VII Postharvest Unlimited Congress
Abstract book Posters

		Day 1 (15-5-2023)		
08:30 - 10:00	1h30'	8:30 - 9:00 Opening 9:00- 9:30 Keynote Toine Timmermans 9:30 - 10:00 Keynote Ernst Woltering		
		chair Woltering		
10:00 - 10:30	**0h30'**	***break: Coffee & poster viewing***		
10:30 - 12:00	1h30'	Invited speakers: Innovations in postharvest technology and engineering Thijs Defraeye; Rick vd Zedde; Bart Nicolai		
		chair Verdonk		
12:00 - 13:30	**1h30'**	***lunch & poster session 1***		
time slot	**time allocated**	**Podium**	**Momentum 2+3**	**Momentum 1**
13:30 - 15:00	1h30'	PHU session 1a Invited: Pedreschi Physiology 1 *chair Brouwer*	PHU session 1b Postharvest Pathogens 1 *Chair Gabriëls*	PHO session 1 Invited: Celikel *Chair Schouten*
15:00 - 15:45	**0h45'**	***break: Coffee & poster viewing***		
15:45 - 17:15	1h30'	PHU session 2a Invited: Mishra Quality Measurements 1 *chair Nicolai*	PHU session 2b Storage and technology 1 chair De Fraeye	PHO session 2 Invited: Fanourakis *chair Celikel*
17:30 - 18:30		***business meeting Unlimited***		
		Day 2 (16-5-2023)		
09:00 - 10:15	1h15'	PHU session 3a Invited: Bovy Pre-harvest conditions 1 chair Gabriëls	PHU session 3b Sensory & nutrition chair Langer	PHO session 3 Invited: Arens chair Fanourakis
10:15 - 11.00	**0h45'**	***break: Coffee & poster viewing***		
11:00 - 12:15	1h 15'	PHU session 4a Invited: Lukasse Logistics and modelling chair Bovy	PHU session 4b Pre-harvest treatments 1 chair Arens	PHO session 4 Chair Zepeda
12:15 - 14:00	**1h45'**	***lunch & poster session 2 & business meeting Ornamentals (momentum 1)***		
14:00 - 15:30	1h 30'	PHU session 5a Quality Measurements 2 *chair Mishra*	PHU session 5b Physiology 2 *Chair Farneti*	PHO session 5 Invited: Verdonk *chair Woltering*
15:30 - 17:00	1h 30'	Excursion NPEC/Phenomea/Unifarm	Excursion NPEC/Phenomea/Unifarm	Excursion NPEC/Phenomea/Unifarm
19:00 - 22:30		***Conference dinner WICC***		
		Day 3 (17-5-2023)		
09:00 - 10:30	1h30'	PHU session 6a Invited: Farnetti Physiology 3 chair pedreschi	PHU session 6b Preharvest conditions 2 chair van de Zedde	PHU session 6c Postharvest Pathogens 2 chair Verschoor
10:30 - 11:00	**0h30'**	***break : Coffee & poster viewing***		
11:00 - 12:30	1h30'	PHU session 7a Quality Measurements 3 chair Lukasse	PHU session 7b Postharvest treatments 1 chair Singh	PHU session 7c Chilling and disorders 1 chair Affandi
12:30 - 14:00	**1h30'**	***lunch & poster session 3***		
14:00 - 15:00	1h30'	PHU session 8a Chilling and disorders 2 chair Ferrante	PHU session 8b Packaging and coating 1 chair Paillart	PHU session 8c Storage and technology 2 chair Pedrotti
15:00 - 15:30	**h30'**	***break: Coffee & poster viewing***		
15:30 - 16:30	1h30'	PHU session 9a Packaging and coating 2 *chair Beaudry*	PHU session 9b Postharvest treatments 2 *chair Campos vargas*	PHU session 9c Storage and technology 3 chair Wood
16:30 - 17:00	0h30'	***Closing of the Symposium***		
17:00 - 18:00		***Farewell drinks***		

VII Postharvest Unlimited
ISHS International Conference
14-18 May 2023 - Wageningen, NL

XII Postharvest Ornamentals
ISHS International Symposium
14-16 May 2023 - Wageningen, NL

Session: Posters 1 - Chilling and other storage disorders

Metabolomic and transcriptome profiling to elucidate the effect of 1-methylcyclopropene on chilling injury in bell pepper

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Abstract

Although cold storage is effective in maintaining postharvest quality and shelf life of fruit and vegetables, but it can cause fatal chilling injury (CI) to bell pepper fruit. CI symptoms in bell pepper include not only shrivelling, pitting, and softening, but also pericarp browning in severe cases, which leads to decay by secondary infection. 1-Methylcyclopropene (1-MCP), which regulates respiration by controlling the ethylene mechanism, is often suggested to solve the problem due to cold storage. 'Volante' and 'Maldonado' are typical yellow and red bell pepper cultivars in Korea, respectively. For these bell pepper cultivars, preliminary experiments show that ethylene has an effect of on the ripening mechanism. Therefore, to confirm the effect of 1-MCP on CI, after harvest, the 1uL L -1 1-MCP was treated at room temperature for 18 h, stored at 0.5 o C for 2 weeks, then shelf life at 22 o C for 1 week to induced CI. In the 'Volante', severe CI symptoms such as pericarp browning were effectively alleviated by 1-MCP, whereas in the 'Maldonado' fruit had only mild CI in the control group and had no 1-MCP effect on severe shrivelling. To identify the factors involved in these results, we performed a transcriptome analysis using RNA-Seq technology to compare 1-MCP effects on CI occurrence in two bell pepper cultivars. Transcript levels changed dramatically in different cultivars rather than in the treatment of 1-MCP. Nevertheless, Maldonado and Volante differently responded to the treatment of cold and 1-MCP. Three clusters can be classified, and gene ontology enrichment analysis revealed that DEGs are closely related to carbon metabolism, ubiquitination and membrane proteins, and phenylpropanoid and signaling pathways. Interestingly, biosynthetic pathways and secondary metabolites such as free sugars, organic acids, amino acids, and fatty acids by metabolomic analysis are linked to transcriptome analysis results, providing in-depth understanding of the regulatory mechanism associated with controlling CI by 1-MCP treatment in bell pepper cultivars. (Financial support for this research was supported by the research program (PJ01455903) of Rural Development Administration, Republic of Korea.)

Session: Posters 1 - Chilling and other storage disorders

Superficial scald incidence in 'Abate Fetel' pears in relation to maturity, ethylene production and antioxidant capacity

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Abstract

Superficial scald (SS) is a storage disorder that affects 'Abate Fetel' pears stored for long period resulting in important economic losses. Maturity at harvest, together with storage conditions, strongly affect SS: late harvest, controlled atmosphere storage, and 1-MCP treatment can prevent SS development. SS can be considered a chilling injury linked to oxidative processes occurring during storage, and its susceptibility depends on the interaction between ethylene production, α-farnesene and conjugated trienols accumulation, antioxidant content (phenols, ascorbate) and antioxidant capacity. The aim of this work was to study the relationships between maturity at harvest, non-destructively measured by time resolved reflectance spectroscopy (TRS), and SS incidence in relation to ethylene production and antioxidant potential in 'Abate Fetel' pears. At harvest, 780 pears were measured by TRS for absorption coefficient at 670 nm(μa670), ranked by μa670 in three maturity classes (less-LeM, medium-MeM and more-MoM mature), and randomized in different samples according to 1-MCP treatment (treated, untreated), storage time (17, 21, 25 weeks) and atmosphere (−1°C; air-NA; CA: 8-12 kPa O2, 1 kPa CO2). Fruits were examined after 7 days of shelf life for SS incidence and severity. LeM and MoM pears were also analyzed for ethylene production (EP), total phenol content (TPC) and antioxidant capacity (TAC). SS increased with storage time reaching the highest values in untreated pears stored for 21 weeks. Maturity class significantly affected SS incidence as well as EP, TPC and TAC in combination with storage conditions and 1-MCP treatment. LeM untreated pears stored in NA showed the highest SS incidence and severity, coupled with the highest EP and low TPC and TAC. MoM 1-MCP-treated pears stored in NA and in CA showed the lowest SS incidence and the highest TPC and TAC while no difference was found for EP in treated LeM and MoM pears.

Session: Posters 1 - Chilling and other storage disorders

Delaying Quality Changes in 'Namdokmai Sithong' Mango during Low-Temperature Storage Using Trisodium Phosphate

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Abstract

'Namdokmai Sithong' is a popular cultivar of mango in Thailand that is widely exported to foreign countries, however, its quality can deteriorate during storage. This study aimed to investigate the effects of trisodium phosphate (TSP) on the preservation of mango fruit quality during low-temperature storage. The experiment was conducted in a completely randomized design (CRD) with four treatment groups and four replications. Mango fruits were dipped in TSP solutions at concentrations of 0 (control), 0.25, 0.50, and 0.75 g/L for 10 min prior to being stored at 6+-2°C and 85+-5% relative humidity for 25 days. Quality measurements were recorded at 5-day intervals. The results indicated that TSP treatment had no effect on fruit firmness, but it significantly delayed changes in peel color, increased TSS and H 2 O 2 , and TA and phenols. The highest TSP concentrations (0.50 and 0.75 g/L) were found to be most effective in preserving the quality of mangoes with no significant difference observed between the two concentrations. Based on these results, it is recommended to use 0.50 g/L of TSP for cost efficiency.

Session: Posters 1 - Chilling and other storage disorders

Biochemical compounds related to superficial scald in 'Abate Fetel' pears

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Abstract

The biochemical mechanism related to superficial scald (SS) development is still unclear: compounds such as α-farnesene and its oxidation products, the conjugated trienols (CT), seem to be involved, but several antioxidants can also have a role in the protection against this disorder. Untreated (C) or 1-MCP treated (T) 'Abate Fetel' pears were stored at −1°C in air (NA) or under controlled atmosphere (CA, 8% O2, 1% CO2). Untreated fruit were also subjected to initial low oxygen stress (IL) and then stored in CA at -1°C . Fruit peel was analyzed after 4 and 5 months of storage plus 7 days at 20°C. C-NA pears showed a high SS percentage (> 70%), followed by C-CA (40%), T-NA (7%), and T-CA (≈1%). IL treatment had very low SS incidence, but 15% of the fruit were affected by soft scald. No difference in α-farnesene concentration was found among treatments. T-fruit had the lowest CT269 and CT281 content and the highest CT258/CT281 ratio, while IL pears showed similar values to NT-fruit. Malondialdehyde concentration was lower in T-CA fruit, indicating a lower lipid peroxidation. T-fruit had higher antioxidant activity and polyphenol content than other treatments, regardless of the storage atmosphere. Some phenolics, such as catechin and chlorogenic acid, were definitely higher in T-fruit, either stored in CA or NA. The content of two, still unidentified, quercetin glucosides was higher in T than in C-treatment when fruit were stored under the same conditions, while it was lower in IL-fruit. IL-fruit also revealed the lowest content of quercetin 3-rhamnoside and quercetin-3-galactoside. The triggering factor for pears scald development is, probably, the α-farnesene oxidation to CT. The higher phenolics concentration and antioxidant activity in the peel of T-fruit could have reduced the α-farnesene oxidation and the subsequent SS occurrence.

Session: Posters 1 - Pathogens and Pests

Sprout suppressing 1,4-dimethylnaphthalene treatment delays dry rot infection in potato tubers

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Abstract

Fourteen species of Fusarium are associated with dry rot disease in potato tubers. Postharvest losses related to dry rot can reach up to 60% during long-term storage. Current control methods do not provide efficient solution; one promising way of controlling this disease is by activating natural defense mechanisms via elicitors to induce resistance. In this study we evaluated the effects of 1,4-dimethylnaphthalene (DMN) and methyl jasmonate (MeJa) to induce natural resistance to dry rot caused by Fusarium nirenbergiae using a resistant cv. Asterix and susceptible cv. Challenger under cold storage. In vitro and in vivo tests were carried out by evaluating the volume of infection and the activity of antioxidant and defense-related enzymes, including polyphenol oxidase, peroxidase, catalase, ascorbate peroxidase, phenylalanine ammonia-lyase, lipoxygenase and glucanase. The results indicate that the reduction in the volume of infection due to DMN application is not coupled with the expression of evaluated enzymes. Changes observed in such enzyme's behavior are likely to be associated with differences in disease susceptibility between cultivars and not with the applied compounds. Our data suggest that the efficiency of DMN in reducing the volume of infection is linked to a direct action on the pathogen rather than the activation of defense mechanism via antioxidant and defense-related enzymes.

Session: Posters 1 - Pathogens and Pests

Synergistic effect of salicylhydroxamic acid in quinone outside inhibitor fungicides and its sensitivity on fruit rot pathogens

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Abstract

The synergistic effect of salicylhydroxamic acid (SHAM) with azoxystrobin (AZ), trifloxystrobin (TF), and pyraclostrobin (PR) in quinone outside inhibitor (QoI) group on fruit rot pathogens was investigated. Twenty-five fungal pathogen isolates were collected from chili, mango, and durian fruit rot. There were 10 isolates of Phytophthora palmivora from durian fruits and 15 isolates of Colletotrichum spp. from chili and mango fruits. The efficiency of SHAM interacts with AZ, TF, and PR at various concentration to the growth of mycelial was statistically defined by a synergy factor (SF). A value of SF above 1 represented the synergism of SHAM and fungicide in QoI to inhibit fungi respiration.The fungicide sensitivity was evaluated with the classification of the levels of sensitivity based on 50% effective concentrations (EC 50). All of the tested isolates were susceptible to QoI fungicides at EC 50 lower than 10 mg/l. Only isolate of Colletotrichum sp. from chili (CC_P003) was intermediately resistant to AZ at 16.52 mg/l EC 50 .

Session: Posters 1 - Pathogens and Pests

Fungicidal activity of some essential oils and zinc oxide nanoparticles on Colletotrichum capsici and C. gloeosporioides causing chili anthracnose

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Abstract

Natural products are currently important sources in the antifungal spectrum properties for managing plant diseases. The study aimed to evaluate the potential protective role of essential oils (EOs) and zinc oxide nanoparticles (ZnO-NPs) against C. capsici (CC01) and C. gloeosporioides (CG02) causing chili anthracnose. The EOs extracted from 4 plants (clove bud, sweet fennel, kaffir lime, and holy basil) and ZnO-NPs with 25-50 nm in sizes revealed the fungicidal activity. Each extracted essential oil with 5, 10, and 20 ul/paper disc (d 6 mm) and ZnO-NPs at 0, 500, 1,000, and 2,000 ug/ml were tested for their effects on the mycelial growth of both fungi. They inhibited the mycelial growth of pathogens and infection of chili fruits. The increasing volume of EOs increased the extent of fungal growth inhibition by the inverted petri-dish method. Clove bud oil and sweet fennel oil at 20 ul/paper disc showed the maximum growth inhibition of CC01 at 72.57% and 55.45%, respectively. The sweet fennel oil at 10 ul/paper disc and 20 ul/paper disc inhibited the maximum growth of CG02 at 32.68% and 34.58%, respectively. However, holy basil, sweet fennel, and clove bud oils at 5 ul/paper disc had the greatest efficiency for controlling the lesions after inoculation with both fungal isolates on chili fruits. Moreover, ZnO-NPs with increasing concentrations could significantly inhibit the mycelial growth of both fungi. ZnO-NPs at 2,000 ug/ml had the greatest effectiveness for inhibiting the mycelial growth of CC01 and CG02 at 48.54% and 53.76%, respectively. It also reduced the disease severity of chili fruits at 40.51% and 34.13% in CC01 and CG02, respectively. These results suggest that using EOs and ZnO-NPs could be a good and environmentally safe alternative for fungicides in controlling chili anthracnose.

