogenetic analysis showed that *Trichoderma* isolates belong to the following taxa: *Hypocrea lixii* (10 isolates), *Hypocrea jecorina* (four isolates), *Trichoderma asperellum* (three isolates), *Trichoderma spirale* (two isolates), and *Trichoderma brevicompactum* (one isolate). The genus *Hypocrea* is the teleomorph (sexual) stage of the genus *Trichoderma*, anamorph stage. Seventeen *Trichoderma* isolates showed at least 67% growth inhibition against the phytopathogenic fungus *Colletotrichum gloeosporioides* ATCC MYA 456 and three *Trichoderma* isolates showed complete overgrowth of this pathogen. One member of this group, identified as *T. asperellum* T8a, was able to control *C. gloeosporioides* ATCC MYA 456 in vitro and in vivo, as well as five *C. gloeosporioides* isolates obtained from mango orchards from the State of Oaxaca. Assay of the lytic enzymes involved suggest that cellulases of *T. asperellum* T8a play a role in biological control against *C. gloeosporioides* ATCC MYA 456 more than chitinase or glucanase. Thus, native *T. asperellum* T8a associated with mango trees can be used to enhance mango production, controlling anthracnose through cellulase activity.

Keywords: / Mango/ / Biological Control/ / Anthracnose/

Valente, Marc, Alexia Prades, Didier Laux. 2012. Potential use of physical measurements including ultrasound for a better **mango** fruit quality characterization. *J. Food Eng.* 116: 57 – 64.

Abstract

The potential use of ultrasound measurements, combined with other physical measurements, has been investigated. The good relationship between soluble solids content (SSC) and ultrasonic wave velocity reported in the literature being confirmed by our study, our main goal was to evaluate the added value of ultrasound measurements around 25 MHz for the determination of biochemical compounds responsible of organoleptic quality of mangoes. Among the main sugar constituents of mango juice, only sucrose content prediction was improved by combining SSC and ultrasonic waves velocity using a PLS model ($R^2 = 0.81$, RMSECV = 12.3, bias = 0.10, RPD = 2.3) when compared to the linear model with SSC only ($R^2 = 0.75$, SEP = 14.05, bias = 0.08). The same conclusion was obtained for titratable acidity PLS model using whole fruit hardness, SSC and ultrasonic wave velocity ($R^2 = 0.82$, RMSECV = 1.84, bias = 0.02, RPD = 2.4) compared to the linear model with fruit hardness only ($R^2 = 0.78$, SEP = 2.07, bias = 0.02). However, the added value of ultrasound measurements was not always found to be significant ($P = 0.05$) when a Wilcoxon statistical tests was conducted on the residuals of the linear and PLS models for both sucrose and titratable acidity.

Keywords: /Mango/ /Fruit Quality/ /Texture/

ORANGE

Palma, A. et al. 2013. Cold quarantine responses of 'Tarocco' **oranges** to short hot water and thiabendazole postharvest dip treatments. *Postharvest Biol. & Technol.* 78: 24 – 33.

Abstract

This study investigated the effects of brief hot water and thiabendazole (TBZ) postharvest dip treatments on ultrastructural changes of fruit epicuticular wax (ECW), TBZ residues, decay development and quality traits of 'Tarocco' oranges [*Citrus sinensis* (L.) Osbek] subjected to cold quarantine, subsequent simulated transport and shelf-life. Commercially mature fruit were submerged in water at 20 °C (control fruit) or TBZ at 1000mg/L and 20° C for 60 s, or in hot water without or with TBZ at 300mg/L and 53, 56, or 59° C for 60, 30, and 15 s respectively. Following treatments, fruit were stored for 3 weeks at 1°C (simulated quarantine conditions for fruit disinfestations against Mediterranean fruit fly, Medfly), followed by 4 days at 3°C (simulated long distance transport), and finally kept at 20°C for 3 days (shelf-life, SL). Scanning electron microscopy (SEM) analysis of 'Tarocco' orange surface showed that the typical wax platelets, lifting around edges of wax plates and areas free of epicuticular wax (ECW), that disappeared after hot water dips at 53–59°C for 60–15 s, become visible again after storage for 21 days at 1°C (quarantine conditions), and changes involving the appearance of rough ultrastructure, presence large curled plates, fissured wax crusts, and areas with ECW deficiencies, became much more pronounced after shelf-life. These occurrences were related to the transient effect of hot water treatment in decay control. Conversely, treatments with 300mg/L TBZ 53°C for 60 s or 56°C for 30 s effectively reduced decay after quarantine. These treatments were as effective as standard treatment with 1000mg/L TBZ at 20°C and produced similar TBZ residue levels in fruit, without impairing fruit quality traits such as visual appearance, weight loss, compression test, sensory attributes, juice color parameters (a^* , b^* , h , L^* , and Chroma), and juice chemical characteristics (soluble solids content, titratable acidity, ascorbic acid, glucose, sucrose, citric acid, total phenols, total anthocyanins, and total antioxidant activity).

Keywords: / Oranges/ / Postharvest Dip Treatment/

Vilanova L. et al. 2013. Wound response in **orange** as a resistance mechanism against *Penicillium digitatum* (pathogen) and *P. expansum* (non-host pathogen). *Postharvest Biol. & Technol.* 78: 113 – 122.

Abstract

Penicillium digitatum is the most devastating postharvest pathogen of citrus. In addition, *Penicillium expansum* is the main pathogen of pome fruit, although recent studies have demonstrated its ability to infect oranges under some conditions. In this study, we evaluated wound response in 'Valencia' oranges harvested at three different maturity stages and the effect of wound response on the establishment of both pathogens when fruit were stored at two different temperatures (20 and 4 °C). The effect of wounding and pathogen inoculation on lignin content was also quantified. Lastly, the expression of several phenylpropanoid pathway-related genes was also analyzed by semi-quantitative RT-PCR. Results indicated that, in general, *P. digitatum* exhibited lower decay incidence and severity as time between wounding and inoculation increased. Decay incidence and severity were higher in fruit from the over-mature harvest than in fruit from immature and commercial harvests. *P. expansum* was able to infect fruit at 20 °C but lesions were small compared to lesion size of fruit stored at 4 °C. Lignin

content in wounded fruit (control) and in samples wounded and inoculated with *P. expansum* was highest in fruit from the immature harvest at 7 d post-wounding and inoculation. Wounded fruit had higher expression of *pal1*, *comt1* and *pox1* genes at 48 h than at 24 h. However, samples inoculated with *P. digitatum* showed lower expression at 48 h than at 24 h. Our results indicated that maturity and storage temperature play an important role in orange wound response.

Keywords: /Orange/ /Pathogen/

PEACH

Soto, Alvaro, et al. 2013. ABA may promote or delay **peach** fruit ripening through modulation of ripening- and hormone-related gene expression depending on the developmental stage. *Plant Physiol. & Biochem.* 64: 11 – 24.

Abstract

Peach (*Prunus persica laevis* L. Batsch) was chosen as a model to further clarify the physiological role of ABA during fruit ripening. To this aim, branches bearing one fruit at mid-S3, S3/S4 and S4 stages of fruit development and characterized by a different ripening index (IAD), as revealed by a non-destructive device called a DA-meter, were treated with ABA (0.02 mM) for 1 and 5 days. Exogenously applied ABA interfered with the progression of ripening leading to less ripe or riper fruit depending on the physiological stage. To better understand the molecular basis of ABA interference with ripening, the time-course changes in the expression of ethylene-, cell wall-, and auxin-related genes as well as other genes (NCED, PIP, LOX, AOS and SOT) was evaluated in the fruit mesocarp. Real-time PCR analyses revealed that in mid-S3 fruit transcript levels of ethylene biosynthesis and signaling (*ACS1*, *ACO1*, *ETR2*, *ERF2*), cell wall softening-related (*PG*, *PMEI*, *EXP1*, *EXP2*) and auxin biosynthesis, conjugation, transport and perception (*TRPB*, *IGPS*, *Aux/IAA*, *GH3*, *PIN1* and *TIR1*) genes were substantially down-regulated on day 5 indicating a ripening delay. On the contrary, in more advanced stages (S3/S4 and S4) the same genes were early (day 1) up-regulated suggesting an acceleration of ripening. Transcript profiling of other ripening-related genes revealed changes that were in accord with a ripening delay (mid-S3) or acceleration (S3/S4 and S4). Thus, in peach fruit, ABA appears to modulate ripening through interference not only with ethylene and cell wall but also with auxin-related genes.

