Calcium dips and chitosan coatings on Strawberries as post-harvest treatment

The researchers at Institute of Agrochemistry and Food Technology, Valencia and Department of Preventive Medicine, Faculty of Pharmacy, University of Valencia, Spain explored the possibilities of enhancing the calcium contents and shelf-life of strawberries by dipping the fruits in calcium dips and chitosan coatings. Strawberries (Fragaria × ananassa Duch.) were treated either with 1% calcium gluconate dips, 1.5% chitosan coatings or with a coating formulation containing 1.5% chitosan +1% calcium gluconate and stored at 20°C for up to 4 days. The effectiveness of the treatments was assessed by evaluating their impact on the following parameters: fungal decay incidence, loss of weight, firmness, external colour, pH, titratable acidity and soluble solids content. Calcium dips were effective in decreasing surface damage and delaying both fungal decay and loss of firmness compared to untreated fruit. No sign of fungal decay was observed in fruit coated with 1.5% chitosan which also reduced fruit weight loss. Chitosan coatings markedly slowed the ripening of strawberries as shown by their retention of firmness and delayed changes in their external colour. To a lesser extent titratable acidity and pH were also affected by coatings. Whilst addition of calcium gluconate to the chitosan coating formulation did not further extend the shelf-life of the fruit, however, the amount of calcium retained by strawberries was greater than that obtained with calcium dips alone, thus resulting in increased nutritional value of the strawberries [Hernández-Muñoz Pilar, Almenar Eva, José Ocio María and Gavara Rafael, Effect of calcium dips and chitosan coatings on postharvest life of strawberries (Fragaria × ananassa), Postharvest Biol Technol, 2006, 39(3), 247-253].

Ethanol vapour treatment for fresh-cut mangoes storage

The scientists in USA conducted a study to optimize ethanol vapour application as a ripening inhibitor on whole mangoes to extend fresh-cut mango shelf-life. Freshly harvested mangoes were first subjected to hot water (+HW) at 46°C for 60 or 90 minutes to simulate quarantine heat treatments, or remained untreated (−HW). Fruit of each batch (+ or −HW) were then held at 20-25°C for 4 or 7 days (D4 and D7) after the hot water treatment before being exposed to ethanol vapours [0h (E0), 10h (E10) or 20h (E20)]. Fruits were then peeled and cut into slices, packed in plastic clamshells and stored at 7°C for 15 days. Only slices from +HW-D4-E20-treated fruit maintained higher firmness, hue angle and titratable acidity (TA) in storage. The +HW-D7-E10- or E20-treated fruit had higher hue angle than E0, but firmness, total soluble solids, TA, pH and respiration rate did not differ. Internal ethanol and acetaldehyde were very high in slices from +HW, D4 and D7, E20 and −HW-D7-E20-treated fruit. A sensory panel could perceive higher firmness and acidity in slices from fruit treated with ethanol. However, E20 induced off-flavour and these fruit were least preferred.

Ethanol exposure on fruit was repeated with purchased mangoes that had been subjected to a commercial quarantine heat treatment. A second heat treatment of 18 hours at 38°C and 98% relative humidity was added to one batch of fruit in this experiment. Ethanol vapours did not result in delayed ripening in those mangoes. However, this treatment inhibited microbial growth. The second heat treatment did not improve fresh-cut mango shelf-life, and further, microbial growth increased compared to other treatments. It is concluded that, due to inconsistent results, ethanol vapour applied for 20 hours to whole mangoes prior to processing for fresh-cut is not a practical approach to delay ripening; however, at lower doses (10hr), it could be used as a safe microbial control in a fresh-cut production sanitation system [Plotto A, Bai J, Narciso JA, Brecht JK and Baldwin EA, Ethanol vapor prior to processing extends fresh-cut mango storage by decreasing spoilage, but does not always delay ripening, Postharvest Biol Technol, 2006, 39(2), 134-145].
Fruit

Beta-carotene content in stored papaya

Papaya (Carica papaya Linn.) is a rich source of carotene and needs special attention during storage to make the final product attractive and retain their nutritive value and flavour. The scientists at Department of Food Technology and Biochemical Engineering, Jadavpur University, Kolkata, India evaluated the change in beta-carotene content of papaya during storage after treating it with citric acid and sodium hydroxide solution of varying pH. During experiment papaya fruit was treated with citric acid solutions of different concentration and sodium hydroxide solutions of different molarity (expressed as pH) and stored at 0°C, −18°C and −40°C up to 40 days to study its beta-carotene retention. The beta-carotene content initially increased when the processed papaya fruits were stored for 10 days and afterwards gradually decreased during subsequent 40 days at all temperatures. Decrease in beta-carotene was more at 0°C as compared to −18°C and −40°C. Beta-carotene content was higher in papaya treated with citric acid than with sodium hydroxide [Dutta Debjani, Ghosh Debdatta, Chaudhuri Utpal Ray and Chakraborty Runu, Retention of beta-carotene in papaya during low temperature storage, J Food Sci Technol, 2006, 43(5), 544-548].

