parameters $L^*$, $a^*$ and $b^*$ and extinction measurements of water-saturated butanol extracts of flour, from rice with different DOM, indicated that bran contained much more yellow and red pigment than endosperm. The levels of yellow and red pigment decreased from the surface of the brown rice to the middle endosperm (DOM = 15%). Once bran (DOM = 9%) and outer endosperm (additional DOM = 6%) were removed, the yellowness and redness of the middle endosperm of the raw rice remained constant, indicating that the pigments were uniformly distributed in the middle endosperm. Cooking of rice containing residual bran layers (DOM < 9%) increased rice brightness ($L^*$) and decreased its redness ($a^*$) and yellowness ($b^*$), as expected from a dilution effect resulting from the uptake of water, as well as from leaching of pigments in the cooking water and diffusion of bran pigments to the endosperm. Cooking of rice with DOM > 9% resulted in products of constant brightness and redness but with yellowness which decreased as a function of DOM. Proteins, minerals and starch were not uniformly distributed in the brown rice kernel. The endosperm (DOM > 9%), contained most of the rice kernel proteins (84.2%), and proteins were mostly concentrated in the outer endosperm (9% < DOM < 15%). Bran (0% < DOM < 9%) contained most of the minerals (61.0%) and starch (84.6%) was concentrated in the core endosperm fraction (DOM 25%). The study of the effect of milling on the nutritional properties confirmed that the level of proteins and minerals decreased from the surface to the endosperm of brown rice and that the level of total starch increased from the surface to the endosperm [Lamberts Lieve, Bie Els De, Vandeputte Greet E, Veraverbeke Wim S, Derycke Veerle, Man Walter De and Delcour Jan A, Effect of milling on colour and nutritional properties of rice, Food Chem, 2007, 100 (4), 1496-1503].

**Fruit**

Effect of pre-treatments on drying, density and shrinkage of apple slices

The scientists at Brazil studied the effects of different pre-treatments on convective drying of apple slices and compared to drying without pre-treatments. An impregnation with starch, an high temperature/short time (HTST) process, and a combination of the two were used. When HTST was applied, air drying at mild (conventional) temperatures was used to finish the drying process. The HTST process had high mass transfer rates, however, when it ceased, the drying rate returned to the behaviour observed on mild temperature curves, at all air velocities studied. The apparent density was also investigated and showed lower values for several conditions applied. Analysis of variance (ANOVA) indicated which factors are significant to the observed decrease in apparent density. The Duncan test highlights experimental situations where these variables have an influence. Apparent density is almost constant as dimensionless moisture content diminishes, but it decreases when values are below around 0.2. Volume variations showed a linear behaviour with the moisture content changes at the studied conditions [Schultz EL, Mazzuco MM, Machado RAF, Bolzan A, Quadri MB and Quadri MGN, Effect of pre-treatments on drying, density and shrinkage of apple slices, J Food Eng, 2007, 78(3), 1103-1110].
Effect of 1-MCP on softening of fresh-cut kiwifruit, mango and persimmon slices

Ethylene has an undesirable effect on the quality of fresh-cut fruits. Its production is stimulated by physical actions used in the processing and removal of ethylene from the storage environment may extend the shelf-life of fresh-cut fruits. 1-Methylcyclopropene (1-MCP) is a recently developed inhibitor of ethylene action. Ripening and senescence of intact and fresh-cut fruits have been delayed by 1-MCP action. The scientists at Brazil and University of California jointly worked and determined the effects of 1-MCP on changes in firmness, colour, ethylene production and respiration rate of fresh-cut kiwifruits, mangoes and persimmons. The effect of 1-MCP, applied before or after processing, on the quality of fresh-cut kiwifruits, mangoes and persimmons was evaluated during storage at 5°C. Fresh-cut ‘Hayward’ kiwifruit slices softened at a slower rate and their ethylene production rate was decreased in response to 1-MCP. 1-MCP was applied directly on fresh-cut ‘Kent’ and ‘Keitt’ mango slices. Respiration rate of mango slices was not influenced by 1-MCP whereas the ethylene production was affected only towards the end of their shelf-life. Fresh-cut ‘Fuyu’ persimmons treated with 1-MCP after processing presented higher ethylene production rate, slower softening rate and slower darkening of colour (decrease in $L^*$ value), whereas the respiration rate was not affected [Vilas-Boas Eduardo V de B and Kader Adel A, Effect of 1-methylcyclopropene (1-MCP) on softening of fresh-cut kiwifruit, mango and persimmon slices, Postharvest Biol Technol, 2007, 43(2), 238-244].

