Post-harvest Technology

NPARR, 8(1), 2017-220 Packaging conditions to preserve the quality of intermediate moisture artichoke

The ability of packaging conditions to preserve the quality of intermediate moisture artichoke (IMA) during storage at different conditions was evaluated. In this aim, artichoke (Cynara cardunculus L. subsp. scolymus (L.) Hayek, 'Locale di Brindisi') heads were deprived of external bracts, cut in quarters, dipped in acid solution (0.5% citric acid and 0.05% ascorbic acid in water) for 30 min and blanched at 95°C for 8 min in a 1% citric acid and 1% wine vinegar water solution. After this pretreatment, artichoke pieces were dried with heat pump technology equipment at 55°C up to 40% weight loss and 22.4±0.5% dry matter and then packed in polypropylene trays sealed with a composite covering plastic in air and active modified atmosphere (MA = 30% CO2 + 70% N2). In order to evaluate postharvest performance, differently packed IMAs were stored at 4 and 20°C up to 28 days. After 0, 7, 14, 21, and 28 days in storage, visual and sensorial scores, water activity, sugars (glucose, fructose, and sucrose), total phenolic content, antioxidant activity, and total microbial load were evaluated. The results showed that IMA storage in MA packaging conditions at 4°C was the most effective to preserve physical, sensorial, biochemical and hygienic properties. This innovative "ready to use" product could be of great interest from a commercial point of view due to its excellent nutritional quality, good shelf-life and convenience [Sergio, L.*, Gatto, M.A., Spremulli, L., Pieralice, M., Calabrese, N. and Di Venere, D. (CNR - Institute of Sciences of Food Production (ISPA), Via Amendola 122/O, Bari, Italy), Acta Horticulturae, 2016, 1147, 393-398].

NPARR, 8(1), 2017-221 Effect of ultraviolet-c irradiation on phenolic compounds and antioxidant activity of postharvest Actinidia arguta fruit

The effect of ultraviolet (UV)-C irradiation at different dosages on fruit quality, phenolic contents, and antioxidant activity of Actinidia arguta during storage were investigated. Fresh fruits were exposed to different doses (1.05, 2.1, and 4.2 kJ/m²) of shortwave UV-C immediately after harvest, while fruit firmness, total soluble solid content, total phenolic content, flavonoid content, anthocyanin content, and antioxidant capacity of Actinidia arguta were determined during room-temperature storage and cold storage. The results showed that UV-C treatment increased the total soluble solid content, delayed the decrease in fruit firmness, significantly enhanced the synthesis and accumulation of total phenolics, total flavonoids, and anthocyanins, and effectively improved the antioxidant activity of fruit during storage. When stored at 25 °C, the fruits treated with 4.2 kJ/m² UV-C irradiation showed the highest content of phenolic compounds after five days of storage. During storage at 0 °C, the highest phenolic content was reached in fruits treated with 1.05 kJ/m² UV-C irradiation and stored for three days. These results suggest that UV-C irradiation can serve as a safe and non-toxic postharvest treatment method to improve and enhance fruit quality, phenolic content, and antioxidant activity of Actinidia arguta fruits [Jiao, Z.-G.*, Hu, L.-N., Zhang, C.-L., Liu, H., Yang, W.B., Lv, Z.-Z., Wang, S.X. and Liu, J.-C. (Zhengzhou Fruit Research Institute, Chinese Academy of Agricultural Sciences, Zhengzhou, China), Modern Food Science and Technology, 2016, 32(11), 177-183].

NPARR, 8(1), 2017-222 Effect of postharvest gibberellic acid treatment on the chilling injury of tomato fruits during cold storage

The effect of exogenous gibberellic acid (GA₃) treatment on chilling stress tolerance of harvested tomato fruits was investigated in this study. Solanum lycopersicum L. `Zhefen' No. 702
at the mature green stage was used as the test material, treated with 0, 0.2, 0.5, or 1 mM GA$_3$ aqueous solution at room temperature, and stored at 4 °C. Tomato samples were collected on days 0, 3, 7, 14, 21, and 28, and stored at room temperature for three days before the chilling injury index was measured to determine the most suitable GA$_3$ concentration. In addition, microstructure changes, malondialdehyde (MDA) content, electrolyte leakage, and changes in the activities of phospholipase C (PLC), phospholipase D (PLD), lipoxidase (LOX), and polygalacturonase (PG) were measured. These results showed that compared with the control, 0.5 mM exogenous GA$_3$ treatment effectively alleviated the chilling injury symptoms, protected cellular microstructure, and significantly inhibited increases in the MDA content, electrolyte leakage, and activities of PLC, PLD, LOX, and PG, thus enhancing the chilling stress tolerance of postharvest tomato fruits [Zhu, Z.*, Ding, Y., Zhao, J.H., Nie, Y., Zhang, Y. and Tang, X.-M. (Institute of Agro-food Science and Technology, Key Opening Laboratory of Agricultural Products Processing and Quality Control, Ministry of Agriculture, Beijing, China), *Modern Food Science and Technology*, 2016, 32(11), 184-189].

