NATURAL DYES, OF VEGETAL ORIGIN, USED IN THE FOOD

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Abstract

Research undertaken over the past decades have shown that due to the antioxidant capacity of natural pigments, their use in the food industry represents an immeasurable therapeutic potential for maintaining human health by preventing cardiovascular diseases, the risk of cancer and other imbalances caused by daily stress and by the disorganized lifestyle of modern man.Plants are established sources of industrial, pharmaceutical and aromatic compounds, which have been for milleniums the main source for obtaining bioproducts essential for the survival of the fauna. Dyes are natural or synthetic organic coloured substances, which absorb light in the visible part of the spectrum and have the property of colouring the substrate they are applied to.

Key words: natural dyes, food industry, food dyes

Always the inanimate nature has represented true bio-chemical factories which provided phytochemical compounds used in different industries like pharmaceutical products, food, cosmetics, agrochemical products.

The natural dyes are natural organic or coloured synthetical substances, which absord light in the visible domain or UV of spectrum and have the property to adhere and colour the supports where they have been applied.

At the moment there are homologated and spread more and more functional foods ,drinks ,seasonings, special prepared products etc, which include in their manufacturing recipes some natural substances, dyes also, with invigorating, stimulating or protective medicamentary effects, extracted from the best known or appreciated cultivated plants or wild flora (Beceanu, D., 2010).

Because the food processing takes place at high temperatures and because the natural dyes are not stable enough in these conditions, from commercial reasons in food industry and not only, there are dyes added to them to improvise the color and reduce the effects of its dissipation.

The first used natural dyes were those of vegetal origin like: red obtained from roots of plants from *Rubiaceae* family, indigo extracted from plants from *Indigofera* family, blue extracted from campeachy wood and less those of animal origin.

The dyes have their colour because in their molecule exist groups of atoms capable to absorb selectively components of white light. The radiations which are not absorbed are reflected, creating the sensation of colour. These groups which give the substance its colour are called chromophore groups, groups „bringers of colour". There are also groups which intensify the colour of certain auxochrome groups.

MATERIAL AND METHOD

For this paper we reviewed a vast specialty bibliography about the industry of vegetal pigments used in food industry, comprising both internet pages, specialty databases and scientific papers presented at different symposyums from our own country and abroad.

RESULTS AND DISCUSSIONS

Food dyes are part of the food additives category, classified according to CEE schedule and have codes from E100 to E200. Some are separated from natural sources, for example curcumin E100, is an yellow dye known as „Indian saffron", E120, red dye obtained from teguments of some insects. Other dyes are synthetical (Cercasov, C., 2005).

Extracts from vegetak tissues contain lots of substances with phenolic functional groups, which

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are part of different classes of organic compounds. Their systematization provides difficulties, because most of the natural compounds have mixed functions and can be ascribable to different classes at the same time.

From a chemical point of view, the vegetal dyes are vegetal substances of secondary origin and can be classified in: chlorophyllian or porphyrian (green pigments from green plants), carotene pigments (yellow pigments from fruits and vegetables), flavones dyes, quinone pigments and indole pigments (Pascal, S.M., Veronique, C., 2006).

Chlorophyllian dyes (E140) (fig. 1) are extracted from green raw materials (leaves) as deficient in proteins as possible, which are a source of contamination.

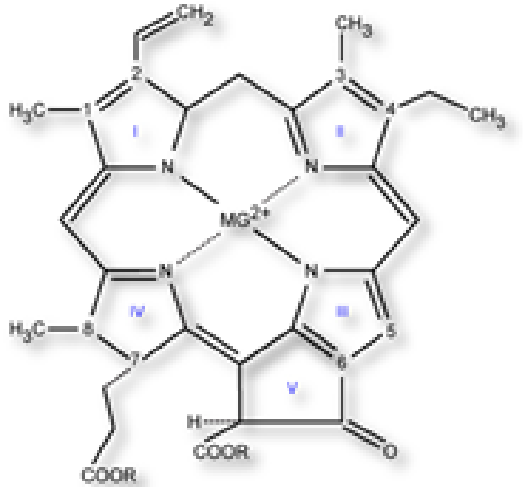

Figure 1 **Chlorophylle structure**

Usually it is obtained from nettles or spinach by extraction with the help of acetone, ethanol, methyl ketone and dichloromethane.

