During our experiment we measured FRAP and colour content in 4 red cabbage hybrids and 20 beet root varieties. In formation of bioactive substances of vegetables are very important the heritable quality parameters too. In this way we examined not only the different species, and the roil of varieties belong to them.

The red pigments were evaluated from diluted samples. A spectrophotometer was used to determine the absorbance of pigments: λ=538 nm for red pigments and λ=476 nm for yellow ones. For total phenol content the colour reaction to Folin-Denis reagents were evaluated at λ=760nm, by means of a katechin standard (mg katechin/100 ml). Total antioxidant content was expressed in the so-called FRAP values (ferric reducing ability of plasma) in μM/l. The method is based on the ability of antioxidants to reduce Fe(III) ions to Fe(II) ions in buffered sour medium (pH 3,6). The produced Fe (II) can be measured on photometers. Absorbance is proportional to the quantity of the produced Fe(II) ions and the antioxidants, respectively.

Our measurements showed more than threefold differences in total antioxidant activity among varieties, the lowest value being 171.13 μM/l and highest 702.57 μM/l. The corresponding betanin (17.18 and 57.80 mg/100 ml) and total polyphenol (37.5 and 85.5 mg/100 ml respectively) contents show similar differences. The highest FRAP values was measured in the *Bonel, Pablo* and *Pronto* varieties (506.97; 571.43; 702.57 μM/l). Based on our results it can be stated that varieties of higher betanin and poliphenol contents have higher antioxidant values as well. With the further measurements we concluded that red cabbage varieties greatly vary in pigment. There is a correlation between the pigment and dry matter content and FRAP. According to our data the highest FRAP parameters were measured in *Sandoro* F_1 whose colour intensity also proved to be excellent. Lower parameters were shown by *Rendero* F_1 which also lagged behind regarding dry matter content and pigment content.

Our measurements showed the varieties with higher pigment and poliphenol content have high antioxidant values too. There is a close correlation between red pigments (betanin), total polyphenol contents and FRAP values. The correlation between the quantity of these compounds and the FRAP values (r = 0.7799 and r = 0.7435, respectively).

Accordingly, the two compounds must have a role in the evolution of antioxidant effects.

Biological evaluation of volatile oils and aromatic agents by FRAP method

M Then[1], I Szőllősi Varga[2], É Héthelyi[1], É Lemberkovics[1], K Szentmihályi[3]

[1]Institute of Pharmacognosy, Semmelweis University, Budapest, Hungary, [2]Department of Genetics and Molecular Biology, University of Szeged, Szeged, Hungary, [3]Institute of Materials and Environmental Chemistry, Chemical Research Center of the Hungarian Academy of Sciences, Budapest, Hungary

Biological (antioxidant) values of volatile oils used in medication and basic components used in flavouring and parfumery have not been known so far. For that reason the authors examined the applicability of a chemical method (FRAP) adapted for plant materials. The aim of the work was to study that the volatile oils and essence of parfume of positive effect to biochemical (allergic) processes in the human body may posses any antioxidant properties.

Volatile oils, fragrance compositions (know and unknown combinations, but known tendency) were studied. The measurements were made in 1% solutions. The components of volatile oils and fragrance compositions were identified by GC-MS and FRAP method was used for measurement of antioxidant property.

The identified and frequently occuring basic-, aromatic- and perfumed compounds may be characterized by the following FRAP values: methyl salicylate 303±1 μmol/L, α-amyl acetate 144±2 μmol/L, borneol 284±1 μmol/L, camphor 286±1 μmol/L, carvon 164±2 μmol/L, menthol 1.86±0.23 μmol/L, menthon 1.88±1.10 μmol/L, thymol 284±1 μmol/L, linalol 299±1 μmol/L, linalyl acetate 221±4 μmol/L, limonene 445±3 μmol/L, terpineol 142±1 μmol/L, cinnamic aldehyde 303±1 μmol/L, anethol 509±2 μmol/L, while the FRAP values of volatile oils were the followings: lemon oil 198±1 μmol/L, geranium oil 152±2 μmol/l, sage oil 313±3 μmol/L, pine oil 255±1 μmol/L, muscate sage oil 484±2 μmol/L, patchuli oil 178±2 μmol/L, petitgrain oil 174±3 μmol/L, dill seed oil 323±1 μmol/L, eukalyptus oil 14±2 μmol/L, clove oil 197±1 μmol/L, peppermint oil 167±1μmol/L, rosemary oil 35 ±1 μmol/L. The FRAP values of essence-compositions varied between 250-1000 μmol/L (female 251±8 μmol/L, male 409±13 μmol/L, kid 1093±7 μmol/L). At the T1-T15 style tendency with unknown compositions the values were between 3000-9000 μmol/L in 10% solutions, while smaller values characterize the american unisex essences (P-18, P-19, P-20): 243±2 μmol/L, 252±4 μmol/L and 520±1 μmol/L, respectively.

