



**2<sup>nd</sup> International Conference**

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**Effect of Pre- and Post-harvest Factors  
on Health Promoting Components  
and Quality of Horticultural Commodities**

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**PROGRAMME  
&  
BOOK OF ABSTRACTS**

**May 24-25, 2010, Skierniewice, Poland**



## **2<sup>nd</sup> International Conference**

### **Effect of Pre- and Post-harvest Factors on Health Promoting Components and Quality of Horticultural Commodities**

May 24-25, 2010, Skierniewice, Poland

Organized by

**Research Institute of Vegetable Crops**

**Research Institute of Pomology and Floriculture**



in cooperation with

**Polish Academy of Sciences - Storage Section of the Committee of Horticultural  
Sciences**

**and**

**EUFRIN - Fruit Quality Working Group**

under the auspices of:

**Polish Academy of Sciences**

**and**

**Polish Society for Horticultural Science**

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**The book of abstracts was partially funded by:  
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Note:

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Acknowledgements:

The Organizing Committee wishes to thank the following sponsors:



**Programme of the 2<sup>nd</sup> International Conference  
Effect of Pre- and Post-harvest Factors on Health Promoting Components and  
Quality of Horticultural Commodities**

**Sunday 23<sup>rd</sup> of May 2010**

18:00 Welcome reception

*Palace of the Research Institute of Vegetable Crops, Konstytucji 3 Maja 1/3 Str., 96-100 Skierniewice*

**Monday 24<sup>th</sup> of May 2010**

*Research Institute of Pomology and Floriculture, Pomologiczna 18 Str., 96-100 Skierniewice*

08:00 - 08:40	<b>Registration and poster hanging</b>
	<b>Opening the Conference</b>
08:40 - 09:00	(Chairman of the Conference, Director of the Research Institute of Pomology and Floriculture, Director of the Research Institute of Vegetable Crops, Chair of the EUFRIN Fruit Quality Group, Representative of Polish Academy of Sciences, Representative of Polish Society for Horticultural Science)
	<i>Moderator: Franciszek Adamicki (Poland)</i>
09:00 - 10:00	The effect of pre- and post-harvest 1-MCP treatment on quality of fruits and vegetables - <b>Christopher B. Watkins (US) Invited Speaker</b>
10:00 - 10:30	<b>Coffee break</b>
	<i>Moderator: Jan Skrzynski (Poland)</i>
10:30 - 11:00	Improving quality and safety of stored apple fruit - <b>Angelo Zanella (Italy)</b>
11:00 - 11:15	Effect of 1-MCP on postharvest physiology and quality of 'Ligol' and 'Sampion' apples during storage - <b>Kazimierz Tomala (Poland)</b>
11:15 - 11:30	On the study of aroma profile of apples as influenced by 1-MCP - <b>Rajko Vidrih (Slovenia)</b>
11:30 - 11:45	Alternative method trial of fruit storage with the SmartFresh™ treatment to maintain quality of 'Idared' apples in the storage season 2009-2010 - <b>Zbigniew Jozwiak (Poland)</b>
11:45 - 12:00	Effect of pre- and post-curing ethylene and 1-MCP treatment on the biochemistry and physiology of onion bulbs ( <i>Allium cepa</i> L.) during storage - <b>David O'Connor (UK)</b>
12:00 - 14:15	<b>Lunch &amp; Visiting of the Research Institute of Pomology and Floriculture</b>
	<i>Moderator: Angelo Zanella (Italy)</i>
14:15 - 14:30	SmartFresh contribution to energy efficiency - <b>Giovanni Regioli (Italy)</b>
14:30 - 14:45	Development supply chain management of baby corn in Thailand - <b>Sirichai Kanlayanarat (Thailand)</b>
14:45 - 15:00	Colour in the orchard - <b>L.M.M. (Pol) Tijskens (The Netherlands)</b>
15:00 - 15:15	Simulation of fruit postharvest quality changes using the Decision Support System "People" - <b>Konopacki Pawel (Poland)</b>
15:15 - 16:00	<b>Poster viewing session &amp; Coffee break</b>
16:00 - 16:30	<b>Discussion and summary of Poster Session</b>
16:40 - 18:00	EUFRIN Fruit Quality Working Group meeting
19:00	<b>Official dinner (Dworek Restaurant, Pilsudskiego 24 Str, Skierniewice)</b>

**Tuesday 25<sup>th</sup> of May 2010***Research Institute of Pomology and Floriculture, Pomologiczna 18 Str., 96-100 Skierniewice*

<i>Moderator: <b>Sirichai Kanlayanarat (Thailand)</b></i>	
08:30 - 09:30	Plant growth regulators for improving postharvest quality - <b>Susan Lurie (Israel)</b> <i>Invited Speaker</i>
09:30 - 09:45	<b>Coffee break</b>
<i>Moderator: <b>Witold Plocharski (Poland)</b></i>	
09:45 - 10:15	Lung health and fruit/vegetable consumption - <b>Dariusz Nowak (Poland)</b>
10:15 - 10:30	Biologically active substances in sweet cherry, sour cherry and cornelian cherry fruit - <b>Jan Skrzynski (Poland)</b>
10:30 - 10:45	The bioactive compounds in fruits of different rowanberry cultivars - <b>Elga Berna (Latvia)</b>
10:45 - 11:00	<b>Coffee break</b>
<i>Moderator: <b>Pietro Tonutti (Italy)</b></i>	
11:00 - 11:15	Quality and storage of 'Kordia' sweet cherries - <b>Krzysztof Rutkowski (Poland)</b>
10:15 - 11:30	The postharvest quality of raspberry 'Glen Ample' as affected by storage temperature and modified atmosphere packaging - <b>Ulvi Moor (Estonia)</b>
11:30 - 11:45	Anatomical traits of sea-buckthorn fruit ( <i>Hippophae rhamnoides</i> L.) and their significance for developing new varieties with higher oil-yield - <b>Elena Yembaturova (Russia)</b>
11:45 - 12:00	Biofortification of spinach plants applying selenium in the nutrient solution of floating system - <b>Antonio Ferrante (Italy)</b>
12:00 - 12:15	<b>Discussion and closing ceremony</b>
12:15 - 13:30	<b>Lunch</b>
13:30 - 14:30	<b>Visiting of the Research Institute of Vegetable Crops</b>
15:00 - 23:00	<b>Professional excursion</b>

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# ORAL ABSTRACTS

## THE EFFECT OF PRE- AND POST-HARVEST 1-MCP TREATMENT ON QUALITY OF FRUITS AND VEGETABLES

### **Christopher B. Watkins**

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The inhibitor of ethylene perception, 1-methylcyclopropene (1-MCP), is the basis of a new technology that is being used increasingly around the world to improve storage potential and maintain quality of fruit and vegetables. 1-MCP is best known as SmartFresh for postharvest treatment of fruit and vegetables, EthylBloc for postharvest treatment of floricultural products, and Harvista or Invinsa for preharvest use on horticultural and field crops, respectively.

As of 2009, 1-MCP has been registered for commercial food use on a range of fruits and vegetables in 37 countries. The fruits and vegetables for which registration has been obtained include apple, avocado, banana, broccoli, cucumber, date, kiwifruit, mango, melon, nectarine, papaya, peach, pear, pepper, persimmon, pineapple, plantain, plum, squash and tomato; however, the number of products registered with each country varies greatly and according to the importance of the crop in that country. Of these products, the most successful to date for application of 1-MCP, has been the apple. In contrast, commercial application of 1-MCP to other products is not always straightforward. This is particularly true for those fruit that soften to a melting texture and/or have major color change during ripening, and therefore where a delay but not inhibition of ripening is essential. Product type, the maturity of the product at the time of treatment, 1-MCP concentration and exposure time are all factors that are important in successful 1-MCP application for these fruits and vegetables.

The term 'quality' is one that has different meanings according to personal preferences and needs, and the criteria for quality changes as products move through the supply chain. Consumer satisfaction is related to product quality, but there is no general agreement about what quality is, how it can be measured, and how it relates to consumer acceptability. Moreover, quality characteristics that are important to packers, transporters and retailers are often quite different than those of consumers. In this context, it is possible to evaluate the advent of such a revolutionary treatment as 1-MCP using the key quality criteria of appearance, taste, aroma, texture, and nutritional value. 1-MCP has also been shown to impact quality by affecting the susceptibility of fruit and vegetables to physiological disorders. Several horticultural products will be used to illustrate the effects of 1-MCP on quality, but most focus will be on the apple fruit for which most commercial uptake has taken place. The variety of cultivar responses, effects of ripening, both pre- and postharvest, have provided a great deal of information that helps us understand the strengths and weaknesses of the technology.

## IMPROVING QUALITY AND SAFETY OF STORED APPLE FRUIT

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The search for improved quality and safety of apple fruit after storage has led to innovative handling methods that produce different effects, dependent on the framework of conditions set.

The physiological disorder superficial scald forced the apple industry to treat the fruit after harvest with the chemical antioxidant DPA (diphenylamine). It will not be possible anymore by EU regulation beginning with the year 2011.

Different technologies have been developed as alternatives to the treatment with DPA: An initial low oxygen stress period (ILOS), e.g. 0.4 kPa O<sub>2</sub> for 14 days has been effective, but only for short and medium term storage, depending on cultivar, susceptibility of the fruit, maturity stage. A further development of this method are repeated stress periods, monitored by the ethanol content in the fruit that has to be assessed regularly by analyses of samples of the stored fruit.

Chlorophyll fluorescence can be used to detect low-O<sub>2</sub> stress before associated disorders would develop, allowing to store chlorophyll containing fruits and vegetables at beneficial very low oxygen levels. It is a continuous, non-destructive monitoring of the fruit during their whole storage life in CA. In contrast to the usually static conditions of CA-storage, it allows the dynamic adaptation to the lowest O<sub>2</sub> level tolerated by the fruit, slowing down oxidative reactions and senescence processes, thus preventing the development of physiological disorders and maintaining efficiently the eating quality.

Another way of getting a satisfactory inhibition of superficial scald, and moreover an excellent retention of the fruit quality, even on the shelf, when CA cannot exert any influence, is the treatment with 1-MCP/SmartFresh<sup>SM</sup>. Moreover, fruits treated with this ethylene inhibitor could be stored at slightly higher temperatures obtaining still high quality, with all the positive consequences regarding sustainability. On the other side, fruit's postharvest quality could be improved without any treatment, only by optimizing the storage temperature as low as possible. Obviously in the case of ethylene inhibition, the maturity stage of the fruit plays an eminent role.

Treating scald susceptible fruits with the antioxidant DPA was not only controlling the development of scald, but it had other, often forgotten side effects, such as the beneficial reduction of internal browning. It has to be taken into account in the future. We know that 1-MCP/SmartFresh<sup>SM</sup> and DCA can counteract these disorders with flesh browning symptoms in different ways.

The inhibition of ripening, however it is achieved, could reduce considerably the development of rot causing pathogens, such as the 'Gloeosporioses' (Bulls Eye Rot), as the comparison of fruits treated and untreated with 1-MCP/SmartFresh<sup>SM</sup>, stored in regular air, shows.

Moreover, in the future non-destructive technologies could provide us information on the storage potential as a decision supporting tool for storage handling and marketing strategies.

All the storage technologies require appropriate handling in the respect of the complex network of variables that is acting during the post-harvest and storage period of the fruit along the chain to the consumer

## EFFECT OF 1-MCP ON POSTHARVEST PHYSIOLOGY AND QUALITY OF 'LIGOL' AND 'ŠAMPION' APPLES DURING STORAGE

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The study was carried out on 'Ligol' apples in two storage seasons (2007/2008 and 2008/2009). The harvest date was determined on the basis of starch test and the induced ethylene method. Directly after harvest, some fruits were treated for 24 h with 1-MCP at the concentration of  $0.65 \mu\text{l}\cdot\text{l}^{-1}$  and the remaining apples were stored in the normal atmosphere, at  $1^{\circ}\text{C}$ . Then fruits were placed in the ultimately assigned storage conditions for the period of 2, 4, 6 or 8 months. Three gaseous compositions of the controlled atmosphere (CA) were used ( $\text{CO}_2 : \text{O}_2$ ): 1.5:1.5; 3:3 and 5:3. The conditions of the common cold storage comprised the control. Flesh firmness, soluble solids content, titratable acidity and intensity of ethylene production as well as the incidence of physiological disorders and fungal diseases and the percentage of healthy fruits were determined directly after storage and after 7 days of shelf life. In the common cold storage 'Ligol' apples maintained good quality up to 4 months after harvest. Longer storage under these conditions resulted in the excessive loss of flesh firmness and titratable acidity. The loss of firmness and of titratable acidity could be delayed to at least 8 months after harvest by storing apples in the controlled atmosphere, irrespective of its gaseous composition. The storage of 'Ligol' apples in a common cold storage after subjecting them to 1-MCP allowed maintaining apple quality not poorer than that observed in apples stored in the CA, but not treated with 1-MCP. Slowing down physiological and biochemical processes as a result of the 1-MCP treatment was connected with a strong decrease of the intensity of ethylene production. However, 'Ligol' apples treated with 1-MCP and stored in the atmosphere containing more than 1.5% of  $\text{CO}_2$  showed skin injuries caused by the excess of  $\text{CO}_2$ .