Proper harvesting time of Ber

Harvesting at proper time prevents spoilage of fruits especially during transport and storage. The scientists at Central Arid Zone Research Institute, Regional Research Station, Pali-Marwar, Rajasthan, India carried out investigation to find out proper time of harvest for Ber (Ziziphus mauritiana Lamk. cv. ‘Umran’). During experiment the physiologically matured fruits of ber were harvested at colour turning stage during morning (6-7 AM), noon (12-1.00 PM) and evening (5 to 6 PM). Two kg of fruits in each treatment were placed in perforated fruit trays and kept at ambient temperature (30°C ±2). The fruits were analysed for their physico-chemical composition just after harvesting and on 2nd, 4th and 6th day of the storage. TSS, acidity, ascorbic acid content and organoleptic evaluation were done by various methods and panel of experts. The results revealed that TSS, acidity, ascorbic acid contents and organoleptic score of fruits were significantly affected with the different harvesting stages. The maximum TSS (15.05%), acidity (0.21%), ascorbic acid (118.83 mg/100g pulp) with highest organoleptic score (9.01) were recorded in fresh fruits harvested during morning time while these parameters were at lowest level in the fruits harvested during noon hours. The fruits harvested during morning time were acceptable up to day six of storage while the fruits harvested during noon time were acceptable only up to day four of storage [Lal G, Effect of fruit harvesting time on post-harvest behaviour of ber (Ziziphus mauritiana Lamk. cv. Umran, J Res ANGARU, 2005, 33(4), 117-119].
Sweet cherry quality and safety maintenance by Aloe vera gel treatment

As post-harvest treatment to maintain sweet cherry quality and safety an edible coating based on Aloe vera Linn. gel has been used by the researchers at Spain. During cold storage, uncoated fruits showed increase in respiration rate, rapid weight loss and colour changes, accelerated softening and ripening, stem browning and increased microbial populations, these processes being more intense during the shelf-life periods.

One hundred fruit of Sweet cherries (Prunus avium Linn. cv. ‘StarKing’) were used to analyse properties at harvest (5 lots of 20 fruit) and the remainder were split into two batches. Half of them were treated with Aloe gel (pharmaceutical quality, 100% purity). The treatment was performed at 20°C by immersion for 5 minutes in a solution of A. vera diluted 1:3 with distilled water. The other half were immersed in distilled water and served as the control. Following treatment, sweet cherries were air-dried, randomly divided into 20 fruit lots (average mass of 140g) and stored at 1°C and 95% RH in permanent darkness. Ten lots for both treated and control fruit were taken out after 2, 6, 9, 13 and 16 days of cold storage, half of them were immediately analysed and the remainder after one additional day of storage at 20°C. Sweet cherry treated with A. vera gel significantly delayed the above parameters related to post-harvest quality losses, and storability could be extended. The sensory analyses revealed beneficial effects in terms of delaying stem browning and dehydration, maintenance of fruit visual aspect without any detrimental effect on taste, aroma or flavours. Thus this gel can be used as edible coating for commercial application and as alternative of the use of post-harvest chemical treatments [Martínez-Romero D, Alburquerque N, Valverde JM, Guillén F, Castillo S, Valero D and Serrano M, Postharvest sweet cherry quality and safety maintenance by Aloe vera treatment: A new edible coating, Postharvest Biol Technol, 2006, 39(1), 93-100].