Session: Posters 1 - Pathogens and Pests

Insecticidal properties of lemon grass, clove, and star anise essential oils and their main chemical compounds against maize weevil (Sitophilus zeamais Motschulsky)

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Abstract

The use of plant essential oils (EOs) as an alternative approach to traditional pesticides for controlling stored product pests has gained increasing attention due to the potential to reduce insecticide resistance and toxic residues in products and the environment. In this study, the EOs of lemon grass (Cymbopogon citratus), clove (Syzygium aromaticum), and star anise (Illicium verum) and their main chemical compounds were evaluated for insecticidal properties in both toxicity and repellent forms against the maize weevil (Sitophilus zeamais). While the chemical compositions of the EOs were analyzed using gas chromatography-mass spectrometry (GC-MS). The results showed that citral was the major component (84.93%; cis-citral (49.10%) and trans- citral (35.83%)) in lemon grass EO, while eugenol (88.66%) and trans-anethole (95.28%) were the major compounds in clove and star anise EOs, respectively. The EOs demonstrated higher toxicity against adult maize weevils compared to their main chemical compounds. The clove EO showed the greatest potential for killing maize weevils, with an LC 50 of 3.044 μL·L air -1 , followed by the EOs of star anise (4.925 μL·L air -1) and lemon grass (5.769 μL·L air -1). The chemical compounds eugenol, trans-anethole, and citral had LC 50 values of 4.640, 5.441, and 6.433 μL·L air -1 , respectively. Lemon grass EO and citral showed potential for repelling maize weevils, with the highest repellence response observed at a concentration of 0.12 μL·cm -2 (over 75% response). Overall, the results suggest that clove EO may be effective for killing maize weevils, while lemon grass EO may be suitable for repelling this insect. However, further studies are needed to determine the suitability of these substances for use in farm conditions.

Session: Posters 1 - Pathogens and Pests

Development of microbial biocontrol agents against Thielaviopsis basicola on carrots

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Abstract

Thielaviopsis (T.) basicola is a plant pathogen responsible for the black root rot, which can lead to massive crop and storage damage. The soil-borne mould is associated with at least 170 plant genera including various root vegetables. Nowadays, no method for controlling this phytopathogen exists, neither synthetic nor biological. The only current way to prevent the spoilage of the vegetables by the black root rot is to maintain them in the cold chain until consumption. The aim of our project is to develop a microbial biocontrol agent consisting of lactic acid bacteria originating from Swiss plant material as well as bacteria isolated from the surface of the carrots to inhibit the development of black root rot on carrots. For that purpose, we screened 109 bacteria for their antagonistic activity against the mycelial growth and the spore germination of T. basicola in vitro . Among these bacteria, the eleven candidates showing the best results were consequently selected to evaluate their protective effect in post-harvest treatments of the carrots. The treated carrots were stored for three weeks and we assessed their T. basicola infection rate each week according to a previously established disease scoring. The treatment based on Serratia plymuthica showed a significant reduction of the infection during the whole observation period. We performed field experiments in two consecutive years, applying selected bacteria on the carrot seeds prior planting. Although none of the treatment conferred a significant protection of the carrots, some showed positive trends in controlling T. basicola growth. To increase the inhibitory potential of the treatments, we are currently testing consortia of the 11 bacteria in vitro . We have already observed an inhibition on the mycelial growth of almost 60% for the best mixtures. The next steps are to test these consortia as post-harvest treatments as well as in field experiments.

Session: Posters 1 - Pathogens and Pests

Assessing the use of an alternative solution for the microbial decontamination of Cannabis production facilities

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Abstract

Cannabis sativa is susceptible to contamination by harmful pathogens, from cultivation and harvest, to distribution. These pathogens may pose a r isk to consumer health in the form of diseases such as mild allergies, to potentially life-threatening opportunistic infections in the immunocompromised host. In addition, disease in the plant often leads to product of low quality and yield, resulting in significant financial losses for the Cannabis producer. The use of highly hazardous pesticides also poses a further threat to human health. Terra Vera provides a potential disinfectant solution for pathogen control, at a time when safer alternatives are increasingly being sought. The objectives of this study were to a ssess the level of contamination within Cannabis cultivating facilities, whilst evaluating the efficacy of the Terra Vera biopesticide. Environmental swabbing was performed at multiple sites within a Cannabis processing facility at the University of the West Indies Department of Life Sciences (Kingston, Jamaica) and the cultivator, processor and distributor, 'Sugar Top Buddery' (Eugene, Oregon) . At each facility, six surfaces were swabbed before and after cleaning with a neat concentration of Terra Vera. Swab samples were transported to PathogenDx laboratory (Scottsdale, Arizona) and processed through the Enviro x molecular testing platform, which utilises the Microarray DNA identification technique to detect the presence of various microbial species. Among the 24 swabs that were screened against 13 bacterial targets and 19 fungal targets, 44 (of a total 156) and 7 (of a total 228) targets were detected, prior to cleaning. Of these, 54.5% of bacterial and 55% of fungal targets were undetectable after cleaning. These results h ighlight the need to establish recommendations for environmental monitoring, to fulfil quality and safety standards for Cannabis production. Suggestions for further work are proposed.

Session: Posters 1 - Physiology and ripening

Sorbitol accumulation as an adaption mechanism in pome fruit to low oxygen storage environments

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Abstract

The long-term preservation of pome fruit during storage is centered around establishing controlled atmosphere settings (CA), which entails a reduction of the oxygen partial pressures. Hypoxic storage atmosphere, however, may alter metabolic processes, including carbohydrate metabolism as a fruit response to the low oxygen stress. Previous literature cite an enhanced accumulation of sorbitol in yeast in response to drought or salt stress. This study gives an overview of different experiments that analyzed the sorbitol content in pome fruit after long-term storage (~ 6 - 9 months) under different storage systems. Multiple apple varieties including 'Elstar', 'Nicoter', 'Shalimar', 'Jonagold' and 'Royal Gala' and pear varieties such as 'Xenia', were demonstrated to show higher sorbitol abundance after storage in DCA in comparison to static CA or regular air. This mechanism may serve as a physiological pathway for fruit to adapt in extremely low oxygen stress storage environments. Oxygen deficiency limits the availability of ATP, which is however required for life-sustaining processes. The biosynthesis of sorbitol could present an additional way to regenerate NAD+ in order to maintain the glycolytic flux and generate ATP. Sorbitol may also play a role in counteracting compounds such as acetaldehyde or ethanol which are accumulated during the anaerobic metabolism pathway and have cytotoxic properties. By acting as an osmolyte and adjusting intracellular osmotic pressure, sorbitol could protect cell membrane integrity. Consequently, an increase in sorbitol content in DCA-stored fruit can signal low oxygen stress and present an adaption mechanism of the fruit.

Session: Posters 1 - Physiology and ripening

Transcriptional and metabolic investigation of the post-harvest performance of a red flesh type of apple

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Abstract

Due to their uniqueness and excellent nutraceutical qualities, as well as their increased anthocyanin and phenol content, red flesh apple types have received great attention in recent years and certainly represented a potentially valuable horticultural novelty. However, a particular red flesh cultivar showed a poor storage quality and a high susceptibility to internal browning disorders. In the present study, we compared the red flesh apple 'Kissabel®', to the world-wide known white flesh apple 'Golden Delicious,' which is typically considered as the standard reference for apple ripening behaviour. Fruits were collected at commercial harvest and stored for a month at room temperature in regular oxygen conditions. The cortex deriving from five apple were sampled every two days along this period. The global RNA was extracted, and RT-qPCR were performed on ethylene biosynthetic genes (MdACS3, MdACS1 and MdACO1), genes involved in the ripening process such as the polygalacturonase-1 (MdPG1) and genes involved in glucose metabolism (MdAMY3, MdHXK1). Moreover, for both cultivars, ethylene was quantified during the whole stored period and glucose content was assessed in three different timepoints. In 'Kissabel®', the accumulation of ethylene started instantly after harvest, reaching the first peak at 9 days after harvest (DHA), one week earlier than 'Golden Delicious'. A second peak was moreover observed at 14 and 21 DHA, respectively. In 'Golden Delicious', the highest expression level, for all the ripening related genes investigated, corresponded with the maximum of ethylene production at 16 DAH, concurrent with the ripening onset. In 'Kissabel®' the maximum expression was instead detected two days earlier respect the ethylene burst. Interestingly, in 'Golden Delicious' glucose content remained constant during the whole period. Contrarily, in 'Kissabel®', glucose amount raised regularly during the month of storage. These findings provide the first step toward better characterizing the ripening behaviour of this novel variety and clarify the molecular mechanism underlying its shortened post-harvest performance.

Session: Posters 1 - Physiology and ripening

Candidate genes transcriptional study in 'Granny Smith' apples in response to prolonged storage at different conservation strategies

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Abstract

Apple (Malus domestica) is one of the most cultivated fruit crop word wide (86.442.716 tons, FAOSTAT 2020) characterized by a mid-late summer harvesting. To satisfy the continue demand of fresh product ensuring a constant availability of this produce to the market, fruit must be stored for prolonged period. Nowadays this is facilitated by the employment of modern storage technologies based on low temperatures (1-4°C), slowing down the entire metabolisms, and the inhibition of the ripening process. The control of the ripening syndrome can be achieved through a controlled atmosphere characterized by a low-oxygen and high CO 2 content, inhibiting the biosynthesis of the hormone ethylene, and/or treatment with the ethylene competitor 1-MCP that acting at the perception level efficiently block the signal transduction pathway. With the aims to improve and optimized the storage strategy reducing the quality loss and avoiding and/or limiting the onset of related physiopathology or post-harvest disorder, a deeply understanding of how these conditions affect the ripening process and the quality of apples becomes essential. In this study, different batches of 'Granny Smith' apple fruit were stored in various storage conditions, such as: Dynamic-Controlled-Atmosphere (DCA), static Ultra-Low-Oxygen mode (ULO) and classical Regular-Atmosphere, with and without application of 1-MCP treatment. After six months of storage, apples were transferred at room temperature for 12 hours or 7 days simulating a commercial shelf-life. The postharvest ripening physiology was assessed by analyzing the transcriptional pattern of candidate genes involved in ethylene biosynthesis and ripening (ACO1 , ACS1 and PG1), signal transduction pathway in response to low-oxygen (ERF-VIIs), sugars and anaerobic metabolisms (amylase, glucose-6-P-isomerase, pyruvate dehydrogenase and alcohol dehydrogenase). The transcriptional profiles of these elements provided important results about the physiological behavior of the fruit stored at different atmospheric conditions.

Session: Posters 1 - Physiology and ripening

ERF1 is involved in UV-C ripening signaling in peach fruit by regulating water loss

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Abstract

Peach is a climacteric fruit with a high respiration rate and, consequently, after its harvest, it tends to lose rapidly weight, which is an undesirable commercial characteristic. Ultraviolet-C (UV-C) radiation is used as a postharvest treatment to prolong the shelf life of fruit. However, this stressful process may also affect ripening and, consequently, water loss. To test this hypothesis, 'Luciana' peach fruit was harvested, exposed to UVC irradiation for 10 minutes and ripened at room temperature (20 ^{0}C) for 8 days in the absence or presence of cold storage (7 days at 0 ^{0}C). Treatment with UV-C impaired several anatomic features of peach peel. Exposure to UV-C radiation altered peel color indicators, and reduced the softening rate and the weight loss of fruit. Several primary and secondary metabolites were changed by UV-C in flesh and especially in peel samples. We identified various UV-C affected genes in both flesh and peel tissues following 8 hours of UV-C application. Particularly, UV-C specifically regulated the expression of a significant number of transcription factors, including ethylene response factor 1 (ERF1). To characterize the role ERF1 in UV-C ripening, we analysed its site-specific methylation and mutation status, and we also performed the ERF1gene silencing by RNA interference (RNAi) in peach fruit prior to UV-C exposure. Downregulation of ERF1 gene expression in peach peel tissue increased weight loss during ripening. In conclusion, a relationship has been established between UV-C treatment and water loss, correlated to changes in ERF1 evaluated during the postharvest ripening of peach fruit.

Session: Posters 1 - Physiology and ripening

Transcriptional and metabolomic changes during storage identify genes potentially involved in sucrose loss and carbohydrate impurity formation in postharvest sugarbeet roots

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Abstract

During storage, sugarbeet roots lose sucrose and commonly accumulate carbohydrate impurities such as glucose, fructose and raffinose that interfere with processing. Although these processes are economically important to the industry, amazingly little is known of the genetic changes in stored sugarbeet roots that are responsible for sucrose degradation and conversion to other carbohydrates. Research was conducted to identify genes contributing to sucrose catabolism in stored sugarbeet roots by analyzing gene expression and metabolite concentration changes in sugarbeet roots stored at 5 and 12°C for up to 120 days. Gene expression and metabolite concentrations were quantified by RNA sequencing and HPLC-MS analysis, respectively, in roots at time of harvest and after 12, 40, and 120 days in storage. Metabolite analysis documented a decline in sucrose and an increase in glucose and fructose during storage at both temperatures, while raffinose concentration increased during storage in roots stored at 5°C but not in those stored at 12°C. Gene expression was minimally altered for the enzymes, sucrose synthase and invertase, which are directly responsible for sugarbeet root sucrose degradation. In contrast, genes encoding bidirectional sucrose transporters were highly upregulated during storage. Although uncharacterized in sugarbeet, these proteins facilitate sucrose transport across membranes in other plant species and may have a role in remobilizing stored sucrose to allow its reentry into active metabolism in the sugarbeet taproot. Respiratory and fermentative pathway enzymes were also altered during storage, most notably the glycolytic enzyme, fructose-bisphosphate aldolase and several enzymes involved in ethanol production. Gene expression for galactinol synthase and raffinose synthase, two enzymes of cardinal importance in raffinose biosynthesis, increased in roots stored at 5°C but not at 12°C, with similarities to raffinose accumulation in these roots. Overall, this research identifies genes with potential roles in sucrose loss and carbohydrate impurity formation during storage.