The investigation on 'Šampion' apples started in the storage season 2007/2008 on fruits from 10 orchards from different regions of Poland. Representative apple samples, both treated and untreated with 1-MCP, were stored in a common cold storage (NA) and in a controlled atmosphere (CA) for 6 months. With the passage of storage time a quick decrease of flesh firmness was noted and, as a rule, after two months of storage apples became too soft. Firmness decrease was only slightly slower under the CA than NA conditions. Softening of apples treated with 1-MCP stored in NA was delayed even by 4 months and in CA these changes were nearly totally inhibited. 1-MCP and CA conditions also favoured a higher titratable acidity. However, fruits treated with 1-MCP showed some unfavourable changes in the stem cavity. Skin damage in the form of dark brown spots, clearly visible on the healthy surface, was more often observed in NA than in CA conditions. This problem became an objective of the experiment inaugurated in September 2008. It showed that 1-MCP damaged apple skin when it was used on non-cooled apples. The risk of damage could be eliminated by cooling apples to  $1.5\text{-}5^{\circ}\text{C}$  before treating them with 1-MCP, providing that for the successive 4 weeks they would be stored in a low and stable temperature. This means that 'Šampion' apples cannot be subject to commercial traffic for 4 weeks after the 1-MCP treatment. Later the apples could be marketed as safe.

## ON THE STUDY OF AROMA PROFILE OF APPLES AS INFLUENCED BY 1-MCP

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1-MCP treatment considerably prolong the storage and shelf life of apples. Beside prolonging the storage life, 1-MCP diminish the appearance of some physiological diseases like scald. More fruit quality parameters define the fruit acceptance by the consumers, some of them (firmness, acidity, internal ethylene concentration) also determine the storability of fruits. Aroma of apple is regarded as one of the most important quality parameters. Many factors influence the aroma profile but ethylene plays a key role in biosynthesis of flavour compounds. 1-MCP is an inhibitor of ethylene synthesis and is now widely used. In our experiment, apples of three main varieties grown in Slovenia ('Idared', 'Jonagold' and 'Golden Delicious') were treated with  $1\mu\text{L}^{-1}$  1-MCP at  $+2\text{ }^{\circ}\text{C}$  and stored under regular ULO storage conditions (1,2%  $\text{O}_2$ , 1,5%  $\text{C O}_2$ ) for 6 months. Analyses of fruit firmness, ground colour and headspace analyses of aroma compounds were determined before and after storage. Compared to control fruits, 1-MCP treated apples had significantly higher firmness better colour ( $L^*$ ,  $a^*$ ,  $b^*$ ) parameters and showed a strong inhibition of total aroma production. Among aroma compounds esters were most severely suppressed by 1-MCP with the exception of 2-methylethyl acetate. In general, 1-MCP proved to influence positively most of the quality parameters (fruit firmness, ground colour, acidity) but profoundly suppressed synthesis of aroma volatiles.

Keywords: apple, 1-MCP, aroma compounds, quality parameters, fruit firmness, ground colour

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## ALTERNATIVE METHOD TRIAL OF FRUIT STORAGE WITH THE SMARTFRESH™ TREATMENT TO MAINTAIN QUALITY OF 'IDARED' APPLES IN THE STORAGE SEASON 2009-2010

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Application of SmartFresh™ technology (1-MCP, 1-methylcyclopropene) to maintain post harvest quality of apples is becoming increasingly popular in Poland. Because of that a small, practical experiment was carried out in the storage seasons 2009-2010, to check the effect on treating apples with 1-MCP and storing without refrigeration (common storage, natural storage). The experiment was designed and carried out by the fruit growers in cooperation with the AgroFresh company, the developer of the SmartFresh™ technology.

Apples of 'Idared' cultivar were harvested according to a commercial practice at two (K and L) orchards locations. The optimum harvesting window for fruits at each location was determined individually by the grower. At harvest samples of fruits were evaluated for flesh firmness and starch index. Harvested apples were cooled down before treatment in a cold storage room for at least 24 hours. A standard commercial dose of  $0.625 \mu\text{l l}^{-1}$  1-MCP was applied for the treatments. The treatment lasted for 24 hours in the cold storage room conditions. Following the treatments, samples of the treated (SF) and untreated control (CT) fruits were brought to the lab and held for 1 and 7 days in the shelf live conditions at room temperature (18-20 °C), then quality parameters measurements were carried out in the fruit storage lab of RIPF, to validate the treatment efficiency.

Treated and control apples were stored in commercial rooms under refrigerated air (RA) and in packing rooms in natural storage (NS) conditions, for a duration of 10, 12, 14 and 16 weeks. Following storage the apples were evaluated in the fruit storage lab of RIPF for quality aspects, after being held for 1 and 7 days in shelf live conditions. Internal ethylene content (IEC), flesh firmness (FF), total soluble solids (TSS) and titratable acidity (TA) were measured. At the end of the storage period the fruits from all combinations were also evaluated by the panel test for the sensory attributes. At the same time the vitamin C content was also measured by the HPLC method.

In general, for an efficient treatment, application of 1-MCP delayed softening and stabilized titratable acidity. Internal ethylene content was lower for the treated apples. Total soluble solids were comparable for treated and control apples. Short term storage without refrigeration of 1-MCP treated apples can be considered as a substitute for refrigerated air storage of untreated fruits.

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## EFFECT OF PRE- AND POST-CURING ETHYLENE AND 1-MCP TREATMENT ON THE BIOCHEMISTRY AND PHYSIOLOGY OF ONION BULBS (*ALLIUM CEPA* L.) DURING STORAGE

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The storability of onion bulbs is dependent on the rate of sprouting. Maleic hydrazide is a sprout suppressant used to extend storage life however, concern over chemical residues has led to a need for new methods. When applied exogenously, ethylene causes varying symptoms in a range of fruits and vegetables and has been demonstrated as a sprout suppressant. A dichotomy exists whereby the compound 1-methylcyclopropene (1-MCP) also acts as a sprout suppressant by blocking the perception of ethylene possibly by binding to ethylene receptors. Our aim is to understand the mechanisms by which exogenously applied ethylene and 1-MCP affects the biochemistry and physiology of the onions during storage. Following harvest, onions cv. Wellington and Sherpa were treated pre- and post-curing with 0 (control), 10 ppm ethylene or 1 ppm 1-MCP for 24 h at 20 °C. Replicated outturns were sampled after each treatment then every 6 weeks into storage (0 °C). Following treatment pre- and post-curing, onion bulbs were sealed in jars and gas samples taken for GC analysis. The concentration of ethylene and 1-MCP evolved from the onion tissue was 15 and 73% less in cured onions, respectively. Respiration rate of bulbs treated with ethylene increased significantly ( $P < 0.001$ ) in both cultivars pre- and post-curing. Respiration rate of 1-MCP treated bulbs was only significantly higher in pre-cured bulbs cv. Sherpa. Both data suggest curing reduces the absorbance and effect of treatment gases, especially 1-MCP. Further biochemical and physiological analysis will be conducted toward the end of storage to understand the effect of each treatment on extending storage life.

These results are from the first year of a 3 year project, part funded by Defra in UK investigating storage practice more widely. Title of the HortLink Project 182 is "Sustaining UK Fresh Onion Supply by Improving Consumer Acceptability, Quality and Availability" and is funded under the Hortlink scheme on the Defra website [www.Defra.gov.uk](http://www.Defra.gov.uk). Overall scope of the project will be reviewed in addition to these specific results.



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# SMARTFRESH<sup>SM</sup> (1-MCP) CONTRIBUTION TO ENERGY EFFICIENCY DURING THE STORAGE OF APPLES: 2 YEARS OF RESULTS IN THE EUROPEAN REGION

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1-MCP, inhibitor of ethylene perception, reduces the respiration of the fruits. Their lower metabolism (lower production of heat) both in standard storage practices (same as for no 1-MCP fruits) and with increased storage temperature/changed storage practices determines improved energy efficiency when compared to no 1-MCP fruits.

SmartFresh (3.3% 1-MCP) has been tested in commercial applications and in laboratory trials in the apple seasons 2008/2009 and 2009/2010 in Europe (7 countries) and Middle East (Israel) in cooperation with the local postharvest researchers.

The results consistently show that 1-MCP allows slower cooling of fruits and reduces CO<sub>2</sub> scrubbing when fruits are stored at same temperature as no 1-MCP fruits while further improving energy efficiency and reducing weight loss when fruits are stored at higher temperatures (up to 4 °C), at the same time delivering the expected high quality of SmartFresh fruits.

The presentation will deliver an overview of the results from the 2008/2009 apple season (Germany, Italy, Israel) and the first interim results from the 2009/2010 apple season (Germany, UK, Spain, France, Israel), discussing 1-MCP contribution to energy efficiency and input for future applications, including proposed changes in storage practices.

## DEVELOPMENT SUPPLY CHAIN MANAGEMENT OF BABY CORN IN THAILAND

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Thailand is the largest exporter of baby corn in the world. The production area is approximately 32,000 Hectares.

The major importers are the United States of America, Japan, the Netherlands and Taiwan. The demand of baby corn continues to increase. The supply chain and logistics management is very important to maintain the quality and minimize the cost of baby corn exporting. In this study, the key members of fresh baby corn supply chains in Kanchanaburi, Ratchaburi and Nakhon Pathom provinces of Thailand are growers, suppliers, packinghouse and consumers. Issue of baby corn supply chain management for exporting are transportation time, dehusking process time, transportation temperature, storage temperature and also humidity. After harvesting, baby corn must transport to the packinghouse as soon as possible, then quickly dehused by workers, pack and keep in cold storage after that transport to the Airport. In the storage period, the temperature and relative humidity are important to maintain baby corn qualities. Thus, the storage temperatures and relative humidities were studied. It was found that baby corn stored at 4 degree C at 90-95% RH showed the suitable conditions in reducing weight loss, respiration and in maintaining soluble solids, external appearance including high acceptability for the customers. The storage life of baby corn kept at 4 degree C at 90-95%RH was 21 days. However if baby corn kept at 7 degree C at 90-95%RH, the storage life was only 18 days. In condition 25 degree C at 80%RH, the storage life of baby corn was 7 days. Therefore cold chain is very important for prolonging storage life of baby corn. A number of data were recorded and analysis for developing the logistics and supply chain management of baby corn.

## COLOUR IN THE ORCHARD

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Colour is traditionally one of the important appearance features of all fruit for consumers in deciding to buy them. Colour is therefore important in the postharvest supply chain. But where does that colour of fruit come from? Clearly the period of growing and the circumstances during growth are important for developing this important feature.

During several seasons (2007-2009), the skin colour of individual apples of different cultivars (Golden Delicious, Gala, Fuji, Braeburn) were measured using a Minolta CR-200 chromameter during the last 30-40 days before (commercial) harvest. By including the biological variation between individual apples in the analyses and applying non linear indexed regression analysis based on process oriented models, explained parts were obtained for the  $a^*$ -value, all exceeding 90%.

The estimated rate constants for the colouration process were remarkably similar for all cultivars (except Fuji) and growing conditions. That would indicate that the process of colouration is really reflecting the degradation of chlorophyll and not the production of red or yellow coloured blush (anthocyanins). The effect of growing conditions (fertilisation and crop level, hail net or not, sunny side or shady side of the tree) could all be attributed to the maximal or minimal obtainable skin colour (asymptotic values of the logistic model).

This type of information from the production period may constitute an important link to postharvest supply chain management.

## SIMULATION OF FRUIT POSTHARVEST QUALITY CHANGES USING THE DECISION SUPPORT SYSTEM "PEOPLE"

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The Decision Support System "People" is created within the framework of the FP6 European Integrated Project "ISAFRUIT", with the objective to simulate quality changes of apples and peaches along different supply chains, to meet the demands of consumers, and consequently stimulate the increase of fresh fruit consumption. The "People" is made as a multi-cultivar system which allows the design of various supply chains from harvest to the retail, with technological parameters (e.g. duration, temperature, atmosphere etc.) set by the user.

The analyses of data collected in different orchards for different seasons and fruit cultivars indicate that some model parameters might depend on growth location and on season. Thus the DSS user has to select fruit cultivar and growth location for the requested simulation. Upon this selection the DSS provides the list of available models. There might be the models for firmness, acidity and soluble solids prepared for one or more seasons (for which the data analyses were conducted). The user may select one or more models from the list, and all selected models will be used for simultaneous simulations.

Then the user has to provide information on the initial fruit status (i.e. firmness, acidity, etc. at starting point of simulation). The stages of the supply chain have to be defined, including (CA) storage, transport and shelf life, and planned technological parameters for each chain stage typed in. Once the development of the supply chain has been finished, the user can generate the graph presenting quality changes along the whole supply chain, or create the report presenting the status of the fruit batch at the end of each stage (and the description of the designed supply chain). For better planning of the optimal supply chain, several chains can be simulated in one run and presented in a series of adjacent graphs or in one report.

The final version of Decision Support System "People" will be available for free download from [www.people-dss.eu](http://www.people-dss.eu) or [www.people-dss.pl](http://www.people-dss.pl).

## PLANT GROWTH REGULATORS FOR IMPROVING POSTHARVEST QUALITY

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Ethylene is known as the 'ripening' hormone. Manipulations of fruits and vegetables by either exogenous ethylene or inhibitors of ethylene production or perception are widely used to influence the postharvest behavior of commodities. However, other plant growth regulators are also used in horticultural production and have ramifications for postharvest quality. Auxins are used to enhance the size of pome and stone fruits, and to prevent calyx disorders in citrus. Gibberellins are used for increasing berry size of grapes, maintaining the green color of pomello and pomelit, and delaying senescence and yellowing of leafy herbs and some vegetables. Inhibitors of gibberellin synthesis which inhibit shoot elongation have also been used to increase fruit size by decreasing the competition between fruit and vegetative growth. Cytokinins are used to increase fruit size, and, in grapes, to improve rachis thickness which in turn increases shelf life. These plant growth regulators have also been found to decrease fungal infections, either by delaying ripening or senescence, or by altering the structure of the fruit. For example, treating persimmons with gibberellin will decrease infection by *Alternaria alternata* after storage, because gibberellin causes the calyx to be raised from the shoulder of the fruit, thus decreasing the permissive humidity levels at that site and reducing inoculation.