Post-harvest curing of ker fruits

Capparis decidua Linn. (Hindi – Ker) fruits are available throughout and semi-arid regions of India. These fruits are rich in digestible carbohydrate (59.41%), proteins (14.80%), ascorbic acid (120.70 mg/100g) and dietary fibre. Ker is also processed as pickle. The dried fruits are preserved for future use. The fresh fruits have bitter taste due to the presence of sulphur compounds like glucosinolates, hence, need to be cured before consumption. The fruits are dried in sun for domestic purposes but it needs to be cured and processed before drying. The scientists at Department of Horticulture, SKN College of Agriculture, Jobner, Rajasthan, India carried out studies on different curing treatments (salt, butter milk and blanching) on the quality of solar dried ker fruits. Medium sized fruits (25 days after fruit set) of ker were harvested and subjected to different curing treatments, viz. salt (5, 10 and 15%), butter milk (25%), with or without blanching. Results revealed that application of 10% salt + 25% butter milk + blanching for 5 minutes maintained the quality of dried fruits with highest dry matter recovery, reconstitution ratio and maximum ascorbic acid content. The total soluble solids (TSS), protein and carbohydrates contents of the fruits were not influenced significantly by curing treatments. The organoleptic score revealed the acceptability of these fruits in terms of colour, taste and appearance with highest score as compared to fruits cured under other treatments. It is suggested that post-harvest curing of fruits in 10% salt + 25% butter milk + blanching for 5 minutes can improve the quality of ker fruits [Lal G and Dhaka RS, Effect of curing treatments on the quality of dried fruits of ker (Capparis decidua Linn.), J Food Sci Technol, 2005, 42(1), 106-108].
Oxalic acid for controlling post-harvest browning of litchi pericarp

Litchi (Litchi chinensis Sonn.) is a tropical and subtropical fruit with a high market value. However, rapid pericarp browning and decay of litchi fruit during storage are the main problems that result in drop of its market value. Currently, sulphur dioxide fumigation and acid-dipping were shown to be effective for controlling skin browning and are commercially available in many countries. It is reported that application of 1 M HCl, after sulphur dioxide treatment, could restore fruit to the initial skin colour and it is also noted that litchi fruit presented the best red colour after soaking in 1% NaHSO₃ containing 0.5% HCl for 8 minutes and proposed NaHSO₃ with HCl be an alternative method for preserving litchi red colour. However, with respect to the side-effects, such as the residue problems and tainting that can be harmful to human health, alternative chemicals without toxic effects are still urgently needed for commercial use. Oxalic acid is a metabolic product that is distributed among different organs of plants. It is available as a natural antioxidant and might play an important role in the natural and artificial preservation of oxidized materials. For instance, oxalic acid was shown to be an anti-browning agent for apple and banana slices by decreasing PPO activity. Researchers from China investigated the effect of oxalic acid on the browning of litchi fruit in order to improve the texture of litchi using exogenous oxalic acid. Litchi fruit, cv. ‘Huaizhi’, was treated with 2 and 4 mM oxalic acid and stored at room temperature to investigate the effect of oxalic acid on pericarp browning. The results showed that the pericarp browning indices of the fruit, treated with both oxalic acid concentrations, were significantly lower than that of the control, due to increase of membrane integrity, inhibition of anthocyanin degradation, decline of oxidation and maintenance of relatively low peroxidase activity in the fruit during storage. It appears that application of oxalic acid can effectively control the pericarp browning of litchi fruit during post-harvest storage [Zheng Xiaolin and Tian Shiping, Effect of oxalic acid on control of postharvest browning of litchi fruit, Food Chem, 2006, 96(4), 519-523].

Star fruit residue as functional food ingredient

Star fruit (Averrhoa carambola Linn.) is grown in the tropic and subtropic regions of the world. It is quite a popular fruit and largely planted in Southeast Asia and many other countries. It is usually consumed fresh or made into fruit juice or juice drinks. The star fruit is a good source of natural antioxidants and the antioxidants in star fruit were found to be proanthocyanidins, (−)-epicatechin and vitamin C. When star fruit is used to produce fruit drinks, normally only the juice will be used and the residue is often discarded as waste or used to produce low-value by-products. The researchers at Food Science & Technology Programme, Department of Chemistry, National University of Singapore, Singapore, further investigated antioxidant capacities and total phenolic contribution of the residue. They also investigated the possibilities of utilizing the residue as a valuable food ingredient or a resource for nutraceutical products in the future.