Applications of calcium on harvested peach fruits

The effect of post-harvest calcium applications on cell wall properties and quality attributes of peach fruits (Prunus persica Batsch cv. ‘Andross’) after harvest or cold storage up to 4 weeks were determined by scientists at Greece and Italy. The fruits were immersed in deionised water or in different calcium sources (calcium chloride, calcium lactate and calcium propionate) at two calcium concentrations (62.5 and 187.5 mM Ca). Calcium concentration profiles in fruits (peel and flesh), in cell wall and in pectin fractions were determined. The calcium content in the peel increased up to 2.7-fold, whereas flesh calcium increased up to 74%, one day after immersion. The increase of flesh calcium was accompanied by increase of cell wall calcium, which corresponded to a significant increase of calcium in the water-insoluble pectin fraction. However, calcium became saturated in the water-insoluble, but not water-soluble, pectin fraction with 62.5 mM Ca treatment. Treatment with 62.5 mM Ca salts was as effective as higher concentrations of calcium chloride maintaining tissue firmness during storage. Inversely, calcium lactate and calcium propionate at high
Analytical quality characteristics of packaged fresh-cut watermelon slices from non-treated and 1-methylcyclopropene (1-MCP)- and/or ethylene-treated whole fruit were investigated by the scientists at USA because maintaining the post-harvest quality of fresh-cut fruit after processing and throughout distribution and marketing is a major challenge facing the fresh-cut fruit industry. Freshly harvested seedless watermelon (cv. ‘Sugar Heart’) were stored 7-14 days in air before exposure to 0, 0.5 or 1.0 µl/l 1-MCP for 18 hours followed by 5 days exposure to 0 or 10 µl/l ethylene, all at 20°C. Following treatment, fruits were processed into wedge-shaped slices, packaged into rigid trays sealed with a high oxygen transmission rate film overlap and stored for 1, 6 or 12 days at 5°C. During storage, fresh-cut watermelon slices from non-treated and 1-MCP- and 1-MCP+ethylene-treated whole fruit maintained similar respiration rates and internal atmospheres of CO₂ and O₂ and were of similar quality with total aromatic volatile concentrations decreasing and puncture firmness, soluble solids content (SSC), cut surface pH and colour remaining relatively stable. In contrast, fresh-cut slices from fruit treated with ethylene alone had higher respiration rates and modified package atmospheres containing more CO₂ and O₂; lower firmness, SSC and chromaticity values; higher pH and an altered volatile profile compared to those of slices from non-treated and 1-MCP and 1-MCP+ethylene-treated fruit. The 22 most abundant volatiles were various aldehydes, alcohols and ketones. During storage, many individual volatiles decreased in concentration but some increased including (Z)-6-nonen-1-ol, a volatile having a pumpkin-like aroma. The results indicated that low dosage 1-MCP treatments prior to ethylene exposure of whole watermelons prevented ethylene-mediated quality deterioration in fresh-cut slices stored under modified atmosphere conditions at 5°C [Saftner Robert, Luo Yaguang, McEvoy James, Judith A Abbott and Vinyard Bryan, Quality characteristics of fresh-cut watermelon slices from non-treated and 1-methylcyclopropene- and/or ethylene-treated whole fruit, Postharvest Biol Technol, 2007, 44 (1), 71-79].
Effects of edible chitosan coating on quality and shelf-life of sliced mango fruit