Other less well known plant growth regulators have been used to affect biotic and abiotic stresses of harvested fruits and vegetables. Abscisic acid improves grape coloration and postharvest life. Salicylic acid and jasmonic acid induce defense reactions in fruits and vegetables that help prevent fungal infection and induce resistance to low temperature injury. Growers and researchers should be aware that plant growth regulators applied in the field may have beneficial carry-over effects on postharvest quality.

## LUNG HEALTH AND FRUIT/VEGETABLE CONSUMPTION

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Abundance of oxygen and exposure to a variety of prooxidant (e.g ozone, nitrogen dioxide, cigarette smoke) and airborne carcinogens over the whole life are the hallmarks of lung environment. Therefore the tight control of redox processes by network of antioxidants is crucial for the maintenance of normal function of respiratory system. Long-term and repeated redox imbalance resulted either from enhanced oxidant formation or suppression of anti-oxidant activity may lead to the acceleration of pulmonary ageing processes and be responsible for the development of chronic obstructive pulmonary disease (COPD), emphysema, and lung cancer.

Dietary components, in particular fruits and vegetables are rich source of antioxidant vitamins (C, E), vitamin A, carotenoids (e.g  $\beta$ -carotene, lycopene), variety of flavonoids (quercetin, catechins, oligomeric procyanidins, hesperidin) and other phytochemicals.

They can augment pulmonary antioxidant defense and interact with various pathological processes (airway inflammation, air pollutants toxicity, mutagenesis) to prevent or inhibit lung disorders occurrence and progression.

In several cross-sectional epidemiological studies positive associations between lung functions in adults and dietary intake of vitamins C, E and  $\beta$ -carotene have been demonstrated. In a prospective cohort study a strong positive association between lung function and the number of apples eaten per week was found. However, the tendency to slow decline in lung function by high average apple consumption did not reach statistical significance. Higher dietary intake of vitamin C was associated with reduction of the rate of loss of lung function in another longitudinal cohort study.

High fruit or vegetables intake was inversely related to the risk of COPD and respiratory symptoms. Consumption of apples, pears and grapes was independently associated with reduced cough and phlegm. Also high consumption of soy foods decreased risk of COPD in Japan population. In an extensive Dutch cross-sectional study solid fruits (apples, pears) were inversely associated with the prevalence of COPD symptoms (chronic cough and breathlessness).

The best protection against lung cancer seems avoidance of airborne carcinogens and increased consumption of fruits and vegetables. Apples due to high content of oligomeric procyanidins could be used for anti-cancer dietary intervention. Apple products have been shown to prevent skin, mammary and colon carcinogenesis in animal models and epidemiological studies indicate that regular consumption of one or more apples a day may reduce the risk for colon and lung cancer. Monitoring of gene promoter hypermethylation events in cells present in sputum seems to be promising method for early detection of lung cancer. Significant protection against promoter hypermethylation was observed in current or former cigarette smokers consuming increased amounts of leafy green vegetables. Higher dietary intake of isoflavone (expressed as genistein content from soy foods) decreased the risk of lung cancer in never smoked subjects in a large scale, population-based (about 76 000 subjects) prospective study.

These data indicate the impact of diet, especially fruits and vegetables consumption on the incidence and evolution of lung diseases. Further studies are necessary to elucidate mechanisms of this beneficial effect for lungs health.

The work is supported by a grant from the EU Regional Development Fund through the Polish Innovation Economy Operational Program, contract N. UDA-POIG.01.03.01-10-109/08-00.

## BIOLOGICALLY ACTIVE SUBSTANCES IN SWEET CHERRY, SOUR SHERRY AND CORNELLIAN CHERRY FRUIT

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The fruit content of anthocyanins and ascorbic acid was compared in several cultivars and ecotypes of sweet cherry, sour cherry and cornellian cherry (dog wood). Results were calculated on the fresh basis. Ascorbic acid is commonly known as potential biologically active compound involved in many reactions. During last years there is a growing number of substantial data on the anthocyanin biological activity as well. In literature so far one may found conflicting results referring to the content of studied fruits.

Analyzed cultivars and selection ecotypes were having various amounts of compounds in question. Anthocyanin content was for sweet cherry fruit from 68 to 240 mg/100g 'Johana'; sour cherry respectively 66 – 'Nefris', 114 – 'Łutówka' and 136 mg/100g 'Kerezer'. Cornellian cherry ecotypes contained respectively from 37 – '11/1' to 180 mg/100g – '13/1'. Ascorbic acid content values were: for sweet cherry – 10 mg/100g – 'Johana'; sour cherry – 13 mg/100g 'Łutówka'. Higher amounts of ascorbic acid were noted for ecotypes of cornellian cherry – '13/1' – 64 mg/100g and 110 mg/100g – '15/1'.

Keywords: fruit quality, ascorbic acid, anthocyanin content

## THE BIOACTIVE COMPOUNDS IN FRUITS OF DIFFERENT ROWANBERRY CULTIVARS

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Rowanberries (*Sorbus aucuparia* L.) are small orange-red “fruits” of a rowan tree, which grow in the northern part of Europe. Berries have been described as an important source of flavonoids; their antioxidant activity affects reactive oxygen species and lipid peroxidation; therefore they are suitable for production of health-food products. The aim of this experiment was to evaluate biochemical composition of the different rowanberries cultivars and their hybrids with the other *Rosaceae* L. cultivars grown in Latvia and to find correlation of the biochemical composition with the antiradical activity.

The experiments were done in Customs laboratory of National Customs Boards, State Revenue Service (Latvia) and Faculty of Food Technology, Latvia University of Agriculture. The rowanberry and their hybrid fruits were picked in Pure Horticultural Research centre. Contents of ascorbic acid, total phenols, anthocyanins, carotenoids and antiradical activity of frozen wild rowanberries (*Sorbus aucuparia*) and 18 cultivars of the following sweet rowanberries were analysed: *Sorbus aucuparia* var. *fructolutea*, *Sorbus aucuparia* var. *sibirica* (syn. *uralensis*), 'Konzentra', 'Nevezhinskaya', 'Businka', 'Sorbinka', 'Zholtaya' (syn. 'Presnaya'), 'Michurinskaya Krasnaya', 'Moravica', 'Moravskaya Krupnoplodnaya CGL', 'Rosina', *Sorbus hybrida*, *Sorbus arranensis*, rowanberry × pear 'Alaya Krupnaya' and 'Titan', rowanberry × hawthorn 'Granatnaya', rowanberry × chokeberry 'Likernaya' and 'Burka'. For determination of ascorbic acid content high performance liquid chromatography was used and for determination the other parameters spectrophotometric methods were used.

The results showed that the highest content of the ascorbic acid was in rowanberry 'Sorbinka' fruits and the highest content of the carotenoids were detected in the fruits of rowanberry × hawthorn hybrid 'Granatnaya'. The highest content of the total phenols and the anthocyanins as well as the highest antiradical activity was in the fruits of rowanberry×chokeberry hybrids 'Burka' and 'Likernaya'.



## QUALITY AND STORAGE OF 'KORDIA' SWEET CHERRIES

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The experiment was carried out in the years 2007 and 2008. Sweet cherries of 'Kordia' cv. were harvested in the first week of July at the orchard near Skierniewice. After harvest, according to intensity of skin colour, two groups of fruits were distinguished ("dark" and "light"). Cherries were stored at -0.5 °C and 3 °C in air, till the beginning of September. In 2007 fruit were also stored under controlled atmosphere conditions. Two storage atmospheres were used: 15%CO<sub>2</sub> + 3%O<sub>2</sub> and 5% CO<sub>2</sub> + 3% O<sub>2</sub>. After harvest and after storage the following quality parameters were measured: fruit colour, total soluble solids content (TSS), titratable acidity (TA), total polyphenols (TP), total anthocyanins (A) and vitamin C (AA). Additionally, the content of delphinidin-3-glucoside, cyanidin-3-galactoside, cyanidin-3-rutinoside, peonidin-3-rutinoside were determined.

In 2008 fruits were characterized by higher TSS and TA than those in 2007. Regardless of the season light red fruits had lower TSS content and higher TA compared with dark red fruits. In 2007 the TSS content in "light" cherries at harvest was 12.6% and in "dark" 15.6% but in 2008, 13.4% and 18.2% respectively. In both seasons the color of fruits (expressed as L\*, a\* and b\* value) indicated that at harvest the "dark" fruits were similar. The light red cherries in 2007 were characterized by higher a\* and b\* value than those fruits in 2008.

In both seasons the light red fruits were characterized by lower total polyphenols and vitamin C content. At harvest in the year 2007, the total anthocyanins content was higher in dark red fruits than in light red ones, but in 2008 there were no significant differences.

The changes of quality parameters during storage depended on season and storage conditions.

The experiment was carried out in the frame of the COST Action 924 "Enhancement and Preservation of Quality and Health Promoting Components in Fresh Fruit and Vegetables" activity and founded by Ministry of Science and Higher Education (previously State Committee for Scientific Research), project No 580/E-177/SPB/COST/P-06/DWM 16/2005-2008.

## THE POSTHARVEST QUALITY OF RASPBERRY 'GLEN AMPLE' AS AFFECTED BY STORAGE TEMPERATURE AND MODIFIED ATMOSPHERE PACKAGING

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The aim of the experiment was to find out the effect of two storage temperatures (+1 °C and +4°C) and modified atmosphere packaging (MAP) on postharvest quality of raspberry 'Glen Ample'. Fruits were picked into 450-g well ventilated plastic punnets, cooled down during 24 hours and packed as follows: control: unpacked ventilated punnets covered with lid; Xtend® raspberry film, product of Stepac, Israel; PP30: 30 µm polypropylen film; OPP 25: 25 µm oriented polypropylen film, products of Muovijaloste, Finland. One treatment consisted of eight replicate bags. After 3 days cool storage period, all packages were kept in +15 °C for 24 hours to simulate retail conditions.

O<sub>2</sub> and CO<sub>2</sub> content in the packages was analyzed daily. Soluble solids content (SSC), titratable acidity (TA), fruit firmness, ascorbic acid content (AAC), anthocyanins (ACY) and total antioxidant capacity (TAC) were determined at harvest, and at the end of storage. The amount of rotted fruits was counted and sensory evaluation was carried out at the end of experiment.

During the first 24 hours the CO<sub>2</sub> increased to 10% in PP30 and OPP25 packages at +4°C, in +1°C it took 48 hours. In Xtend® packages CO<sub>2</sub> concentration increased over 10% only after shelf life simulation. Environment in the PP30 and OPP25 packages became anaerobic in retail conditions. Fruit spoilage was significantly lower in PP30 and OPP25 packages where CO<sub>2</sub> content increased fast. Raspberries had higher SSC, TA, SSC/TA and ACY at +4 °C than at +1 °C. Fruits in Xtend® packages were significantly firmer than in all other treatments. The mean effect of the MAP and storage temperatures showed no significant influence on raspberry appearance, flavour and off-flavour. Raspberries kept at +4°C tasted better to consumers.

ANATOMICAL TRAITS OF SEA-BUCKTHORN FRUIT  
(*HIPPOPHAE RHAMNOIDES* L.) AND THEIR SIGNIFICANCE FOR DEVELOPING  
NEW VARIETIES WITH HIGHER OIL-YIELD

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Rich in vitamins and BAS, sea-buckthorn fruit oil is used to treat skin diseases and gastrointestinal disorders.

A fleshy part of a sea-buckthorn fruit (hypanthium) together with leaves produces assimilates for the developing seed. Subepidermal zones are photosynthesizing ones; the central zone is in charge of transport and storage. Subepidermal zones continue to photosynthesize after seed isolation. Assimilates are accumulated in cells of the central zone and excluded from the metabolism through oil synthesis. The oils are stored as drops in hyaloplasm. Overload with the products of synthesis leads to aging of subepidermal cells and induces the transformation of their chloroplasts into lipochromoplasts. The major amount of buckthorn oil is extracted from the cells of the central zone. The oil is colored by the contents of lipochromoplasts.

We believe that for developing varieties with the highest oil yield and the largest fruits, plants with early-ripening elongated fruits are the most promising. The earlier the seed becomes isolated, the more oil is accumulated in the fruit. The hypanthium in such fruits is active in summer time, when conditions (day length, temperature, etc.) are the most favorable for the photosynthesis. A globular fruit is the largest in volume while its surface area is the smallest. The elongation of the fruit shape results in the increase of relative area of its photosynthesizing surface and therefore in better oil accumulation.

## BIOFORTIFICATION OF SPINACH PLANTS APPLYING SELENIUM IN THE NUTRIENT SOLUTION OF FLOATING SYSTEM

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The selenium (Se) is very important element for human health. They are involved in defense mechanism and biosynthesis of hormones in adult and babies. The Se is a trace element and in the human body is involved in the membrane protection and has anti-cancer action. The Se is a cofactor of glutathione peroxidase and may play an important role against oxidative tissue damage. The aim of this work was to evaluate the floating system for enriching the baby leaf plants by applying the Se directly in the nutrient solution. This experiment was performed using spinach (*Spinacia oleracea* L.) plants grown in the nutrient solution containing 0, 2.6, 3.9 and 5.2  $\mu\text{M}$  Se applied as  $\text{Na}_2\text{SeO}_4$ .

At harvest time the yield, Se content and quality parameters such as chlorophyll, carotenoids, total soluble sugars and sucrose were determined. The yield was not affected by treatments and depended by seasons.

The Se content in leaves linearly increased with Se concentration in the nutrient solution. The highest value was 160 mg/kg DW. The spinach growth in the 2.6  $\mu\text{M}$  gave the adequate concentration for providing the recommended dietary allowance of 55  $\mu\text{g}/\text{d}$  for adults. The chlorophyll and carotenoids did not change among treatments. Reducing sugars expressed as glucose equivalent did not change among treatments and ranged from 6 to 9 mg/g FW. The sucrose content ranged from 0.6 to 3 mg/g FW but no difference was observed among treatments.