It has been stated that the FRAP method is suitable for measurement of in vitro antioxidant property of complex compositions.

The FRAP values of volatile oils of the knowledge of main componenst help to estimate the quality of volatile oil with 20-30% deviation. In the case of fragrance compositions with known essence style tendency, the values show the reducing power and they do not contain any other information.

It is recommended to determine the antioxidant values of all aromatic agents, volatile oils and essence-compositions beside physico-chemical characteristics.

Modification of fully activated NADPH oxidase activity by antioxidants

Zs Varga, E Kosaras, M Katkó

Ist. Department of Medicine Health and Medical Science Center, University of Debrecen, Debrecen, Hungary

The first reactive oxygen-derived substance is the superoxide anion produced by NADPH oxidase. This is a multicomponents enzyme containing several cytosolic (phox proteins) and membrane-bound (Cytochrome b558) parts. NADPH oxidase can be activated by receptor-mediated and non-receptor-mediated ways. During the activation the cytosolic components are phosphorylated and translocated to membrane, where they are combined with the membrane-bound part of Cytochome b558. Cytochrome b558 consists of two parts, gp91phox and p22phox proteins. During the last few years it became clear that this complex is not able to produce superoxide anion, it requires coupling of a Rac 1 or 2 GTPase G protein to complex. When coupling of Rac 1/2 is inhibited the NADPH oxidase enzyme could not produce superoxide anion. Now, it is well demonstrated that NADPH oxidase can be found not only in phagocytes such as neutrophils, monocytes, but many other cells as well, they are called to NOX enzymes. NOX was identified in uterus, renal cells, hepatocytes, endothelial cells, lymphocytes, smooth muscle cells etc. Those non-phagocyte NADPH oxidases (NOX1, NOX3, NOX4) differ from phagocyte one (NOX2) in the structure of gp91 phox subunit. This difference results in that non-phagocyte NADPH oxidase produces smaller amounts of superoxide anion and its activation does not require activation of PKC.

During the last years, our group studied the effects of several natural and synthetic antioxidants on superoxide anion production and activation of PKC in human neutrophils. These examinations involved the study the effects of antioxidants on superoxide anion production by fully activated NADPH oxidase (NOX2) as well. During experiments we have found that some antioxidants can decrease it, while others have not such effects. It was also demonstrated that the effects of antioxidants on fully activated NADPH oxidase was independent on PKC inhibiton; and as a consequence, independent from the modification of superoxide anion production in intact neutrophils induced by antioxidants. These differences were the most pronounced in case of tocopherols and their water soluble metabolites (CEHC). Both tocopherols and CEHC-compounds inhibited PKC and superoxide anion production in phorbol-ester stimulated neutrophils, and CEHC were more effective inhibitors as parent tocopherols. In contrast, superoxide anion production by fully activated NADPH oxidase was only decreased by lipid-soluble tocopherols.

On the basis of our observations, we suggest the following mechanism for the action of antioxidants on superoxide anion production by fully activated NADPH oxidase: the bound between the enzyme complex and the small Rac 1/2 protein - which is necessary for superoxide anion production by NOX – might be slack or broken by antioxidants, which is due to the counteraction of lipid-soluble antioxidants and cell membrane. This observation might be useful in those clinical states when activation of NADPH oxidase occurs - in either phagocyte or non-phagocyte cells-, since in these cases we can choose antioxidants which are able to decrease superoxide anion production by fully activated NADPH oxidase(s) (NOX) and prevents development of oxidative stress.

Reaseach was sponsored by Fund of Hungarian Academy of Sciences (T 42550).