Whole mango (*Mangifera indica* Linn.) fruits exhibit chilling injuries if stored at temperatures of under 13°C for several days and sliced mango fruit are very perishable because they lack protective pericarp. The pulp is very vulnerable to dehydration, colour breaking to dark and disease also. Edible coatings have the potential to improve the quality and to extend the shelf-life of lightly processed produce. Chitosan has been successfully used as a food wrap because of its film-forming. Therefore, the scientists at Taiwan worked to elucidate the effects of chitosan coating on quality and shelf-life of sliced mango fruit. Manually sliced mango was treated with aqueous solutions of 0, 0.5, 1 or 2% chitosan; placed into plastic trays, and over-wrapped with Polyvinylidene Chloride Coated (PVDC) film and then stored at 6°C. Changes in the sensory qualities of taste, colour and water loss, were evaluated. A chitosan coating retarded water loss and the drop in sensory quality, increasing the soluble solid content, titratable acidity and ascorbic acid content. It also inhibited the growth of microorganisms. The data revealed that applying a chitosan coating effectively prolongs the quality attributes and extends the shelf-life of sliced mango fruit [Chien Po-Jung, Shu Fuu and Yang Feng-Hsu, Effects of edible chitosan coating on quality and shelf life of sliced mango fruit, *J Food Eng*, 2007, 78(1), 225-229].

Active package for wild strawberry fruit

The scientists at Spain have developed an antimicrobial active package for improving the safety and quality of wild strawberries (*Fragaria vesca* Linn.), as well as extending their shelf-life. The fruits were packed in equilibrium-modified atmosphere packaging (EMAP) and the effect on *Botrytis cinerea* growth and on the quality parameters of the fruit by the addition of different amounts of 2-nonanone, an antifungal volatile compound naturally present in strawberries, was investigated during storage at 10 and 22°C. The temperature of 10°C was chosen as the temperature used at points of sale, and 22°C was chosen as the control temperature. Fungal growth was inhibited in all cases, possibly due to the synergistic effect of high CO₂ partial pressures and the presence of the antifungal compound. Weight, soluble solids, titrable acidity and anthocyanin losses were retarded by the presence of 2-nonanone. This effect was more pronounced as the 2-nonanone concentration was increased at both temperatures. Therefore, an active package that releases 2-nonanone inhibits fungal decay and delays the senescence of highly perishable wild strawberry fruit [Almenar E, Del Valle, Catala V, Gavara R, Active package for wild strawberry fruit (*Fragaria vesca* L.), *J Agric Food Chem*, 2007, 55(6), 2240-2245].

Pre-harvest and post-harvest treatments for increasing the rate of ripening of date palm fruit

‘Helali’ is one of late season date palm (*Phoenix dactylifera* Linn.) cultivars being extensively cultivated in the Gulf region. At the mature (*Bisir*) stage, the fruits are astringent as a result of high contents of soluble tannins and removal of tannins is necessary for the fruit to be edible. The fruit do not ripen evenly, even in the same bunch, and consequently several harvests (10-15) are required during the harvest season (early August to late November). However, only 30-40% of the total fruit might normally ripen on tree and the remaining fruit fail to ripen, causing economic loss. Thus, hastening fruit ripening on or even off the tree is a critical process. Generally, the rate of fruit ripening is much higher during August and sharply declines during September, October and November. The remarkable decrease in temperatures occurring during
Skin colour is a predictor of shelf-life for retail distribution and texture is an important part of eating quality of banana fruit. As the yellowing of the skin intensifies, the flesh colour changes from the typical ‘opaque white’ of a product with a high starch content to a very soft yellow. The scientists at Spain investigated two aspects of the quality of two different varieties of bananas (Musa cavendishii Lamb ex Paxt. and M. paradisiaca Linn.) namely, (i) analyse the evolution of sensory quality and its relation with colour and texture changes during ripening in the shop or after purchase, at 20°C without any controlled atmosphere and (ii) determine its sensory acceptability.