# POSTER ABSTRACTS



## THE EFFECT OF STORAGE IN CONTROLLED ATMOSPHERE ON QUALITY AND HEALTH-PROMOTING COMPONENTS IN BROCCOLI (*BRASSICA OLERACEA* VAR. *ITALICA*)

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One of the main vegetables species, with the unique diabetic and antitumor features related to bioactive components (glucosinolates, flavonoids, vitamins and fiber) are broccoli. Hydrolysis products of glucosinolate - isothiocyanates have been identified as the primary components having anti-cancer activity. The most bioactive isothiocyanates found in broccoli are sulforaphane, allyl isothiocyanates and indole-3-carbinol.

The aim of the study was to determine the influence of different controlled atmosphere conditions during storage on quality and health-promoting components in broccoli. Broccoli Marathon F<sub>1</sub> cultivar was kept at 0°C for 100 days in controlled atmosphere consisting of: 1) 5% CO<sub>2</sub> – 3% O<sub>2</sub>, 2) 8% CO<sub>2</sub> – 1% O<sub>2</sub>, 3) 10% CO<sub>2</sub> – 3% O<sub>2</sub>, 4) 15% CO<sub>2</sub> – 3% O<sub>2</sub> and at normal atmosphere conditions.

The highest content of dry matter, ascorbic acid, mono and disaccharide were found in a fresh broccoli. Low decrease of dry matter, and high decrease of ascorbic acid, mono and disaccharide during storage was noticed in all examined treatments. Highest loss of these components occurred in broccoli, stored at atmosphere consisting of 15% CO<sub>2</sub> – 3% O<sub>2</sub>. Both of glucosinolates (sulforaphane and indole-3-carbinol) were identified in broccoli. Slight decrease of sulforaphane occurred in broccoli held in atmosphere consisting of 15% CO<sub>2</sub> – 3% O<sub>2</sub>. In other treatments sulforaphane decrease was from 28 to 70%. Lower content of indole-3-carbinol was in fresh broccoli compared to the stored one. The highest content of this compound was determined in broccoli kept in controlled atmosphere consisting of 8% CO<sub>2</sub> – 1% O<sub>2</sub>.

Broccoli marketable quality after storage in controlled atmosphere consisting of 15% CO<sub>2</sub> and 3% O<sub>2</sub> was quite good, in other treatments satisfactorily. Broccoli held in normal atmosphere lost their marketable quality [completely](#) as a result of decay, tightness loss and yellowing.

## THE EFFECTIVENESS OF AVG USED ALONE AND JOINTLY WITH NAA AGAINST PRE-HARVEST DROP IN APPLE

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The results of three experiments carried out in 2007 and 2008 in Experimental Orchard of Research Institute of Pomology and Floriculture at Skierniewice on the apple cultivars 'Gala Must' and 'Ligol' are presented. The preparations ReTain (as formulation VBC-30033 ) containing AVG (aminoethoxyvinylglycine) and Pomonit Super 050SL( a salt of NAA with triethanolamine) were used against preharvest fruit drop by spraying the trees alone and subsequently. ReTain was used 4 weeks before anticipated harvest at two doses: 180 and 360 g/hl, but Pomonit Super 1 week before harvest at 20 g/hl or at 40 g/hl. The effect on the dynamics of fruit drop, on fruit quality at harvest and after storage, as well as on shoot growth and subsequent blooming was determined. It was found: in all experiments, the lowest number of apples abscised before the harvest when both preparations were used at half of optimal doses, respectively at 4 and 1 week earlier. The efficiency of subsequent use of preparations was better than the use of ReTain alone at twice higher dose (optimal). The effect on preharvest fruit drop of low dose of ReTain used alone was too weak. No significant effect of preharvest treatments with ReTain and Pomonit Super on the total yield of apples, and on the average fruit weight was found. However, in 2008 in both cultivars the joint treatment with low doses of ReTain and Pomonit Super, caused distinct increase % of large apples (of diameter more than 70 mm), while other treatments with preparations have no effect as on the distribution of apple in size classes as on average fruit weight. The effect of both preparations on other parameters of apple quality depended on the cultivar. Treatment with ReTain alone at high dose and at low dose but jointly with NAA caused the significant reduction of red color of apples in 'Gala' but caused significant increase of firmness of 'Gala' apples at harvest, and after storage and reduced rotting of them. However, in 'Ligol' no effect on red color of apples and reduction of firmness was found. Effect on red color of 'Ligol' apples was not observed. Joint treatment with ReTain with NAA induced significant better blooming of 'Gala' apples in 2008.

## CHEMICAL FRUIT THINNING OF PEAR

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Keywords: auxin, cytokinin

The experiment was conducted in the Experimental Station near Krakow in 2008 and 2009 year. The objects of experiments were twelve-year old pear apple trees cv. 'Conference'. The aim of experiment was the evaluation of two forms of auxin NAA and cytokinin BA on percentage of fruit setting, total yield, fruit mass and firmness of flesh, acidity and soluble solids. Treatment was carried out when fruitlets have 12 mm diameter. Control trees were not sprayed. All used combinations decreased fruit set and total yield but increased fruit mass. Used compounds didn't have clear influence on acidity of fruit juice extract. All treatments did not have influence on fruit storage ability assessed on the base of firmness, acidity and fruit juice extract.



## INFLUENCE OF THE GIBBERELIC ACID AND THE HARVEST DATE ON THE CAVITIES IN CHILLED "CONFERENCIA DEL BIERZO" PEARS WITH DELAYED COADYUVANTS TREATMENTS

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Field treatments, with gibberellic acid ( $GA_3$ ), consisted in 1g/1000L/ha or 3g/1000L/ha, applied for both the fruits of the 1<sup>st</sup> harvest (optimum harvest date) and the 2<sup>nd</sup> harvest (10 days after), of "Conferencia del Bierzo" pears cultivated in El Bierzo, Spain North, were stored for long-term at 0°C in continuous air flow cabinets, and after 50 days a lot of them were conditioned in dynamic CA-storage of 1%  $CO_2$  + 4%  $O_2$  and other two with low (3,5-5 g/kg fruit) or high dose (15-16 g/kg fruit) of ethylene absorbent from sepiolite impregnated with permanganate in sachets of polyethylene tissue (Tyvek<sup>®</sup>), during the last three months from the global storage period of five months, with the goal to control the presence of great cavities or dried caverns, for what that Spanish cultivar of pear with Guarantee Mark from Castilla-León is very sensible in function of the atmosphere composition when harvest is delayed.

The investigation considers the quality attributes evolution (acidity, soluble solids, firmness and colour of pulp and puree) and physiological activity (respiration and ethylene production) through the storage period and complementary ripening at +20°C, in each lot. The higher dose of ethylene absorber has influenced drastically in obtaining high  $CO_2$  in the cabinet (2% or 5%, if the atmosphere is confined), specially in fruits from the 2<sup>nd</sup> harvest with the low dose of gibberellin, with all the fruits affected by great cavities or caverns, after two months of this delayed treatment. The best internal quality of the fruit as well as the great level of cavities control, corresponds for the fruits of 1<sup>st</sup> harvest sprayed with gibberellin at 3g/ha, stored in dynamic atmospheres with very low  $CO_2$ .

Is it possible to extend storage life of raspberry fruit

## CHANGES OF PHYSICAL AND CHEMICAL TRAITS OF ROOTS OF DIFFERENT CARROT CULTIVARS UNDER COLD STORE CONDITIONS

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Carrot cultivars used in horticultural practice differ in root quality traits, including root colour and shape. Recently, cultivars of creamy-white, yellow, or purple roots have been introduced to horticultural practice in Poland. The objective of the study, performed in 2006–2008, was to determine the influence of long-term cold storage of carrot roots on some physical and chemical parameters influencing nutritive and biological value of the roots of cultivars of different root colour and shape. Eight cultivars were chosen for the experiment: 'Perfekcja', 'Interceptor' F<sub>1</sub>, 'Vita Longa', 'Nebula' F<sub>1</sub>, 'Purple Haze' F<sub>1</sub>, 'Deep Purple' F<sub>1</sub>, 'Mello Yello' F<sub>1</sub> and 'White Satin' F<sub>1</sub>. Quality parameters of the carrots: CIE L\*a\*b\* parameters of the whole roots and juice, root firmness (with HPE firmness tester), dry matter, soluble solids, sugars, total phenolics, total carotenoid, antioxidant activity of the whole roots and juice (with DPPH method), were determined directly after harvest and after 6-month storage of the roots in a cold store at temperature of 0–1°C and 97% RH. The results showed significant influence of the storage on most of the quality traits of the roots, particularly colour, firmness, soluble solids and phenolics content. These changes were also related to the cultivars. Storage of the carrot roots caused a decrease in their firmness. Soluble solids and sugars content showed a tendency to increase during the storage period. Storage of the carrots resulted in decreasing nitrates content and increasing phenolics and carotenoid compounds content in the roots. Antioxidant activity of the juice showed small increasing tendency resulting from the storage of the roots, but antioxidant activity of the roots decreased.

## DYNAMICS OF CHANGES OF STARCH AND ITS COMPONENTS IN FRUITLETS AND MATURING JONAGOLD AND GALA MUST APPLES

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In 2003 and 2004 the volume of 'Jonagold' and 'Gala Must' (*Malus domestica* Borkh.) apples fruitlets and their concentrations of starch, amylose and amylopectin were assessed at two-week intervals. The investigations started in the 7<sup>th</sup> or 8<sup>th</sup> week after full bloom (WFB) and continued until harvest. 'Gala Must' apples contained on average by about 40% more starch than 'Jonagold' apples. The dominant starch form was amylopectin; its maximum content was 68% in 'Jonagold' and 63% in 'Gala Must' apples. Dynamics of changes of starch content and its components in growing and maturing apples revealed considerable differences in both years of the experiment. In 2003 highest starch accumulation occurred in the 7<sup>th</sup> WFB for both apple varieties, whereas in 2004, fruits of 'Jonagold' showed highest starch accumulation in the 14<sup>th</sup> week and those of 'Gala Must' in 12<sup>th</sup> week. At this stage apple fruit volume was 2.5 times smaller in 2003 than in 2004. It seems that higher than average temperatures at that time were the main factor determining considerable enhancing of starch accumulation in apple fruitlets in 2003. In both years the period of starch breakdown in 'Jonagold' apples was two weeks shorter than in 'Gala Must' apples.

## ETHYLENE EVOLUTION INTENSITY AND FRUIT SETTING AFTER THINNING WITH NAA AND ETHEPHON

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Experiment was carried out in 2006 and 2008, at the Experimental Station near Cracow. In 2007 they stopped it because of serious frost damages. This experiment compared the influence of auxin NAA and ethephon on amount of ethylene evolution by fruitlets from apple-tree "Sampion". Percentage of fruitlets was also examined. Preparations, in two different concentrations, were used at the end of the flowering process. Then, during five days after this procedure, amount of ethylene evolution was estimated. It was the greatest after the usage of ethephon  $600 \text{ mg}\cdot\text{L}^{-1}$  and reached over 100 nL of ethylene  $\text{g}^{-1}\cdot\text{h}^{-1}$ . Ethylene evolution after NAA treatment was smaller and average reached 20 of ethylene  $\text{g}^{-1}\cdot\text{h}^{-1}$ . All those procedures decreased the percentage of fruitlets equally and increase fruit quality.

Keywords: apple, auxin, structure of yield

## THE INFLUENCE OF POSTHARVEST CARROT TREATMENT WITH BACTERIA CELLS ON INHIBITION OF FUNGAL DISEASES DURING STORAGE

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In postharvest experiments the roots of carrot cv. Kazan F<sub>1</sub> were dipped in the suspensions of bacterial cells to inhibit the development of *Sclerotinia sclerotiorum* and *Botrytis cinerea*. The bacteria used in the studies exhibited antifungal properties in laboratory tests.

It was found that *S. sclerotiorum* caused more serious disease on carrot roots than *B. cinerea*. In the successive years of storage experiments the most effective bacterial strains or their mixtures were selected. The bacteria, which did not show any protective properties in these experiments (2007–2008) were replaced by new strains. In the year 2009 carrot roots were treated with bacteria SZ61, PT42, B5, B32 and the mixtures SZ61+B32, SZ61+PT42, B5+B32, B32+PT42, B5+PT42. The mixture of strains SZ61+PT42 was able to reduce white mold and SZ61+B32 reduced grey mold.

The diffusion tests have showed that the strain SZ 61 produces strong antibiotics, inhibited evidently the fungus development. The bacterial B 32 did not cause the inhibition of mycelium proliferation.

The identification of bacterial isolates SZ 61 and B 32 carried by biochemical and molecular methods showed the great similarity of SZ 61 to *Bacillus* sp. but B 32 to *Pseudomonas* sp.

## EFFECTS OF EDIBLE COATING AND COLD STORAGE ON CHEMICAL COMPOSITION AND STORAGE ABILITY OF SOME TOMATO CULTIVARS

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The experiment was carried out in the years 2006-2007. The field part of the study was conducted at the Horticultural Experimental Station in Dołuje. The laboratory part took place in the Department of Plant Raw Material Processing and Storage of the West Pomeranian University of Technology in Szczecin.

The aim of the experiment was the estimation of the effect of cultivar ('Aurelius F<sub>1</sub>', 'Daniela F<sub>1</sub>', 'Nemo-Nadin F<sub>1</sub>', 'Nemo-Netta F<sub>1</sub>', 'Merkury F<sub>1</sub>', 'Malinowy Henryka F<sub>1</sub>'), postharvest factor (control – without edible coating, Semperfresh,) and storage period (control – directly after harvest, after two weeks of storage) on the chemical composition and storage ability of tomato (*Lycopersicon esculentum* Mill.). Harvested at the red-ripe stage fruit was placed in single layer in plastic trays, lined with perforated polyethylene film, and stored for fifteen days in a cold storage at 10°C, and 90% RH.