Keywords: /Peach/ /Fruit Ripening/ /Ethylene/

PEAR

Chiriboga, M. et al. 2013. Antioxidant potential of 'Conference' **pears** during cold storage and shelf life in response to 1-methylcyclopropene. *LWT – Food Sci. & Technol.* 51: 170 – 176.

Abstract

Antioxidant metabolism and changes in membrane permeability were studied during cold storage and shelf life in 'Conference' pears. The fruit were harvested at different harvest dates and growing locations and treated with 300 nL L⁻¹ of 1-methylcyclopropene (1-MCP). 1-MCP-treated fruit exhibited higher superoxide dismutase (SOD) and catalase (CAT) activity, together with higher ascorbic acid levels during cold storage. During shelf-life, the 1-MCP treatment reduced the electrolyte leakage and improved the capacity of the fruit to remove reactive oxygen species by increasing SOD, CAT and

peroxidase (POX) activities. The effect of 1-MCP treatment on the antioxidant metabolism differed between orchards but not between harvest dates.

Keywords: /Pears/ /Cold Storage/ / Shelf Life/ /1-MCP/

Liu, R. et al. 2013. Changes in physiology and quality of Laiyang **pear** in long time storage. *Scientia Hort.* 150: 31 – 36.

Abstract

Physiological disorders easily occur in Laiyang pear (*Pyrus bretschneideri* cv. Laiyang) fruit after harvest and result in quality deterioration and short postharvest life. In this paper, we mainly investigated the effects of 1-methylcyclopropene (1-MCP) treatment and controlled atmosphere (CA) with 2% O₂ plus 2% CO₂ on quality of Laiyang pear and storage time. The results indicated that 1-MCP treatment and CA were effective in maintaining quality and prolonging storage time of Laiyang pear fruit, because 1-MCP and CA could significantly delay fruit senescence via limiting ethylene production, reducing fruit respiration rate, regulating anti-oxidant enzymes and membrane permeability. We consider that the major action modes of 1-MCP and CA, that can maintain harvested quality of Laiyang pear fruit, may be greatly contributed to inhibiting ethylene biosynthesis and regulating anti-oxidant pathways.

Keywords: /Pear/ /Storage/

PINEAPPLE

Hong, K. et al. 2013. Quality changes and internal browning developments of summer **pineapple** fruit during storage at different temperatures. *Scientia Hort.* 151: 68 – 74.

Abstract

The influences of storage temperature on quality parameters, comprising total soluble solids (TSS), free sugars, vitamin C, titratable acidity (TA) and soluble proteins, and internal browning (IB) of summer pineapple (*Ananas comosus* L. cv. 'Comte de Paris') fruit were investigated. The fruit were subjected to three different temperatures (6, 10 and 25 °C) with relative humidity of 80% for 24 days. In addition, the activities of polyphenol oxidase (PPO), peroxidase (POD) and catalase (CAT) were measured during storage. The results indicated that a decrease in TSS in fruit kept at 25 °C was noted, while TSS remained relatively constant in fruit storage temperature at 10 and 6 °C. A high correlation was observed between the different sugars during storage periods. There was a noticeable decline in sucrose content in pineapple fruit during storage, with a more rapid decrease with higher temperature. The maximum retentions of glucose and fructose concentrations can be achieved with storage of fruit at 6 °C rather than storage at 10 or 25 °C. The effective slowing down of vitamin C and TA rate of decreases was the fruit stored at 6 °C, followed by 10 and 25 °C. There was a decrease in contents of soluble proteins as storage temperature increased throughout the storage period, and significant differences were found between fruit stored at low temperature and room temperature after 12 d in storage. Storage temperature also significantly affected IB development, the incidence of IB was more rapid and with higher intensity in fruit held at 25 °C than 10 °C, and IB intensity was minimal in fruit held at 6 °C. Additionally, PPO activity increased with higher storage temperature during 24 days storage. CAT activity gradually increased at three storage temperatures and in the fruit stored at 25 °C was higher

than those at 10 and 6 °C. However, POD activity was not influenced by storage condition. The results suggest that lower temperature can provide a useful means of maintaining quality and resist IB development during storage of pineapple fruit.

Keywords: /Pineapple/ /Storage/ /Browning/

Mantilla, N. et al. 2013. Multilayered antimicrobial edible coating and its effect on quality and shelf-life of fresh-cut **pineapple** (*Ananas comosus*). LWT- Food Sci. & Technol. 51: 37 – 43

Abstract

The effectiveness of a multilayered edible coating with a microencapsulated antimicrobial complex (beta-cyclodextrin and trans-cinnamaldehyde) in enhancing the quality and shelf-life of fresh-cut pineapple was assessed. Pineapples were washed, cleaned with a 300 mg/kg chlorine solution (1 min), and cut into triangular prisms. Treated fruits were coated using the layer-by-layer technique with a dipping method and stored in sealed Ziploc containers for 15 days at 4 C. Uncoated fruits served as controls. Shelf-life study consisted of evaluating color, texture, pH, Brix, titratable acidity, vitamin C, moisture content, and weight loss every 3e4 days. Total aerobic plates, psychrotrophic, yeast and mold counts and sensory testing were also carried out. The encapsulated trans-cinnamaldehyde affected the fruit's flavor but application of the coating extended its shelf-life to 15 days at 4 C by inhibiting ($P < 0.05$) microbial growth. The coating also helped preserve ($P < 0.05$) color, texture, and pH of the fruit.

Keywords: /Pineapple/ / Fresh-Cut/ /Quality/ /Shelf Life/ /Edible Coating/

POMEGRANATE

Zhang, L. and M.J. McCarthy. Assessment of **pomegranate** postharvest quality using nuclear magnetic resonance. Postharvest Biol. & Technol. 77: 59 – 66.

Abstract

Fruit quality parameters, soluble solids content (Brix), total titratable acidity, pH, and Brix/acid ratio, are often used as indicators of fruit maturity and palatability. Measurement of these fruit quality parameters requires a series of destructive methods, which can only be conducted on extracted fruit juice. The aim of this study is to investigate the relationship between spin-spin relaxation time and pomegranate quality attributes and the potential of MRI for quantitative analysis of pomegranate quality. Spin-spin relaxation time, T₂, measured using a low magnetic field (0.04 T) showed correlation with the soluble solids content of pomegranate. The T₂ relaxation time ranged from 837 ms to 1024 ms for the fruit with soluble solids content from 15.3 °Brix to 18.7 °Brix. However, accurate prediction was not achieved. In the MRI experiment, six MR images with varying contribution to total signal intensity from proton density, relaxation rates, and diffusion weighing were obtained for pomegranate fruit using a 1 T MR imaging system with 0.22 T/m gradient strength. The pH, Brix, total titratable acidity, and Brix/acid ratio of pomegranate were also measured by traditional destructive methods. Partial least square (PLS) analysis was applied to the statistical features of the voxel signal intensities in the MR images and quality parameters to examine the correlation between MR images results and destructive measurements. The MR image based PLS model have a R² of 0.54, 0.6, and 0.63 for predicting titratable acidity, pH, and soluble solids/acidity levels, respectively. The correlation between MR image statistical features and soluble solids content of pomegranate was poor. In these models, T₂ weighted Fast Spin

Echo, diffusion weighted image, and Spin Echo image with short TE and moderate TR are the most important images in predicting the pomegranate quality attributes. Unlike traditional destructive methods, MR imaging is capable of evaluating multiple quality parameters in a single measurement.

Keywords: /Pomegranate/ /Postharvest/ /Quality/ /Magnetic Resonance/

STRAWBERRY

Hashmi, M.S. et al. 2013. Pre-storage hypobaric treatments delay fungal decay of strawberries. Postharvest Biol. & Technol. 77: 75–79.