Session: Posters 1 - Physiology and ripening

Post-harvest physiology of lettuce

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Abstract

Packaged fresh-cut vegetables are a convenient part of today's food consumption habits. However, rapid quality loss due to cut-surface discoloration, dehydration, over-ripening, and deterioration is responsible for a large amount of food waste. This in turn generates non-negligible environmental and economic costs that can be reduced by extending the shelf life of these products. A popular vegetable in fresh-cut products is lettuce (Lactuca sativa). The post-harvest quality loss of lettuce has been extensively studied focusing notably on cut-surface discoloration and the involvement of the phenylpropanoid pathway in this process. Furthermore, breeding, modified atmosphere packaging solutions, and various pre-treatments have been successful in extending shelf life. Nevertheless, the post-harvest physiology of lettuce remains poorly understood thereby hampering the identification of key markers and processes that can be targeted to improve its shelf life. This study aims to further unravel the post-harvest mechanisms influencing the shelf life of lettuce. For analysis, whole and cut ice lettuce leaves packaged with a modified atmosphere are used. Current knowledge of molecular markers and metabolic pathways involved in leafy vegetable quality loss will be used to refine the analysis of the early and late stages of fresh-cut lettuce shelf life. In addition, transcriptomics datasets as well as reliable reference genes for transcriptional analysis by quantitative polymerase chain reaction will be generated. This will serve as a basis for further physiological studies and multi-omics analyses. Here the current approach and preliminary data will be presented.

Session: Posters 1 - Physiology and ripening

Meta-differentially expressed genes to provide an expanded transcriptomic view of strawberry ripening

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Abstract

Strawberry is an economically important horticultural crop and a model crop to study non-climacteric fruit ripening. Fruit ripening is an essential stage to affect fruit quality and postharvest storability, and researches in strawberry fruit ripening have been performed with various cultivars. However, genetic and physiological differences among the cultivars make it difficult to understand common characteristics of strawberry ripening. Therefore, we performed a meta-analysis by mapping publicly available transcriptome data from six cultivars to the newly published and improved strawberry reference genome. We investigated meta-differentially expressed genes (meta-DEGs) to provide an expanded transcriptomic view of strawberry ripening. We found common transcriptomic changes in starch metabolism, chlorophyll degradation, and cell-wall degradation during ripening through gene ontology (GO) analysis. We also identified 483 meta-DEGs not detected as DEGs in the single analysis. This novel meta-DEGs were enriched in GO categories of photosynthesis, amino acid biosynthetic process, and fatty acid biosynthetic process. Anthocyanin biosynthesis regulatory genes, including FaMYB1 , FabHLH27 , and FaBHLH40 , were detected as up-regulated meta-DEGs during ripening, suggesting these genes are commonly involved in coloration of strawberry fruit. Transcription factors, including NAC83 , WRKY40 , and WRKY48 , were also determined as meta-DEGs, indicating the possible relevance to ripening.

Session: Posters 1 - Physiology and ripening

Metabolic and transcriptional exploration of the flesh fruit non-browning phenomenon in Majda' apple cultivar (Malus domestica)

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Abstract

Apple is among the most widely cultivated fruit crops worldwide. Although apple is mainly consumed as fresh fruit, it can also be used in several processing. Among them, the interest in fresh-cut product is increasing, for the possibility to offering fresh fruit in outdoor daily meals. However, its diffusion is still limited by the enzymatic browning, which represents one of the major obstacles in maintaining fruit quality attributes in fresh cut products during the manufacturing process. In apple the enzymatic flesh browning is assumed to be caused by a complex interaction between the activity of the polyphenol oxidase enzyme (PPO) and the content of polyphenols. Among this category of metabolites, chlorogenic acid is the major phenolic substrate in apple and its oxidation has been already identified in previous studies as the causal agent of browning symptoms. In order to prevent browning, several strategies have been developed over the last decades, relying on reaction inhibitors, modified atmosphere or physical treatments, both used alone or in combination. These strategies can be however expensive (modified atmosphere packaging) and/or could altered the quality/flavors of the products (physical or chemical treatments). Taking all this into consideration, a better and definitive solution for preventing this phenomenon could be the use of apple cultivars showing a natural resistance to enzymatic browning. To this end, we initiated a metabolic and transcriptional investigation of 'Majda', an apple cultivar bred in Slovenia characterized by a non-browning flesh even after heavy processing or long air exposure. Preliminary metabolic assessment discovered a great content of vitamin C, high acidity and low phenolics content. The aim of this work is to understand the molecular details regulating the non-browning trait that characterized 'Majda', at metabolic and transcriptional level in comparison with 'Golden Delicious'. In this regard, the expression profiles of genes involved in the polyphenol's biosynthesis, ascorbic acid-glutathione cycle were studied together with the accumulation of the most common phenolic compounds and organic acid in apple. Moreover, the antioxidant activity of the apple extract was investigated through a DPPH assay.

Session: Posters 1 - Physiology and ripening

A wide transcriptome characterization of high and low dry matter kiwifruit

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Abstract

Dry matter content (DMC) is an important indicator of kiwifruit quality. In this study, the transcriptome changes between high and low DMC 'Hayward' kiwifruit was investigated in the presence or the absence of 1-methylcyclopropene (1-MCP) application. Specifically, commercially harvested kiwifruit was divided into groups of high and low DMC based on single fruit DMC estimation by non-destructive near-infrared spectroscopy as well as by destructive methodology. All groups of fruits were systematically monitored for their rioening characteristics at various intervals during cold storage (0 °C). Overall, across treatments, the high DMC kiwifruit had significantly increased flesh firmness, soluble solid content, titratable acidity and starch content compared to the low group. At day 120 after harvest, high DMC kiwifruit generally displayed an increase in the accumulation level of several sugars such as glucose, fructose and sucrose compared to low DMC groups during ripening at room temperature (20 °C). Interestingly, differential gene expression analysis between low and high DMC kiwifruit following 1-MCP appication revealed a higher number of genes that were identified exclusively in the placenta compared to the pericarp tissue. Likewise, a multitude of transcription factor-associated genes that were solely detected in the placenta was 4 times greater than in the pericarp, indicating a more biologically active role of the placenta in 1-MCP application. Pathway enrichment analysis revealed glycogen biosynthesis I (from ADP-glucose) and starch biosynthesis as significantly enriched pathways in both tissues of the 1-MCP treated kiwifruit. Our data show that dry matter content can play a pivotal role in kiwifruit physiological characteristics and may influence the postharvest application of 1-MCP.

Session: Posters 1 - Quality measurements

Automated image-based assessment of starch pattern index in commercial apple cultivars: reliability and applicability

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Abstract

Assessment of starch pattern index (SPI) by visual comparison of iodine-stained transversely cut fruit with reference charts is widely accepted as an effective method for estimating apple fruit ripeness degree and predicting optimal harvest date. While the method itself is very simple and cost efficient, it is subjective and requires some training. A method based on computer visible-image-analysis of the iodine treated apple tissue for an automated estimation of SPI might be a viable and economical alternative for practical application. In the presented study the subjectivity as well as the repeatability of visual SPI assessment was estimated using an expert panel, aiming to obtain a valid reference for evaluating the acceptable deviation boundaries of the subsequent, instrumentally obtained SPI. The assessments were done with 5- and 10-point SPI scales. The results revealed a high consistency and agreement between different panellists (ICC 2 > 0.9), with the responses deviating by 0.2 and 0.6 points on a 5-point and 10-point SPI scale, respectively, when considering mean values obtained by Bland-Altman analysis. The results of the precision of the panellists when repeating own SPI estimation of the same disks reveal an average repeatability of ± 0.3 units over disks and panellists, with the discrepancies of individual samples amounting to up to 1.1 units. To reveal the potential and reliability of a commercially available instrument (Amilon, Isolcell, I), a further experiment, in which the assessment of the experts on fresh iodine-stained apple disks was compared to the results obtained by the instrument based on computer visible-image-analysis was conducted. The automated image analysis readings were comparable to visual assessments, revealing high absolute agreement (ICC > 0.9) thereby confirming the interchangeability of both methods for SPI estimation. Therefore, a user-friendly technique for objective determination of SPI can potentially be offered to the industry, resulting in rapidization of the SPI determination process.

Session: Posters 1 - Quality measurements

Internal browning severity is related to the percent of intercellular air spaces in apple fruit tissue as determined by X-ray CT

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Abstract

During the development of internal browning in apples stored under a controlled atmosphere (CA), water moves from affected areas to healthy regions, and small intercellular air spaces or cavities in fruit tissue occur from the collapse of cell structures. Air has a lower attenuation than fruit tissue; thus, air spaces appear as dark regions in X-ray computed tomography (CT) scans, which correspond to the brown areas of fruit tissue. This study investigated the relation of the dark regions (air spaces) as visualized by reconstructed X-ray CT scans to internal browning severity. In 2022, 120 'Kanzi' fruit that were previously stored under CA conditions (4 °C, 1 kPa O2, 1.5 kPa CO2) for 8-9 months were scanned using a laboratory X-ray machine (FleX-ray). Fruit were scanned at a resolution of 129.3 μm and had a total scan time of five minutes. Following scanning, fruit were sliced and visually scored on the severity of browning, browning type (radial, flesh and core) and the amount of brown tissue within the fruit (total browning score). Using images from the equator region of reconstructed CT scans, an image-processing algorithm based on threshold values was developed to determine the area percentage of intercellular air spaces, which accounted for apple size (diameter) and the core region. Results showed that the air space percentage increased as the browning severity and total browning scores increased. These results were consistent for affected fruit containing only radial browning, which occurs close to the stem end of fruit. The feasibility of using the air space percentage of slices from only the equator region to classify healthy and affected fruit was also investigated, which showed good predictive performance (AUC > 0.8).

Session: Posters 1 - Quality measurements

Preharvest treatments of 'Colar de Albatera' fig fruit to promote harvest as an alternative of Ethrel

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Abstract

Fig fruit (Ficus carica L.) is a species of the very large number of the genus Ficus belonging to the Moraceae family, characterized by milky latex in all parenchymatous tissue. Exogenous applications of ethylene-releasing compounds, plant growth regulators (PGRs) used to thin fruit, have been effective in improving fruit yield and quality and decreasing production costs in other fruit commodities. Ethrel (ethephon) is a systemic PGR that decomposes to ethylene, phosphate, and chloride ions. Ethylene is widely recognized as an effective agent for accelerating fruit ripening and senescence. Currently, the need to find preharvest strategies to replace the use of Ethrel is urgently demanded by market; therefore, the main aim of the present study was to evaluate the effect of different eco-friendly preharvest treatments [olive oil, oleic acid, neem oil, rosa mosqueta oil, methyl jasmonate (MeJa) at 0.1 and 1 mM concentrations, 24-Epibrassinolide (Bras) at 0.1 mM and abscisic acid (ABA) at 2.84 Mm] as potential alternatives to the use of Ethrel at 2 and 3 mL L -1 . Thus, the influence on precocity of fig maturity process and the effect on fig quality parameters and external appearance were determined. Trees of Ficus carica L., 'Colar de Albatera' cultivar, were grown in a commercial plot located in Albatera (Alicante, Spain) and the experiment was carried out during two seasons (2021 and 2022). Treatments were applied by staining the fruit in the basal area with a swab. Respiration rate, ethylene production, fruit density, fruit weight, colour, firmness, total soluble solids (TSS), total acidity (TA), ripening index (RI) and pH were analysed in fig fruits. Although Ethrel was the most effective treatment to promote fruit ripening process at harvest, neem oil and 0.1 mM MeJa preharvest treatments showed similar results, being the most effective alternatives to harvest early fruits. On the other hand, figs treated with Ethrel showed the lowest density values compared to all treatments tested. However, no significant differences were observed in terms of fruit firmness among treatments, except to ABA treatment that significantly increased this parameter. Finally, RI was significantly improved in those fruits treated with oleic acid, rosa mosqueta, neem oil and MeJa. Nevertheless, rosa mosqueta negatively affect the fig fruit appearance in both seasons. Thus, MeJa at 0.1 mM could be a future useful tool to promote fig fruit ripening as an alternative to Ethrel commercial product.

Session: Posters 1 - Quality measurements

A non-destructive approach of chlorophyll content estimation in fruits by means of LiDAR acquired backscattered intensity

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Abstract

Optimum ripening stage of climacteric fruit should be ensured during different stages of preharvest and postharvest conditions. Good fruit quality at the consumer's level depends on the previous steps of fruit handling such as picking, sorting, storage, packaging, transportation etc. Also, ripening stage of all fruit in a lot should be uniform in all steps of the supply chain to avoid triggering the maturation by ethylene exposure. As the ripening of fruits such as banana and tomato directly related to change in peel colour due to degradation of chlorophyll content, human visual assessment is often carried out in commercial facilities. Besides this visual method, chemical, spectrophotometric and RGB imaging based analyses have been employed to determine the chlorophyll content or ripeness of fruit. In the present study, an approach is proposed for detection of chlorophyll content and ripeness with light detection and ranging (LiDAR) sensor using the backscattered intensity retrieved in the 3D point cloud in banana (Musa acuminate AAA) and tomato (Solanum lycopersicum) fruits. A LiDAR laser scanner, emitting at 660 nm, was employed to analyse banana fruit (n = 180) and tomato fruit (n = 100) with approximately 1 m distance during fruit ripening. The intensity of the echo was recorded at each laser hit. Subsequently, the point cloud of banana and tomato fruit were calibrated and geometrically corrected. The corrected intensity (I cor) and chemically analysed fruit chlorophyll content were used in univariate linear regression and partial least-square (PLS) regression analyses. The PLS approach resulted in enhanced R 2 = 0.70 and 0.71 for banana and tomato, respectively. Fruit classes were built applying I cor and either commercially used colour charts or chlorophyll-derived classes. The overall accuracy of classification with developed PLS-DA model were found 69 % and 70 % for banana and tomato, respectively with cross-validation datasets. Concluding, LiDAR laser scanning appears feasible for non-destructive and non-contact monitoring of banana and tomato fruit pigment and ripening.

Session: Posters 1 - Quality measurements

Estimating mechanics of strawberry fruit using discrete element modeling considering the ripening stage analysed with non-contact laser scanning

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Abstract

Simulation of fruit mechanics has been approached by means of finite element modeling (FEM) or discrete element modeling (DEM), employing measured mechanical properties and visual, subjective or destructive ripeness stage as input variables. In the present work, the effect of ripeness stage based on non-contact light detection and ranging (LiDAR) as well as destructively analysed pectin and pigments contents were considered to simulate fruit mechanics using DEM. At three fruit ripening stages LiDAR sensor system, emitting at 660 nm and 905 nm, was employed to analyse 'Malwina' strawberry fruit (n = 270) at 0.8 m distance between fruit and sensor probe. The multi-spectral intensity of the echo was recorded at each laser hit, subsequently calibrated and geometrically corrected (I cor). With a grid size of 1 mm × 1 mm, mean I cor (n > 1000 per fruit) were further processed. The compression mechanics of cylindric volume of fruit tissue were recorded by Texture Analyzer at 1 mm·s -1 . The Gaussian naive Bayes (GNB) approach was applied to build ripeness classes based on I cor , visual colour inspection, pectin and pigments contents. Particularly the GNB- I cor classes enabled non-contact ripeness classification. Further, the GNB- I cor ripeness classes in comparison to ripeness classes based on subjective or destructive tests, were used to simulate the mechanical properties of tissue cylinder. Simulation results showed enhanced correlation with measured mechanics. The failure stress decreased at different ripening stages (white, turning, and red) showing means of 0.455, 0.096, and 0.030 MPa, respectively, while elastic modulus changed from 1.141, 0.331, to 0.168 MPa, respectively. Concluding, the application of non-contact laser scanning provides new opportunities for modeling the ripeness stage and mechanical properties of strawberries.