Chemical analyses of fruit were done directly after harvest and after 14 days of storage. They included determination of the content of dry matter, titratable acidity, total soluble sugars, nitrates, L-ascorbic acid, total carotenoids, total polyphenols and antioxidant activity. In the experiment weight losses of fruit after 3, 6, 9, 12 and 15 days of storage were also assessed.

The tested cultivars of tomato differed significantly in the content of dry matter, nitrates, L-ascorbic acid and total carotenoids. Among the cultivars the highest content of carotenoids was noted for cultivar 'Malinowy Henryka F<sub>1</sub>'. Analysing the effect of Semperfresh on tomato fruit quality, the significant differences were found only in case of nitrate content. Significantly higher nitrate content was noted for fruit coated with Semperfresh in comparison with control. The two-week storage of tomato fruit caused a significant increase of dry matter, nitrates and polyphenols contents. The content of carotenoids, L-ascorbic acid and titratable acidity were lower than those before storage. Significantly higher losses of weight of tomato fruit were noted after 15 days of storage in comparison with previous measurements.

## ANTIFUNGAL ACTIVITY OF ESSENTIAL OILS FROM DIFFERENT VARIETIES OF SWEET BASIL (*OCIMUM BASILICUM* L.)

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Herbs are a potential source of the substances which have antimicrobial properties and can be used as botanical pesticides. The aim of this work was an estimation of antifungal activity of essential oils from two varieties of sweet basil (*Ocimum basilicum* L.): 'Wala' and 'Fine verde'.

Essential oils from dried, grinded herbs were extracted by hydro-distillation, using Deryng apparatus. A composition of oils was analyzed by gas chromatography. Antifungal activity of oils was tested against following strains: *Alternaria* sp., *Aspergillus flavus*, *Botrytis cinerea*, *Cladosporium herbarum*, *Eurotium amstelodami* and *Eurotium chevalieri*. The disc diffusion agar method was applied. Each oil was used in two doses, 10 and 5 µl/disc. Disc soaked with oil was placed on plates, which were previously inoculated by particular strains. The plates were incubated in 25 °C for 72 hours. The diameters of the inhibition zones were measured in millimeters. Sterile distilled water constituted a negative control and actidion (cycloheximid) and Topsin M 500 SC – a positive one.

It was stated that oils from both varieties of basil inhibited the growth of all tested fungi. However, the inhibition activity depended on a strain of fungi and a dose and origin of oil. *E. chevalieri* was most sensitive to both of the oils (inhibition zone 90 mm) and *A. flavus* was most resistant (inhibition zone 7.5-8.5 mm). The inhibition zones were generally greater when a dose of oils was higher. Essential oil from 'Wala' in both doses was more effective than the oil from 'Fine verde'. For doses 10 and 5µl/disc of 'Wala' oil the average diameters zones of the inhibition growth of tested fungi were 63.1 and 33.9 mm respectively, and for 'Fine verde' oil these zones amounted 42.0 and 18.3 mm. The differences in the composition of both oils probably affected their antifungal activity. The oil from 'Wala' was characterized by a significantly higher content of linalool (69.0%) than 'Fine verde' oil (33.3%). Besides, in 'Wala' oil geraniol was present (5.1%) and it did not occur in 'Fine verde' oil. Both tested oils had a greater antifungal activity than actidion and Topsin. The results of this study show that essential oils from both tested varieties of sweet basil might be used as natural antifungal agents, however 'Wala' oil is significantly more effective than 'Fine verde' oil.

## RESPONSES OF 'GOLDEN DELICIOUS' APPLES TO POSTHARVEST APPLICATION OF 1-METHYLCYCLOPROPENE (1-MCP) UNDER COMMON COLD STORAGE AND CONTROLLED ATMOSPHERE CONDITIONS

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The investigation was performed on 'Golden Delicious' apples in two storage seasons (2006/2007 and 2007/2008). The harvest date was determined on the basis of starch test and the induced ethylene method. Fruits were stored at 1°C in a common cold storage and in three gaseous compositions of the controlled atmosphere (CA) – CO<sub>2</sub> : O<sub>2</sub> –1.5:1.5; 3.0:3.0; and 5.0:3.0. Directly after harvest, half of the apples from each combination was treated with SmartFresh preparation containing 1-MCP. Fruit quality was assessed immediately after 2, 4 and 6 months of storage and after keeping them at room temperature for additional 7 days. At each date the intensity of ethylene production, flesh firmness and titratable acidity were determined. The evaluation of apple storability was also determined on the basis of the occurrence of diseases and physiological disorders as well as the injuries of skin and/or flesh caused by the excessive amounts of carbon dioxide.

The experiment revealed a drastic decrease of the intensity of ethylene production by apples subjected to the 1-MCP treatment, independently from the storage time and conditions. Depending on the storage season, apples treated with 1-MCP started to produce slightly higher amounts of ethylene after 4 or 6 months of storage but only in the common cold storage. Both 1-MCP treatment and the storage of apples in the controlled atmosphere favoured the higher flesh firmness directly after storage and after 7 days of storage at the room temperature. In the first four months of storage the effect of the 1-MCP treatment was clearly higher in the conditions of the common cold storage than in the CA. In the combination without 1-MCP a significantly lower firmness was observed in apples stored in the common cold storage than in CA. On the other hand under the CA conditions the differences between the evaluated combinations were noted only after 6 months of storage. With the passage of storage time a constant decrease of the titratable acidity was noted. The rate of this process was significantly slower in the case of fruits stored in the controlled atmosphere than in the common cold storage. The differences between those storage technologies were even more clear after shelf life than directly after storage. The post-harvest treatment of apples with 1-MCP substantially limited the decrease of apple titratable acidity, especially under the conditions of the common cold storage.

The experiment showed an increase of the number of fruits injured by CO<sub>2</sub> but only in the first year of the investigation and in case of apples treated with 1-MCP and stored for 6 months in the atmosphere containing 5% of CO<sub>2</sub> and 3% of O<sub>2</sub>.

Fungal diseases (grey mould, bull's eye rot and blue mould rot) occurred mostly on fruits stored in the common cold storage. Treating apples with 1-MCP usually decreased the percentage of rotten fruits both directly after storage and after the period of shelf life.



## EFFICACY OF HERBICIDE LENTAGRAN WP FOR CONTROL ANNUAL DICOTYLEDONOUS WEEDS IN LEEK CROP

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In 2007–2008 at the Lithuanian Institute of Horticulture were carried out the investigations of herbicide Lentagran WP (a.i. *pyridate* 45%) efficiency in leek crop.

The investigated herbicide effectively decreased the weed number in leek crop. Annual dicotyledonous weeds were sensitive to herbicide Lentagran WP 0.5 - 2.0 l ha<sup>-1</sup>. Total number of weeds 14 days after application of herbicide decreased by 77.5-86.0%, number of annual dicotyledonous weeds decreased by 79.1-88.0%, air dry weight of weeds decreased by 44.3-78.6%. The number of annual dicotyledonous weeds in Lentagran WP 0.5-2.0 l ha<sup>-1</sup> treatments was essentially lower to compare with untreated and also there was found essentially lower number of annual dicotyledonous weeds in Lentagran WP (a.i. *pyridate* 45%) 0.5-2.0 l ha<sup>-1</sup> treatment to compare with Stomp 330 EC 3.0 l ha<sup>-1</sup> treatment. Very sensitive to Lentagran WP 0.5-2.0 l ha<sup>-1</sup> there was *Senecio vulgaris* L. (94.0-100%), *Galinsoga parviflora* Cav. (77.7-100%), *Stellaria media* (L.) Vill. (75.3-82.3%) and *Chenopodium album* L. (74.0-87.1%).

Keywords: herbicides, pyridate, Lentagran WP, leek, yield, weeds

## THE EFFECT OF HEAT TREATMENTS ON THE RETENTION OF QUALITY OF APPLES

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'Sampion' fruits were picked one week before and at optimum stage of maturity for long term storage. After harvest, apples were subjected to heat treatments at 50, 52 or 54 °C. Heat was applied as an individual fruit hot water dip for 20 seconds. Fruits were cooled and dried immediately after treatments, placed in storage rooms and kept in cold accordingly to recommended in Poland for each of cultivars conditions. Respective samples of non treated fruits and heat treated were subjected to quality evaluations at harvest, after storage and after simulated shelf life for 7 days at 20 °C. The main effect of heat treatment was the maintenance of fruit totally sound, free from the spoilage due to storage diseases, whereas non treated ones were affected mainly by Bitter rot (*Gloeosporium*), Gray mold (*Botrytis*) and Blue mold (*Penicillium*) respectively. As far as quality parameters are concerned treated fruit tend to retain higher flesh firmness than untreated ones. Flesh firmness benefit was more noticeable for fruit picked at optimum harvest date. Soluble solids contents were unaffected by heat treatments. Titratable acidity of heat treated fruits at 50 °C of 'Sampion' after simulated marketing period were greater than non treated apples and other treatments. Respiration data confirm, that 50 °C was the best heat treatment for mainaining fruit quality of 'Sampion' apples.

Keywords: hot water treatment, storage, storage diseases

## EFFECT OF MATURITY STAGE AND SHORT-TERM STORAGE ON BIOLOGICAL QUALITY OF PEPPER FRUITS

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Sweet pepper plants of Spartacus cultivar were grown in plastic tunnel on rockwool using the fertigation technique. The experiment was carried out in 2006-2008. Fruits were harvested in three maturity stages as green, turning and red ones. The contents of ascorbic acid, phenols, soluble sugars, nitrate and ammonium ions, total nitrogen, free amino acids and dry matter were determined in freshly harvested fruits as well as after short-term (two weeks) storage.

Red pepper fruits accumulated significantly more ascorbic acid, soluble sugars and phenols in comparison with the green and turning ones. The level of nitrate ions was highest in the green fruits and decreased during their ripening while ammonium ion concentration increased. The lowest content of amino acids was observed in green fruits.

Two week storage at 5-8°C, followed by two days at room temperature caused reduction of nitrate ions in green and red fruits. Ammonium ion content as well as phenol and soluble sugar level increased in stored fruits, irrespectively of their maturity stage. Ascorbic acid content increased in stored turning and red pepper fruits as related to its initial concentration. Dry matter content did not change after storage. Biological quality of harvested pepper fruits depended of their maturity stage, however, their response to short-term storage was similar.

## SENSORY CHARACTERISTIC OF SOME NEW PEAR CULTIVARS GROWN IN POLAND

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Although pears' growing in Poland has long tradition, the fruit consumption is not very common. The main reasons are relatively high price and problems with purchasing fruit of predictable and stable eating quality that could meet consumers' expectations. However, an interest in pear fruits has increased recently, mainly due to specific nutrition properties concerning with high potassium and dietary fiber contents, and much rare than apple allergenic reactions. These medical facts seem to create good opportunity to encourage consumers to higher pear consumption, especially that a lot of new attractive cultivars available within breeding programs can really satisfy gustative preferences even the most demanding consumers.

The aim of presented study was to prepare a sensory characteristic of some new pear cultivars grown in Poland taking into consideration the quality changes during ripening. Among summer cultivars 'Alfa' and 'Radana' were investigated while within late autumn ones 'Concorde', 'Dicolor', 'Hortensia', 'Nojabrska' and 'Uta'. 'Claps Favorite' and 'Conference' were used as controls. All cultivars were collected in experimental orchard of the Research Institute of Pomology and Floriculture (Skierniewice, Poland) in 2008 and stored at -0.5 °C in air or CA (0.7% CO<sub>2</sub> : 2% O<sub>2</sub>) for 10 to 20 weeks. After storage fruit of each cultivar were subjected to individual procedure of ripening at 18 °C that allowed obtaining sets of 5 samples of diversified quality attributes.

Based on instrumental analyses and descriptive sensory assessment the quality characteristic for investigated cultivars was prepared. All investigated cultivars ripened correctly and the fruit softened up. During that time most of cultivars significantly developed fruit aroma, the exception was 'Radana', 'Dicolor' and 'Uta'. Further, for majority of the cultivars the juiciness was increasing, nevertheless the summer cultivars and 'Uta' after CA hardly reached the medium level. Although in the case of standard cultivars the ripening process enhanced flavour, it was not obvious for the new ones, especially 'Radana' seemed not to be able to produce even medium flavour sensation.

As the attribute of overall quality may be considered as a predictor of consumer appreciation, it can be anticipated that 'Hortensia' and 'Nojabrska' has the biggest chance to fulfil the consumer expectations. Also 'Concorde' looks promising, especially as concerns keeping a decent quality during extended shelf-life. Majority of pear fruit were higher appreciated when getting fine. The only exception was 'Uta', however also in the case of 'Concorde' and 'Hortensia' texture does not seem to influence the sensory appreciation

## THE INTERFACE FEATURES OF THE PREDICTIVE DECISION SUPPORT SYSTEM "PEOPLE"

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The "People" is a Decision Support System created within the framework of European Integrated Project "ISAFRUIT", with the objective of simulating quality changes of apples and peaches along different supply chains, to meet the demands of consumers. The various scenarios describing supply chains from harvest until retail are designed by the "People" user, with technological parameters (such as duration and temperature) set according to individual needs. The user has to select the quality indices for which the simulation is required. The type of model used depends on available information on fruit status at harvest and at the moment selected as the simulation starting point (i.e. beginning of designed supply chain). Once development of the supply chain is finished and all input information provided, the user can generate graphs presenting quality changes along the whole supply chain (indicating every chain step), or create a report presenting status of fruit batch at the end of each supply stage. The report also contains the parameters of designed supply chain steps. Graphs and reports may be printed out or saved as files. The sequence of supply steps (with their technological parameters) can be saved for future use in the "People". Change of quality along different supply chains may be compared by simultaneous run of simulations for selected chains. Results may be presented as a series of adjacent graphs or in one report.

The final version of Decision Support System "People" will be available for free download from [www.people-dss.eu](http://www.people-dss.eu) or [www.people-dss.pl](http://www.people-dss.pl).