Changes in instrumental colour and texture, and in a number of a sensory attributes (green colour, yellow colour, colour uniformity and quantity of dark spots of banana peel and pulp spots, over-ripe zones, hardness, ripe taste, sweetness, astringency and central fibrosity) by a descriptive sensory panel, and acceptability by a consumer panel of the two varieties over storage were analysed. During storage, the change in peel colour from green to yellow was gradual in the M. cavendishii samples, whereas the M. paradisiaca variety presented a different pattern, remaining green for the first 8 days and then changing rapidly to a yellow tone from day 12 onwards. While the flesh texture of the M. cavendishii type bananas softened quite rapidly during storage, it evolved more slowly in the M. paradisiaca variety and there was little variation in the flesh hardness values over the storage time. Maximum sensory acceptability in the M. cavendishii samples was found at 8-12 days’ storage, for 90% of consumers, but did not rise above 50% in the M. paradisiaca variety. [Salvador A, Sanz T and Fiszman SM, Changes in colour and texture and their relationship with eating quality of stored bananas, Postharvest Biol Technol, 2007, 43(3), 319-325].

Changes in colour and texture and their relationship with eating quality of stored bananas

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Different drying treatments effect on the stability of carotenoids in Taiwanese mango

Mango (*Mangifera indica* Linn.), has been reported to contain high amounts of carotenoids and significance of consumption of carotenoids for improvement of human health has been well documented. For instance, β-carotene has been shown to possess high vitamin A activity and antioxidative capacity, it was also reported that β-carotene is the dominant carotenoid in mango, comprising of 48-84% of the total carotenoid content. Hence, researchers at Taiwan studied the stability of carotenoids in Taiwanese mango as affected by different drying treatments.

Mangoes were soaked in 1% sodium hydrogen sulfite solution or 1% ascorbic acid solution, prior to hot-air drying and freeze-drying. Results showed that in most cases, the highest yield of the epoxy-containing carotenoids was achieved by freeze-drying plus soaking in 1% sodium hydrogen sulfite solution. However, freeze-drying plus soaking in 1% ascorbic acid solution resulted in the highest retention of all-trans-β-carotene and its cis isomers, all-trans-zeaxanthin and its cis isomers, as well as cis-lutein. Nevertheless, for hot-air drying, with or without soaking, a mango product of deep orange colour was produced. On freeze-drying, mango could generate yellow colour, while a lighter colour was observed when soaked in antioxidants [Chen JP, Tai CY and Chen BH, Effects of different drying treatments on the stability of carotenoids in Taiwanese mango (*Mangifera indica* L.), *Food Chem*, 2007, **100** (3), 1005-1010].

Coating citrus fruit with chitosan increases post-harvest quality and shelf-life

‘Murcott’ tangor (Honey Tangerine; *Citrus* spp.; Mandarin × *Citrus sinensis*, sweet orange hybrid) is a sub-tropical fruit of high commercial value on the international fruit market and is commonly eaten fresh in Asia. However, the fruit can easily become diseased with stem-end rot, blue mold, green mold, skin shrinkage, oil spotting, scald, or watery rot and its flavour is therefore, lost during post-harvest storage. The researchers at Taiwan investigated the effects of coating with low molecular weight chitosan (LMWC, Mw = 15 kDa) and high molecular weight chitosan (HMWC, Mw = 357 kDa) on the decay of Murcott tangor and the maintenance of its quality. A 0.1% LMWC coating substantially slowed the decay of Murcott tangor stored at 15°C in relation to a control sample and reduced decay by over 20% as compared to the fungicide TBZ (Thiabendazole). A concentration of 0.2% LMWC was more effective in controlling the growth of fungus on citrus fruits caused by *Penicillium digitatum* and *P. italicum*, exhibiting effective antifungal activity. LMWC coating improved firmness, titratable acidity, ascorbic acidity and the water content for Murcott tangor stored at 15°C for 56 days. This study demonstrated that LMWC had the potential to maintain the qualities of the post-harvest citrus fruit and prolong its storage life. This fact may be useful as part of a strategy to reduce the weight loss caused by pathogen isolates that are resistant to currently used post-harvest fungicides [Chien Po-Jung, Sheu Fuu and Lin Hung-Ren, Coating citrus (Murcott tangor) fruit with low molecular weight chitosan increases post-harvest quality and shelf life, *Food Chem*, 2007, **100** (3), 1160-1164].
Effect of nitric oxide on ethylene production in stored strawberry fruits