Session: Posters 1 - Quality measurements

A Multi-Parameter Texture Characterization Of 'Rojo Brillante' Persimmon Subject To Different Storage Conditions

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Abstract

'Rojo Brillante' persimmon is sensitive to low temperature, the main symptom of chilling injury being a drastic firmness loss when fruit are transferred from low to shelf-life temperatures. Therefore, for cold storage of fruit is required the application of 1-MCP, as it has been described to alleviate chilling injury in persimmon. The recommended storage temperature for 'Rojo Brillante' is between 0ºC and 1ºC when 1-MCP is applied. However, significant differences in fruit firmness have been detected between storage at 0ºC or 1ºC. Moreover, after prolonged storage, changes in the flesh structure can be observed. Although persimmon texture is usually determined by puncture test determining the force necessary to break the flesh, other textural studies are needed to understand the flesh changes during cold storage. In this study, 'Rojo Brillante' persimmon was stored at 0ºC or 1ºC with or without 1-MCP. After 30, 60 and 90 days, the fruit was evaluated and other lot was submitted to deastringency treatment before transferring to 20ºC for 5 days, simulating shelf-life conditions. Fruit firmness was evaluated by a texturometer and a study of the typical force/time curve was carried out. Besides, a texture profile analysis (TPA) was performed to measure the parameters of hardness, adhesiveness, cohesiveness, springiness, chewiness, resilience, and gumminess. As expected, differences between fruit treated or not with 1-MCP was observed only after shelf-life simulation in both temperatures. Nevertheless, fruit stored at 0ºC showed higher firmness than those at 1ºC. The study of the force/time curves showed that the flesh breaking moment was highly dependent of the storage period, what was especially relevant in 1-MCP-fruit stored at 0ºC. The behaviour of the force/time curves and TPA parameters, especially gumminess and chewiness, indicated changes in the flesh structure that could reflect the appearance of flesh rubbery symptoms after prolonged cold storage periods.

Session: Posters 1 - Quality measurements

Preharvest application of 1-MCP (Harvista®) to control chilling injury of persimmon

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Abstract

Persimmon is sensitive to chilling injury (CI) when is stored at low temperatures. One of the most important CI symptoms is the flesh softening that occurs when fruit are transferred from cold storage to shelf-life conditions. Postharvest application of 1-Methylcyclopropene (Smartfresh®, SF), a potent inhibitor of ethylene action, has proven to be effective in alleviating the firmness loss caused by chilling in several cultivars, thus prolonging storage at low temperature. In recent years, preharvest treatment with 1-MCP (Harvista® HV), applied as a liquid spray to the trees, has emerged as a novel option for maintaining fruit quality throughout the postharvest in some crops. Nevertheless, scarce information on the application of HV in persimmon is available. This study shows the effect of HV application on the firmness loss suffered by 'Rojo Brillante' persimmon due to its sensitivity to low temperatures, compared to the known effect of post-harvest application of SF. During two consecutive seasons, in two commercial orchards of 'Rojo Brillante' persimmon, HV was applied 3 days before harvest (HV application was performed by technical personnel from Agrofresh©). After harvest the fruit were stored for 40 or 60 days at 0°C plus 6 days at 20°C simulating the shelf life. Three treatments were compared 1) Control (CTL) (fruit without HV); 2) HV (fruit treated with Harvista); 3) SF (fruit treated with Smartfresh® after harvest). In all cases the HV application alleviated the drop of firmness that occurred in the CTL-fruit when was transferred from 0°C to shelf-life conditions. Furthermore, no differences in firmness values were observed between HV and SF treatments. This indicates that the 1-MCP pre-harvest treatment (HV) has the same effect as the 1-MCP postharvest treatment (SF) on the control of chilling injury in 'Rojo Brillante' persimmon, which can be a useful tool to improve operations in packing houses.

Session: Posters 1 - Quality measurements

Non-destructive measured firmness to define maturity in European plum fruit

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Abstract

European plum (Prunus domestica L.) fruit is sold as a luxury product for fresh consum ption to a high prize in Norway . To ensure quality in distribution and storability , the fruit is harvested early . E arly picking compromise s good eating quality of plum fruit . In season 2022, a handheld non-destructive firm ness tester TR Turoni Durometer was evaluated for being an instrument for deciding right strategi for storage, distribution, and sale . Plum fruit of the cultivar s Opal, Mallard, Jubileum and Reeves was measured using the instrument both on tree and i n the laboratory . Plum from packing houses was divided in in two degrees of ripeness and stored for two weeks at 4 °C and tested under simulated " shelf - life " conditions for two days at 20 °C. The f ruit quality parameters Brix%, acid, I AD - index, back ground co lou r and firmness using FirmTech I I w ere measured for comparison. Sensory attributes of the p lum fruit of the two ripening degrees were evaluated by sensory panel. Preliminary results after one season , indicate t hat TR Turoni Durometer is a promising non-destructive tool for deciding the right distribution strategi for plum fruit .

Session: Posters 2 - Effect pre-harvest conditions on postharvest quality

Factors affecting the development of physiological disorders in 'Gala' apple during long term storage

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Abstract

This study investigated factors influencing 'Gala' apple (Malus domestica Borkh.) susceptibility to physiological disorders and decay during long-term storage. Five experiments were performed using fruit from two locations in Santa Catarina State, southern Brazil, over ten production years. The two locations differed in altitude and average temperature. Fruit were harvested at two maturity stages (early and advanced), treated with or without 1-methylcyclopropene (1-MCP) and stored at 0.5 °C or 2 °C in a controlled atmosphere (CA; 1.5 kPa O 2 and 2.5 kPa CO 2), for eight months plus seven days shelf life. Flesh browning (FB) was the predominant disorder, followed by decay, cracking, and lenticel breakdown-wet (LB-wet). The FB index (incidence weighted by severity) was lowest in fruit produced at the colder orchard location, early harvested, treated with 1-MCP, and stored at 2 °C. These factors also influenced fruit softening after storage. The major source of variance for the FB index in order of decreasing contribution were harvest maturity, production year, orchard location, 1-MCP and storage temperature. Storage temperature had the most influence on LB-wet variance. LB-dry was highest in late harvested fruit and fruit stored at 0.5 °C. The average FB index of each production year from the warmer location was positively correlated with early summer rain and negatively with early spring temperature. These results suggest that interactions among harvest and postharvest factors influence the development of 'Gala' FB and other disorders and indicate a possible relationship of chilling in FB development. The information may help implement practical strategies to reduce the development of these postharvest disorders in 'Gala' apple fruit.

Session: Posters 2 - Effect pre-harvest conditions on postharvest quality

Are old onion landraces an option for organic farming? Yield and post-harvest quality of landraces vs. hybrids

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Abstract

Commercial onion breeders limit their selection criteria by focusing almost exclusively on conventional farming. This raises the demand for certain well-known hybrids, but lowers the general diversity available on the mainstream market. A way to maintain biodiversity is to preserve onion landraces. Through their distinct aroma and flavor, these plants are again drawing the interest of farmers and consumers alike, making them a viable alternative to commercial hybrids. The aim of the project “ZwiebÖL” is to directly compare old onion landraces and hybrid varieties with regard to their suitability for organic farming. For this, field experiments were carried out at two locations under organic farming conditions in two consecutive years (2020/2021). Yield and quality parameters were determined and in addition, the storability of three onion landraces (“Rijnsburger 4”, “Birnenförmige”, “Stunova”) and three hybrids (“Hytech F1”, “Hylander F1”, “Summit F1”) were evaluated and compared. First results have shown that onion landraces were on par with hybrid varieties in terms of yield. On the other hand, landraces fared significantly better in terms of quality and storability. After seven months of cold storage (2° C), onion bulbs of the varieties Stunova, Rijnsburger 4, Hytech F1, Hylander F1 and Summit F1 showed reduced quality and partially visible sprout leaves. For this reason, these varieties were classified as "no longer marketable" after 7 months of cold storage. The landrace Birnenförmige was the only variety that could be stored for more than 7 months. Both their firmness and the dry matter content of the bulbs were preserved during storage.

Session: Posters 2 - Effect pre-harvest conditions on postharvest quality

Pre-harvest factors affecting 'Gala' apples quality during long-term storage

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Abstract

Fruit quality at harvest and during storage is strongly influenced by environmental and agronomic factors along the growing season. The present work has been focused on the study of the effect of pre-harvest treatments, such as excess of water and/or nitrogen supplementation, on quality of 'Gala' apples at harvest and during post-harvest storage. As climacteric fruits, apples can be storage for many months in refrigerated chambers with specific gas concentrations. Nevertheless, quality losses, such as loss of weight or firmness, or physiological disorders can develop during this period of conservation, causing important economic losses to producers. So, besides the effect of pre-harvest factors, this work aimed to evaluate the influence on apple quality of three storage conditions: controlled atmosphere + 1-methylcyclopropene (CA+1-MCP), dynamic CA (DCA) and DCA+1-MCP. In addition to physical properties such as size, firmness and peel colour, several important parameters like total soluble solids, acidity, quality index, phenolics and antioxidants were analysed. The incidence of physiological disorders and rot development was also evaluated. We observed that dynamic controlled atmosphere can ensure good fruit quality during storage. However, excess of water and/or nitrogen negatively affects quality parameters compromising long-term storage capacity and commercial value of 'Gala' apple.

Session: Posters 2 - Effect pre-harvest conditions on postharvest quality

Effect of Rootstock on anthocyanins profile in blood oranges

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Abstract

Blood oranges are characterized by their high content of anthocyanins which, in addition to conferring the fruit its characteristic red color, are related to human health properties due to their antioxidant activity. The aim of this study was to evaluate the effect of rootstock on the internal color and anthocyanin content of 'Moro' and 'Tarocco Rosso' throughout the harvest period. The rootstocks studied were ‘Carrizo’ (CC), ‘C-35’, ‘Cleopatra’ mandarin (CL), ‘Citrus volkameriana’ (VK), ‘citrus macrophylla’ (M), ‘Swingle’ citrumelo (CT), ‘Forner-Alcaide 5’ (FA5) and ‘Forner-Alcaide 13’ (FA13). Over fruit collected at three harvest times, four anthocyanins were determined in the fruit juice: delphinidin 3-glucoside (Dp-3-glu), cyanidin 3-glucoside (Cy-3-glu), cyanidin 3-(6″-malonyl)-glucoside (Cy-3,6″mal-glu) and cyanidin 3-(6″-dioxalyl)-glucoside (Cy-3,6″diox-glu). A significant effect of rootstock was found in both cultivars. Fruit juice of 'Moro' grafted on CL presented the highest internal color index throughout the harvest period studied. CT fruit, with the lowest values at first harvest, exhibited the least reduction as the season progressed. C35, M and VK fruit displayed a significant decrease in color and reached similar values to CT fruit at the third harvest. No significant changes were found in the juice color of 'Tarocco Rosso' oranges as the harvest advanced. C35, M and CT induced the lowest color values, while the highest values were found in FA5 fruits. The higher color of ‘Moro’ juice compared to ‘Tarocco Rosso’ was explained by the content of all the individual anthocyanins. Cy-3-glu and Cy-3,6″mal-glu were the major compounds in both varieties followed by Cy-3,6″diox-glu and Dp-3-glu. In ‘Moro’, Cy-3,6″mal-glu and Cy-3,6″diox-glu contributed mostly to juice color intensity and their degradation at the last harvest caused a loss of juice color in most rootstocks. In ‘Tarocco Rosso’, the rootstocks with the lowest color were those with the lowest content of all anthocyanins determined.

Session: Posters 2 - Effect pre-harvest conditions on postharvest quality

Influence of the position of the fruit in the tree on the coloration of blood oranges

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Abstract

This study evaluated the relation among fruit position on the tree with rind color, internal physicochemical and sensory parameters of "sanguinelli" blood oranges, one of the main blood orange cultivars cultivated in the Mediterranean region. The experiment plot was carried out in an experimental farm located in Alicante, Spain. The trees were divided into two orientations (East - West) and two positions on the tree (high - low). In addition, the fruits were separated if they were alone or in a bunch. The red color rind was determined sensorially according to a hedonic scale from 0 to 5. Likewise, the color of the pulp was evaluated sensorially, and the total soluble solids, titrable acidity and anthocyanin content in the fruit juice were also determined. The results showed that the orientation and height of the fruit on the tree influenced the coloration, synthesis of anthocyanins, although it did not correlate the same in the internal and external part. On the contrary, no differences were found if the fruit was collected from a bunch or individual fruit.

Session: Posters 2 - Effect pre-harvest conditions on postharvest quality

Far-red light during cultivation improves postharvest chilling tolerance in basil

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Abstract

Basil (Ocimum basilicum L.) is a temperature sensitive plant and suffers from chilling injury (CI), especially during the postharvest storage. We investigated the effect of additional far-red light (FR) during cultivation at two temperatures on postharvest chilling tolerance. Basil was cultivated under red-white Light Emitting Diodes (LED) at 25 °C. During the last 3 weeks before harvest, plants were maintained at a high temperature (25 °C) or exposed to a low temperature (15 °C). Furthermore, plants were exposed to additional FR (180 μmol m−2 s−1) for different durations (0, 1 or 3 weeks). After harvest, leaves were stored at 4 and 12 °C in darkness. Overall visual quality and maximum quantum yield of PS II (Fv/Fm) as indicators of chilling injury were monitored every third day for 15 d. Abscisic acid (ABA) and jasmonic acid (JA), carbohydrates, and antioxidants were measured at harvest and after 9 d of storage at 4 °C. Additional FR improved the chilling tolerance at both cultivation temperatures. Cultivation temperature had no effect on postharvest chilling tolerance. Hormone levels in basil leaves at harvest were not affected by FR. This indicates that ABA and JA are not involved in development of FR-induced chilling tolerance in basil. FR had no effect on the levels of antioxidants at harvest whereas the levels of soluble sugars and starch increased under additional FR. The positive effect of adding FR during cultivation on chilling tolerance in basil may be due to the increase in soluble sugars and starch.

Session: Posters 2 - Flavour, Sensorial and nutritional quality

Preharvest potassium silicate sprays on consumer-perceived quality variables and antioxidant concentrations in cherries at harvest and after low-temperature storage

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Abstract

, as antioxidants. However, cherries are sensitive to transport and storage and have a short postharvest life. Potassium silicate (PS) has shown increases in red-colour development and cell wall strengthening among many positive effects on plants. The present study aimed to evaluate changes in quality variables of a splitting-sensitive cherry cultivar, 'Prime Giant'. Trees were sprayed twice, to run off, with 0.5 % PS at the stage of colour break of peel fruit and at the pink-colour development on approx. 50 % of the fruit surface in 80 % cherries. Controls were sprayed with water. Fruit, free of visible defects, were harvested at an early commercial stage, placed in clamshells in groups of 10 and stored in air at 1 o C with 95% RH for 27 d. Four dimensions and weight of fruit and rates of respiration and ethylene production were determined only at harvest and showed no treatment effect. During storage (on days 7, 18, 27), colour parameters (L* , h o , C*) and fruit firmness (FF) decreased, but total flavonoids (TF), total anthocyanins (TAN) and total antioxidant capacity (TAC) increased, whereas total phenolics (TP) and pedicel removal force (PRF) did not change significantly. However, at harvest and during storage treated fruit showed consistently lower colour parameter values, indicating a deeper red-colour development, but higher values of FF, PRF and concentrations of TF, TAN and TAC than controls. WL reached approximately 6 % at the end of storage in both controls and treated fruit, while no splitting was observed. Conclusively, PS did increase the red colour, antioxidant concentrations and firmness of fruit at harvest and during storage.