The residue of star fruit was found to contain much higher antioxidant activity than the extracted juice using several methods for assessing antioxidant activity. Under optimized extraction conditions, the residue accounted for
around 70% of total antioxidant activity (TAA) and total polyphenolic contents, however, only contributed 15% of the weight of whole fruit. Freeze-dried residue powder, which accounted for around 5% of total weight, had total polyphenolic content of 33.2 ± 3.6 mg gallic acid equivalent (GAE)/g sample and total antioxidant activity of 3490 ± 310 and 3412 ± 290 mg L-ascorbic acid equivalent (AEAC) or 5270 ± 468 and 5152 ± 706 mg trolox equivalent antioxidant capacity (TEAC) per 100 g sample obtained by 2,2′-azino-bis-(3-ethylbenzthiazoline-6-sulfonic acid) free radical (ABTS*) and 1,1-diphenyl-2-picryl-hydrazyl (DPPH*) scavenging assays, respectively. It was also found to have 510.3 ± 68.1 mol ferric reducing/antioxidant power (FRAP) per gram sample. The residue extract also shows strong antioxidant activity in delaying oxidative rancidity of soya bean oil at 110°C. Antioxidant activity and polyphenolic profile of residue extracts were compared with extracts of standardized pyconogenol. High performance liquid chromatography coupled with mass spectrometry (HPLC/MS) shows that major proanthocyanidins in star fruit were different from their isomers in pyconogenol. High content of phenolics and strong antioxidant activity of residue extracts indicate that residue powder may impart health benefits when used in functional food products and that residue extracts should also be regarded as potential nutraceutical resources in future [Shui Guanghou and Leong Lai Peng, Residue from star fruit as valuable source for functional food ingredients and antioxidant nutraceuticals, Food Chem, 2006, 97(2), 277-284].

Effect of waxing on cold storage and shelf-life of pear

In temperate region, pear, (Pyrus communis Linn.) is the most common fruit due to hardy nature of the tree. ‘Patharnakh’ is the leading cultivar which is grown commercially in Punjab. Storage of the fruit is a problem due to perishable nature of fruits. The scientists at Punjab Horticultural Post-harvest Technology Centre, Punjab Agricultural University, Ludhiana, India carried out investigation on the effect of citrashine wax on the quality and storage life of pear fruits.

During experiment the fruits of pear cv. ‘Patharnakh’ harvested at physiological maturity were divided into two lots. On one lot, citrashine wax was applied with cotton swab, whereas second lot was kept untreated for comparison. These fruits were packed in CFB (Corrugated Fibre Board) boxes and stored in walk-in-cool chambers at 0-1°C temperature with 90-95% RH for 30, 60 and 90 days. The post-cold storage ambient shelf-life was studied at room temperature for 24, 48 and 72 hours and in refrigerator for 48, 96 and 144 hours. The organoleptic rating (OR) calculated on the basis of fruit appearance, taste and flavour was found to be highest (above 7 as per Hedonic scale) up to 60 days of storage and significantly reduced after 90 days. The waxed fruits had slightly better score than non-waxed fruits. The fruits up to 60 days recorded minimum weight loss, retained crisp texture and optimum level of soluble solids and acid content. The core browning which was almost negligible up to 60 days of storage suddenly increased after 90 days. The occurrence of core browning was higher in non-waxed fruits. The post-storage studies revealed that the waxed fruits could be kept for 72 hours at ambient temperature and for 144 hours in refrigerator after 60 days of cold storage [Mahajan BVC, Dhillon WS and Dhatt AS, Studies on waxing of pear: Effect of cold storage and shelf-life environments on the storage behaviour and quality of pear cv. Patharnakh, Indian J Hort, 2006, 63(2), 166-170].

Guava candies

Guava (Psidium guajava Linn.) fruits short shelf-life limits attractive return to the fruit growers. Hence, the scientists at Department of Agricultural Process and Food Engineering, Allahabad Agricultural Institute, Allahabad, India explored the possibilities of developing consumer friendly candies from guava and evaluated its nutritive value and consumer acceptability through organoleptic testing. During experiment guava candies were developed by optimizing amount of butter, amount of sugar and storage temperature and also the keeping quality was studied. Candies preparation was optimum at cooking temperature range of 75-85°C for 2 hours. Addition of 580g sugar, 160g skim milk powder, 40mg colour per kg of guava pulp was optimum for...
There has been a steady increase in consumer demand for convenient and nutritious minimally processed produce like fresh-cut apples. However, the fresh-cut produce industry is challenged with potential outbreaks of illness that could be associated with microbial growth during the extended shelf-life of these products. These current trends in the fresh-cut apple industry have led to a growing interest in investigating natural antimicrobial agents that are compatible with the chemical properties of post-cut dipping solutions of fresh-cut apples. Recently, it has been shown extensively that vanillin is effective in inhibiting yeast and moulds in vitro in fruit puree or juice.

Vanillin (12 mM) inhibited the growth of four food spoilage yeasts, *Debaryomyces hansenni*, *Saccharomyces cerevisiae*, *Zygosaccharomyces bailii* and *Z. rouxii*, in culture media and apple puree for 40 days storage at 27°C.

