# PLANTS PIGMENTS WITH THERAPEUTIC POTENTIAL FROM HORTICULTURAL PRODUCTS

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*Replacement of synthetic colorants with natural ones, obtained from horticultural products is an actual problem, not only because of the global trend of consuming natural products, but also by the fact that the natural pigments bring essential and various benefits to human health.*

*One of the major groups of active plant principles are the vegetal pigments, of which, with the most important therapeutic role are: carotenoids, anthocyanins and flavones.*

*Studies indicate that fruits and vegetables whose pigmentation are in violet-blue-red-orange spectrum are most effective in maintaining optimum human health.*

*Plant pigments play an important role in human health and owing to their capacity of biological antioxidants, conferring to cells and tissues protection against free radicals and oxygen attack.*

*They are also used in the diet to maintain health, protect the body from chronic diseases incidence and to restore its health by stimulating tissues recovery.*

***Key words**: plant pigments, free radicals, antioxidants, therapeutic*

Horticultural products are irreplaceable sources for obtaining drug substances (biologically active) and many other natural compounds used in various industries such as food, pharmaceuticals, cosmetics, with important commercial value [13].

Researches on horticultural products from the beginning of nineteenth century until the present, show that their therapeutic activity is due to chemical compounds produced by plant cells, known as the *vegetal active principles*.

It is known that natural pigmented products have a important *nutraceutical value* (or are *functional foods*).

Unlike the established nutrient classes (proteins, vitamins, minerals etc), plant pigments are not generally considered vital for survival, but instead, in a large variety of ways, have properties that promote optimum human health.

Functional foods are food products and their components, which improve the general health of the consumer, avoid illness, improve physical or mental quality of life and capacity of recovery after exhausting physic exercises or diseases.

In plants, pigments may be present in the free state or in a combination with holoproteides and carbohydrates. They can be located in some horticultural products only in epicarp (apples, aubergines etc), or, in others, in all tissues (tomatoes, beetroot, carrots etc) [2].

## MATERIAL AND METHOD

Was used bibliographic material from specialized literature, both national and international, as well as electronic databases of the Internet, with scientific papers in the field, which allowed the study and evaluation of plant pigments therapeutic importance, from horticultural products.

The focus was on knowledge and understanding of typical issues related to the therapeutic value of plant pigments, less known aspects and highlighted, in our country.

## RESULTS AND DISCUSSIONS

One of the major groups of *vegetal active principles* is the plant pigments, of which, with the most important therapeutic role are: pigments, carotenoids, anthocyanins and flavones.

**Carotenoid pigments**, in addition to their role to give color (red-yellow-orange), carry with them many important biological functions. Carotenoid pigments include some 70 compounds [4].

β-carotene is found in most vegetables, having a higher proportion in carrots, but also in the fruits (apricots are the most representative). Through oxidative enzymatic hydrolysis, β-carotene is converted into two molecules of vitamin A1, the main provitamin A.

α-carotene, δ-carotene, γ-carotene found in plants with β-carotene, in the largest quantities are found in carrots, peppers etc. [8].

Lycopene is met in tomatoes in large proportion, but was still identified in about 70 plant species (red pepper, Kapia pepper, onion, watermelon etc) [4].

The xantofile (oxygenated carotenoids), the most active, in terms of therapeutic, are:

Lutein, encountered mainly in green vegetables and fruits (cabbage, parsley, spinach, etc.). Capsanthin is red pigment in pepper and bell pepper, along with capsorubin and criptoxantină. Zeaxanthin is found in plants with lutein [8]. Research has shown that this pigment is very effective in preventing the aging [17].

Lutein is promoted as “the eye-protective nutrient”, and its action has been shown in epidemiological experiences, to be inversely associated with eye diseases (Khachik et al., 2002, quoted by Davies, 2004).

The most important nutritional role of the carotenoid is their activity as provitamin A [12]. Britton (1995), quoted by Davies (2004) notes that this vitamin, with vital functions in the human body, can be synthesized from carotenoid pigments.