Session: Posters 2 - Flavour, Sensorial and nutritional quality

Investigating the impact on VOC's profile of 'Red Delicious' apples stored under ULO and DCA-CF technologies combined with 1-MCP

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Abstract

Apples are among the most consumed fruit all over the world. The combination of low temperature, low oxygen, and high carbon dioxide (controlled atmosphere) enable the storage of many apple varieties up to one season. The 1-methylcyclopropene (1-MCP) treatment and the application of very low oxygen levels during storage in dynamic controlled atmosphere (DCA) represent the two main breakthrough of the last decade in the postharvest sector. Both, positively affect the fruit quality after storage. The 1-MCP treatment enables the firmness and color retention by delaying the fruit ripening. The DCA based on chlorophyll fluorescence (DCA-CF) technology has a significant effect in preventing the superficial scald on susceptible varieties. Despite these benefits, both affect the volatile organic compounds (VOC's) synthesis and profile. In the present study we investigated 27 typical apple VOC's with a GC-FID, offering a reliable and repeatable quantification of each single VOC's compound. In the three years study on 'Red Delicious' apple variety, the influence on VOC's profile of ultra-low oxygen (ULO) and DCA-CF storage combined with 1-MCP treatment was investigated. Quality parameters and physiological disorders were evaluated too. Our results confirm that each storage technology affect the VOC's profile differently. The combination with the MCP treatment after 7 months storage and 7 days shelf life was characterized by an immature similar VOC's profile mainly characterized by aldehydes-green component as expected. The difference in the VOC's profile between ULO and DCA-CF after storage, was flattened out after the shelf-life period. The impact of the novel storage technologies significantly affects not only the internal and external quality of the fruits but also the whole aromatic profile and its perception by the consumer. The increasing awareness of the consumer towards the aromatic compounds' perception represents a new important challenge for the postharvest quality chain.

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Volatile compounds as affected by storage conditions in different apple cultivars

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Abstract

Flavour is an essential quality attribute of apples characterized by volatile compounds (VC), mainly from the chemical classes esters, alcohols, aldehydes, and acids. Among numerous volatile compounds, Hexanol, Pentanol, Butanol, Hexanal, Butyl Acetate and Hexyl Acetate are common to most apple varieties and are highly perceived to humans. These compounds are affected by various pre- and post-harvest factors. However, storage conditions play a crucial role in setting the endmost flavour perceived. Therefore, in this study, we determine the effects of regular air (RA), ultra-low Oxygen (ULO) and dynamic control atmosphere-CO 2 with varying temperatures (DCA-CD Plus), and 1-MCP on selective VC for 5 different apple cultivars: Red Prince, Jonagold, Pinova, Shalimar, and Fuji. The VC analysis was conducted after 8 months of storage and 7 days of shelf-life at 20°C, using the solid-phase microextraction (HS-SPME) technique, followed by GC/MS analysis. Results confirmed the presence of Hexanol, Hexanal, Butyl Acetate and Hexyl Acetate in all selected varieties. DCA-stored fruit showed a greater concentration of Hexanal than other treatments in all varieties, whereas Butanol remains unaffected in DCA and ULO storage. Using 1-MCP suppresses the concentration of Hexanol, Butyl Acetate, and Hexyl acetate in Fuji and Pinova.

Session: Posters 2 - Flavour, Sensorial and nutritional quality

Differences in the volatile profile of seven onion varieties from two sites in Germany

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Abstract

Since the ages of the pharaohs, onions (allium cepa L.) have been known as part of the human diet and are until today among the most produced crops worldwide. Through the use of modern breeding technologies, hybrid cultivars designed for intensive farming dominate the market contrasting so called old landraces, which are more popular in organic farming as they preserve biodiversity. Some claim that the rather new hybrid cultivars lack aroma and taste compared to the open-pollinated old landraces. The aroma profile of onions is predominantly characterized by a range of sulfur-containing analytes. Upon cell rupture, enzymatic reactions are triggered, leading to the formation of the tear causing lachrymatory factor and further aroma active compounds. In this study, the aroma profile of three hybrid cultivars and four old landraces was compared. The different varieties were grown in a randomized block design (n=4 blocks per variety) under organic farming conditions in two sites in the south-west of Germany. After harvesting, the bulbs were cured according to market standards. The aroma profile was investigated using GC-MS combined with the advanced VTT-ITEX headspace sampling technique. A variety of known onion volatiles, mainly sulfur-containing analytes, was detected, while the reaction product of the unstable 1-propenylsulphenic acid, 2-Methyl-2-pentenal, was the most intensive analyte in each chromatogram. Using principal component analysis, a discrimination of the cultivars based on the profile of volatile compounds was in part possible. In contrast, the samples originating from the two growing sites were not clearly separable, but the overall signal intensity was significantly higher in samples from one site than the other. The old landrace Birnförmige showed the highest intensity in the majority of analytes compared to the other varieties, whereas the hybrid Hytech and the old landrace Rijnsburger were rather low in comparison.

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Terpenoid characterization of Cannabis sativa dried inflorescences in the postharvest environment

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Abstract

Market quality of dried inflorescences of Cannabis sativa is influenced by aroma, which is primarily impacted by terpenoids. Total terpenoid concentration is frequently reported by growers and retailers as an indicator of product quality. The objective of this project was to analyze the terpenoid composition and volatilization of dried inflorescences in the postharvest environment. In this study, the terpene composition of Cannabis sativa buds subjected to different curing treatments was recorded. Cannabis sativa var. 'Jack' flowers were harvested, trimmed, and dried in a room at 18 o C and 55% relative humidity for 14 days. Once dried, the flowers were placed for six weeks in glass containers with and without small fans to alter the rate of terpenoid volatilization. The inflorescences stored without fans produced a desirable aroma, while inflorescences stored with fans lacked the typical cannabis aroma associated with high terpenoid concentrations. Terpenoids in the dried inflorescences were analyzed with hexane extraction, while terpenoids in the head space of the storage containers were analyzed with solid-phase microextraction (SPME). Sesquiterpenes were primarily detected in the tissue while monoterpenes dominated the head space. The exceptions were beta-caryophyllene and alpha-humulene, which are sesquiterpenes which proved to highly volatile due to their high concentrations found in the head space. Nearly 50% of the total terpenoid concentration extracted from inflorescences were the sesquiterpenes guaiol and bisabolol, yet neither of these compounds were found in the headspace, which demonstrates how these compounds are not particularly volatile and contribute little to the aroma perceived at the point of consumer purchase. This observation also suggests that total terpene concentrations extracted from dried inflorescences are not likely to be highly correlated with aroma. Dried inflorescences that were considered to be highly fragrant had 10-15% higher terpenoid concentrations compared to those considered to lacking in fragrance. This difference was relatively small considering the large difference in aroma perceived.

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Microbiome analysis of raw sugarbeet juice from sugar factories

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Abstract

Sugarbeet (Beta vulgaris L. subsp. vulgaris) is grown for its fleshy tap root which contains up to about 21% sucrose and used for sugar production. Sugarbeet contributes nearly 60% the total domestic sugar production in the US. Sugarbeet is cultivated in the US in nearly 450,000 hectares of 9 states including, California, Colorado, Michigan, Minnesota, Montana, Nebraska, North Dakota, and Wyoming. Microbial contamination, especially bacterial growth and secretion of exopolysaccharides and biofilm by those bacteria in the processing streams at sugar factories, cause significant sugar loss and processing challenges. The present study was performed to determine bacterial contaminants in the raw diffuse sugarbeet juice collected from sugar processing streams of 21 sugar factories. Sugarbeet juice samples were collected at 4 different time points including, (i) Period 1 (Late September, 2021) - fresh sugarbeet root processing; (ii) Period 2 (2 nd week in December, 2021) n stockpiles beets; (iii) Period 3 (Mid-February, 2022) n aged, stockpiled beets; and (iv) Period 4 (Mid-April, 2022) - frozen beets. The bacteriome of raw sugarbeet juice was investigated by using the amplicon sequencing of bacterial 16S rRNA gene. The 16S rRNA sequencing protocol from Oxford Nanopore Technology was used to generate near-full length 16S rRNA sequence reads by using the Nanopore MinION sequencer. The most abundant bacterial phyla from this study were found as firmicutes and proteobacteria comprising bacterial species which can metabolize sucrose into organic acids, including lactic and acetic acid. Knowledge of the microbial communities present in the factory processing streams aids in developing management strategies that limit sugar loss due to bacterial contamination during sugarbeet root processing.

Session: Posters 2 - Flavour, Sensorial and nutritional quality

Characterization of the quality of new varieties of loquat of commercial interest

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Abstract

In Spain, the loquat production is mainly based on the 'Algerí' variety and some of its mutations, which account for 95% of the total production. The problems derived from the centralization of the crop have led to the need to develop a program with the objective of expanding the loquat varietal range. Also, the demand for new loquat varieties is increasing in recent years due to its content in bioactive compounds and other compounds involved in the nutritional and biohealthy quality of the fruit (sugars, organic acids, vitamin C, phenolic compounds and carotenoids). In the present work, a comparative study of ten different loquat varieties belong to the Breeding Program developed by the Valencian Institute of Agricultural Research (IVIA) in collaboration with the Designation of Origin Nísperos Callosa d'En Sarrià, has been carried out. For each variety, fruit at two states of commercial maturity were collected (E1 and E2). In all cases the concentrations of the bioactive compounds were in agreement with ranges described in the literature, although the variations observed for the two stages of maturity depended on each variety. The results showed that the varieties 'Algar158', 'Algar15' and 'Algar72' displayed the highest levels of ascorbic acid in the stage of maturity E1, while the varieties with the lowest concentration of vitamin C were 'Algar5', 'Siscar' and 'Ruchey'. Chlorogenic acid was the main phenolic compound in all the varieties studied. In all of them, except in 'Algar158', a significant increase of this acid occurred in the second harvested stage, which was especially significant in 'Juliana'. The variety 'Siscar' showed the lowest levels of the main carotenes, β-carotene and β-cryptoxanthin, as well as lutein and violaxanthin, which is corroborated by the low internal color index.

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Flavonol rhamnoside turnover in postharvest radish

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Abstract

Postharvest senescence of horticultural crops is often linked with the depletion of antioxidants, specifically the redox status of ascorbate and glutathione. Flavonols (e.g., kaempferol) are postulated to serve as antioxidants in plants, but their capacity to do so could be limited as they tend to accumulate as glycoside conjugates (e.g., kaempferol 3- O -rhamnoside-7- O -rhamnoside [kaempferitrin]) in developing plants. A ready pool of flavonols for oxidative stress management would require their supply from the catabolism of flavonol glycosides in plants. Herein, we investigated whether flavonol glycoside turnover (i.e., flavonol de-rhamnosylation) occurs with the postharvest senescence of horticultural crops, specifically radish (as first published in [Planta 256, 36, 2022] by Springer Nature). Radishes were subjected to postharvest storage at 5°C for up to 8 days. The concentrations of all flavonol metabolites and flavonol rhamnoside α-rhamnosidase activities were monitored in the leaves of the stored radishes. Major losses in the fresh weight of radish leaves were apparent over the 8-day storage period. These quality-related changes were associated with a 100% increase in the concentration of kaempferitrin, a phenomenon that could be due in part to leaf desiccation with storage. Although minor levels were apparent in radishes leaves at the beginning of the storage period, the concentrations of kaempferol 3- O -rhamnoside and kaempferol 7- O -rhamnoside were increased up to 5.4-fold following 8 days of radish storage at 5°C. These metabolic occurrences implied catabolism of kaempferitrin as well as other kaempferol glycosides was operating in these postharvest issues. The shift in flavonol profiles coincided with a 5.5-fold change in kaempferitrin 7- O -α-rhamnosidase activity. The turnover of flavonol rhamnosides by way of α-rhamnosidase activtity in postharvest radish could be critical for senescence-related processes, including those driven by oxidative stress in response to low temperature storage.

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The effect of postharvest low oxygen treatments on sensory evaluation in some pear cultivars under different storage technologies

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Abstract

Postharvest low oxygen (O 2) treatments lead to positive results in the maintenance of fruit quality after long-term storage, while in some cultivars it leads to negative effects such as failure to ripen during the marketing period. However, there is not data on response of 'Santa Maria', and 'Ankara' pear cultivars to low O 2 stress conditions after a certain time of cold storage period. In this study the effect of low O 2 treatments was investigated in regular air- and/or controlled atmosphere (CA)-stored fruit in terms of sensory evaluations. Fruit were harvested from a commercial pear orchard in Korkuteli/Antalya and in the same day transferred to Ankara University by a cooled and closed track at 4°C. Low oxygen treatments were applied in CA cabinets as 0.05% O 2 during one or two weeks. Then fruit were stored under regular air and/or CA storage (3% O 2 +1% CO 2) at 0+-1°C conditions. Sensory evaluation parameters included firmness, juiciness, sweetness, bitterness, alcohol formation and it was followed during a shelf life period of 15 days after harvest and low O 2 treatments and a certain period (3, 6 and 9 th months) during cold storage period. In this experiment, storability period of pear cultivars changed based on the storage technology. In 'Santa Maria', after three months under regular air conditions, firmness decreased, and juiciness, bitterness and alcohol formation increased in fruit during shelf life. After 3 and 6 months in CA conditions, one-week low O 2 treatment resulted with juicier fruit and helped to low alcohol formation in tissue during shelf life. In 'Ankara' cultivar, low O2 treatments caused firmer but less juicy fruit but low O 2 treatment for two weeks increased bitterness under regular air conditions but significant effects of treatments were disappeared after 6 th month. On the other side, low O 2 treatment for one-week caused fruit lower bitterness and alcohol formation in fruit during shelf life after 6 th month CA storage but after 9 th month, low O2 treatment for two-week increased alcohol formation. Overall, the effect of low O 2 treatments changed based on storage technology and in both cultivars significant effect of these treatments was not observed during shelf life period after a 6 months cold storage period. Additionally, one-week low O 2 treatment can help to reduce alcohol formation and enhance fruit taste during shelf life period after 6 months cold storage in both cultivars.

Session: Posters 2 - Flavour, Sensorial and nutritional quality

Physicochemical quality of avocado cv. Lamb Hass from Mediterranean area during the commercial season

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Abstract

Avocado production in Spain has increased significantly in recent years. Although the main cultivated variety is 'Hass', in the Mediterranean area later varieties, mainly 'Lamb Hass', are gaining interest to prolong the commercial season. Currently, this variety has a narrow harvest window, May-June, since the European market is supplied with avocados from the southern hemisphere from June. However, it would be interesting to extend the harvesting of 'Lamb Hass' produced in Spain, to be marketed in Europe, which would have a direct impact on reducing the carbon footprint derived from overseas fruit transport. In this study, the main physicochemical quality attributes of avocado 'Lamb Hass' was evaluated in six harvests from May to September. The average fruit weight gradually increased as harvest advanced, from 260 g in June to 317 g in September. Dry matter content, which is the accepted worldwide standard on which harvesting time is based, was 23.3% in May, gradually increasing to 28% in July, and then decreasing in subsequent harvests until 25% in September. A darkening of the fruit skin was observed in June without changes until September, which was mainly reflected in a decrease of values of h° (Cielab color space). Similarly, a change in flesh color was observed, from pale yellow in May to more intense tones in the following harvests, as evidenced by a decrease in h° and an increase in b* (Cielab parameters). The flesh firmness evaluated by puncture test, determining the force necessary to break the flesh without peel, remained without significant changes during the harvest period studied, with values of 200-224 N. Total soluble solids and acidity were maintained without significant differences during the harvest period studied. According to the results obtained, 'Lamb Hass' avocado cultivated under Spanish climactic conditions presents optimum quality for harvesting between May and September.