## EFFECT OF POSTHARVEST PROCESSING ON POLYAMINES IN WHITE HEAD CABBAGE

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The effect of spontaneous fermentation of white head cabbage and storage for 90 days of sauerkraut on polyamines including biogenic amines concentration was investigated. Lactic acid fermentation of white head cabbage of three cultivars, namely Agressor F<sub>1</sub>, Tolerator F<sub>1</sub> and Tekila F<sub>1</sub>, with different earliness, during harvest were studied. Biogenic amines such as spermidine, spermine, putrescine, cadaverine, histamine, tryptamine and tyramine were analyzed using the high performance liquid chromatography and benzoil derivatives. Fresh cabbage contained only putrescine – within range 0.73 g/g – 1.46 µg/g and spermidine 3.65 µg/g – 3.82 µg/g, depending on cultivar. Total content of polyamines in fresh cabbage was highest in cv. Agresor F<sub>1</sub>. After 10 days of fermentation also spermine, cadaverine, and tryptamine were found in sauerkraut. Among these polyamines cadaverine was characterized with highest content in fermented cabbage (5.0 µg/g for cv. Agressor F<sub>1</sub> and 17.0 µg/g for cv. Tolerator F<sub>1</sub>). Spermine occurred in sauerkraut only in first year of experiment. This polyamine was not found in fermented cabbage in the second year of experiment. After one and three months of storage only traces of putrescine were found in sauerkraut. Fermentation process and storage of sauerkraut affected the spermidine content in cv. Tolerator F<sub>1</sub> (increase by 40%) and in cv. Tekila F<sub>1</sub> (increase by 60%). Chromatographic analysis has shown presence of biogenic amines - histamine and tryptamine – in fermented cabbage after its long term storage. Histamine (below 0.6 µg/g) was found in two cultivars - Tekila F<sub>1</sub> i Tolerator F<sub>1</sub> in the first year of experiment. Histamine was not found in fermented cabbage in the second year of experiments. Highest content of total polyamines in stored sauerkraut was found in cv. Agressor F<sub>1</sub> and Tekila F<sub>1</sub>.

## THE INFLUENCE OF GROWING MEDIUM AND HARVEST TIME ON FRUITS QUALITY OF CHERRY TOMATO CULTIVARS

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The objective of this study was to examine some quality traits of tomato fruits, concerning chemical composition and sensory traits, in relation to growing medium kind and harvest time. Cherry tomato cultivars as 'Dasher'F1 with a red skin and 'Organza'F1 with yellow skin were grown in a greenhouse with controlled climate and drip fertilizing system, in the three different growing media. Environment friendly media – coconut fiber (manufacturer: Ceres Intern.) and wood fiber (Steico S.A.) were compared to rockwool (Grodan BV), commonly used as the standard horticultural medium. Fruits for quality evaluation were harvested at the full colored maturity stage in two different date of harvest: at the beginning of July and at the end of September. One part of fruit was examined for dry matter, nitrates (NO<sub>3</sub>), P, K and Ca content and the chemical quality attributes of tomato fruit, such as content of ascorbic acid, total soluble solids (TSS), titrable acidity (TA), pH and total sugars. Another part of tested fruit was sensory evaluated. For the evaluation of fruits the quantitative descriptive analysis (QDA) was used. Also overall sensory quality of the fruits, which is a complex rating of all sensory traits, was evaluated.

The tomato cultivar as well as the harvest time significantly influenced fruit quality. The highest fruit quality was obtained from red cherry 'Dasher'F1 cultivar during July harvest time. The sensory quality of tomato have not depended on growing media such as coconut fiber, wood fiber and rockwool. Coconut fiber, wood fiber and rockwool can be used as an alternative media for different soilless growing systems, without a significant change in the fruit quality of tomatoes.

## THE INFLUENCE OF GA<sub>3</sub>, BA SOLUTIONS AND CHRYSAL CLEAR ON THE POSTHARVEST LONGEVITY FOR FLORIST GREENS OF EUCALYPTUS TESTED SPECIES

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The research was carried out to investigate the influence of Chrysal Clear, GA<sub>3</sub> (mmol·dm<sup>-3</sup>) and BA (mmol·dm<sup>-3</sup>) concentrations on postharvest vase life of cut stalks with leaves of *Eucalyptus cinerea*, *E. 'Blue Boy'* and *E. parvifolia* cultivated for florist greens.

The stalks with leaves received the following treatments: dipping the whole stalks for 30 seconds in GA<sub>3</sub> solution (mmol·dm<sup>-3</sup>) and dipping for 30 seconds in BA solution (mmol·dm<sup>-3</sup>). After that, the stalks were put into distilled water. The stalks with leaves which were not treated by any of these compounds above, were put into distilled water as a control.

**The influence of these growth regulators on the stalks with leaves of tested species were treated, the postharvest longevity, the loss of their fresh weight, chlorophyll and carotenoids concentration was observed. The longevity was counted in days from harvest to the first symptoms of losing decorative value (at least 30 % of leaf blade is stained, curled, the leaf top is dry).**

*E. parvifolia* stalks with leaves (which were put into distilled water as a control) vase life was the longest – 21 days and stalks of *E. 'Blue Boy'* (18 days), the shortest one had the stalks of *E. cinerea* which were treated both BA and GA<sub>3</sub> solution. In this case Chrysal Clear prolonged by 3 days the longevity of tested stalks but it was not a significant one.

The smallest fresh weight losses were recorded in *E. parvifolia* stalks conditioning in distilled water as a control, on the another hand, the stalks of the same variety treated with BA solution in comparison to control showed the great loss of fresh weight.

The highest significant loss of chlorophyll concentration was observed in the leaves of *E. parvifolia* and the lowest one in the case of *E. 'Blue Boy'* and *E. cinerea* leaves.

Each one of tested preparations had an influence on the chlorophyll and carotenoids level of degradations in the *E. parvifolia* stalks with leaves in comparison to the control.

In the case of *E. cinerea*, only the BA solution had an positive, significant influence on tested attribute.

Keywords: florist greens, postharvest treatment, eucalyptus, growth regulators, chlorophyll



## EFFECT OF HARVEST TIME AND STORAGE CONDITIONS ON THE QUALITY OF BLUEBERRY FRUIT

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Phenolic compounds are the best known group of substances with antioxidant traits. Rich source of those compounds are berry fruits, especially of high-bush blueberry fruits which contain significant quantity of anthocyanins. Thus, the subject of the investigation comprised fruits of 'Bluecrop' cultivar picked in 2007 and 2008. Berries were picked on two dates: 1<sup>st</sup> - ripen for storage and 2<sup>nd</sup> - ripen for consumption and stored for 4 weeks in the common cold storage, at the temperature of 0 °C and in the controlled atmosphere (12:12). Immediately after harvest and every two weeks of storage the following determinations were made: total polyphenols, total anthocyanins, vitamin C content and the effectiveness of binding free radicals using the synthetic radical DPPH. Additionally on each date a qualitative and quantitative analysis was performed using the HPLC method. The aim of the present work was the assessment of the effect of the harvest date and fruit storage condition on the health generating traits and antioxidant activity of high-bush blueberry of 'Bluecrop' cultivar.

It is known that in shaping antioxidant traits an important role is played by anthocyanins. The content of anthocyanin compounds in fruit was the highest after 2 weeks of storage. The total anthocyanin content was significantly higher in berries stored under CA condition, as compared to those placed in common cold storage. 'Bluecrop' blueberries contain 14 anthocyanins: delphinidin-3-glucoside, delphinidin-3-galactoside, delphinidin-3-arabinoside, cyanidin-3-glucoside, cyanidin-3-galactoside, cyanidin-3-arabinoside, peonidin-3-glucoside, peonidin-3-galactoside, petunidin-3-glucoside, petunidin-3-galactoside, petunidin-3-arabinoside, malvidin-3-glucoside, malvidin-3-galactoside, and malvidin-3-arabinoside. Antioxidant activity, expressed as per cent of DPPH reduction changed during the storage of berries. The highest activity was characteristic for fruits after 2 weeks of storage. Here, it should be stressed that the gaseous composition of atmosphere does not cause any changes in the antioxidant activity.

The experiment was carried out within the COST 924 "Enhancement and Preservation of Quality and Health Promoting Components in Fresh Fruit and Vegetables" activity and partly founded by State Committee for Scientific Research, project Nr 580/E-177/SPB/COST/P-06/DWM 16/2005-2008.

## EFFECT OF PLANT GROWTH REGULATORS ON PREHARVEST DROP AND FRUIT QUALITY

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The effect of preharvest treatment with Pomonit Super 050SL (5% triethanolamine salt NAA) alone and in mixture with Agrostym 480 SL (ethephon) on 'Auksis' apple fruit abscission and quality was investigated. Trials were conducted on full bearing apple trees grafted on M.9 rootstock at the Institute of Horticulture in 2008-2009. Chemical treatments were applied one week before predictable optimum harvest date. Fruit drop was measured four times at weekly intervals and cumulative preharvest drop was assessed by summing the number of fruits shed at each harvest date. The fruit weight, blush colour, flesh firmness, soluble solids, starch pattern index and Streif index were monitored along investigation period. It was found that Pomonit Super reduced fruit drop by 67 % in comparison with untreated control. The effectiveness of Pomonit Super applied in mixture with Agrostym 480 SL on fruit drop control was lower. Nevertheless fruits in this treatment had more intensive blush, but significantly lower fruit firmness and starch content. Mixture of Pomonit Super and Agrostym 480 SL determined more intensive fruit ripening processes.

## THE INFLUENCE OF PRODUCTION SYSTEM (ORGANIC AND INTEGRATED) AND ORCHARD LOCATION ON QUALITY OF 'TOPAZ' APPLES

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The aim of the experiment was to compare the quality parameters of 'Topaz' apples grown under organic or integrated conditions. Eleven orchards in various region of Poland were chosen for the experiment. Three of them are organic farming. At harvest following quality parameters were measured: fruit weight, percentage of blush, background and skin colour, firmness (FF), total soluble solids content (TSS), titratable acidity (TA), ascorbic acid and polyphenols content. As a maturity indicators internal ethylene concentrations, starch index and Streif index were used.

Regardless of orchard location fruits from organic orchards were bigger than from integrated production. The others quality parameters seems to be not close related to production system and ripening stage, but depend on orchard location. The percentage of blush varied from 40% to 90%, TSS from 11.5% to 14.8%, and TA from 1.29% to 0.76%.

The health promoting components content (ascorbic acid and phenolic compounds) content was strongly depended on production system. Ascorbic acid content varied from 9.6 up to 19.9 mg/100g with the average on 13.3 mg/100g. Total phenolic compounds content determined by Folin - Ciocalteu spectrophotometric method was from 80.2 to 110 mg/100g. However no correlation was found comparing both measured parameters.

The work has been supported by a grant from the EU Regional Development Fund through the Polish Innovation Economy Operational Program, contract N. UDA-POIG.01.03.01-10-109/08-00

## THE QUALITY OF 'DEBRECENI BÖTERMÖ' CHERRIES GROWN UNDER ORGANIC OR INTEGRATED CONDITIONS

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Sour cherries are the stone fruits that are typically picked once at the peak maturity when have optimal taste and color. However, the sour cherries may be stored for up to a few days in cold room to extend supply; storage could affect the quality and fruit composition. Other important issue is the effect of agricultural practices on fruit quality. Information about the changes in the chemical composition of cherries during maturity and postharvest storage is limited.

Sour cherries cv. 'Debreceni Bötermö' were harvested from two orchards with different cultivation techniques. Fruits obtained from Experimental Orchard at Dąbrowice were grown according to integrated fruit production system (IFP); on the contrary orchard at Nowy Dwór was organically managed. Fruit were picked twice in July 2009. After harvest and after 4 days of cold storage (at 4.5°C) fruit colour, total soluble solids content (TSS), titratable acidity (TA), dry matter (DM), total anthocyanins, total phenolics, simple sugars (glucose and fructose) and sorbitol content were determined.

In general the higher TSS and TA were observed for fruits from organic orchard compared to IFP, 13,2% and 1,27% versus 12,8% and 1,22% respectively. Regardless of the cultivation system, harvest date and time of analyses the predominant simple sugar in sour cherries fruit was glucose - no saccharose was detected in sour cherries. During fruit storage the anthocyanins and phenolics increased (except fruits from the first harvest in Dąbrowice). Fruits from the second harvest always were characterized by a lower dry matter than fruits from the first harvest. Regardless of harvest date fruits from organic orchard had higher polyphenols content than those from integrated production, 396 mg·100g<sup>-1</sup> and 357 mg·100g<sup>-1</sup> respectively.

The work has been supported by a grant from the EU Regional Development Fund through the Polish Innovation Economy Operational Program, contract N. UDA-POIG.01.03.01-10-109/08-00.

## CONTENT OF CALCIUM, NITRATES AND PESTICIDES RESIDUES IN APPLES AND SOUR CHERRIES GROWN IN ORGANIC AND INTEGRATED FRUIT PRODUCTION ORCHARDS

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The aim of the experiment was to compare the content of calcium, nitrate and pesticides residue in 'Topaz' apples and 'Debreceni Bötermö' sour cherries. Apples were harvested in eleven orchards in various region in Poland. Three orchards were organic and eight integrated fruit production system (IFP) managed. Sour cherries were harvested twice in two orchards (organic and IFP).

Pesticides residues in fruits were analyzed according QuEChERS method using gas chromatography with mass detector (GC/MS) and liquid chromatography tandem mass spectrometry (LC/MS-MS) for 170 pesticides. Allowable quantities of Captan, Propargit Pirimikarb and Triadimentol were found in IFP apples, but in two orchards managed IFP pesticides were not detected. Apples from organic production were free from the residues. Sour cherries harvested in organic orchard were free from residues but from IFP orchard only the residues of Pirimicarb were found. The pesticide residues in all tested fruits were below Maximum Residue Level (MRL).