Abstract

Fungal decay is a major cause of postharvest losses in strawberries. The traditional approach for controlling fungal decay is the use of fungicides. However, the use of fungicides has been questioned as a sustainable and safe method, and is also prohibited in many countries. One potential physical method for reducing fungal decay is application of a short-term hypobaric treatment prior to storage. In this study efficacy of postharvest hypobaric treatments to control natural rot development in strawberries was evaluated. Strawberries were treated with hypobaric pressures (25 kPaa, 50 kPaa and 75 kPaa) for 4 h at 20 °C and subsequently stored at 20 °C or 5 °C. A 50 kPaa treatment consistently delayed rot development in samples stored at either temperature confirming that the technique has potential as a non-chemical treatment. Moreover 50 kPaa treatments did not affect weight loss and firmness at either 20 °C or 5 °C. An initial increase in respiration rate was observed in 50 kPaa treated samples potentially indicating mild stress due to hypobaric treatment. An in vitro fungal study found that 50 kPaa treatment for 4 h did not affect the rate of radial growth of colonies of *Botrytis cinerea* and *Rhizopus stolonifer*, providing further evidence that the potential mechanism of hypobaric treatment is induction of the defence system within the fruit rather than a direct effect on fungal viability. Further molecular and biochemical research is required to evaluate the possible stimulation of resistance in fruit through short-term hypobaric treatments.

Keywords: /Strawberry/ /Fungal Decay/

SWEET CHERRY

Feliziani, E. et al. 2013. Pre- and postharvest treatment with alternatives to synthetic fungicides to control postharvest decay of sweet cherry. Postharvest Biol. & Technol. 78: 133 – 138.

Abstract

The effectiveness of alternatives to synthetic fungicides for the control of pathogens causing postharvest diseases of sweet cherry was tested in vitro and in vivo. When amended to potato dextrose-agar, oligosaccharides, benzothiadiazole, chitosan, calcium plus organic acids, and nettle macerate reduced the growth of *Monilinia laxa*, *Botrytis cinerea* and *Rhizopus stolonifer*. Treatment of sweet cherries three days before harvest or soon after harvest with oligosaccharides, benzothiadiazole, chitosan, calcium plus organic acids, nettle extract, fir extract, laminarin, or potassium bicarbonate reduced brown rot, gray mold, *Rhizopus* rot, *Alternaria* rot, blue mold and green rot of cherries kept 10 d at 20 ± 1 °C, or 14 d at 0.5 ± 1 °C and then exposed to 7 d of shelf-life at 20 ± 1 °C. Among these resistance inducers, when applied either preharvest or postharvest, chitosan was one of the most

effective in reducing storage decay of sweet cherry, and its antimicrobial activity in vitro and in field trials was comparable to that of the fungicide fenhexamid. Benzothiadiazole was more effective when applied postharvest than with preharvest spraying. These resistance inducers could represent good options for organic growers and food companies, or they can complement the use of synthetic fungicides in an integrated disease management strategy.

Keywords: /Sweet Cherry/ / Postharvest Treatment/

WATERMELON

Sipahi, R.E. et al. 2013. Improved multilayered antimicrobial alginate-based edible coating extends the shelf life of fresh-cut **watermelon** (*Citrullus lanatus*). LWT- Food Sci. & Technol. 51: 9 – 15.

Abstract

This study evaluated the effectiveness of an improved multilayered antimicrobial alginate-based edible coating in increasing the shelf life of fresh-cut watermelon without affecting its quality attributes. A set of solutions containing sodium alginate (0.5, 1, 2 g/100 g), beta-cyclodextrin and microencapsulated transcinnamaldehyde (natural antimicrobial agent), pectin, and calcium lactate were used as coating systems and made into a coating using the layer-by-layer (LbL) technique. The samples were coated using the layer-by-layer dipping technique and stored at 4 C for 15 days. Texture, color, weight loss, oBrix, pH, and growth of total coliforms, yeasts and molds, aerobics, and psychrotrophs were monitored every 3 days throughout storage. Controls were uncoated washed fruits. A consumer acceptance test showed high acceptance ($P < 0.05$) of the coated samples except for the 2 g/100 g alginate coating. Texture (firmness) was particularly enhanced ($P < 0.05$) by application of the coating. Both the 1 and 2 g/100 g alginate coatings extended the shelf life of fresh-cut watermelon from 7 (control) to 12e15 days. The application of the multilayered edible coating with 1 g/100 g alginate will maintain the quality and sensory acceptance of fresh-cut watermelon while extending its shelf life.

Keywords: /Watermelon/ /Fresh Cut/ /Edible Coating/ / Shelf Life/

ORNAMENTALS

CARNATION

Kazemi, M and A. Ameri. 2012. Extending the 'vase life of **carnation** with different preservatives. Int'l. J. Botany. 8(1): 50 – 53.

Abstract

In this research were analysed effects of different concentrations of 5- sulfosalicylic acid (5-SSA), essential oil of Thyme (*Thymus vulgaris*) (Eos) and silver nitrate (AgNO_3) on extending carnation (*Dianthus caryophyllus*) vase-life. For this purpose trial were conducted using a factorial test based on completely randomized design with six replications. The treatments of this experiment consisted of 5-SSA (1,2,3,5,4 and 5 mM) essential oils *Thymus vulgaris* (50,100,150 and 200 mg L⁻¹) and silver nitrate (AgNO_3) (0, 1.5,2, 2.5, and 3mM). Evaluated traits consisted of flower longevity, ACC-oxidase activity (ACO), anthocyanin leakage, microbial population, SPAD value, water uptake, superoxide dismutase (SOD) activity, Assays of MDA content. Results of this experiments showed that the microbial population

of vase solution which treated with essential oils *Thymus vulgaris* and 5-sulfosalicylic acid were lower than other treatments. ACC-oxidase activity, anthocyanin leakage and the vase life of cut flowers significantly affected by 5-SSA treatment, in comparison with control so that this treatment had better effect than control. It is distinguished that silver nitrate treatment had the best effect on fresh weight (%), followed by 5-SSA treatment, respectively.

Keywords: /Carnation/ /Vase Life/

LILY

Gul, F. et al. 2012. Senescence and postharvest Performance of cut *Nerine sariensis* flowers: effects of cyclohexamide. Int'l. J. Botany. 8 (1): 22 – 30.

Abstract

A study was conducted to determine the effects of pre-treatment at varying concentrations of Cyclohexamide (CHI) on senescence and postharvest performance in *Nerine sariensis*. At a particular threshold concentration CHI delays senescence and above which it prevents flower opening and promotes senescence. The fact that cyclohexamide delays tepal senescence demonstrates the synthesis of particular proteins probably enzymes, responsible for degradation of cellular constituents, executes the cell death programme in flower tepals. Pre-treatment of scapes with CHI at 0.01 and 0.05mM concentrations was found to delay visible signs of senescence, maintain a sustained rate of flower blooms and increase fresh and dry mass, besides lowering electrical conductivity of ion leachates and solution absorption. An increase in total sugar, phenolic and soluble protein content was observed with a concomitant decrease in alpha amino acid content. Pre-treatment of scapes with 0.05 or 0.01 CHI for 1 h can be used as an effective treatment to improve the postharvest longevity in this flower system.

Keywords: Lily/ /*Nerine sariensis*/Lily/ /Cutflower/

LOTUS

Imbasai, W. et al. Petal blackening and lack of bud opening in cut **lotus** flowers (*Nelumbo nucifera*): Role of adverse water relations. Postharvest Biol. & Technol. 79: 32 – 38.

Abstract

Lotus flowers (*Nelumbo nucifera* Gaertn.) are commercially sold as closed buds. When placed in water the buds fail to open and the outer petals show rapid blackening. We investigated whether this is due to adverse water relations. Placing a plastic bag over the flower head delayed petal blackening, indicating that it was induced by early water stress. This treatment did not result in bud opening. A rapid occlusion of the stem xylem was found. Four possible causes of this occlusion were investigated: air uptake into the xylem, microorganisms in the vase solution, a plant-induced effect, and exuded latex. Preventing the uptake of air into the stem ends did not affect water uptake. Inclusion in the vase water of antibacterial compounds, or antioxidants that inhibit the plant-induced xylem blockage in other species, similarly did not alleviate the xylem occlusion. Cut stems exuded copious latex, close to the opened xylem conduits. Latex exudation was prevented by cutting under water, allow the latex to flow out, and cut again in air, within 1 cm from the previous cut. This treatment did not promote water

uptake of the cut stems. A pulse treatment with citric acid also reduced latex flow, but also did not prevent the decrease in water uptake. Treatment with ethephon or GA3 delayed the xylem occlusion, which suggests that it is induced by the plant itself. Only GA3 delayed petal blackening. None of these treatments promoted flower opening. It is concluded that adverse water relations are a cause of early petal blackening in cut lotus, but is not a cause of the lack of bud opening. The adverse water relations are apparently due to a plant-induced xylem occlusion which is different from those studied thus far in other species.