Table 1

**Total carotenoid pigments content of some horticultural species (Dobreanu, 1979)**

| Species | mg/100 g fresh product | Species | mg/100 g fresh product |
|---|---|---|---|
| Carrots | 7,0 – 18,0 | Apricots | 1,2 – 4,2 |
| Tomatoes | 6,5 – 12,0 | Peaches | 0,1 – 0,7 |
| Green Beans | 0,1 – 0,2 | Apples | 0,1 – 0,8 |
| Pepper | 8,0 – 25,0 | Pear | 0,1 – 0,2 |
| Pepper Kapia | 25,0 – 35,0 | Oranges | 0,3 – 3,5 |
| Pepper bell | 23,1 – 25,0 | Blackcurrants | 0,1 – 0,2 |
| Spinach | 13,0 – 14,0 | Strawberries | 0,03 – 0,1 |
| Watermelon | 3,0 – 4,0 | Bilberries | 0,2 – 0,3 |
| Lettuce | 3,1 – 6,0 | Lemons | 0,4 – 0,8 |
| Radishe | 1,5 – 2,0 | Banana | 6,8 – 8,3 |

The presence of natural carotene has a higher protective effect. It is known that smokers are exposed to oxidative aggression more than other people and need greater quantities of vitamin C and beta-carotene. Was given to smokers beta-carotene form of drug tablets and was found that the percentage of lung cancer has increased, instead of decrease. Giving them the synthetic beta-carotene, they become more vulnerable to cancer, while consuming beta-carotene from natural sources they are protected, because this is a natural antioxidant that confers protection to cells and tissues against attack of oxygen and free radicals [19].

It was found that these pigments have also a photoprotective function in human metabolism and are used to treat diseases of photosensitivity (Zeigler, 1993, quoted by Davies, 2004). Sies and Stahl, in 2003, found that lycopene, lutein and zeaxanthin are excellent protectans of tissues exposed to sunlight, against radiation. Carotenoid pigments are filtering blue light and scavenging reactive intermediates generated in photooxidation [7].

Carotenoids are associated with inhibition of some cancers, an epidemiological study found an inverse relationship between consumption of foods rich in lycopene (tomatoes, tomato paste, etc) and risk of prostate cancer, a relationship attributed to accumulation of lycopene in prostate specific tissues (Deming and Erdman, 1999, quoted by Davies, 2004).

**Anthocyanin pigments** are a class of compounds belonging to phenolic substances widely distributed in vegetables, giving shades of red and blue to fruits and vegetables (beet, red cabbage, blackberries, blueberries etc).

They represent, in chemical terms, glycosides of anthocyanidins [8].

Anthocyanins are located in the vacuolar juice of plant tissues and by pH they can form flavilium salts, with red colour (pH=3), quinones, violet (pH=8.5), or complex salts of quinones, blue (pH=11)[8].

The most important anthocyanidin are *pelargonidin, cyanidin* and *delphinidin,* which differ among themselves by number and position of hydroxyl groups on the benzene ring. Through methylation of anthocyanidins mentioned, will result different color pigments: *peonidin, pentunidin* and *malvidin* [8].

Distribution of anthocyanin pigments in horticultural products is uneven. For apples, on the colored part they are missing.

Therapeutic value of anthocyanins is given by their bacteriostatic activity and by the biological value of vitamin P (rutin) [4].

Norton (1999) shows that the group of phenols, which include anthocyanin pigments, is responsible for a wide range of biological actions in human metabolism, and important antimicrobial properties, such as inhibiting the biosynthesis of aflatoxin, a toxin produced by molds, which can cause liver problems who can lead to liver cancer.

The most studied role of anthocyanins is the improvement in visual acuity, including here and view to overnight. Anthocyanins obtained from black currant juice, administered in humans favored rapid visual adaptation to darkness and increased capillary resistance [7].