Cherries harvested in organic orchard characterized by lower calcium content compare to fruits from IFP system. Calcium content in apples varied from 0.018 % dm to 0.051 % dm. There was no clear correlation between system of production and calcium content. Calcium uptake in fruits depends on orchard location.

Nitrates content in sour cherries at first harvest was higher in IFP orchard than organic, 7.6 mg\*kg<sup>-1</sup> and 6.4 mg\*kg<sup>-1</sup> respectively and decreased with delay of harvest. In apples level of nitrates was very low, in general below limit of detection (1 mg\*kg<sup>-1</sup>).

The work has been supported by a grant from the EU Regional Development Fund through the Polish Innovation Economy Operational Program, contract N. UDA-POIG.01.03.01-10-109/08-00

## ANTIOXIDANTS OF AMARANTH

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Amaranth is one of the perspective and multifunctional crops, which has great potential for combating malnutrition.

In the present study, we investigated the content such antioxidant as ascorbic acid and carotenoids in the green coloured leaves of *Amaranthus hypochondriacus* L., cv. Krepish and in the red coloured leaves of *A. tricolor* L., cv. Valentina during ontogenesis.

It was found that accumulation of ascorbic acid and carotenoids in the leaves of amaranth depends on genotype and stage of plant development. During the vegetative stage in the leaves of cv. Valentina, the content of ascorbic acid and carotenoids was 44 mg% and 0.65 mg/g, respectively. It was higher than in the leaves of cv. Krepish (ascorbic acid – 30 mg%, carotenoids – 0.62 mg/g). During the flowering stage, the accumulation of carotenoids decreased in the leaves of amaranth and was almost equal in cv. Valentina and cv. Krepish (0.53 mg/g and 0.55 mg/g, respectively). The content of ascorbic acid in the leaves of amaranth increased at the flowering stage. The leaves of cv. Valentina accumulated ascorbic acid more than cv. Krepish (70.4 mg% and 65 mg%, respectively).

These findings should be considered upon the processing of green row material of amaranth for production of biologically active additives.

## THE CHANGES OF FIRMNESS AND CHEMICAL COMPOSITION OF HIGHBUSH BLUEBERRY FRUITS DURING STORAGE

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The experiment was carried out in Department of Pomology Agricultural University in Szczecin in 2008-2009.

The aim of the experiment it was to determine firmness, chemical composition, and fruit weight-loss depending on fruit shock-cooling after the harvest and storage method applied for highbush blueberry. Both the shock-cooled berries (temperature drop to 2-3 °C within 1-3 hours after picking) and not shock-cooled berries were then stored in a cold room with a control atmosphere (Palliflex system), or in a normal atmosphere, or in a simulated "shelf-life" conditions.

The measurements of fruit firmness were done directly after the harvest. The berries cooled rapidly after the harvest had 25% higher firmness than fruits not shock-cooled.

The lowest changes in polyphenol, vitamin C, and organic acid content were found for shock-cooled berries stored in a Palliflex system and in a normal atmosphere.

Fresh berries showed 246 mg 100 g<sup>-1</sup> polyphenol content, whereas shock-cooled and stored in a control atmosphere 231mg 100 g<sup>-1</sup>, and shock-cooled and stored in a normal atmosphere 198 mg 100 g<sup>-1</sup>. The fruits of best quality were obtained after storage in a control atmosphere prior to shock-cooling. They were the firmest, showed the smallest weight-losses, and minor changes in chemical composition. The biggest losses of polyphenol and vitamin C content were found for fruits stored in "shelf-life" conditions.

Keywords: storage, fruits rapid cooling, Palliflex system, firmness, chemical composition, phenolics, vitamin C

## THE INFLUENCE OF NEW PRE-HARVEST PROTECTANTS ON CARROT LONG TERM STORAGE

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The aim of the scope were diseases development limitation, occurring in long term storage carrot roots. Investigations over new pre-harvest protectants and their influences on storage life and roots quality, was conducted in years 2007-2009 at Research Institute of Vegetable Crops in Skierniewice.

The following active substances were examined: AEC 656948+tebuconazol 400 SC, trifloxystrobin, piraclostrobin+boscalid, azoxystrobin, azoxystrobin+clorothalonil, melaleuca oil and grapefruit extract.

Products were applied preventative and curative. Three to five days before harvest and storage were the limitation term of curative spraying. Carrot roots were kept in boxes lined with polyethylene film at temperature 0°C and relative humidity 95-98% in cold room. The experiments were randomized blocks with four replications, each 10 kilograms.

The valuation of efficacy of examined products on carrot roots was conducted after storage time. The symptoms of *Sclerotinia sclerotiorum* and *Botrytis cinerea* growth was evaluated by using a 0-7 rating scale: 0 – no disease symptoms, 4–30% diseased root, 7 – all roots covered with pathogens. Afterwards the marketable roots and weight losses were estimated.

In year 2008 the best efficacy against grey mould showed products including trifloxystrobin (100% efficacy), piraclostrobin+boscalid and melaleuca oil (82% efficacy), AEC656948+tebukonazol and grapefruit extract (73% efficacy), but there were not significant differences. The percentage of marketable roots was from 93,3 to 98,7.

In year 2009 efficacy against white mould was above 80%. There was no significant differences in efficacy and marketable roots.

All new pre-harvest protectants on carrot long term storage were found to be sufficient to satisfactory in control of white mould (*Sclerotinia sclerotiorum*) and grey mould (*Botrytis cinera*). Obtained results showed that pre-harvest protection influences positive on quality and quantity of storage carrot roots.



## THE INFLUENCE OF HOT WATER TREATMENT ON STRUCTURE OF APPLE-FRUIT TISSUES

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The postharvest apple treatment using hot water could be effective in reduction of losses caused by storage diseases. The hot water treatment can also modify fruit ripening and quality. The temperature of water is usually between 48 and 54 °C. Typically apples are dipped in hot water for a second to a few minutes (depending on temperature and cultivar). It warms the fruit surface, in fact several cell layers below. Unfortunately, the treatment sometimes causes fruit damage, mainly visible as skin discoloration.

The aim of the study (carried out within the ISAFRUIT Project) was to analyze the structure of apple fruits (untreated and treated with hot water). 'Golden Delicious', 'Topaz' and 'Shampion' apples were treated with hot water at 52 °C for 2 minutes.

The reaction of apple-fruit tissues on treatment was examined using stereoscopic microscope. On chosen fragments of materials the histological study was done using light microscope with polarization and pictures were taken using digital camera. The structure of epidermis and parenchyma tissue apple - fruits was also analyzed with scanning electron microscope. Anatomical preparations were made using paraffin method. Fragments of apple-fruits (epidermis with parenchyma of mezocarp) were fixed in CrAF (chromic acid, acetic acid, formalin), dehydrated in ethanol and prepared for light microscope (LM) and scanning electron microscope (SEM) analysis. First part of prepared fragments was next embeded in paraffin, cut and stained with safranin and fast green for LM investigation. Next part of apple fragments was desiccated with Critical Point Drying CO<sub>2</sub> and sputter - coated with gold and next examined with the scanning electron microscope in the Laboratory of Electron Microscopic in Nencki Institute of Experimental Biology in Warsaw.

In the year 2009 at the Wrocław Technology Park (<http://www.technologypark.pl>) in the Diagnostic Laboratory for Physical, Mechanical and Electrical Properties the distribution of temperature within hot water treated fruits was assessed using hand-held thermal imaging camera. The fruits of 'Golden Delicious' were treated with hot water (48 °C, 50 °C, 52 °C and 54 °C) for 1, 2 and 3 minutes. Results obtained are discussed in reference to treatment conditions and cultivars used.

The ISAFRUIT project is funded by the European Commission under the Thematic Priority 5–Food Quality and Safety of the 6th Framework Programme of RTD (Contract no. FP6-FOOD–CT-2006-016279).

## IS IT POSSIBLE TO EXTEND STORAGE LIFE OF RASPBERRY FRUIT

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Usually raspberry fruit is considered as one of the extremely perishable commodities due to the nature of fruit and a very high respiration rate. Suggested safe period of storage, handling and transportation is only 4-5 days. With a special containers we may keep raspberry fruit harvested in a regular commercial technique (small 250 g punnets) in low temperature chambers for up to one month. The main benefit is the maintenance of fruit totally sound, free from the spoilage, the result of the development of common soft fruit disease Gray mold (*Botrytis*). Fruit features of raspberry fruits were evaluated by soluble solids content, titratable acidity and ascorbic acid content at harvest and during consecutive time after storage. All measured features were subjected to the very low decline only if any at all may be observed.

Keywords: fruit quality, soluble solids, ascorbic acid

## SUMMARY OF SOME EXPERIMENTS WITH THE APPLICATION OF 1-MCP

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'Jonagold' and 'Šampion' apples harvested at optimum maturity for long term storage, were exposed to  $0.6 \mu\text{l l}^{-1}$  of 1-MCP at  $3^\circ\text{C}$  for 24 h and than stored in regular air at  $0-1^\circ\text{C}$ . Treated and untreated fruits were analyzed after 180, and 240 days plus after additional 7 days at  $20^\circ\text{C}$ . Fruit treated with 1-MCP had benefit by 10-20 N in flesh firmness after storage and also after additional 7 days at  $20^\circ\text{C}$ . 1-MCP application greatly inhibited ethylene production. Despite the cultivar radical scavenging activity of treated apples was lower than in control fruits. Organic acid content as expressed by titratable acidity (TA) in 'Sampion' apple was not affected by 1-MCP in a first year of study but 'Jonagold' fruits following treatment were having higher TA. During next two seasons TA for treated apples was always higher for both cultivars. 1-MCP treated fruit of both cultivars had higher soluble solids content only in the first season. The results indicate that 1-MCP applied at the beginning of storage greatly affects maturity related processes but its efficacy is in general cultivar's and year's dependent.

Key words: fruit quality, radical scavenging activity, ethylene production

## INFLUENCE OF FUNGICIDE TREATMENT ON GREY MOULD OF CABBAGE

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The major cause of postharvest decay in cabbages is the grey mold fungus *Botrytis cinerea*. One of the measures to reduce losses, which cause the grey mould, is using pre-harvest fungicides. The aim of this investigation was to establish the influence of fungicides applications to control grey mould in cabbages cultivars Kingston F<sub>1</sub>, Lennox F<sub>1</sub> and Paradox F<sub>1</sub> during storage. The experiments were carried out in the Institute of Horticulture in 2008–2009. **The study was supported by the Lithuanian State Science and Studies Foundation.** Tested cabbages cultivars are characterized by a good keeping ability and were grown under intensive cultivation technologies accepted at Institute of Horticulture. Three fungicide applications with Amistar 250 SC (azoxystrobin) 0.8 l ha<sup>-1</sup>, Signum 334 WG (boscalid, pyraclostrobin) 1.0 kg ha<sup>-1</sup>, Folicur 250 EW (tebuconazole) 1.0 l ha<sup>-1</sup>, Rovral Aqua Flo (iprodione) 1.0 l ha<sup>-1</sup> and Fluopyram + Tebuconazole 400 SC 1.0 l ha<sup>-1</sup> were made on second part of plant vegetation (growth stage by BBCH 41-46), the last spray was conducted not later than 21 days up to the harvesting. Cabbage heads (20 units from every replication) were kept in a controlled atmosphere chamber for four months after harvest. Lesions of grey mould were assessed every month. Obtained data showed that fungicide treatments allow for reducing the incidence of grey mould and reduced losses during the four-month storage period average up to 56.2–85.9%.

## ANTIOXIDANT PROPERTIES OF VARIOUS PEPPER CULTIVARS

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Pepper is an excellent source of natural antioxidants, containing many different antioxidant components which provide protection against harmful free radicals.

The aim of study was the effect of influence of storage conditions on the antioxidant activity of pepper fruits. Material of experiments were fruits of six pepper cultivars in the stage of consumption ripeness: Applause F<sub>1</sub> (white), Sunny F<sub>1</sub> (yellow), Magno F<sub>1</sub> (orange), Yecla F<sub>1</sub> (red), Tequila F<sub>1</sub> (violet), Brownie F<sub>1</sub> (brown). Fruits of pepper were stored at temperature: 2-3 °C, 7-8 °C and 18-20 °C for 7 and 14 days. Phenolics, ascorbic acid, flavonoids, total carotenoids, antioxidant activity and visual quality were determined in fresh and stored pepper. Two different methods were selected for evaluation of the antioxidant activity: β-carotene/linoleic acid assay and free radical scavenging assay.

Phenolics, flavonoids, ascorbic acid and carotenoids contents varied in different colored bell peppers. Red and brownie peppers had higher level of phenolics than the others.

Antioxidant activity AOA (%) of red pepper (measured by coupled oxidation β-carotene and linoleic acid) was highest and increased after 7 and 14 days of storage. Values of antioxidant activity (AOA) of peppers changed depending on cultivar and time of storage. In the phenolic extracts fruits of red, yellow and orange peppers showed a higher level of DPPH radical scavenging activity compared to the others. DPPH radical scavenging activity was highest in temperature 8°C and increased after 7 and 14 days of storage.

THE EFFECT OF PLANT AGE AND CARBONATE FOLIAR FERTILIZATION ON YIELD AND QUALITY OF 'POLKA'  
STRAWBERRIES

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The experiment was carried out with 'Polka' strawberries (*Fragaria x ananassa* Duch.) in 2007 and 2008 at the Rõhu Research Center of the Estonian University of Life Sciences (58°21' N, 26°31' E). Experimental factors were plant age (second and third year after planting) and foliar fertilization with Lithovit (79.19% CaCO<sub>3</sub>). Fertilizer was used as 0.5% solution at the rate of 2 kg per hectare three times during summer: at the beginning of flowering, at full bloom and ten days after full bloom. Total yield and the amount of spoiled fruits, fruit ascorbic acid content (AAC), soluble solids content (SSC), titratable acidity (TA), anthocyanins (ACY) and total antioxidant capacity (TAC) were recorded.