Keywords: /Cut Lotus/ /Petal Blackening/ /

ROSE

Fanourakis, D. et al. 2013. Sources of vase life variation in cut **roses**: A review. *Postharvest Biol. & Technol.* 78: 1 – 15.

Abstract

In determining vase life (VL), it is often not considered that the measured VL in a particular experiment may greatly depend on both the preharvest and evaluation environmental conditions. This makes the comparison between studies difficult and may lead to erroneous interpretation of results. In this review, we critically discuss the effect of the growth environment on the VL of cut roses. This effect is mainly related to changes in stomatal responsiveness, regulating water loss, whereas cut flower carbohydrate status appears less critical. When comparing cultivars, postharvest water loss and VL often show no correlation, indicating that components such as variation in the tissue resistance to cavitate and/or collapse at low water potential play an important role in the incidence of water stress symptoms. The effect of the growth environment on these components remains unknown. *Botrytis cinerea* sporulation and infection, as well as cut rose susceptibility to the pathogen are also affected by the growth environment, with the latter being largely unexplored. A huge variability in the choices made with respect to the experimental setup (harvest/conditioning methods, test room conditions and VL terminating symptoms) is reported. We highlight that these decisions, though frequently overlooked, influence the outcome of the study. Specifications for each of these factors are proposed as necessary to achieve a common VL protocol. Documentation of both preharvest conditions and a number of postharvest factors, including the test room conditions, is recommended not only for assisting comparisons between studies, but also to identify factors with major effects on VL.

Keywords: / Cut Roses/ /Vase Life/

TULIP

Hiroko, Mochizuki-Kawai, Kenichi Shibuya, Kazuo Ichimura. 2013. Programmed cell death begins earlier in the mesophyll cells of **tulip** petals than in the epidermal cells. *Postharvest Biol. & Technol.* 70: 9 - 12.

Abstract

Based on histological observations, the onset of programmed cell death (PCD) occurs earlier in the mesophyll cells of petals than in the epidermal cells, but few biochemical studies have addressed the onset of PCD in mesophyll cells. We sampled epidermal cells and, separately, mesophyll cells from tulip

petals, and then used biochemical methods to examine the onset of PCD in the two different tissue types. DNA laddering and collapse of cells had begun in mesophyll cells before petals had visibly wilted, but DNA laddering was not evident in epidermal cells at that point. Changes in protein content and total proteinase activity during senescence also supported the conclusion that the onset of PCD occurred in mesophyll cells before it occurred in epidermal cells. This study is the first to use multiple biochemical methods of analysis, as well as microscopic observations, to demonstrate that PCD begins earlier in the mesophyll cells than in the epidermal cells of tulip petals.

Keywords: /Tulip/ /Senescence/

VEGETABLES

ASPARAGUS

Qiu, M. et al. 2013. Effect of chitosan coatings on postharvest green **asparagus** quality. *Carbohydrate Polymers*. 92: 2027 – 2032.

Abstract

Fresh postharvest green asparagus rapidly deteriorate due to its high respiration rate. The main benefits of edible active coatings are their edible characteristics, biodegradability and increase in food safety. In this study, the quality of the edible coatings based on 0.50%, 0.25% high-molecular weight chitosan (Hchitosan), and 0.50%, 0.25% low-molecular weight chitosan (L-chitosan) on postharvest green asparagus was investigated. On the basis of the results obtained, 0.25% H-chitosan and 0.50% L-chitosan treatments ensured lower color variation, less weight loss and less ascorbic acid, decrease presenting better quality of asparagus than other concentrations of chitosan treatments and the control during the cold storage, and prolonging a shelf life of postharvest green asparagus.

Keywords: /Asparagus/ / Postharvest/ / Chitosan/

BAMBOO SHOOTS

Chen, H. et al. 2013. Effect of hypobaric storage on flesh lignification, active oxygen metabolism and related enzyme activities in **bamboo shoots**. *LWT-Food Sci. & Technol.* 51: 190 – 195.

Abstract

Freshly harvested bamboo (*Phyllostachys violascens*) shoots were stored for 35 days under various hypobaric conditions (101, 75, 50 and 25 kPa) at 2 °C to investigate the effects of hypobaric storage on flesh lignifications. It was found that hypobaric storage at 50 kPa was most effective in preventing the increase in shoots firmness and allied accumulations of lignin and cellulose. Furthermore, the hypobaric storage at 50 kPa inhibited the ethylene production, reduced the rate of O₂ production and the accumulation of malondialdehyde (MDA) and H₂O₂, and maintained significantly higher activities of superoxide dismutase (SOD), catalase (CAT) and ascorbate peroxidase (APX), but restrained the activities of phenylalanine ammonia-lyase (PAL) and peroxidase (POD). These data indicate that the delay in flesh lignification of bamboo shoots by hypobaric storage was due to maintenance of higher antioxidant enzymes activities and reduced ethylene production, leading to less ROS accumulation and better cellmembrane integrity.

Keywords: /Bamboo Shoots/ /Storage/

BROCCOLI

Fernández-León et al.2013. Different postharvest strategies to preserve **broccoli** quality during storage and shelf life: Controlled atmosphere and 1-MCP. Food Chem. 138: 564 – 573.

Abstract

Broccoli (*Brassica oleracea var. italica*) is a vegetable that requires the application of postharvest techniques to extend its marketability. Controlled atmosphere and 1-MCP treatments are most used to extend the shelf life of broccoli and reduce post-harvest deterioration. The aim of this study was to evaluate the visual, physicochemical and functional changes of broccoli head samples stored at 1–2 °C and 85–90% relative humidity (RH) in air (Control samples), under controlled atmospheres (10% O₂ and 5% CO₂) (CA samples) and treated with 1-MCP (0.6 l/L). After storage all samples were maintained at 20 °C for 2 and 4 days, in order to assess their shelf life. The most suitable postharvest treatment to extend broccoli quality during storage and shelf life, in terms of maintaining the visual quality and reducing loss of health promoting compounds, was achieved by storage under controlled atmosphere conditions. The use of 1-MCP reduced the loss of green colour and chlorophyll pigments, but only during cold storage not during shelf life at 20 °C.

Keywords: /Broccoli/ /Storage Quality and Shelf Life/1-MCP /

Fernandez-Leon, M.F. et al. 2013. Altered commercial controlled atmosphere storage conditions for 'Parthenon' **broccoli** plants (*Brassica oleracea* L. var. *italica*). Influence on the outer quality parameters and on the health-promoting compounds. LWT- Food Sci. & Technol. 50: 665 – 672.

Abstract

Parameters such as bright and dark green compact heads, firmness to hand pressure and closed florets, and the evolution of main health-promoting compounds such as carotenoid and chlorophyll pigments, phenolic compounds and glucosinolates, were assessed to determine the effects of the atmosphere composition during the cold storage of broccoli 'Parthenon'. The controlled atmosphere evaluated in this study was a gas mixture containing 10% of O₂ and 5% of CO₂, with 85–90% relative humidity. The storage temperature was established at 1 and 2 °C. We found that the loss of weight and firmness was greater in the reference samples compared to samples stored under controlled atmosphere conditions (20.60% and 84.88%, for loss of weight and firmness in reference samples respectively, and 4.80% and 16.48%, for loss of weight and firmness in controlled atmosphere samples respectively) after 9 days of storage, approximately. In addition, the proposed controlled atmosphere conditions helped to maintain the concentration of the main healthpromoting compounds, such as ascorbic acid, carotenoid and chlorophylls pigments, total phenolic compounds and intact glucosinolates, and the values of the antioxidant activity in vitro were also maintained.

Keywords: /Broccoli/ /Storage/ /Controlled Atmosphere/

Fernandez-Leon, M.F. et al. 2013. Retention of quality and functional values of **broccoli** 'Parthenon' stored in modified atmosphere packaging. Food Control 31: 302 – 313.