NPARR, 8(1), 2017-223 Vaporization of biological control organisms in cold Storage rooms to control postharvest diseases

Storage diseases can cause important losses on pome fruits. Disease management to control storage diseases includes several treatments with different fungicides in the weeks prior to harvest. Nowadays, the presence of residues on fruits becomes more and more a public and governmental concern. In order to reduce the chemical residue on fruits to a minimum, more and more research is performed on alternative disease management. In this respect, in 2013, a project concerning the 'Vaporization of biological control organisms (BCOs) in cold storage to control postharvest diseases', which was funded by the Agency for Innovation by Science and Technology (IWT), has started at the research station for fruit cultivation (Pcfruit) in collaboration with the Institute for agricultural and fisheries research (ILVO) and the Catholic University of Leuven (KULeuven). In a first step, the influence of fungicides applied in the months prior to storage on different BCOs was tested in vitro and in vivo. Besides that, also the influence of additives on the efficiency of biological control organisms in their control of storage diseases caused by *Neofabraea alba* or *Botrytis cinerea* was investigated after artificial inoculation experiments. This pointed out that some fungicides can have important negative effects on the BCOs tested and that additives, like calcium chloride and calcium-D-gluconate, can enhance the efficacy of BCOs in the control of fungal storage diseases. Furthermore, out of different tests the vaporization device 'Swingtec Fontan Starlet' was selected for the vaporization of the BCOs and research is going on to optimize the homogeneous distribution of the BCOs in the cold storage room with the help of a Computational Fluid Dynamics (CFD) model [Vanwalleghem, T., Dekeyser, D., Nuyttens, D., Tsige, A., Verboven, P., Van Hemelrijck, W. and Bylemans, D*. (Pcfruit npo, Research Station for Fruit Cultivation, Department Mycology, Sint-Truiden, Belgium), *Acta Horticulturae*, 2016, 1144, 121-127].

NPARR, 8(1), 2017-224 Postharvest noninvasive classification of tough-fibrous asparagus using computed tomography images

This research was devised to evaluate Computed Tomography (CT) for *Asparagus fibrousness* detection and more specifically develop and test an automatic image analysis method (algorithm) to classify CT images obtained from 859 asparagus (*Asparagus officinalis* L.) segment (samples), collected during two harvesting seasons (2014 and 2015). Classification accuracy was calculated by comparing the classes obtained using a combination of imaging, image processing, feature extraction, and classification schemes per asparagus segment against an industry-simulated invasive quality assessment. Grayscale intensity
and textural features, 3762 total, were extracted from minimum and maximum resultant images from three CT planer views. A 4-fold cross-validation linear discriminant classifier with a performance accuracy of 91.2% was developed using 75 relevant features, which were selected using a sequential forward selection algorithm with the Fisher discriminant objective function. This objective method is accurate in determining the presence of tough-fibrous tissue in asparagus, which demonstrates a potential for such technology to objectively forecast asparagus quality and thus supports the asparagus industry through optimizing consumer acceptability and product utilization.


NPARR, 8(1), 2017-225 The antifungal activity of essential oils in combination with warm air flow against postharvest phytopathogenic fungi in apples

Essential oils (EOs) are strong plant-derived antimicrobials. For their efficient use in the agri-food industry, the problems with technology of their application have to be solved. In vitro antifungal activity of cinnamon, oregano, lemongrass and clove essential oils (EOs) was tested by innovative method using EO in combination with warm air flow (WAF). EOs in concentrations from 0.25 to 512 µL/L of air were tested against eleven phytopathogenic fungi. Application of EOs in concentration of 4 and 16 µL/L by WAF method was used for treatment of apples inoculated with Penicillium expansum. Detailed sensory analysis of treated apples was performed. The WAF was more effective compared to standard disc volatilization method (DVM), the average minimum inhibitory concentrations in vitro were 5.6 µL/L during 5 min WAF treatment, compared to 136 µL/L during the DVM 24 h treatment. EOs applied by WAF delayed the incidence and development of P. expansum on apples with minimal adverse effect on their sensory profile. The WAF treatment could be considered for the development of antifungal treatments in the agri-food industry [Frankova, A., Smid, J., Bernardos, A., Finkousova, A., Marsik, P., Novotny, D., Legarová, V., Pulkabek, J. and Kloucek, P*. (Czech University of Life Sciences Prague, Department of Quality of Agricultural Products, Kamycka 129, Prague, Czech Republic), Food Control, 2016, 68, 62-68].

