

patients groups that was significantly higher on the 6th day compared to the controls. The induction time of ROS production was longer in the Omegaven group during the examination period than in the control group, and it was significantly longer on the 5th day compared to the Intralipid group. We detected higher catalase activity in Omegaven and in Intralipid group as well, but this activity was significantly lower on the second day in the Omegaven group versus Intralipid group. GSH and PSH levels weren't influenced by the treatment of omega-3 fatty acids.

These data suggest, that polytraumatic injury causes considerable oxidative stress, on which omega-3 fatty acid supplementation has only a moderate effect.

The study was supported by OTKA K060227.

## **In vitro toxicity testing of PPI dendrimers**

A Rucinska<sup>1</sup>, K Maczynska<sup>1</sup>, S Rozalska<sup>2</sup>, D Appelhans<sup>3</sup>, B Voit<sup>3</sup>, B Klajnert<sup>1</sup>, M Bryszewska<sup>1</sup>, T Gabryelak<sup>1</sup>

<sup>1</sup>Department of General Biophysics, University of Lodz, Lodz, Poland, <sup>2</sup>Department of Industrial Microbiology and Biotechnology, University of Lodz, Lodz, Poland, <sup>3</sup>Leibniz Institute of Polymer Research Dresden, Dresden, Germany

Dendrimers are a new type of promising synthetic polymers characterized by a dendric branched spherical shape and a high density surface charge. The defined structure of these molecules has led to the interest in dendrimers as substrates for the attachment of antibodies or agents for applications in a number of different areas of biology and medicine. However, information on the mechanisms of dendrimer-induced cytotoxicity and a cell death is still limited. Therefore, it is necessary to undertake studies to determine biological properties of these compounds *in vitro*.

Thus, the aim of our investigation was to compare the effects of poly(propyleneimine) (PPI) dendrimers (PPI with 25% maltotriose units attached to the surface) on cultured human ovarian cancer cells (SK-OV-3) and Chinese hamster ovary cells (CHO). The cells were exposed to various concentrations of dendrimers (ranging from 1 to 300  $\mu\text{M}$ ). The toxicity of PPI dendrimers was studied immediately after the incubation with dendrimer (24 h) or 24 h after removing the dendrimer from the medium.

The cytotoxicity of dendrimers was studied by a MTT assay. The morphological features of apoptosis and necrosis were examined by Nomarski DIC combined with a confocal laser scanning microscope (CLSM). The level of reactive oxygen species (ROS) was evaluated with fluorescent probe: dichlorofluorescein-diacetate ( $\text{H}_2\text{DCFDA}$ ) by flow cytometry. Changes in mitochondrial membrane potential were determined using JC-1.

Our studies demonstrated that PPI dendrimers exerted multiple suppressive effects on cancer SK-OV-3 cells, including proliferation inhibition, induction of an apoptotic cell death and a collapse of mitochondrial membrane potential. Most importantly, these compounds were more cytotoxic to cancer cells than to normal CHO cells.

These findings will help to understand the mechanisms of PPI dendrimer cytotoxicity in normal and tumor cells and open the possibility to use them in clinical applications.

Project "Biological properties and biomedical applications of dendrimers" operated within the Foundation for Polish Science Team Programme co-financed by the EU European Regional Development Fund.

## **Bioactive compounds in *Alliums* from Vojvodina - antioxidants**

D Štajner<sup>1</sup>, B. M. Popovic<sup>1</sup>

<sup>1</sup>Faculty of Agriculture, University of Novi Sad, Novi Sad, Serbia

Toughout recorded history *Alliums* especially garlic and onion played rich diverse commercial, culinary, and mystic roles. Today garlic and onion are used for their flavour, aroma and taste, being prepared domestically or forming basic materials for a variety of food manufacturing processes. Onions were among the earliest vegetables to be processed, canned, dried and frozen. Many epidemiological studies have suggested that certain natural foods could prevent the development of different diseases. Garlic and onion are such natural foods. They have a variety of pharmacological effects including tumour cell growth inhibition and chemopreventive activity. Much of the data about human use came from reports of lowered rates and risks of disease (such as cancer) in people with relatively high levels of garlic or other *Alliums* consumption. People also use garlic

and onion to help with several different types of ailments, high cholesterol, high blood pressure, excess blood clotting and coagulation, atherosclerosis, inflammation, bacterial and fungal infections. Garlic is also functional food product composed of numerous macronutrients, vitamins, organosulfur active compounds.