Therefore, an investigation of antimicrobial properties of vanillin when incorporated with a commercial anti-browning dipping solution (calcium ascorbate, NatureSeal™), 12 mM vanillin inhibited the total aerobic microbial growth by 37% and 66% in fresh-cut ‘Empire’ and ‘McIntosh’ apples, respectively.

Vanillin is a potential antimicrobial agent for fresh-cut apples

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Therefore, an investigation of antimicrobial properties of vanillin when incorporated in calcium ascorbate (NatureSeal™), a commercial post-cut dipping solution, could offer new opportunities for extending the shelf-life of fresh-cut fruits. Thus, antimicrobial effect of vanillin against four pathogenic or indicator organisms: *Escherichia coli*, *Enterobacter aerogenes*, *Pseudomonas aeruginosa* and *Salmonella enterica* subsp. *enterica* serovar Newport and four spoilage organisms: *Candida albicans*, *Lactobacillus casei*, *Penicillium expansum* and *Saccharomyces cerevisiae* that could be associated with contaminated fresh-cut produce, was examined by researchers of Canada. The minimal inhibitory concentration (MIC) of vanillin was dependent upon the microorganism and this ranged between 6 and 18 mM. When incorporated with a commercial anti-browning dipping solution (calcium ascorbate, NatureSeal™), 12 mM vanillin inhibited the total aerobic microbial growth by 37% and 66% in fresh-cut ‘Empire’ and ‘McIntosh’ apples.
‘Crispin’ apples, respectively, during storage at 4°C for 19 days. Vanillin (12 mM) did not influence the control of enzymatic browning and softening by NatureSeal. These results provide a new insight for vanillin as a potential antimicrobial agent for refrigerated fresh-cut fruits and vegetables.

In conclusion, vanillin that is commonly used as a flavouring agent in foods was found to be effective in reducing growth of eight selected microorganisms in vitro and total microbial load on fresh-cut apple slices. Vanillin retained its effectiveness as well as that of NatureSeal when the two chemicals were combined. However, further research is required in order to obtain information about the organoleptic quality and consumer acceptance of fresh-cut apples treated with vanillin, before making a recommendation for its use as a preservative in post-cut dipping solution [Rupasinghe HP Vasantha, Boulter-Bitzer Jeanine, Ahn Taehyun and Odumeru Joseph A, Vanillin inhibits pathogenic and spoilage microorganisms in vitro and aerobic microbial growth in fresh-cut apples, Food Res Int, 2006, 39(5), 575-580].

Pomegranate fruit : A natural antioxidant

The preparations of various parts of Punica granatum Linn. fruits possess a significant antioxidant activity in all tests performed by researchers of Italy Pomegranate arils, juice and rind exhibited almost always a higher activity as compared to their aqueous and ethyl acetate extracts. In particular, the activity was higher in the juice than in the arils and this difference seems to be due to the presence of rind tannins in juice. The use of pomegranate as table fruit or juice can so be recommended in human nutrition for its antioxidant qualities, in the form of the relative contributions of hydrophilic and lipophilic components. The rinds, that usually cannot be utilized and represent waste material, in all tests performed showed the best antioxidant activity and their aqueous extracts resulted quite as active as the whole rind, suggesting the possibility to utilize this kind of extract as an enriched source of antioxidant compounds in human diet [Ricci D, Giamperi L, Bucchini A and Fraternale D, Antioxidant activity of Punica granatum fruits, Fitoterapia, 2006, 77(4), 310-312].

Fuel

Production of bio-fuels from cottonseed cake

Although cotton is being cultivated mainly for its lint, which is universally used as a textile raw material, cottonseed is an important source of vegetable oil. Cottonseeds contain approximately 17-21% of oil and only 15% of it can be recovered; the rest remains in the residue (cake). Cottonseed oil factories produce cottonseed cake as a by-product (waste). Energy potential of cottonseed cake can be calculated as 1.75 GJ/km². Cottonseed cake also has high protein content. Therefore, it is commonly used for animal feed. Generally, collection and disposal of the residues are becoming more difficult and expensive, but if they are not used efficiently they create environmental problems. Pyrolysis could be a promising way for residue management to convert them to bio-oils, which have more advantages in transport, storage, handling, retrofitting, combustion and flexibility in production and marketing.

Researchers from Turkey conducted studies to evaluate the amounts of catalytic pyrolysis products of cottonseed cake in steam atmosphere and investigate the effects of both zeolite and steam on pyrolysis yields. The effect of steam was investigated by co-feeding steam at various velocities (0.6:1.3:2.7 cm/sec) in the presence of zeolite (20 wt%...