Session: Posters 2 - Packaging, coatings and processing

Opuntia ficus indica mucilage edible coating regulates cell wall softening enzymes and delays ripening of banana fruit at retail conditions

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Abstract

Climacteric fruits such as bananas are prone to high perishability. The rapid ripening and softening due to cell wall polysaccharides degradation and disassembly are major concerns in extending fruit storability. The objective of this study was to examine the efficacy of Opuntia ficus indica (OFI) mucilage edible coating to minimize softening and cell wall degradation in banana fruit under retail conditions. Mucilage was extracted from freshly harvested OFI cladodes and dried into a powder. Coating formulations (1,2 & 3% concentrations) were prepared and applied to banana fruit collected from Johannesburg fresh produce market in South Africa. During the experiment, fruit weight loss, total soluble solids (TSS) & titratable acidity (TA) in pulp, peel colour (greenness (a*) and yellowness (b*)), pulp firmness, ethylene and carbon dioxide (CO 2) production, ion leakage, malondialdehyde (MDA), total chlorophyll and carotenoids, chlorophyll degrading enzymes (chlorophyllase (Chlase), pheophytinase (PPH), magnesium-dechelatase (mg-dech) & chlorophyll-degrading peroxidase (Chl-POD) activities), softening related enzymes (Cellulase (CX), pectin methyl esterase (PME) and polygalacturonase (PG) activities) in the peel. Results showed that mucilage treatments effectively delayed cell wall and chlorophyll degrading enzymes, and carotenoid accumulation inhibited ripening-associated processes compared to control fruit. OFI mucilage treated fruit significantly had higher firmness, chlorophyll content and TA and lower TSS content, ethylene, and CO 2 production and MDA concentration, as well as ion leakage compared to uncoated fruit. These findings suggest that OFI mucilage edible coating maintained quality and enhanced banana fruit shelf life by suppressing softening enzymes during storage. This could be associated with an abundant calcium nutrient found in OFI cladodes, hence making the biomaterial for postharvest applications.

Session: Posters 2 - Packaging, coatings and processing

1-MCP combine modified atmosphere packaging treatment delays the softening of Actinidia arguta by reducing cell wall degradation and sugar metabolism

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Abstract

Actinidia argute fruit were fumigated with 1-MCP combine modified atmosphere packaging (3%O2+5%CO2+92%N2) stored at 1±1℃ with 90-95 % relative humidity for 80 d. The effects of 1-MCP combine modified atmosphere packaging (CA) on changes were reflected on fruit firmness, activities of cell wall degrading enzymes and sucrose degradation. 1-MCP combine CA treatment significantly preserved higher firmness values in hardy kiwifruit. This treatment reduced the activities of enzymes related to sucrose degradation, and increased activity of sucrose synthase synthesis, resulting in a lower rate of sucrose degradation and the increase of glucose and fructose content during the storage. The results showed that the decline in fruit firmness, contents of dry matter, starch, cellular matter(CWM), and covalently bound pectin(CBP), as well as the increase in water-soluble pectin (WSP), acid invertase (AI), neutral invertase (NI) activity, the contents of 6-phosphofructokinase (PFK) and Sorbitol dehydrogenase (SH) of the hardy kiwifruit could be delayed by 1-MCP combine CA treatment relative to the control. 1-MCP combine CA treatment also suppressed the activities of polygalacturonase (PG), Pectin esterase (PE),cellulase (CX), β- galactosidase (β-Glu) α-galactosidase (α-Gal) and β-galactosidase （β-Gal） during the storage. These results indicated that 1-MCP combine CA treatment delayed the disruption of cell wall structure of the hardy kiwifruit, retarding the disassembly of cell walls polysaccharides via inhibition of an array of cell wall degrading enzymes activities to help maintain the intactness of the cell walls, which might be one possible mechanism by which 1-MCP combine CA treatment can help prevent softening of the hardy kiwifruit.

Session: Posters 2 - Packaging, coatings and processing

Effect of vacuum packaging combined with different storage temperature on the quality of fresh-cut carrots

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Abstract

resh-cut carrots are favored by consumers due to their nutritional and health-promoting benefits, pleasant favor and convenient safety. However, fresh-cut carrots are prone to dehydration and lignification during storage, which resulting in the lose of their bright orange appearance. Moreover, increased respiration rate, tissue softening and microbial spoilage, finally leading to the loss of product quality. In the present study, the effect of vacuum packaging and different storage temperatures on the quality fresh-cut carrots were investigated. Fresh carrots were cut into shreds and stored at 4, 10 and 25 ℃ for 5, 12 and 25 d, respectively. The firmness, color, aromatic substances, respiratory rate, total phenol content, antioxidant capacity and total bacterial count of fresh-cut carrots during storage were determined. The results showed that vacuum packaging could reduce the oxygen content around fresh-cut carrots and inhibit the respiration rate, thereby reducing the growth of microorganisms. Compared with storage at 10 and 25 ℃, low temperature storage at 4 ℃ significantly inhibited the increase of total bacterial count, whiteness and aromatic substances and maintained the firmness of fresh-cut carrot. The total phenol content of fresh-cut carrots were significantly higher when stored at 25 ℃ than at 4 and 10 ℃, indicating that high temperature storage could promote the synthesis and accumulation of phenolic compounds. However, the DPPH and ABTS free radical scavenging activities were maintained high at 4 ℃ of storage. In conclusion, storage at a higher temperature for a shorter period could promote the synthesis and accumulation of phenolic compounds, whereas low temperature combined with vacuum packaging could maintain the quality and safety of fresh-cut carrots.

Session: Posters 2 - Packaging, coatings and processing

From lab to packhouse: efficacy of gum arabic-based edible coatings for extended postharvest life of exported plums

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Abstract

Edible coatings have shown great potential in reducing postharvest losses in horticultural produce. However, there is limited focus on the technological readiness of edible coating applications for postharvest applications in stone fruit. In this study, we investigated the commercial viability of edible coating application on 'African delight' plums using gum arabic (GA) based edible coatings at 2%, 5%, and 10%) in a commercial packhouse. Postharvest quality was evaluated throughout a simulated export regime, including a cold storage shipping period (-0.5°C for 6 weeks) and subsequent shelf life (20°C for 15 days). According to industry practice, fruit were packed with HDPE bags during cold storage; however, an additional trial was conducted without HDPE bags. Coated fruit with HDPE bags had a superior quality to control fruit, with reduced respiration rate and delayed climacteric peak until 10 d shelf life compared to 5 d shelf life in control plums. Furthermore, softening was significantly delayed in coated fruit, with flesh firmness in plums coated with GA 5% (10.69 N) and GA 10% (14.04 N) at 15 d shelf life resembling that of control plums at 5 d shelf life (12.31 N). Colour changes in the peel and flesh of coated plums were delayed, with the greatest effect in GA 10% coated plums. At the end of cold storage, titratable acidity was significantly higher in GA 5% (0.83% malic acid) and GA 10% (0.84% malic acid) coated plums compared to control plums (0.67). At the end of shelf life, decay incidence was lower in coated than in control plums. Weight loss and shrivel incidence, however, were not significantly controlled with coating application, potentially due to poor coating coverage on the fruit's surface as a result of the method of application and, thus, poor moisture barrier properties. Nevertheless, considering these results, applying GA 10% may potentially delay postharvest losses and extend the shelf life of plums. Sensory analysis showed that the investigated coatings did not cause any off-flavours. Results also showed that the coated fruit without HDPE bags exhibited similar quality features as control plums packed with HDPE bags. Therefore, coating applications may replace HDPE bags used to pack export plums during shipment. This potential, however, is limited by the high weight loss and shrivel incidence observed in coated plums packed without HDPE bags. Further research should, therefore, optimise coating moisture barrier properties and application to improve coverage, keeping in mind the commercial viability.

Session: Posters 2 - Packaging, coatings and processing

Influence of hot air temperatures on drying kinetics of whole persimmon

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Abstract

Persimmon (Diospyros kaki) has become one of the most important crops in Mediterranean area of Spain in last years. The production is based in 'Rojo Brillante', an astringent cultivar that requires a post-harvest treatment of deastringency before commercialization. The high volume of production, the short harvesting season and the high quality requirements of the market have led to an increase in post-harvest losses in recent years, which can reach up to 16-20% of production. Therefore, the development of value-added by-products is one of the challenges facing the persimmon sector. Recent studies show that the technique of natural drying of whole fruit, widely used in Asian countries, could be a good strategy to valorize the surplus of 'Rojo Brillante'. However, the optimization of the drying process is necessary. In this study three different drying conditions were studied with the aim to determine the optimal condition to obtain an acceptable product for consumers and industrially profitable. Peeled persimmon fruit were subjected to forced air drying conditions at 35ºC, 40ºC or 45ºC. The target product must have a water content (Xw) of 30% and water activity (aw) of 0,7 approximately. For this, drying curves, physicochemical characterization of the three products were made. The results showed that drying at 45ºC reached that target parameters at the 6th day, while when the drying process was carried out at 40ºC or 35ºC, the same humidity was reached on the 8th and 12th day, respectively. During drying, changes in texture were observed, with the percentage of deformation increasing until the third day and stabilizing thereafter. However, the desired texture was achieved by the product obtained at 35ºC, since at higher temperature the fruit texture was very dry and corky. The thickest epidermis of the persimmons (3 to 5 mm) was obtained when dried at 45ºC.

Session: Posters 2 - Packaging, coatings and processing

Optimising citrus opentop cartons for efficient container cooling and minimal bottom sag

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Abstract

The South African citrus industry recently designed and implemented a high-ventilation A15C telescopic carton that significantly improves cooling performance during shipping. This carton allows the industry to ship chilling-injury-sensitive fruit to phytosanitary-sensitive markets at higher set points than was previously possible. However, citrus fruit packed in Opentop (display) cartons do not have access to similarly warm set points. The study's aim was thus to design an "Ultravent" opentop carton with an equivalent porosity to new A15C carton. However, the main challenge is overcoming bottom sag displacement due to the loss of structural strength as the vent size increases along the bottom wall of the carton. Finite-element analysis was applied to identify optimal vent hole positioning. The resistance to airflow (inverse of cooling rate) was evaluated using a custom-built wind tunnel. The mechano-sorptive creep (bottom sag) was tested experimentally for each carton design by loading carton stacks with 20 kg water bags and placing them in cold storage (0°C, ~95%) for 28 days. Key findings indicate that a vent area of 28000 mm 2 is needed to reach thre desired resistance of 2000-2500 kg m -4 . Bottom sag displacement was significantly higher for the "Ultravent" cartons (35.5 +- 4.5 mm) compared to "standard opentop" (26.0 +- 3.0 mm) and "No-vent" (23.3 +- 2.8 mm) designs. However, slightly increasing the board strength, significantly reduced bottom sag when applying the "Ultravent" ventilation design. The study thus showed the "Ultravent" has a comparable porosity to the new A15C carton and is mechanically viable for commercial export.

Session: Posters 2 - Postharvest treatments to improve quality

Increased shelf-life of raspberries (Rubus idaeus L.) after UV-C treatments

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Abstract

Raspberry is one of the most popular berry fruits, but due to very high sensitivity to different postharvest losses, it has a short shelf life. To improve postharvest storage, there are some useful treatments, one of that is the UV treatment: a non-destructive method consisting of irradiating the fruit after harvest with light at certain wavelengths and intensities. For that reason, UV-C radiation (200-280 nm) treatments were applied to sanitize cv 'Diamond Jubilee' raspberries and reduce their postharvest decay following fungal attacks. All treatments were carried out with a relative radiation power of 18.58 W/m 2 , using different irradiation times: 2 n 5 n 10 - 15 minutes (irradiation energy of 0.25; 0.6; 1.2; 1.8 J/cm 2). After the UV treatments, samples were stored in plastic clamshell in a climatic chamber at 10°C (3 n 7 - 9 days) to simulate retail conditions. Analyses on the samples focused on total polyphenol content, L* and h* colorimetric parameters, and the percentage of disease incidence in relation to the day of harvest. Results show a decrease in the incidence rate of disease in treated samples, with a greater decrease for longer exposure times. UV-C treatment does not involve losses in total phenol content, but on the contrary, it is improved after 7 days of storage. Finally, the treated fruits turn out to have more intense and brighter colors. In conclusion, the sanitizing action of UV-C results in an increased shelf life. Furthermore, direct exposure of raspberries to UV-C light does not lead to a deterioration of nutraceutical and quality parameters.

Session: Posters 2 - Postharvest treatments to improve quality

Blueberry (Vaccinium corymbosum L.) post-harvest UV-B treatments induce changes in bioactive compounds and reduce weight losses during cold storage

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Abstract

The blueberry post-harvest chain management is challenging. Complications are related to ripeness monitoring, which manifests as colouring of the peduncolar area. This leads to premature collections, with potential retrogradation during storage as an effect of decreasing bioactive components and a reduction in quality characteristics. Aiming to mitigate these complications, the impact of increased artificial UV-B radiation on nutraceutical compounds of cv 'Cargo' blueberries (Vaccinium corymbosum L.) was evaluated. Blueberries samples, aboveground cultivated, were homogeneously yielded partially immature (stalk point of insertion still green/pink) and immediately processed under UV-B action. UV treatments were performed with a total peak emission, at 310 nm of 18.58 W/m 2 . Two exposure times (5 n 20 minutes) were performed in triplicate, then samples were stored for 1 n 2 n 24 h at 20°C (adaptation time) in a perforated plastic box, next cold stored at 2°C for 6 days (storage time) and finally processed for qualitative analysis. The findings show that shorter treatments and longer adaptation times provide significantly greater accumulations of anthocyanins than the control. Low irradiation (5 min) caused some distinctive changes in fruit pigmentation characterized by a color change towards darker shades than the control. It emerged that the treatment is improving for samples kept at 2 h in the chamber at 20°C. Moreover, the weight loss results remain significantly lower than the control during cold storage. On the other hand, the samples seem to be negatively affected by the UV dosage; the berries firmness in fact remarkably decreases with increasing exposure to lamps. Thus, the anthocyanin accumulations between the adaptation times are quite similar and the mechanical properties are better preserved with short UV treatments. Therefore, short adaptation times and low dosage would be promising to improve post-harvest management. These latter results would provide consumers with fully mature, defect-free, and nutraceutical compound-rich products.