Abstract

The aim of this research was to identify, quantify and compare the main quality parameters and functional compounds of 'Parthenon' broccoli florets stored at two different conditions. The first condition consisted in a modified atmosphere packaging (MAP) using microperforated polypropylene plastic. Then, the second one was in an unpackaged storage (Control). The main quality parameters assessed in this research were the overall appearance, odour, weight loss and colour. While, the functional compounds evaluated in this study were the chlorophyll and carotenoid pigments, vitamin C, total phenol content and intact glucosinolates, as well as the in vitro antioxidant activity. The results indicated that the loss of quality was lower in MAP than in Control samples when comparing with Fresh sample. In addition, the weight loss in MAP samples was 0.75% while in the Control samples was 3.36% at the end of storage. Besides, the losses of external attributes were also more pronounced in Control than in the MAP samples. Moreover, this degradation tendency was also observed for bioactive compounds, where their retention in the MAP was higher than in Control samples. In fact, the loss of total phenol content and intact glucosinolates content in MAP samples was about 20 and 23%, respectively, while in Control samples was about 48% and 57% correspondingly. This was also observed in the antioxidant activity (AA) values, since AA is correlated with these functional compounds.

Keywords: /Broccoli/ Modified Atmosphere Packaging/

Martinez-Hernandez, G.B. et al. 2013. Quality changes after vacuum-based and conventional industrial cooking of kailan-hybrid **broccoli** throughout retail cold storage. *LWT Food Sci. & Technol.* 50:707 – 714.

Abstract

The microbial, physical, sensory and nutritional quality changes of kailan-hybrid broccoli after industrial boiling, steaming, sous vide (SV), microwaving (MW), SVeMW and grilling throughout 45 days at 4 °C were studied. Boiling, SVeMW and MW induced the highest total colour differences. Boiling and steaming produced the greatest stem softening. Based on the overall sensory quality, the commercial life was established in 45 days, except grilling (14 days) and SV (21 days). Apparently, cooking increased the total phenolic content up to 2.0 and 1.7-fold for grilling and MW, respectively, owing to a better extraction. SVeMW, SV and MW produced the highest total antioxidant capacity increases around 5.4e4.7-fold, contrary to the low enhancements of boiling and grilling (2.9-fold). The best chlorophylls retention was attained by boiling. The total carotenoids content was enhanced up to 1.5e2- fold. Conclusively, these treatments generally showed an excellent microbial reduction and nutritional quality, which, in some cases, was enhanced after 45 days.

Keywords: /Broccoli/ /Cold Storage/

Raseetha, S. et al. 2013. Understanding the degradation of ascorbic acid and glutathione in relation to the levels of oxidative stress biomarkers in **broccoli** (*Brassica oleracea L. italica cv. Bellstar*) during storage and mechanical processing. *Food Chem.* 138 : 1360 –1369.

Abstract

The purpose of this research was to understand the degradation of ascorbic acid and glutathione content in broccoli florets (*Brassica oleracea* L. italica cv. Bellstar) during prolonged storage and subsequent mechanical processing. The initial content of total ascorbic acid and glutathione in broccoli florets averaged at 5.18 ± 0.23 and 0.70 ± 0.03 $\mu\text{mol/g}$ fresh weight, respectively. Results showed that the content of ascorbic acid and glutathione in broccoli degraded during storage at 23 °C, for at least 4.5-fold after 6 days of storage. On each day of storage, broccoli florets were mechanically processed, but the content of total ascorbic acid and glutathione was not significantly affected. When the mechanically processed broccoli florets were further incubated for up to 6 h, the amount of ascorbic acid was greatly reduced as compared to glutathione. To obtain an in-depth understanding on the degradation of ascorbic acid and glutathione, the activity of enzymes involved in plant antioxidative system via ascorbate–glutathione cycle, as a response towards oxidative stress that took place during storage was determined in this study. The content of total ascorbic acid and glutathione in broccoli florets before and after mechanical processing were found to decrease concurrently with the activity of ascorbic acid peroxidase and glutathione reductase over the experimental storage duration. Meanwhile, the effect of oxidative stress on the content of ascorbic acid and glutathione was apparent during the 6 h of incubation after mechanical processing. This phenomenon was demonstrated by the level of oxidative stress biomarkers examined, in which the formation of lipid peroxides, protein carbonyls and DNA oxidised products was positively associated with the degradation of total ascorbic acid and glutathione.

Keywords: /Broccoli/ / Storage/

CELERY

Vandamm, Joshua P., et.al. 2013. Fate of *Escherichia coli* O157:H7, *Listeria monocytogenes*, and *salmonella* on fresh-cut **celery**. *Food Microbiol.* 34: 151 – 157.

Abstract

Illnesses from *Escherichia coli* O157:H7, *Listeria monocytogenes*, and *Salmonella* have been associated with the consumption of numerous produce items. Little is known about the effect of consumer handling practices on the fate of these pathogens on celery. The objective of this study was to determine pathogen behavior at different temperatures under different storage conditions. Commercial fresh-cut celery was inoculated at ca. $3 \log \text{CFU/g}$ onto either freshly cut or outer uncut surfaces and stored in either sealed polyethylene bags or closed containers. Samples were enumerated following storage for 0, 1, 3, 5, and 7 days when held at 4 °C or 12 °C, and after 0, 8, and 17 h, and 1, and 2 days when held at 22 °C. At 4 °C, all populations declined by $0.5 \text{e}1.0 \log \text{CFU/g}$ over 7 days. At 12 °C, *E. coli* O157:H7 and *Salmonella* populations did not change, while *L. monocytogenes* populations increased by ca. $0.5 \log \text{CFU/g}$ over 7 days. At 22 °C, *E. coli* O157:H7, *Salmonella*, and *L. monocytogenes* populations increased by ca. 1, 2, or $0.3 \log \text{CFU/g}$, respectively, with the majority of growth occurring during the first 17 h. On occasion, populations on cut surfaces were significantly higher than those on uncut surfaces. Results indicate that populations are reduced under refrigeration, but survive and may grow at elevated temperatures.

Keywords: /Celery/ /Fresh-Cut/ / *Escherichia coli* O157:H7/

LETTUCE

Posada-Izquierdo, Guiomar D. et.al. 2013. Modelling growth of *Escherichia coli* O157:H7 in fresh-cut lettuce submitted to commercial process conditions: Chlorine washing and modified atmosphere packaging. *Food Microbiol.* 33: 131 – 138.

Fresh-cut iceberg lettuce inoculated with *Escherichia coli* O157:H7 was submitted to chlorine washing (150 mg/mL) and modified atmosphere packaging on laboratory scale. Populations of *E. coli* O157:H7 were assessed in fresh-cut lettuce stored at 4, 8, 13 and 16 °C using 6e8 replicates in each analysis point in order to capture experimental variability. The pathogen was able to grow at temperatures 8 °C, although at low temperatures, growth data presented a high variability between replicates. Indeed, at 8 °C after 15 days, some replicates did not show growth while other replicates did present an increase. A growth primary model was fitted to the raw growth data to estimate lag time and maximum growth rate. The prediction and confidence bands for the fitted growth models were estimated based on Monte-Carlo method. The estimated maximum growth rates (log cfu/day) corresponded to 0.14 (95% CI: 0.06e0.31), 0.55 (95% CI: 0.17e1.20) and 1.43 (95% CI: 0.82e2.15) for 8, 13 and 16 °C, respectively. A square-root secondary model was satisfactorily derived from the estimated growth rates ($R^2 > 0.80$; $B_f \frac{1}{4} 0.97$; $A_f \frac{1}{4} 1.46$). Predictive models and data obtained in this study are intended to improve quantitative risk assessment studies for *E. coli* O157:H7 in leafy green products.

Keywords: /Lettuce/ /Fresh-Cut/

MUSHROOM

Jiang, T. et. al. 2013. Physicochemical responses and microbial characteristics of shiitake mushroom (*Lentinus edodes*) to gum arabic coating enriched with natamycin during storage. *Food Chem.* 138: 1992 – 1997.