Retinopathy and cataracts, serious consequences of diabetes mellitus, can be combated using plant-derived anthocyanin pigments, because the pigments inhibit the α-glucosidase enzyme (AGH) located in the epithelium of the small intestine. AGH normally catalyzes cleavage of glucose from disaccharides, leading to excess glucose absorption and aggravation of diabete. Anthocyanin extracts from a wide range of plant species including sweet potatoes and red cabbage have demonstrated ability to inhibit AGH [7]. Red cabbage was found to have more compounds with antioxidant role and a quantity of vitamin C at least five times higher than white cabbage.

Anthocyanins are denoted by Kang et al., 2003, as inhibitors of cyclooxygenase enzyme, considered a marker for the early stage of carcinogenesis.

Significant new research has revealed a role for anthocyanin pigments in protection against neurological disorders, especially declines related to aging.

This association was based on *in vivo* evidence. Results obtained by Joseph, 1999, Youdim, 2000, b, that rats administered an anthocyanin-rich diet showed significant improvements in motor and cognitive function, and protection against age-associated impairments [7].

Youdim et al. (2000, c), quoted by Davies K. (2004) found in examinations *in vitro* and *in vivo* that these polyphenolic compounds (especially cyanidin), increased red blood cell resistance to oxidative stress.

Anthocyanidins derived from fruit sources (elder, mountain ash, raspberry, blueberry, etc.) have demonstrated ability to accelerate ethanol metabolism, reduce inflammatory and edematic symptoms, and improve permeability and strength of capillaries (Francis, 1989, quoted by Davies, 2004).

Anthocyanins, depending on the concentrations ingested, confer protection to DNA by preventing radical hydroxyl attack. In these reactions, cyanidin-DNA co-pigmentation is suggested as a possible defense mechanism against oxidative damage of DNA; once ananthocyanin (e.g. cyanidin) complexes with DNA, it is no longer vulnerable to nucleophilic attack by an OH group (Sarma and Sharma, 1999, quoted by Davies, 2004).

Table 2

**Total anthocyanin content in some species of wild berries (Neamţ County, Romania) (Beceanu, D. et al., 2003)**

| Species and order in anthocyanins content | Anthocyanins content (g/100g product) |
|---|---|
| Blueberries (I) | 0.579 |
| Black cherry (II) | 0.412 |
| Blackberries (III) | 0.326 |
| Raspberries (IV) | 0.091 |

**Flavone pigments** are those pigments that contribute to the yellow color of horticultural products. Currently over one hundred pigment of this class are known [13].

The leading representatives of flavone pigments are *apigenin, kaempferol, quercetin, myricetin, luteolin, tricin, izoramnetin* [8].

Quercetin is one of the most important flavonoids. The richest sources are: apples, onions, plants of family Cruciferae, Sambucus nigra.

Research shows that of flavonoids, quercetin have the most number of beneficial biological effects: antioxidant action, anti-inflammatory, gastro protector, anti-allergic, antiviral, immunomodulatory and anti-carcinogenic [10].

Apigenin has potent antioxidant activity; antiinflammation, reduces oxidative DNA lesions, inhibits growth of human leukemia cells and induces apoptosis in cancer cells. It is found in: celery, parsley, basil etc.

Luteolin, met in the same plant like apigenin, it has similar effects, but also unique properties. It is effective in prevention and treatment of many respiratory diseases (asthma, chronic bronchitis). Antioxidant activity of luteolin-7-O-rutinozid is comparable to that of L-ascorbic acid.

Rutin, protective blood vessels, reducing bleeding capillaries (vascular complications), reduced hypertension, is coronary vasodilator, improves cardiac contractility and pumping function of heart muscle, have antibacterial properties, antifungal and antiviral, is hepatoprotector and relieves inflammation [10].