Session: Posters 2 - Postharvest treatments to improve quality

Cranberry (Vaccinium macrocarpon) quality may be affected by different light spectra postharvest

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Abstract

The proven health benefits of cranberries (Vaccinium macrocarpon) have aroused interest in their cultivation. As the growing season in Finland is too short for field cultivation of cranberries, we have initiated cranberry production in a high tunnel in soilless culture. Even so, in some years berries have to be harvested partly unripe and further ripening occurs during storage. The aim of this study was to examine how different light spectra applied postharvest affect the ethylene production, anthocyanin concentration, and color in cranberries harvested at different maturity stages. Cranberry cv. Pilgrim berries were harvested at three different maturity stages: green, white, and turning. They were incubated either in darkness, or under blue light, red light, or wide spectrum for 7 and 14 days. Light treatment, degree of maturity, and their interaction had a significant effect on cranberry ethylene production, color, and anthocyanin formation postharvest. Ethylene production declined along with ripening of the berries. In berries harvested at a green stage all light treatments increased ethylene production as compared to darkness. When harvested at a white stage, blue light increased ethylene production as compared to other treatments. Ethylene production was very low in berries harvested at a turning stage and not affected by light treatments. Red color development was enhanced in particular by blue light in cranberries harvested at a green stage. Minor effects were observed in white-collected berries, and no effect of light treatment was observed in berries harvested at a turning stage. Negligible amounts of anthocyanins were measured in berries harvested at green and white stages. At green stage blue light enhanced anthocyanin synthesis, and at white stage all light treatments increased anthocyanin, blue light being the most efficient. At a turning stage highest anthocyanin concentration was observed in berries treated under wide spectrum. This study demonstrated that the quality of cranberries harvested partly unripe may be influenced by light spectra postharvest. Blue light had the most prominent effects on ethylene production, anthocyanin synthesis, and color development.

Session: Posters 2 - Postharvest treatments to improve quality

The activity of 1-methylcyclopropene (1-MCP) on post-harvest life of the mango fruit (Mangifera indica L.) after irradiation

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Abstract

Mangoes are perishable fruit that loses their fruit firmness and weight rapidly during harvest, post-harvest treatment, and transport. Thai fresh mangoes are usually treated with ionizing radiations as a phytosanitary treatment before being exported to overseas markets. In this study, the effect of 1-methylcyclopropene (1-MCP) on mango fruit quality and their shelf-life were investigated after irradiation. The fruit was treated individually through fumigation with a 1-MCP via different at 500 and 1,000 ppb for 12 and 24 hr. then stored at 13-15°C for 24 days. It was found that irradiated mango treated with 1-MCP at 1,000 ppb was more effective in maintaining quality on color, TSS/TA, fruit firmness, respiration rate, and ethylene production. 1-MCP also decreased the decay incidence during storage than treatment of 500 ppb 1-MCP and controls. All treatments were significantly suppressed in the ripening process more than non-treated. Moreover, the effect of 1-MCP successfully extended the postharvest life of 'Nam Doc Mai Si Thong' mango for 24 days. These results demonstrate that mango fruit responds differentially to a concentration of 1-MCP and is a useful method for the preservation of mango fruit for long distances by sea freight.

Session: Posters 2 - Postharvest treatments to improve quality

Reduce the post-harvest losses in organic beetroot production

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Abstract

The market for organic agriculture is rapidly growing. In Switzerland, the production of organic Beetroot is particularly renowned. However, their storage until spring has become increasingly difficult in recent years, and losses due to post-harvest rots can lead to over 50 % by March. Therefore, most organic beetroots sold in spring need to be imported. The causes for the various storage rots in beetroot are currently unclear, and therefore there are few measures to prevent them in organic production. Pathogen infections causing storage rots in beetroot, but also in other long-stored vegetables, can occur via the seed, in the field, or post-harvest. Understanding the process of infection is, therefore, critical to find preventive solutions. Here, we present the results of a two-year project aiming at reducing post-harvest losses in organic beetroot production. In a combination of on-farm field experiments and laboratory analyses, we aim to elucidate the causes of storage rots in organic beetroot and develop measures to improve storability. Analysis of stored beetroot in February 2021 revealed Fusarium species and Phoma betae as predominant pathogens in Switzerland. Botrytis cinerea , Rhizoctonia solani, and Pythium sp. were found as additional causative agents of storage rots. In summer 2021, a field trial in cooperation with four producers of organic beetroot was started, where the production from sowing to storage was monitored. Different measures, such as steam sterilization of the seed, the use of biocontrol products in the field and before storage, or processing and cooling methods after harvest, as well as cultivar differences were investigated. The various measures were found to affect seed health, seedling emergence, leaf health, and the quality of beetroot after storage.

Session: Posters 2 - Postharvest treatments to improve quality

1-Methylcyclopropene treatment maintains the postharvest quality and delays softening of hardy kiwifruit by regulating cell wall metabolism and carbohydrate metabolism

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Abstract

The rapid softening of hardy kiwifruit (Actinidia arguta) fruit can significantly reduce its marketing potential. Therefore, the effect of 1-methylcyclopropene (1-MCP) on the softening of hardy kiwifruit was investigated. The results showed that hardy kiwifruit treated with 1.0 uL L -1 1-MCP maintained better postharvest quality, including higher firmness, titratable acidity, ascorbic acid, total phenolic and flavonoid content, relative to untreated fruit. Fruit treated with 1-MCP and placed in long-term cold storage had higher sensory scores, as determined by the tasting panel and supported by electronic nose and tongue data. Notably, 1-MCP delayed the degradation of cell wall components, including pectin, cellulose and hemicellulose, by reducing the activity of cell-wall-modifying enzymes (pectinesterase, polygalacturonase, cellulase, β-glucanase, α-galactosidase, and β-galactosidase). Transmission electron microscopy observations also indicated that the 1-MCP treatment maintained the the structural integrity of cell walls in hardy kiwifruit, particularly in the appearance of pectin in the middle lamella and intracellular starch grains. In addition, 1-MCP reduced the activity of carbohydrate metabolism-related enzymes (amylase, neutral invertase, acid invertase, sucrose phosphate synthase, sucrose synthase, phosphofructokinase, and sorbitol dehydrogenase), resulting in higher levels of starch and sucrose and lower levels of glucose, fructose and sorbitol in the fruit. In conclusion, these results suggest that 1-MCP can delay fruit softening and extend the storage and shelf life of hardy kiwifruit.

Session: Posters 2 - Postharvest treatments to improve quality

Improving suberization of wounded potato tubers with biological elicitor treatment

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Abstract

Wounding-induced postharvest losses of potato tubers impose serious economic burden to potato stakeholders worldwide. Currently, potato industry do not have effective and commercially relevant postharvest strategy to mitigate wound-related economic losses. Therefore, finding a benign and grower-friendly postharvest treatment strategy to improve wound healing/suberization of potato tubers has significant economic relevance. Formation of protective suberin layer through accumulation of suberin polyphenolics (SPP) and suberin polyaliphatics (SPA) is the most important step in the suberization process of wounded potato tubers. The initial phase of this protective layer formation is known as closing layer formation, which mostly occurs within 8-9 days after wounding. In this study, biologically processed compounds (combination of water soluble chitosan oligosaccharide and bioprocessed cranberry pomace) were utilized as postharvest treatment to improve suberization of potato tubers. A standardized disc model system was used to study the wound-healing/suberization of potato tubers following postharvest treatments. Additionally, elicitor treatment-induced suberization was compared among 15 different potato cultivars. The formation of SPP in wounded and elicitor treated tissues after 3, 6, and 9 days of wound-healing was investigated using microscopical analysis. Statistical differences in SPP formation were observed among 15 potato cultivars and between postharvest treatments (control vs. elicitor). Irrespective of the effect of postharvest treatments, enhanced formation of SPP was found in Atlantic potato cultivar after 6 days of wound-healing, and it was statistically superior when compared to all other potato cultivars. Improvement in SPP formation was also observed with elicitor-based postharvest treatment in 10 potato cultivars after 9 days of wound-healing. The results of this study indicate that biological elicitor treatment can be an effective postharvest strategy to improve suberization of wounded potato tubers. Future studies with different potato market classes and under different postharvest storage conditions are required to validate the efficacy of this elicitor-based treatment strategy.

Session: Posters 2 - Postharvest treatments to improve quality

Applications of LED lighting during post-harvest to improve strawberry quality

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Abstract

The application of new technologies, including light-emitting diode (LED) lamps, proved to be effective in extending the shelf life of fresh products while also maximizing their quality attributes. As non-climatic fruit, strawberries must be harvested almost fully ripe, requiring appropriate storage methods to delay the senescence process and maintain their market value. This study aimed at assessing the effect of light treatments on the physiological and qualitative changes of strawberries (Fragaria x ananassa 'Elsanta') during storage. Fruits were subjected to LED illumination (blue, red, far-red with 80 umol m-2 s-1 and UV-A with 30 umol m-2 s-1), at the beginning of the storage period either with continuous irradiation for 48 hours and intermittent irradiation for two days (12 h per day). Strawberries kept in dark conditions were used as control. Changes in fruit weight, total soluble solids, colour, anthocyanin content, and volatile organic compounds, were monitored during 7 days of storage at 5+-1°C. Preliminary results suggest that the application of LED light in the first days of storage could effectively enhance some strawberry quality parameters. In particular, intermittent irradiation of blue and far-red lights positively influences SSC/TA ratio and dry matter content, while continuous irradiation with all four LED illuminations increased by almost 20% the total anthocyanin content. In addition, the continuous irradiation, especially with blue and red LED lamps, considerably modified the VOC profile of fruit, enhancing the concentration of the main ester compounds responsible for the fruity aroma of strawberry. Further research should evaluate the effect of irradiation at the beginning of storage on microbial spoilage and focus on optimizing lighting parameters for the application in the fruit and vegetable sector.

Session: Posters 2 - Postharvest treatments to improve quality

Fruit quality parameters, ethylene production and development of physiological disorders after postharvest 1-MCP treatment of the apple cultivar Rubinstep harvested at different maturity stages

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Abstract

The ethylene-competitive inhibitor 1-MCP is an established method to reduce postharvest ripening; however, application at the right fruit maturity stage is crucial. Fruit of the apple cultivar Rubinstep was harvested at optimal commercial maturity and additionally one and two weeks before and after. Fruit quality was assessed after harvest and fruit were either treated with 1-MCP or not treated. Subsequently, the fruit was stored at 4°C in regular atmosphere for 12 weeks. Ethylene levels were measured regularly using an electrochemical sensor (EASI-1N, Absoger, France) during cold storage and shelf-life period of 14 days at 20°C. Fruit firmness and starch content decreased with progressing harvesting date, displaying the fruit ripening process. The effect of harvest date on ethylene production was significant at each measurement date in cold storage. Significant lower ethylene production in cold storage of 1-MCP treated than non-treated fruit was found in fruit harvested from all five harvest dates. However, significant differences were not found at every measurement date. After the storage and shelf-life period, fruit quality was analysed, and the incidence of physiological disorders such as superficial and soft scold was assessed. The development of physiological disorders and fruit quality will be discussed in context with the maturity stage at harvest and the expression of genes involved in ethylene perception and production.

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Application of bioethylene in postharvest treatments

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Abstract

Nowadays, most of the world's ethylene production comes from the petrochemical industry by steam cracking of naphtha. Nevertheless, steam cracking of hydrocarbons is one of the largest carbon dioxide (CO2) emitting processes in the chemicals industry. The production of bioethylene is a very interesting option as sustainable alternative with low CO2 emissions. Recently, through a European funded project (URBIOFIN), a demonstration scale preparation of high purity bioethylene has been obtained from the catalytic conversion of second-generation bioethanol from the organic fraction of municipal solid waste (OFMSW). Since ethylene is a gas commonly used in postharvest treatments, studies to validate the use of this bioethylene in these processes are needed. In this study was evaluated the application of bioethylene in banana ripening and citrus degreening treatments. The high purity bioethylene was diluted in nitrogen to 5 %. Two ripening trials were carried out on 'Candevish' bananas. After harvest, the fruit were subjected to a ripening treatment with bioethylene or commercial ethylene at 300 ppm for 24h at 17ºC. After the ripening process, the fruit were transferred at 17ºC for up 7 days. The evolution of color, firmness and total soluble solids after ripening treatment was similar when it was carried out with commercial ethylene or with bioethylene. Degreening treatments were performed on citrus ('Iwasaki Satsuma'). Two homogeneous color groups of fruit were subjected to degreening treatment by application of bioethylene or commercial ethylene at 2 ppm, for 48 h at 20ºC. After degreening treatment, the fruit were transferred to 20ºC for 3 days. In both groups, no differences in external color, firmness, total soluble solids or acidity were found between treatments. According to the results obtained, bioethylene produced from OFMSW via bioethanol is shown to be a good alternative to the use of commercial ethylene in postharvest processes.

Session: Posters 2 - Postharvest treatments to improve quality

Product and active substance registration for postharvest applications

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Abstract

To ensure postharvest pest control and quality assurance Plant protection products are essential. These products and the active substances they contain need to be registered. Hereby the task of the Board for the Authorisation of Plant Protection Products and Biocides (Ctgb) is to assess whether plant protection products and biocidal products are safe for humans, animals and the environment in accordance with international agreements and criteria laid down in legislation. Furthermore, Ctgb assesses if the product is effective. Our scientific assessment work is subject to many European regulations, European directives and national laws, including the Plant Protection Products and Biocidal Products Act (Wgb). Based on this assessment, the Ctgb decides whether products can be sold and used in the Netherlands. When a product acquires authorization to be used in the Netherlands Ctgb ensures that clear instructions for use are printed on the label of the product.

Session: Posters 2 - Postharvest treatments to improve quality

Influence of precooling on fruit cracking rate and quality of sweet cherry

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Abstract

Fruit cracking is a complex physiological disorder that can be caused by a variety of factors such as excessive or inadequate water, changes in environmental conditions, disease, and internal metabolic disturbances. This phenomenon poses a significant economic challenge in sweet cherry production. In order to investigate the potential of precooling as a means of mitigating this issue, the present study examined the effects of precooling on the cracking and quality of six sweet cherry cultivars: "Summit", "Big Red", "Jiahong", "Hongdeng", "Yellow Crystal", and "Bing". The fruits in the experimental group were precooled (4 ℃ for 24 h) while the control group received no precooling treatment. To examine the impacts, various parameters were measured, including cracking index, water uptake, firmness, pressure resistance, respiration rate, ethylene release, total soluble solids (TSS), titratable acidity (TA), soluble protein, and vitamin C (Vc) content. The results of this study revealed that precooling significantly reduced the cracking rate and water uptake across all six cultivars, especially for the “Big Red”, Jiahong”, “Yellow Crystal” and “Bing” cultivars. Although precooling had no significant effect on color, soluble protein, and Vc content, it led to a marked enhancement in firmness, pressure resistance, TSS, and TA, and also resulted in a considerable decrease in respiration rate and ethylene release. These findings indicate that precooling could be a promising strategy for improving cracking resistance and overall quality in sweet cherry.