Abstract

Physicochemical responses and microbial characteristics of shiitake mushroom (*Lentinus edodes*) to gum arabic (GA) coating incorporating natamycin (NA) during storage were investigated. Mushroom weight loss, firmness, total soluble solids, total sugar, reducing sugar, ascorbic acid, and microbial and sensory quality were measured. Mushroom coated with gum arabic + natamycin (GANA) maintained tissue firmness and showed reduction in microbial counts from yeasts and moulds compared with the control. In addition, GANA coating also delayed changes in the soluble solids concentration, total sugar and ascorbic acid. Sensory evaluation proved the efficacy of GANA coating by maintaining the overall quality of shiitake mushroom during the storage period. The efficiency was better than that of GA or NA treatment alone. Our study suggests that GANA has the potential to improve the quality of shiitake mushroom and extend its shelf-life up to 16 d.

Keywords: /Mushroom/ /Storage/

SPINACH

Gergoff Grozeff, G.E. et al. 2013. Low irradiance pulses improve postharvest quality of spinach leaves (*Spinacia oleracea* L. cv Bison). *Postharvest Biol. & Technol.* 77: 35–42.

Abstract

The aim of this work is to extend and improve the postharvest life of mature spinach leaves using clean technologies like the use of short pulses of light at low irradiance. After harvest spinach leaves were immediately sealed in polyethylene bags in the laboratory. These bags were placed in a dark chamber at 23 °C under continuous dark or with the application of light pulses (LP) consisting of 15 min each 2–6 h or 7 min each 2 h for 3 d. The chosen irradiance, 30 mol m⁻² s⁻¹ PPFD, corresponded to the light compensation point previously measured in spinach plants under greenhouse conditions. After the leaves were treated with LP for 3 d, all the samples were transferred to a chamber at 4 °C under continuous dark for another week. Senescence was triggered in leaves under continuous dark after 3 d of storage and delayed in those receiving LP. In addition ascorbic acid and glutathione contents were kept higher in LP-treated than in untreated spinach. These trends were conserved after storage under continuous dark and refrigeration for another week. When LP was applied in combination with 1-MCP the antioxidant capacity was further improved. These results demonstrate that short LP of low irradiance can be used to extend and to improve postharvest life of mature spinach leaves.

Keywords: /Postharvest Quality/ / Spinach/

Puerta- Gomez, A.F. et al. 2013. Quantitative assessment of the effectiveness of intervention steps to reduce the risk of contamination of ready-to-eat baby spinach with *Salmonella*. Food Control. 31: 410 – 418.

Abstract

The objective of this study was to develop a quantitative risk assessment model to evaluate the microbial hazards during processing of baby spinach leaves using scenario analysis and predictive microbiology. The effectiveness of intervention strategies (temperature control during harvest, washing, and irradiation) was also integrated into the risk assessment model. Monte Carlo simulation was used to take into account the variability of the model parameters. Cross-contamination seems the most probable scenario for prevalence of contamination on an entire lot of daily production. If the cross-contamination level of bacteria was low (w1 log₁₀ CFU/g, normal distribution) either on the field or after the washing treatments, the percentage of samples over the safety limit (1.33 log₁₀ CFU/g of sample) increased from 16.8% to 84% for a highly cross-contaminated lot (w3 log₁₀ CFU/g). The risk assessment revealed that exposure of the leafy greens to irradiation (1 kGy) reduces the number of tainted samples from 84% to 0.1%, for highly cross-contaminated lots (3 log₁₀ CFU/g). This study shows that the spinach processor can deliver a highly safe product in a cross-contamination scenario (on the field or packing shed) if the produce is harvested at 20 C, stored for at least 5 h, washed with water and chlorine (220 ppm), and exposed to irradiation treatment with a dose of 1 kGy.

Keywords: /Spinach/ /Baby Spinach/ /Ready to Eat/

TOMATO

Quattrucci, A. et al. 2013. Biological control of tomato bacterial speck using *Punica granatum* fruit peel extract. Crop Protection. 46: 18 – 22 .

Abstract

Pseudomonas syringae pv. tomato, the causal agent of tomato bacterial speck, is common in greenhouses and fields all over Italy. The antibacterial activity of ethanol extracts of *Punica granatum* (pomegranate) fruit peels on *P. syringae* pv. tomato was studied both in vitro and in vivo. The minimum in vitro inhibition value for peel extract of *P. granatum* on the *P. syringae* pv. tomato Pt 1301 strain (from Turkey) was obtained at a concentration of 0.5%. The in vivo antibacterial action of this natural substance lasted at least 15 days, permitting the replacement or reduction of the commonly used copper compounds. The active components of the pomegranate peel extracts were ellagic and gallic acids.

Keywords: /Tomato/ /Bacterial Speck/ / Biological Control/

Ahmed, L. et al. 2013. Effect of delactosed whey permeates treatment on physico-chemical, sensorial, nutritional and microbial properties of whole **tomatoes** during postharvest storage. LWT - Food Scie.& Technol. 51: 367 – 374.

Abstract

The objective of this study was to investigate the efficacy of delactosed whey permeate (DWP) treatment on the physico-chemical, microbial and antioxidant compounds of tomatoes stored at 15 C for 21 days compared with traditional chlorine treatment. Fresh tomatoes were treated with 3 ml/100 ml DWP or 120 mg/l chlorine solutions and packed in perforated polypropylene bags. The results showed that DWP treatment significantly reduced the number of total aerobic counts ($w1.62 \log \text{cfu/g}$) and yeast and moulds ($w1.66 \log \text{cfu/g}$) of tomatoes compared to chlorine during storage. Moreover, the tomatoes treated by DWP remained firmer (22%) than the control fruits and maintained significantly ($p < 0.05$) higher levels of vitamin C (15%), total phenols (10%) and antioxidant activity (26%) at the end of storage. Sensory scores confirmed that the DWP treated tomato fruits retained a good appearance and overall quality compared to the chlorine treated samples. The aroma and texture attributes were maintained better in DWP treated tomatoes than chlorine treated tomatoes during storage. Therefore, DWP treatment could be used as a potential washing agent for fresh tomatoes to extend the shelf-life and maintain the nutritional quality during storage.

Keywords: /Tomatoes//Postharvest Storage/

Castagna, A. et al. 2013. Effect of postharvest UV-B irradiation on nutraceutical quality and physical properties of **tomato** fruits. Food Chem. 137: 151 – 158.

Abstract

Nutraceutical (ascorbic acid and carotenoids) and physical (colour and firmness) parameters were evaluated in two tomato genotypes (Money maker and high pigment-1) subjected to post harvest UV-B irradiation at different ripening stages (mature green and turning). UV-B treatment increased the concentration of ascorbic acid and carotenoids in Money maker flesh and peel, while high pigment-1 fruits underwent only minor changes, suggesting that hp-1 mutation decreased the fruit ability to respond to UV-B radiation. Colour parameters appeared to be more influenced by harvesting stages than UV-B with the exception of redness (a), which in Money maker was found to increase in both flesh and peel of irradiated fruits at turning stage, although not significantly, while control was more red than treated at mature green stage. Firmness was negatively influenced by UV-B, as tomatoes were found to soften after the treatment, although this aspect needs further studies to be clarified.

Keywords: /Tomato/ /Postharvest/ /Quality/

Tzortzakis, N. et al. 2013. Profiling shifts in protein complement in tomato fruit induced by atmospheric ozone-enrichment and/or wound-inoculation with *Botrytis cinerea*. *Postharvest Biol. & Technol.* 78: 67 – 75.

Abstract

To unravel the mechanism by which low level atmospheric ozone-enrichment (0.05 mol mol⁻¹) increases the shelf-life of tomato fruit (*Lycopersicon esculentum* Mill.) by suppressing the growth of pathogens (*Botrytis cinerea*), protein yield and composition were examined during and following exposure to the gas at 13 °C/95% RH. Ozone-enrichment caused marked changes in protein yield and composition in control tomato fruit and suppressed shifts in the proteome induced by wounding/fungal attack. Wound/fungal-inoculation with *B. cinerea* resulted in a 7% increase in protein yield, and the down-regulation of at least 32 proteins. A number of proteins affected under ozone and wound/fungal inoculation treatments are involved in the control of cellular oxidative status. Proteins that may be enhanced under oxidative stress were induced during ozone exposure (e.g. thioredoxin peroxidase-TPX), but suppressed following transfer to 'clean air' (e.g. ascorbate peroxidase-APX1). Constitutively expressed proteins tended to increase reversibly under ozone-treatment, however proteins involved in ripening such as an enzyme related to ethylene biosynthesis (1-aminocyclopropane-1-carboxylate oxidase-ACO) were markedly reduced in ozone-treated tomato fruit but increased in wound-inoculated fruit. Levels of proteins involved in carbohydrate metabolism, pentose phosphate pathway, terpenoid and flavonoid biosynthesis differentiated among the treatments. The presented dataset makes a central contribution to a comprehensive analysis of the manner in which tomato fruit react to ozone-enrichment and/or pathogen infection during storage/transit.