The results indicated that plant age affected yield and fruit composition much more than the treatment with Lithovit. The mean effect of foliar fertilization on total yield was not significant in either of years. Contrarily what was expected, treatment with Lithovit increased the amount of spoiled fruits in both years.

In 2007 foliar fertilization did not affect SSC, TA, AAC and TAC of strawberries and decreased ACY content. In 2008 treatment did not affect fruit SSC, AAC, ACY content and TAC, but increased TA and decreased SSC/TA.

In 2007 plant age did not affect fruit size, fruits from three years old plants had higher SSC, TA and SSC/TA, also AAC, but contained less anthocyanins.

In 2008 plant age did not affect ACY content and TAC. Three years old plants had smaller fruits and less spoiled fruits, fruits contained less soluble solids and more titratable acids and ascorbic acid.

PHENOLIC COMPOUNDS IN PLUMS (*PRUNUS DOMESTICA* L.)  
GROWN IN NORWAY

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Due to positive health effects, the consumption of fruits and vegetables ought to increase in Norway. The content of coloured anthocyanins and other phenolic compounds with antioxidative effect are believed to be important in this matter. Hence the contents of these compounds are regarded as an important quality factor.

Commercially grown European plum cultivars (*Prunus domestica* L.) show a large variation in colour, fruitsize and other important fruit quality factors. Six important cultivars in Norway differed also in phenolic content.

Cultivars with dark blue fruits (cv. Jubileum and Valor) had high contents of anthocyanins. Cyanidin 3-rutinoside accounted for more than 60% of the total anthocyanins. Phenolic acids, in particular neochlorogenic acid, were found to be the most important phenolic compounds in all cultivars. It ranged from 153 mg 100<sup>-1</sup> g FW in cv. Valor to 23 mg in cv. Reeves. The antioxidative effect measured was closely related to total content of phenolic and less closely related to content of anthocyanins. Even though cv. Victoria has fruits with red blush colour, the antioxidative effect of plums of this cultivar was as high as the antioxidative effect in cv. Jubileum and Valor.

Different fertilization strategies may affect the content of phenolics in the plums, and during storage a decrease was observed. However, changes due to orchard management and storage were small compared to the cultivar differences.

## CONTENT OF CERTAIN FOOD COMPONENTS IN FLESH AND SEED OF THE CORNELIAN CHERRY FRUIT (*CORNUS MAS L.*)

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The purpose of the research was to determine the content of soluble solids, water, L-ascorbic acid and colour components ( $L^*$ ,  $a^*$ ,  $b^*$ ) in fruits of ten different clones of the Cornelian cherry fruit (*Cornus mas L.*) In seeds the fatty acid composition, the content of total fat, the content of ash and minerals were determined. Fruits of ten different clones of Cornelian cherry contained from 10.70 to 19.30% of soluble solids. The content of the L-ascorbic acid ranged between 29.29 and 86.40 mg/100 g. The values of the colour  $L^*$  parameter for individual clones were between 21.51 and 27.85, the values of parameter  $a^*$  between 8.64 and 26.22 and values of parameter  $b^*$  between 2.15 and 11.90. Speaking in terms of statistics, the clone significantly affects the content of soluble solids, L-ascorbic acid and colour parameters. In 100 g of seeds there was between 5.82 and 6.73 g of water and between 0.84 and 1.51 g of ash. The content of fat in 100 g of dry seeds ranged between 4.45 and 7.94 g. Again the content of water and total fat was statistically significantly dependent on the clone. Regarding fatty acid composition following fatty acids were found: from 64.78 to 72.21 % of linoleic acid, from 15.50 to 22.97 % of oleic acid, from 7.31 to 8.11 % of palmitic acid, from 2.02 % to 2.99 % stearic acid, from 1.47 to 1.62% linolenic acid and from 0.27 to 1.52 of arachidic acid. The clone does not affect the content of essential linolenic acid, but has a statistically significant influence on the content of other fatty acids. In 100 g of seeds of different clones following minerals were found: calcium between 385,79 and 432, 91 mg, potassium between 243.09 and 327.04 mg, phosphorus between 152.01 and 261.48 mg, magnesium between 39.38 and 56.68 mg, sodium between 13.22 and 19.40 and copper between 0.39 and 0.81 mg.

Keywords: (*Cornus mas L.*), clones, soluble solids, ascorbic acid, fatty acids, minerals



## USE OF MODIFIED ATMOSPHERE TO PREVENT THE OXIDATION OF GROUND WALNUT

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The purpose of the study was to determine the impact of the atmosphere composition on oxidation of ground walnut during storing. Seven varieties of walnut (*Juglans regia* L.) were grounded and stored in the O<sub>2</sub> or N<sub>2</sub> atmosphere in hermetically closed vials for 10 months at room temperature. Antioxidative potential, the content of total phenols, fatty acid composition and oxidation degradation products were determined at the beginning and after 10 months of storage. Variety, atmosphere and interaction variety x atmosphere significantly influenced antioxidative potential. The ratio of unsaturated fatty acids (linolic, linolenic) decreased after storage. The O<sub>2</sub> atmosphere provoked an increase the synthesis of oxidation degradation products. Regarding degradation products the concentration of hexanal, 1-octen-3-ol, octanal, 2-octenal and 1-octen-3-ol increased in walnut stored in O<sub>2</sub> atmosphere.

Keywords: walnut, fatty acids, antioxidative potential, oxidation degradation products

## CHANGES OF APPLE FRUIT QUALITY IN CONTROLLED ATMOSPHERE

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Water evaporation, consistence, change colouring from biophysical process are important in the fruit storage. Modelling various modify content of atmosphere, fruits of cv. 'Štaris', 'Auksis', 'Cortland' and 'Spartan' were stored at  $+1\pm 1^{\circ}\text{C}$  and relative humidity was 90-95%. Apple fruits were tested at the Institute of Horticulture in the laboratory of Biochemistry and Technology. Fruits texture and colour parameters  $L^*$ ,  $a^*$ ,  $b^*$ ,  $h^{\circ}$  and  $C$  were measured before storage and after 8 storage month. Soluble solids, respiration rate, sugar and amount of ascorbic acid were performed by standard methods. It was determined that fruit skin firmness of cv. 'Spartan' was the highest ( $355.4 \text{ N/cm}^2$ ). On the other hand most thin skin was observed on fruits of cv. 'Auksis' ( $215.8 \text{ N/cm}^2$ ). Fruit firmness change slightly when increasing carbon dioxide concentration at a controlled atmosphere. The same tendency was found then flesh firmness was at 2% and 4% of carbon dioxide. The amount of soluble solids and sugar in fruits at 4% of carbon dioxide was stable. The obtained results showed that ascorbic acid losses at 2% and 4% of carbon dioxide content was respectively 18% and 10.5% in controlled atmosphere. Fruit colouring properties had more influence for colour coordinates  $a^*$  and  $b^*$  value.

## EFFECT OF STORAGE TEMPERATURE ON FRUIT QUALITY OF SOME WINTER PEAR CULTIVARS

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In pears, storage life and quality retention depend principally on the cultivar and storage condition. One of the most important factor during the storage of pears is temperature. The aim of this study was to evaluate the effect of storage temperature on some quality parameters of winter pears.

Three cultivars were chosen for the experiment: 'Amfora', 'David', and 'Uta'. Trials were conducted for three storage seasons: 2005/2006, 2006/2007, and 2008/2009. Pears were obtained from the experimental orchard of the Research Institute of Pomology and Floriculture, located near Skierniewice. After harvest fruits were stored for 4 months at -0.5°C or +2.5°C in normal atmosphere conditions. On removal from storage the fruits were placed for 4 days at 18°C to simulate shelf life. Flesh firmness, total soluble solids, and titratable acidity were recorded at harvest, after storage and after shelf life. The colour parameters of the fruit skin ( $L^*$ ,  $a^*$ ,  $b^*$ ) were also determined.

The results showed a significant influence of the temperature on postharvest fruit quality of all evaluated cultivars. Pears stored four months at -0.5°C were firmer than those kept at +2.5°C. The great difference in skin colour was also observed.

**Keywords:** acidity, cold storage, flesh firmness, skin colour, soluble solids

## INSTRUMENTAL EVALUATION OF APPLE TEXTURE WITH CAED

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Texture attributes like crispness, crunchiness, hardness, juiciness and mealiness are important for fruit and vegetables because consumers associate them with freshness and wholesomeness. Most of these attributes are related to tissue fracturing and sound. Sensory analysis is usually used for texture evaluation although a great deal of effort has been expended in the use and development of instrumental techniques for the meaningful estimation of texture attributes.

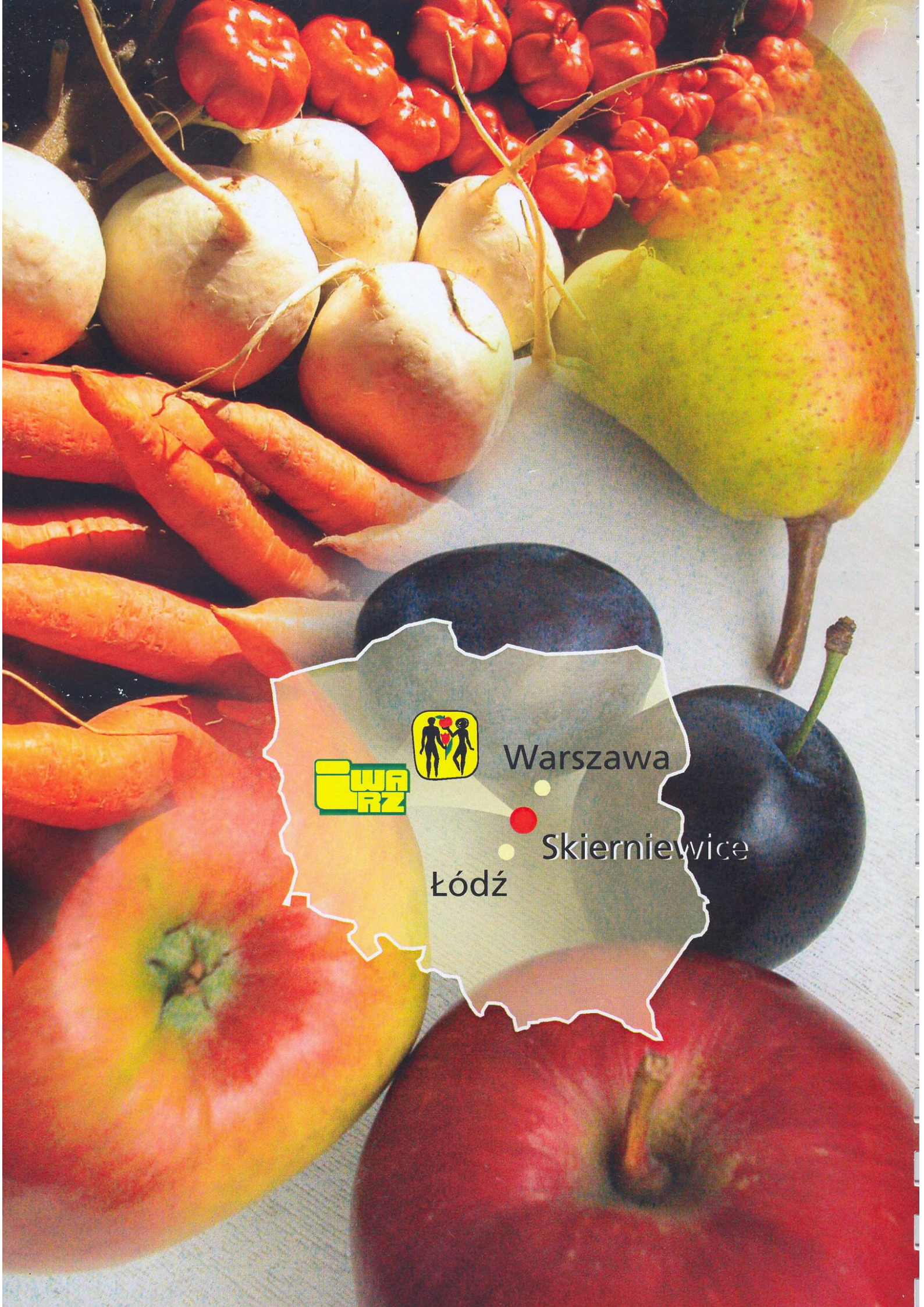
The goal of this research was to determine the relations between instrumental parameters and sensory texture attributes, and to develop calibration models for instrumental evaluation of the sensory texture of apples performed with using a new device – contact acoustic emission detector (CAED).

The apple cultivars 'Szampion', 'Idared', 'Topaz', 'Elstar', 'Gloster', 'Ligol' and 'Golden Delicious' were stored under a variety of conditions: NA, CA, and 1-methylcyclopropene (1-MCP) postharvest treatment (625 ppb) and then CA storage followed by shelf life in order to obtain variable texture. Apples were subjected to measurement with CAED and then immediately subjected to sensory evaluation. The CAED punctured the fruit at the equator whereas two quarters from the part of the fruit which was not punctured were provided to panelists.

It was shown that CAED is particularly useful for instrumental evaluation of crispness, crunchiness and hardness. Total AE counts can be used for the estimation of overall texture. There is also some potential to predict juiciness and mealiness, although determination coefficients of the calibration models for these sensory attributes are not satisfactory. As expected, CAED is not useful for the evaluation of taste attributes. Hence, CAED allows instrumental prediction of apples texture attributes and can be used instead of sensory panel.

### Aknowledgements

The work was carried out within the framework of NR 12 0031 04 project. The authors thank the members of the sensory panel from the Institute of Agrophysics PAS, Lublin, Poland



WARZ

Warszawa

Skierniewice

Łódź