Session: Posters 2 - Storage systems & postharvest technologies

Effect of the Repeated Low Oxygen Stress on Dynamic Controlled Atmosphere storage of ‘Elstar’ and ‘Nicoter’ apples

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Abstract

DCA technology has been available for the last two decades, and this technology aim to store fruit at their lowest tolerated oxygen limit at present different principles to control lowest oxygen limit (LOL) stress exist. Namely, chlorophyll fluorescence (DCA-CF), ethanol the anaerobic metabolism products (DCA-Eth), respiratory quotient (DCA-RQ), and CO 2 production (DCA-CD). DCA allows the fruit to be stored at the LOL, the level at which apples can be stored without low oxygen damage. The LOL changes according to the variety, storage period, temperature, maturity stage, etc., ranging between 0.05 and 0.8kPa O 2 . DCA-RQ is a technology that allows fruit storage in a RQ higher than 1.0, which induces slight anaerobic metabolism. However, the impacts of repeated low oxygen stress (RLO) under DCA-RQ remain unclear. The aim was to evaluate the effect of RLO under DCA-RQ storage when compared to ULO-CA-storage. Both apple varieties were stored for 6 months at a fixed RQ of 1.3 and at 1ºC and 3ºC. In one treatment, the RLO stress was induced twice a week by allowing the fruit to use the O 2 inside the experimental chamber during 14 hours of closure to determine the RQ. DCA-RQ reduced respiration rate and ethylene production in both varieties in comparison to ULO. Interestingly, DCA-RQ without RLO resulted in lower respiration rate in 'Nicoter' apples, while no differences were observed in 'Elstar'. For both varieties, storage under either DCA technologies improved the conservation of key quality defining parameters and fruit health in comparison to CA, although differences were more pronounced for 'Nicoter'. DCA-RQ proved beneficial in maintaining membrane integrity in 'Nicoter' apples, as electrolyte leakage and core browning incidences were decreased. However, while RLO in DCA-RQ was determined in 'Elstar' to be beneficial in maintaining higher firmness, amount of healthy fruit and greener peel color, it proved detrimental in 'Nicoter' due to higher decay and cavity incidences. The varieties were thus determined to have different tolerances to low oxygen stress

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Evaluation of storage potential of fresh pistachios under different forms of exposure to storage

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Abstract

Fresh (raw, non-dried) pistachios are gaining popularity among the consumers due to their unique sensory attributes and nutritional value. However, they are very perishable to kernel deterioration and to loss of 'fresh' character by loss of kernel moisture (threshold of 20% w/w) that limit their availability. The aim of the present study was the extension of fresh pistachio storage potential by evaluating four different forms of their exposure to storage facilities. Fresh pistachio (Pistacia vera L. cv. Aegina) fruits were harvested at 32% (w/w) kernel moisture and stored at 4o C and 90% RH in the form of whole fruit (in-hull pistachios) in open trays or endocarps (de-hulled nuts) in open trays (Control) and trays sealed with modified atmosphere packaging (MAP) films of polyethylene (PE) or polyamide/polyethylene (PA/PE) materials. Weight loss, composition of package atmosphere, kernel moisture, color (red and green part, CIELAB L*, a* and b*), texture (puncture peak force and total force of 3 mm puncture) and respiratory (O_2 consumption, CO_2 production, RQ at 20o C) attributes were measured after 0, 1 and 2 months (mo) of storage. The in-hull pistachios had the highest (34% in average) and PA/PE (0.3% in average) the lowest WL during storage. The WL was 16% and 6%, in average for Controls and PE, respectively. These WLs resulted in loss of 'fresh' character for controls (12.6% kernel moisture in average) from the 1st mo and for in-hull pistachios at the 2nd mo (21 and 14% kernel moisture at 1 and 2 mo, respectively), whereas MAP packaged nuts retained a kernel moisture >25% during the whole storage period. The package atmosphere was 17.8% O_2 – 3.7% CO_2 in PE (in average) and 1.8% O_2 – 23.0% CO_2 in PA/PE (in average) packages. MAP (both PE and PA/PE) limited the sharp decrease in all kernel respiratory attributes that were observed in stored in-hull and control pistachios. The in-hull pistachios had the most intense red kernel color (the highest a* and b*) during storage, and the browning (decrease in L*) of the green part of kernels was limited by in-hull and PA/PE storage. The texture of kernels had slight changes during storage and differences among samples were observed only at 1 mo where PE showed the highest values (1830 g puncture peak force, 2680 g × mm total force). Conclusively, an extension of storage potential for fresh pistachios can be achieved by in-hull storage for 1 mo and by nut storage under MAP for 2 mo.

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Factors affecting 1-MCP release from various formulations and release systems

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Abstract

1-Methylcyclopropene (1-MCP) is an important synthetic growth regulator used to delay ripening and senescence during postharvest storage of fruits and vegetables. One common commercial mechanism to deliver 1-MCP to the treatment room is releasing it from an α-cyclodextrin encapsulant complex. In a common version of this application, the α-cyclodextrin complex is a powder (or tablet) is sealed within in a water-soluble poly co-vinyl alcohol (PVOH) pouch or coating. The 1-MCP generation unit is placed into a water-containing vessel containing an air bubbler, water pump, stirring paddle, or other means of agitation. We evaluated a commercial α-cyclodextrin encapsulating powder, sachets of 1-MCP adsorbed to activated carbon material, and an α-cyclodextrin matrix sprayed onto the surface of a polymer. Factors evaluated include agitation style, temperature, proportional water volume, PVOH amount, and the amount of dissolved α-cyclodextrin on the release rate of 1-MCP from the powdered α-cyclodextrin. The effect of humidity and temperature was evaluated for the sachet and the polymer-based 1-MCP releasing materials. Agitation style impacted the rate of 1-MCP release; lack of agitation prevented dissolution of the α-cyclodextrin complex. Undissolved α-cyclodextrin complex, despite being immersed in water for 24 hours, contained substantial amounts of unreleased 1-MCP. The rate of 1-MCP release from the α-cyclodextrin complex was temperature dependent, increasing with temperature in a non-linear fashion from 0 to 30°C. The extent of release was reduced approximately 28% at 0°C relative to higher temperatures. The amount of PVOH material did affect the extent or the rate of 1-MCP release. For the activated carbon and polymer-based matrices, elevated temperature and humidity markedly impacted the release of 1-MCP from both materials. The release from the activated carbon material was drawn out over days or weeks, even at saturating humidity. The release from the polymer matrix was complete within one or two hours from the polymer matrix. Collectively the data demonstrate that each release system has dramatically different release kinetics, sensitivity to temperature, and sensitivity to humidity and these factors must be accounted for or controlled to achieve target exposure concentrations.

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Apple Ripening After DCA Storage: Assessing the Risk of Flavor Loss

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Abstract

Dynamic controlled atmosphere (DCA) storage suppresses the ripening of apple fruit during storage to a greater extent than standard CA storage. DCA is a relatively new technology and, as yet, its impact on the quality attributes of apple fruit after storage is not described in a manner that provides guidance on the handling of fruit following storage. We do know, however, that DCA has the potential to markedly alter the volatile profile of apple fruit. It has been found that DCA storage can suppress the most important aroma volatiles of stored apple fruit. What we don't know is the length of time and the conditions needed to recover that loss in aroma, especially when DCA is applied to fruit treated with the ethylene action inhibitor 1-methylcyclopropene (1-MCP). A critical concern about 1-MCP is that apple flavor is compromised in treated fruit because aroma volatiles are so closely linked with ethylene response. Apple fruit from high-value cultivars were stored under a DCA regimen (approximately 0.4% O 2), with and without 1-MCP treatment, for 3, 6, and 9 months. Following removal of fruit from DCA, the volatile profile and fruit quality traits were measured for up to 5 weeks while being held at room temperature. The recovery of aroma formation following storage for 6 months was essentially immediate for Red Delicious fruit if 1-MCP was not used (Fig. 1). The recovery was a little slower for one of the replicate studies if DCA was used. If the fruit were treated with 1-MCP, there was a 2-week delay in the recovery of aroma formation. Evercrisp aroma formation was much lower than Red Delicious and the responses to DCA and 1-MCP differed from that of Red Delicious. Aroma formation remained very low for 3 to 4 weeks at room temperature following CA and DCA storage and never recovered following 1-MCP treatment for the 5-week duration of the study. The data for aroma formation after 9 months was similar to that at the 6-month time point for Red Delicious in terms of 1-MCP responses. However, the effect of DCA seemed to be more pronounced, suppressing aroma recovery for an additional week at room temperature. For Evercrisp, the 9-month data were quite similar to those from 6 months storage.

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Effects of deviations from the optimal storage temperature on the quality of grapes

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Abstract

Optimal storage conditions of grapes are well established but under commercial conditions, deviation from the optimal temperature can occur. In this study, we assessed the quality of grapes stored at 0, 3, and 6°C and 3 days of shelf life at 3 week intervals for up to 12 weeks, and defined the maximum storage time until decay was established. In a second experiment, we studied the effects of various interruptions from the optimal temperature of 0°C during the first 3 weeks of storage. For that purpose, grapes were stored at 2.5°C, 5°C, 10°C and 15°C for one, two, or three weeks and afterwards stored at 0°C for up to 12 weeks, and fruit quality was evaluated at 3 week intervals and 3 d of shelf life. Another aspect tested was the effect of a 24 h interruption at 10°C or 20°C on grape quality. Our results show that storage of grapes in 6°C, 3°C and 0°C can enable maintaining the grapes free of decay for 3, 6 and 9 weeks, respectively. Other main parameters measured were rachis quality, firmness, bleaching, weight loss and fruit color. The results from the interruption experiment showed that the temperature interruption was more important than the length of interruption on some major parameters of grape quality, such as rachis quality, spectral properties, bleaching, decay and acceptability. The collective information which is composed of 1792 clusters and their features was used to generate models that will assist in prediction of shelf life of table grapes. The results achieved in this research will help to understand the significant effect of deviations from the optimal storage temperature on grape quality, and will facilitate improved logistic management of table grape.

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Effects of plasma-activated water treated with helium on storage quality of fresh-cut apple

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Abstract

As a new non-thermal food preservation technology, plasma activated water (PAW) is considered to be a promising method for fresh-cut fruits and vegetables because of its efficacy against a wide range of bacteria and fungi with no adverse impact on product quality. The influence of plasma activated water (PAW) on the storage quality of fresh-cut apple during cold storage was studied. Fresh-cut 'Fuji' apples were immersed for 5 min in PAW generated, by plasma generated with helium concentration of 500 mL min -1 and voltage of 10 kV discharging continuously for 10 minutes at 30 cm below the liquid level. The control group was soaked in distilled water for 5 min instead of PAW. The results indicated that the quality decline of fresh-cut apples was delay by PAW generated with helium during storage at 4 +- 1 °C. Compared with CK group, PAW treatment effectively inhibited the increase of L * value and BI value of fresh-cut apple, and also inhibited the decrease of its firmness. It could reduced the increase of cell permeability, malondialdehyde (MDA) content and lipoxygenase (LOX) activity. PAW treatment could slow down the rising trend of phenylalanine ammonialyase (PAL) activity and promote the increase of superoxide dismutase (SOD) activity, but there was no significant difference in the changes of polyphenol oxidase (PPO), peroxidase (POD), catalase (CAT) and ascorbic acid peroxidase (APX) activities compared with CK group. In addition, PAW treatment controlled the decrease of total phenols (TP) and flavonoids content of fresh-cut apple, but had no significant effect on anthocyanin and ascorbic acid content. It can be seen that the PAW treated with helium has an obvious effect on maintaining the quality of fresh-cut apples, controlling membrane lipid peroxidation and surface browning, and it has an inhibitory effect on active oxygen metabolism, but the effect is not significant.

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Monitoring approaches in Refrigerated Containers Loaded with Citrus and Apples

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Abstract

Refrigerated containers (RC) are the main mode by which fresh produce reaches international markets and thus influence how efffectively fruit are handled along the cold chain. This study made use of a validated container model to explore optimal monitoring positions for commercial trade. The model predicted heterogeneous airflow distributions through the pallets as well as airflow bypass from freestream regions. As the distance of the pallet to the refrigeration unit increases, the airflow rates decrease rapidly. Pallets near the refrigeration unit thus cool significantly faster than pallets near the door. The simulations indicate that significant improvements in cooling performance may be possible by optimising package ventilation and using container loading kits. Optimum container monitoring approaches for commercial shipments were considered. The results showed that an air sensor placed within a carton at the internationally recognised USDA3 position is ideally located to monitor the slowest container cooling region.

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A commercial tool for characterizing airflow resistance of fresh produce packaging

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Abstract

Cooling is a critical component of citrus export as it inhibits decay, reduces respiration rates and is often a requirement for market access. Phytosanitary regulations for citrus fruit export to international markets determine the precooling and shipping temperature conditions. Efficient control over fruit temperatures is thus a high priority. However, packaging significantly restricts cold airflow from reaching fruit. Ventilation holes are therefore applied to fruit cartons to facilitate improved airflow porosity. The cooling potential of a packaging system is linked to its resistance to airflow, which is a factor of the cartons design, stacking pattern, ventilation design and the packed fruit characteristics. Commercially, the airflow resistance properties of a pallet structure are a challenge to define or estimate at an industry level. This study thus developed a circuit network approach, initially introduced in mining industries, to calculate shaft ventilation requirements. This method uses the Ventilation law, which is similar to Ohm's law, and was fitted to many experimental studies of various packaging systems (designs and configurations). This approach has shown considerable value as a commercial tool for producers/exporters to match appropriate packaging to specific markets. However, this approach will not displace costlier experimental or numerical methods when high precision is required.

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Arduino-based control system for temperature-dependent gas modification in a fruit storage container

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Abstract

Proper design and practices during transportation, storage, and packaging can help minimize postharvest losses. One solution is the use of modified atmosphere containers, which use gas permeable membranes to passively create a desired gas concentration within a sealed container. However, such systems are limited to low temperature storage as the gas permeation rate through the membrane is low and the membranes are only effective at temperatures below 3°C. These systems also cannot maintain a consistent gas concentration during temperature fluctuations as the respiration rate of the produce changes with temperature, while the gas permeability of the membranes remains largely unaffected. The aim of this study was to develop a method to indirectly control O 2 and CO 2 concentrations in a storage container as a function of fluctuating temperature. This method utilizes a thin and elongated hollow metal tube, that effectively blocks air from entering the container, but allows for air exchange when a small air blower is activated periodically based on temperature changes. The blower ON frequency was modelled as a function of storage temperature, taking into account the type and amount of fruit, blower properties, tube dimension, and gas setpoint. The model was then used in programming an Arduino micro-controller to control the blower in response to real-time measurement of storage temperature. The system does not require any gas sensors, as the control of O 2 and CO 2 concentrations was solely determined by the predictions of the model. The addition of an air blower increased the mass transfer coefficient for O 2 and CO 2 through the tube by at least 100 times. The proposed storage container was able to maintain O 2 (5.7%) and CO 2 (11.2%) which was within the optimal range of modified atmosphere storage conditions for sweet cherries under different temperatures. The blower ON frequency ranged from 32 s/h at 6°C to 350 s/h at 17°C. The system has the potential for larger-scale use and commercialization for the storage and transport of fresh horticultural produce that is highly perishable and has a high value. However, it is only suitable for commodities that can tolerate high levels of CO 2 , unless it is used in conjunction with a CO 2 scavenger or a high-selectivity membrane that quickly removes CO 2 .