Strawberry (Fragaria ×ananassa Duch.) is a non-climacteric fruit, with low ethylene production rate after harvest. Researchers at China studied its response to nitric oxide (NO), which can be released from sodium nitroprusside (SNP). They examined the effect of 1.0, 5.0 and 10.0 µmol/l SNP aqueous solution on ethylene production, respiration rate, 1-aminocyclopropane-1-carboxylic acid (ACC) content and the activities of ACC synthase and ACC oxidase in post-harvest strawberry (cv. ‘Fengxiang’). The most remarkable effect was obtained with 5 µmol/l SNP aqueous solution, which significantly inhibited ethylene production, respiration rate, the activity of ACC synthase and reduced the content of ACC, but did not significantly affect the activity of ACC oxidase. SNP at 10 µmol/l harmed the fruits; 1 µmol/l SNP was too low to significantly extend strawberry storage life. It was suggested that NO could decrease ethylene output, through inhibiting ACC synthase activity reducing ACC content [Zhu Shu-hua and Zhou Jie, Effect of nitric oxide on ethylene production in strawberry fruit during storage, Food Chem, 2007, 100 (4), 1517-1522].

Relationship between light, fruit and leaf mineral content with albinism incidence in strawberry

Strawberry (Fragaria ×ananassa Duch.) is one of the most delicious and refreshing fruits of the world. Strawberry suffers from various physiological disorders, but albinism causes greater loss, in which, insufficiently coloured and sometimes white fruits are produced. Such fruits develop almost normally but look swollen, have mottled pink peel with pale spots and show waxy appearance. Pulp of such fruits is usually white, poor flavoured and bitter acidic in taste. Albinism in strawberries is probably caused by certain climatic conditions and extremes in nutrition. Hence, systematic studies were conducted in commercially grown strawberry varieties under shade and open field conditions in sub-tropical climate, to determine the relationship, if exists, between light (shade), leaf and fruit mineral content with albinism disorder by researchers of Division of Fruits and Horticultural Technology, Indian Agricultural Research Institute, New Delhi, India.

Plants grown under shade produced albino fruits in higher proportion than those grown in open fields. Similarly, plants under shade produced smaller sized fruits and have lower fruit yield. Among cultivars, ‘Etna’ had highest incidence of albinism (49.6%) and ‘Sweet Charlie’ the lowest (14.4%). Dry matter content (%), concentration of five major nutrients, viz. N, P, K, Ca, Mg, S and N:Ca and K:Ca nutrient ratios did not differ significantly in the leaves of plants producing normal or albino fruits. However, in contrast, the concentration of K was notably higher (1.97 mg/g fresh tissue weight) and that of Ca was lower (0.098 mg/g fresh tissue weight) in albino fruits than normal ones. Consequently, the ratios of N:Ca and K:Ca were higher in albino fruits than normal ones. Cultivars also differed widely in respect to dry matter, mineral content and nutrient ratios. Thus, it appears that lower light intensity favours the development of albinism in strawberry and it seems that calcium is not the basic cause of albinism, but increased vigour associated with overuse of N and K might be positively associated with it [Sharma RR, Patel VB and Hare Krishna, Relationship between light, fruit and leaf mineral content with albinism incidence in strawberry (Fragaria x ananassa Duch.), Sci Hortic, 2006, 109 (1), 66-70].
### Effect of osmotic dehydration on volatile profile of mango