The aim of our study was to investigate different cultivated (*Allium nutans* L., *A. fistulosum* L., *A. vineale* L., *A. pskemense* B. Fedtsch, *A. cepa* L. and *A. sativum* L.) and wild (*A. flavum* L., *A. sphaerocephalum* L., *A. atroviolaceum* Boiss, *A. schoenoprasum* L., *A. vineale* L., *A. ursinum* L., *A. scorodoprasum* L., *A. roseum* L. and *A. subhirsutum* L.), *Allium* species, in order to evaluate their antioxidant properties.

All the antioxidant enzyme activities were determined spectrophotometrically at 25°C using phosphate buffer (pH 7) plant extracts. The amount of reduced glutathione (GSH) was determined with Ellman reagent, lipid peroxidation (LP) was determined by the thiobarbituric acid (TBA) method. Hydroxyl radical (OH) was determined by the inhibition of deoxyribose degradation, total flavonoids were estimated according to Marckam and soluble protein content was determined by the method of Bradford. Radical scavenging capacity was determined using 1, 1-diphenyl-2-picryl-hydrazil radical (DPPH) and ESR. Reduction of DPPH radical was determined measuring disappearance of DPPH. Total antioxidant capacity was estimated according to the FRAP. Lipofuscin pigments (LFS), were determined fluorimetrically.

Our results are one more confirmation that antioxidant and scavenger activities influence the pharmacological activity of garlic and other *Alliums*. In leaves of *Allium fistulosum* L., LFS accumulation was also not observed. As LFS is generated as a product of tissue decay, caused by toxic oxygen species it means it has a high antioxidant capacity. The scavenger activity of *Allium fistulosum* L. was also high; in its presence, generation of the OH radical (the most toxic oxygen species) was reduced by 87.09%. Other results concerning *Allium fistulosum* L. support this assessment because the activities of all antioxidant enzymes SOD, CAT, GPX, and GP were high, concentrations of O<sub>2</sub><sup>-</sup>, OH and MDA were low, and the quantity of GSH, flavonoids, vitamin C and soluble proteins were high, as was the carotenoids content.

Presented results indicated that crude extract of *Alliums* from Vojvodina exhibited antioxidant and scavenger abilities in all investigated plant parts especially in leaves. Therefore overground part of *Alliums* could be used as the source of natural antioxidants in the pharmaceutical, cosmetic and food industries for manufacturing antioxic products with potent medicinal and antioxidant activity.

## Comparison of antioxidant power in fruits of commercial apple cultivars and cultivar candidates grown in Hungary

É Stefanovits-Bányai<sup>1</sup>, N Papp<sup>1</sup>, B Szilvássy<sup>1</sup>, M Tóth<sup>2</sup>, T Szabó<sup>3</sup>, B Fekete<sup>1</sup>, A Nemes<sup>1</sup>, A Hegedűs<sup>4</sup>

<sup>1</sup>Department of Applied Chemistry, Corvinus University of Budapest, Budapest, Hungary, <sup>2</sup>Department of Pomology, Corvinus University of Budapest, Budapest, Hungary, <sup>3</sup>Research and Extension Centre for Fruit Growing, Újfehértó, Hungary, <sup>4</sup>Department of Genetics and Plant Breeding, Corvinus University of Budapest, Budapest, Hungary

The apple (*Malus domestica* Borkh.) has a privileged role among fruits in the temperate zone. Its consumption is not limited to any particular season because several cultivars are available to cover supply during the whole year. Furthermore, it can be processed, *i.a.* it is an essential components of baby foods. Its valuable inner contents greatly contribute to the wide applicability of this fruit. Apple has remarkable contents of energy and raw fibre and it is also a rich source of vitamins and mineral elements. Apple is one of the most consumed fruits in Hungary, and hence its valuable compounds (vitamins, minerals, polyphenolic compounds) may significantly contribute to the health-promoting effects of human diet.

The aim of this study was to characterize the inner contents, antioxidant power, total phenolic content and mineral nutrient element contents of commercial apple cultivars in comparison with perspective cultivar candidates and estimate their contribution to the coverage of physiological requirements.

Among the main inner content parameters, total phenolic content and antioxidant capacity (FRAP) were measured spectrophotometrically. Mineral element contents in fruits were determined by ICP-OES. Different apple genotypes (well-known commercial cultivars and perspective cultivar candidates) grown under the same conditions were used for the analyses. Antioxidants were compared in different parts (skin and flesh) of the apple samples.

Our results indicate significant differences in all measured parameters among the assayed cultivars and cultivar candidates. Different antioxidant assays revealed 2- to 3-fold differences between the lowest and the highest values in commercial cultivars and cultivar candidates. The antioxidant power of fruits was much influenced by the skin/flesh ratio as smaller fruits