Keywords: /Tomato/ /Modified Atmosphere Storage/

Zhang, X. et al. 2013. Arginase induction by heat treatment contributes to amelioration of chilling injury and activation of antioxidant enzymes in tomato fruit. *Postharvest Biol. & Technol.* 79: 1 – 8.

Abstract

Treatment of tomato (*Solanum lycopersicum* L. cv. Messina) fruit with hot air (HA) at 38 °C enhanced the transcript levels of LeARG1 and LeARG2, the two genes encoding arginase, and arginase activity. The strongest induction of LeARG1 and LeARG2 transcripts was observed after fruit treated with 38 °C HA for 12 h, which also effectively alleviated chilling injury (CI) of tomato fruit, manifested as decreased CI index, electrolyte leakage and malondialdehyde content during cold storage. To investigate the potential role of arginase in HA-induced chilling tolerance, fruit were treated with HA, or arginase inhibitor N-hydroxy-nor-L-arginine (nor-NOHA) combined with HA and then stored at 2 °C for up to 28 d. The results showed that HA-induced arginase activity was strongly inhibited by pretreatment with nor-NOHA and the reduction of CI by HA was nearly abolished by the arginase inhibitor. In addition, HA treatment increased activities of superoxide dismutase, catalase and ascorbate peroxidase, inhibited peroxidase activities, and promoted the accumulation of arginine, proline and putrescine. These effects were partially counteracted by nor-NOHA except that arginine and putrescine accumulation was unaffected. Our results indicate that arginase induction may be partly involved in HA-induced chilling

tolerance in tomato fruit, possibly by a mechanism involving activation of antioxidant enzymes and an increase in proline levels.

Keywords: /Chilling Injury/ / Tomato Fruit/

HERBS AND SPICES

ARTICHOKES

Ghidelli, Christian, et.al. 2013. Antibrowning effect of antioxidants on extract, precipitate, and fresh-cut tissue of **artichokes**. LWT – Food Sci. & Technol. 51: 462 – 468.

Abstract

The effect of antioxidants controlling enzymatic browning of artichokes cv. 'Blanca de Tudela' was studied in extracts and fresh-cut tissue. Initially, the effect of ascorbic acid (AA), citric acid (CA), peracetic acid (PA), calcium chloride (CaCl₂), cyclodextrin (CD), cysteine (Cys), hexametaphosphate (HMP), and 4-hexylresorcinol (Hexyl) at different concentrations was studied in extracts and precipitates. Absorbance at 450 nm of artichoke extract and color of the pellets were measured, as a preliminary screening of antioxidants controlling browning. AA at 10 mol/m³ was the most effective controlling browning in the extract and pellet; whereas, Cys and 4-Hexyl were effective at a higher concentration (50 mol/m³) and CA was only effective in the extract. Application of AA, CA, Cys, and Hexyl at different concentrations was studied on fresh-cut artichokes during storage at 5 °C. Samples treated with Cys (0.1, 0.3, 0.5, 1%) showed the highest L* and lowest a* values. An increase in Cys concentration decreased a* and increased b* values, which correlated with a decrease in browning and an increase in yellowness of the tissue. Application of CA (1, 2.7, 5.3%), AA (0.5, 1, 1.5, 2%) and Hexyl (0.002, 0.005%) did not inhibit enzymatic browning. Visual evaluation confirmed these results.

Keywords: /Artichokes/ /Fresh Cut/ /Antibrowning/ /Antioxidants/

GARLIC

Llamas, D.P. et al. 2013. The effects of storage duration, temperature and cultivar on the severity of **garlic** clove rot caused by *Fusarium proliferatum*. Postharvest Biol. & Technol. 78: 34 – 39.

Abstract

Diseases that affect garlic during storage can lead to severe economic losses for farmers worldwide. One causal agent of clove rot is *Fusarium proliferatum*. Here, the progress of clove rot caused by *F. proliferatum* and its dependence on different storage conditions and cultivar type were studied. The effect of temperature on mycelial growth, conidial viability, and fungal survival during garlic commercial storage was documented. Samples of 50 bulbs from a randomized field trial with three different clonal generations for purple garlic (F3, F4 and F5) and the F4 clonal generation for white garlic were labelled and stored for two months (short-term storage). In addition, another sample of the F5 clonal generation of purple garlic was stored for 6 months after harvest (long-term storage). The presence of the pathogen and the percentage of symptomatic cloves were evaluated. A notable difference in the rot severity index (RSI) of different garlic varieties was observed. In all studied cases, clove rot increased with storage time at 20 °C, and the white garlic variety had a higher index of rot

severity after two months of storage. Additionally, there were clear differences between the growth rates of *F. proliferatum* isolates. Studies conducted on the temperature responses of the pathogen propagules showed that exposure for at least 20 min at 50 °C was highly effective in significantly reducing the viability of fungal conidia. Pathogenicity studies showed that the fungus is pathogenic in all commercial varieties. However, there were significant differences in varietal susceptibility between Chinese and white garlic type cultivars ($81.84 \pm 16.44\%$ and $87.5 \pm 23.19\%$ symptomatic cloves, respectively) and purple cultivars ($49.06 \pm 13.42\%$ symptomatic cloves).

Keywords: /Garlic/ /Clove Rot/ /Storage/

PEPPER

Marmura, T. Y. Elkind B., A. Nussinovitch. 2013. Increase in gloss of coated red peppers by different brushing procedures. LWT – Food Sci. & Technol. 51: 531 – 536.

Abstract

Coating glossy surfaces may reduce their surface shine to undesirable levels. To minimize this effect, we studied pepper, a naturally highly glossy material, which had been coated with a hydrocolloid-wax preparation, reducing its gloss by w30%. We hypothesized that the reduced gloss could be increased by a simple brushing procedure. We examined various parameters related to brushing e type of brush, revolutions per minute (RPM) and brushing time e to determine what might best restore the fruit's initial, pre-coating gloss. Brushes with horse hair or nylon bristles, run at 100, 200 or 300 RPM for 1 or 10 min were tested. It was concluded that the horse hair brush gives better results for the coated and brushed commodity than the nylon brush, possibly due to the structure of the fibers and the nature of the formulation. A sensory evaluation panel concluded that coating and then brushing results in a product that is closer in appearance to the natural non-treated pepper, although still not as glossy as the non-coated product.

Keywords: /Pepper/ /Brushing/

SWEET PEPPER

Kong, Y. et al. 2013. Pearl netting affects postharvest fruit quality in 'Vergasa' sweet pepper via light environment manipulation. Scientia Hort. 150: 290 – 298.

Abstract

Red sweet pepper (*Capsicum annuum* L. cv. Vergasa) was grown under Pearl or black (control) nettings with 35% shading to compare their effects on postharvest fruit quality. Fully colored fruits were harvested four times from October to December, and after each harvest they were stored at 7 °C for 16 days, followed by 20 °C for 3 days. Compared with black netting, the Pearl netting significantly reduced water loss, decay incidence and titratable acidity, and increased fruit firmness, elasticity, ascorbic acid level and antioxidant activity, but did not change the external quality, except for a decrease in chroma. The effects of the Pearl netting were most pronounced on late-season-harvested fruits. Significant interactions were obtained between the shade netting type and harvest date. Analysis of correlations among the quality traits indicated that increased antioxidant activity and ascorbic acid content were tightly associated with the postharvest fruit quality attributes affected by the Pearl netting. Comparison

between climatic parameters under the two netting treatments revealed no significant difference in air temperature and humidity, but the Pearl netting increased not only transmittance of long-waveband light but also light intensity within plant canopy. The findings suggest that the Pearl netting is more effective in maintaining postharvest sweet pepper fruit quality than the traditional black netting, especially at late-season harvests. The effects of the Pearl netting can be related to alteration of antioxidant levels induced by the pre-harvest light environment manipulation.