## CONCLUSIONS

1. Plant pigments have multiple roles in maintaining human health through their biological diversity, as evidenced by *in vitro*, *in vivo* and clinical trials. A balanced diet containing many plant pigments from all known groups, is the key to preventing or treating a large number of diseases and dysfunctions of the body.

2. Research shows that reducing the incidence of cardiovascular disease, cancer risk and a significant number of chronic diseases is closely linked to the consumption of horticultural products with a high content of vegetal pigments: carotenoids, anthocyanins and flavones.

3. Increased incidence of cancer worldwide, implicitly in Romania, is the reason amplification of epidemiological and therapeutical studies who aiming the cancer treatment and beyond.

4. In vivo experiments have demonstrated the role of plant pigments as antioxidants, enzyme inhibitors or activators, anti-inflammatory and antimicrobial agents.

5.The bioavailability of polyphenols is largely unknown. Anthocyanins are absorbed into plasma mainly in intact form, unlike tannins, which are highly derivatized.

6. Given the relative complexity of the natural plant pigments, these molecules for the most part cannot be synthesized in the laboratory.

## BIBLIOGRAPHY


1. Banu, C., Nour, Violeta, Stoica, A., 2009 – *Alimentaţie pentru sănătate*, Edit. ASAB, Bucureşti.
2. Beceanu, D.,1999 – *Valorificarea legumelor şi fructelor, aspecte generale*, Edit. „Ion Ionescu de la Brad", Iaşi.
3. Beceanu, D. şi colab., 2003 - *Études concernant la composition chimique de quelques fruits de bois récoltés de la flore spontanée du département de Neamţ*. Lucrări Ştiinţifice U.S.A.M.V. Iasi, Seria Horticultură, vol. 46, Iaşi.
4. Beceanu, D., 2009 – *Materii prime horticole pentru industria alimentară, struguri, fructe, legume*, Edit. PIM, Iaşi.
5. Bodea, C.,1984 – *Tratat de biochimie vegetală, partea a II a, Compoziţia chimică a plantelor de cultură*, vol. V, Editura Academiei Republicii Socialiste România.
6. Cercasov, Cornelia, Popa Valentina-Claudia, 2005 – *Compuşi naturali cu acţiune terapeutică*, Edit. Universităţii din Bucureşti.
7. Davies, K., 2004 – *Plant pigments and their manipulation*, Annual plant reviews, Volume 14, CRC Press, Boca Raton, Florida, USA.
8. Gherghi, I., Burzo, I., Mărgineanu, Liana, Deneş, Steliana, Dobreanu, M., Pattantyus, K., 1983 – *Biochimia şi fiziologia legumelor şi fructelor*, Edit. Academiei, Bucureşti.
9. Hororoi, Anişoara, 2003 – *Principii active vegetale, natura chimică şi utilizarea lor,* Revista Hortinform, vol. 1, nr. 125, p. 41.
10. Mişcalencu, D., Mailat, Rodica, Caraene, Georgeta, Nicolae, Ilinca, Schipor, Sorina, 2008 – *Cancerizare chimică şi substanţe anticancerigene din plante*, Edit. Tipografică, Bucureşti.
11. Snyderman, Nancy L., 2008 – *Mituri medicale care te pot ucide*, Edit. House of Guides, Bucureşti.
12. ***, 2009 - http://www.astaxanthin.org/carotenoids.htm, accessed August.
13. ***, 2009 - http://www.bio.unibuc.ro/old/biochemistry/Enzimology, accessed September.
14. ***, 2009 - http://www.dyespigments.com/natural-pigments, accessed August.
15. ***, 2009 - http://www.farmaciata.ro, accessed September.
16. ***, 2009 -http://lpi.oregonstate.edu/ss01/anthocyanin.html 18, accessed September.
17. ***, 2009 - http / / www.health24.com/news, accessed September.
18. ***, 2009 -http://www.romedic.ro/flavonoid, accessed September.
19. ***, 2009 - http://www.ziarullumina.ro/articole, accessed September.