NPARR, 8(1), 2017-226 Effect of modified atmosphere packaging (MAP) on rachis quality of 'Red Globe' table grape variety

Rachis browning corresponds to a postharvest disorder that drastically reduces overall table grape quality. This problem has been associated mainly to water loss, but the possibility of having other factors involved like green pigment degradation and brownish compound synthesis that mask the green tissue is also feasible. Modified Atmosphere Packaging (MAP) is a technology used to extend table grape postharvest life, including rachis appearance. The objective of this study was to analyze the effects caused by MAP on rachis browning during cold storage of 'Red Globe' table grape variety. MAP helped to reduce the green color loss on rachises stored for 90 days of storage at 0 °C compared with a conventional storage (CS) even after a shelf life period, without to affect negatively the quality of the berries. Interestingly, MAP storage decreased the content of chlorophyll-a and increased the amount of pheophytin-a, a chlorophyll degradation product, compared to CS both after cold storage period and shelf life. Additionally, the expression of genes involved in the chlorophyll breakdown pathway was analyzed by qPCR. We found that MAP induced an increase in the transcript abundance of metal-chelating substance (MCS) and Red Chlorophyll Catabolite Reductase (RCCR) genes. However, Pheophytinase (PPH) and Pheophorbide-a Oxigenase (PaO) transcript accumulation revealed no changes compared with CS. Apparently, MAP generated a
modification in the chlorophyll breakdown process allowing an accumulation of green like compounds responsible for the greener color of rachises in the MAP stored bunches. On the other hand, histological analysis reveals that after cold storage and shelf life, morphological changes and brown compounds accumulation take place at the periderm and cortex tissues, and these symptoms are less severe in MAP stored bunches helping to keep longer the green coloration of the rachises. In this study we observed that MAP storage increases rachis postharvest quality by reducing green color loss probably due to a combination of processes involving a delay of green pigments degradation and a less accumulation of brown compounds at the periderm and cortex tissues, thus preventing green pigments masking [Silva-Sanzana, C., Balic, I., Sepúlveda, P., Olmedo, P., León, G., Defilippi, B.G., Blanco-Herrera, F. and Campos-Vargas, R*. (Centro de Biotecnología Vegetal, Facultad Ciencias Biológicas, Universidad Andres Bello, República 217, Santiago, Chile), Postharvest Biology and Technology, 2016, 119, 33-40].

NPARR, 8(1), 2017-227 Effects of nano-CaCO$_3$-modified low-density polyethylene films packaging on the quality and physiology of Chinese bayberry fruit

Chinese bayberry fruit is a characteristic high-quality fruit in China, but it decays very quickly after harvest. In order to study preservation techniques for Chinese bayberry fruits, the effects of nano-CaCO$_3$-modified low-density polyethylene (NCCLDPE) packaging on the quality and physiology of Chinese bayberry fruit stored at $2^\circ$C were investigated. The results showed that the O$_2$ and CO$_2$ transmission rates of the NCCLDPE film were 72.39% and 81.33% of those of low-density polyethylene (LDPE) film, respectively, thus favoring the faster formation of an environment with low O$_2$ and high CO$_2$ levels in the packaging bag. The decay rate of Chinese bayberry fruit in NCCLDPE packaging was 23.74% lower than that in LDPE bags, while the firmness, titratable acid, total phenolic content, and anthocyanin content of Chinese bayberry fruit in NCCLDPE packaging were 5.69%, 12.07%, 7.63%, and 14.75% higher than those in LDPE packaging, respectively. NCCLDPE packaging more effectively inhibited pectin esterase and polygalacturonase activities, which were 87.92% and 92.67% of those in LDPE packaging, respectively. Additionally, NCCLDPE packaging inhibited the degradation of protopectin and increased the water-soluble pectin content. These data suggest that the NCCLDPE packaging is more favorable for maintaining the postharvest quality of Chinese bayberry fruit and may have commercial value for the preservation of Chinese bayberry fruits [Xu, T.-Q*, Wei, Y.X., Wang, Y., Luo, Z.S. and Yue, Y. (Hangzhou Yuhang District Monitoring Centre of Food and Drug, Hangzhou, China), Modern Food Science and Technology, 2016, 32(10), 205-210].