Keywords: /Sweet Pepper/ / Postharvest/ /Quality/

TUBERS & ROOTCROPS

POTATO

Blauer, J.M. et al. 2013. Changes in ascorbate and associated gene expression during development and storage of **potato** tubers (*Solanum tuberosum* L.). *Postharvest Biol. & Technol.* 78: 76 – 91.

Abstract

Reducing postharvest loss of AsA in potato (*Solanum tuberosum* L.) tubers could greatly increase their contribution to vitamin C in our diet. Knowledge of developmentally linked changes in AsA content in relation to associated gene expression (from tuberization through bulking, maturation and storage) will facilitate elucidation of the mechanisms regulating tuber AsA content, and is a prerequisite to developing high vitamin C retaining genotypes. Transcript levels of genes in the Smirnoff-Wheeler pathway increased as field-grown tubers developed to 10 g, suggesting *de novo* synthesis *in situ* contributes to AsA content early in development. Transcripts of GGP (GDP-L-galactose phosphorylase/guanylyltransferase), a potential rate limiting step in AsA biosynthesis, increased as tubers developed from non-tuberized stolons to the 0.6–1.5-g tuber stage, in parallel with an increase in AsA concentration. High levels of GGP expression continued through 84 DAP (~54-g tubers) when 75% of the final AsA concentration of fully mature (240-g) tubers had been established. Expression levels of other key genes in the AsA pathway were also temporally correlated with AsA accumulation during tuberization and early bulking. Tuber AsA concentration began to fall during vine senescence and continued to decline progressively through maturation and storage, consistent with low levels of gene expression, and losses reached 65% over an 8.5 month storage period. The rate of loss was genotype dependent. Storage of tubers under reduced O₂ attenuated AsA loss, suggesting a regulatory role for oxidative metabolism in AsA loss/retention. Wounding of tubers induced AsA biosynthesis and recycling, indicating metabolic competence for AsA synthesis in the detached organ. Crop breeding and postharvest handling strategies for enhancing content and retention of tuber AsA will evolve from a better understanding of the metabolic regulation of these processes.

Keywords: /Potato / /Potato/

Gachango, E. et al. 2013. Evaluation and comparison of biocontrol and conventional fungicides for control of postharvest **potato** tuber diseases. *Biological Control* 63: 115 – 120.

Abstract

Two biocontrol fungicides (*Bacillus subtilis* and *Bacillus pumilus*) and three conventional fungicides (phosphorous acid, azoxystrobin and hydrogen peroxide) were evaluated in two storage trials

over 2 years for efficacy in suppressing tuber infection caused by *Phytophthora infestans*, *Phytophthora erythroseptica*, *Pythium ultimum* and *Fusarium sambucinum*. A chip-processing cultivar, FL 1879, stored at 10 C was used for the two trials. Tubers were inoculated followed by treatment with the fungicides prior to storage. Disease incidence was assessed after 120 d in storage. The biocontrol fungicides had limited control of the storage pathogens compared to the conventional fungicides. Phosphorous acid, hydrogen peroxide and azoxystrobin were moderately effective in controlling diseases caused by the oomycete pathogens. Although none of the products evaluated completely controlled the storage diseases, the conventional fungicides showed a higher potential for suppressing tuber infection in storage than the biocontrol fungicides. Use of these biocontrol fungicides could be integrated with other management strategies.

Keywords: /Potato/ /Postharvest/ /Biocontrol/

Wood, E.M., T.D. Miles & P.S. Wharton. 2013. The use of natural plant volatile compounds for the control of the **potato** postharvest diseases, black dot, silver scurf and soft rot. *Biological Control*. 64: 152 – 159.

Abstract

Many naturally occurring plant volatile compounds are known for their anti-fungal properties. In this study, acetaldehyde and 2E-hexenal were chosen as prototype volatiles in order to investigate the use of volatile compounds for control of blemish pathogens in fresh-pack potato packaging. Pure cultures of the three main potato blemish pathogens, *Pectobacterium atrosepticum* (bacterial soft rot), *Colletotrichum coccodes* (black dot), and *Helminthosporium solani* (silver scurf), were used in the study. Pathogen cultures were exposed to the pure volatiles that were injected into the atmosphere of sealed jars for 4–8 days at 23 C. Results showed that 2E-hexenal was the most effective of the two volatiles with 5 IL/L providing complete inhibition of growth for all three pathogens in vitro. Cytological studies showed that a concentration of 2.5 IL/L of 2E-hexenal was capable of inhibiting germination in both fungal pathogens. These results suggest that the primary mode of action of 2E-hexenal was inhibiting germination for fungi and suppressing bacterial growth. The quantities required to achieve pathogen inhibition are extremely low. This study suggests that these volatiles may be used to effectively manage potato postharvest blemish diseases in storage.

Keywords: /Potato Postharvest Diseases/ / Biological Control/

SUGARBEET

Ferrareze, J.P. et al. 2013. Jasmonic acid does not increase oxidative defense mechanisms or common defense-related enzymes in postharvest **sugarbeet** roots. *Postharvest Biol. & Technol.* 77: 11–18

Abstract

Jasmonic acid (JA) treatment significantly reduces rot due to several sugarbeet (*Beta vulgaris* L.) storage pathogens. However, the mechanisms by which JA protects postharvest sugarbeet roots from disease are unknown. In other plant species and organs, alterations in antioxidant defense mechanisms and elevations in common pathogenesis-related defense enzymes have been implicated in jasmonate-induced disease resistance. To investigate whether these mechanisms are involved in JA-induced disease resistance in stored sugarbeet roots, the activities of several reactive oxygen species (ROS)-scavenging

and pathogenesis-related defense enzymes and the total concentration of antioxidant compounds were determined in harvested sugarbeet roots in the 60 d following treatment with JA. ROS-scavenging and pathogenesis-related defense enzymes and the concentration of antioxidant compounds were largely unaffected by JA as JA-treated roots exhibited small declines in superoxide dismutase (SOD) and chitinase activities, and were generally unaltered in ascorbate peroxidase (APX), catalase (CAT), peroxidase (POD), β -1,3-glucanase (β -Gluc), polyphenol oxidase (PPO) and phenylalanine ammonia-lyase (PAL) activities or antioxidant compounds concentration. The lack of increase in enzyme activities or metabolites related to defense against oxidative stress or pathogens suggests that JA-induced disease resistance in postharvest sugarbeet roots does not arise from a direct increase in any of the ROS-scavenging and defense-related enzymes examined, or the concentration of total antioxidant compounds. However, ROS-scavenging enzymes and pathogenesis-related defense enzymes were affected by storage duration with POD, SOD, β -Gluc, chitinase, and PPO activities elevated and APX and CAT activities reduced in roots stored for 10 d or more. Storage-related changes in activities of ROS-scavenging enzymes and defense-related enzymes provide further evidence that these enzymes are uninvolved in sugarbeet root disease resistance during storage since many of these enzymes increased in activity after prolonged storage when disease resistance generally declines.

Keywords: /Sugarbeet/ /Postharvest/

TURNIP

Martinez, S. et al. Effect of blanching methods and frozen storage on some quality parameters of **turnip** greens ("grelos"). LWT- Food Sci. & Technol. 51: 383 – 392.

Abstract

In this research, the effects of different blanching conditions and frozen storage on the stability of some quality factors in turnip greens ("grelos") grown in the northwest of Spain were studied. The turnip greens were blanched in water, in water with different concentration of citric acid or in water with different concentration of ascorbic acid. The heat treatment was carried out at 90 C for 1 or 2 min. Blanching in water reduced the content of total soluble solids, chlorophyll and total phenolics as well as the antioxidant activity of turnip greens. Blanching in water with citric acid caused the most important changes in pH values and titratable acidity. The use of ascorbic acid during the blanching process gave rise to a high antioxidant capacity of turnip greens. The chlorophyll loss depended on the type of acid and its concentration as well as on the blanching times. The use of acids in the blanching water minimized the loss of total soluble solids, antioxidant capacity and total phenolic during frozen storage.

Keywords: /Turnip/ /Storage/