Researchers of Polytechnic University of Valencia, Spain studied the effect of osmotic dehydration on the volatile fraction of mango (*Mangifera indica* Linn.) fruit. Osmotic treatments were carried out at atmospheric pressure (OD) and by applying a vacuum pulse (PVOD). Sucrose at 35, 45, 55 and 65°Brix was used as osmotic solution until reaching 20 or 30°Brix in the liquid phase of dehydrated mango. Volatile compounds of fresh and dehydrated samples were obtained by simultaneous distillation-extraction, and analyzed by GC-MS. In general, osmotic dehydration provoked changes in the concentration of analyzed compounds to different extents, depending on process conditions. The use of highly concentrated osmotic solutions, and the high level of sample osmodehydration, induced losses of volatiles with respect to the fresh samples. On the other hand, more heavily diluted solutions and shorter treatment times (lower osmodehydration level) could give rise to the enhancement of volatile production. In these cases, sample mass loss was reduced during treatment since sugar gain was promoted against water loss [Torres Juan Diego, Talens Pau, Carot José Miguel, Chiralt Amparo and Escriche Isabel, Volatile profile of mango (*Mangifera indica* L.), as affected by osmotic dehydration, *Food Chem*, 2007, 101 (1), 219-228].

### Biodiesel production using anionic ion-exchange resin

Scientists at Japan conducted the transesterification reactions of triolein with ethanol using various ion-exchange resin catalysts to produce ethyl oleate as a biodiesel. The effects of the resin’s structural factors and the operating factors on the reaction rate were investigated. The possibility of a continuous biodiesel production was studied by constructing an expanded bed reactor packed with active resin. The anion-exchange resins exhibited much higher catalytic activities than the cation-exchange resin. The anion-exchange resin with a lower cross-linking density and a smaller particle size gave a high reaction rate as well as a high conversion. By combining the three-step regeneration method, the resin could be repeatedly used for the batch transesterification without any loss in the catalytic activity. A continuous transesterification reaction was carried out using an expanded bed reactor packed with the most active resin. The reactor system permitted the continuous production of ethyl oleate with a high conversion [Shibasaki-Kitakawa Naomi, Honda Hiroki, Kuribayashi Homare, Toda Takuji, Fukumura Takuya and Yonemoto Toshikuni, Biodiesel production using anionic ion-exchange resin as heterogeneous catalyst, *Bioresour Technol*, 2007, 98 (2), 416-421].

### Enzymatic production of biodiesel from cotton seed oil

The enzymatic production of biodiesel by methanolysis of cottonseed oil was studied by scientists at Argentina using immobilized *Candida antarctica* lipase as catalyst in *t*-butanol solvent. Methyl ester production and triacylglycerol disappearance were followed by HPLC chromatography. It was found, using a batch system, that enzyme inhibition caused by undissolved methanol was eliminated by adding *t*-butanol to the reaction medium, which also gave a noticeable increase of reaction rate and ester yield. The effect of *t*-butanol, methanol concentration and temperature on this system was determined. A methanolysis yield of 97% was observed after 24 hours at 50°C with a reaction mixture containing 32.5% *t*-butanol, 13.5% methanol, 54% oil and 0.017 g enzyme/g oil. With the same mixture, a 95% ester yield was obtained using a one step fixed bed continuous reactor with a flow rate of 9.6 ml/hour/g enzyme. Experiments with the continuous reactor over 500 hours did not show any appreciable decrease in ester yields [Royon D, Daz M, Ellenrieder G and Locatelli S, Enzymatic production of biodiesel from cotton seed oil using *t*-butanol as a solvent, *Bioresour Technol*, 2007, 98 (3), 648-653].