It is used in oils, chewing gum, instant soups, sweets.

Carotene dyes (E160) represent a group of pigments which are obtained in various forms and compositions and have colours from yellow to red, being represented by pro-vitamin A (alfa– figure 2, beta and gama carotene).

Some products are more expensive and some are cheaper, like crocin from saffron (*Crocus sativus*), or oleoresin extracted from paprika, with capsanthin, have a high price. At the opposite pole there are lycopene from tomatoes, an yellow pigment extracted inclusively from residual peels resulted from tomato paste manufacturing (Cotrău, A. cited by Beceanu, D., 2009).

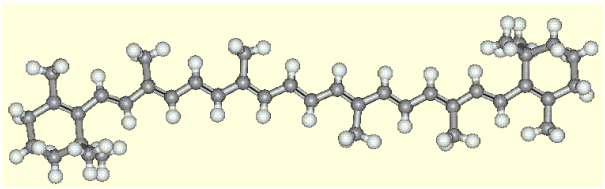

Figure 2 **α-carotene structure**

Multiple studies emphasized that for the animal life, the main role of carotenes is that of predecessor in synthesis of vitamin A, which is an essential component in daily human diet, because it is implied in preventing cancer and cardiovascular diseases. In USA the average daily consumption is of aproximatively 6.5 mg/person and in Europe of aproximatively 14 mg/person (Socaciu, C., 2008).

In carrots there accumulated around 7-8 mg/100 g carotenes, of which 4 mg betacarotene. Yellow genera contain a smaller quantity than the red ones.

They are used for colouring butter, margarine, in coffee cakes, sweet drinks or milk products.

Flavone dyes are secondary metabolites with the widest spread from vegetal polyphenols category which contain in their molecule a pyran or furan condensed heterocycle with a benzene ring. Another benzene ring is coupled to the heterocycle (fig. 3). The rings have hydroxyl groups, which determine the phenole character of these pigments. These compounds determine the colour of flowers, fruits and even leaves: chalcones, dihydrochalcones, aurones, flavones, flavanoles, (yellow compounds), dihydro-flavanoles, flavones, flavanoles, flavonoids (leuco-antocianidins), antocianidins (red, blue or violet compounds).

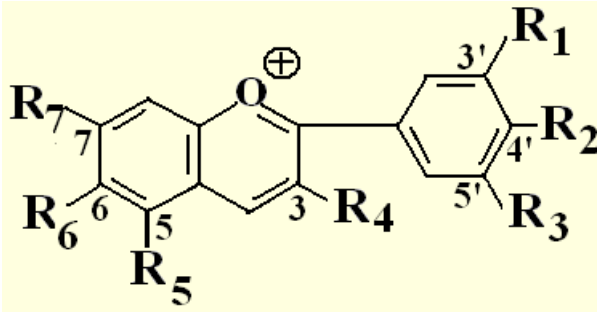

Figure 3 **Flavylium cation's structure and numbering**

Antocyanin dyes (E163) are natural glycosides which in plants are represented by six compounds: cianidin-3-glucoside (E163a) – red colour; delphinidin-3-glucoside (E163b) blue; malvidin-3-glucoside (E163c) mauve; pelargonidin-3-glucoside (E164d) orange;

peonidin-3-glucoside (E164e) red-brown and petunidin-3-glucoside (E165f) dark red.

Antocyanins are the widest spread pigments. These pigments exist abundantly in nature and are responsible for the red,blue or violet colour of flowers and fruits (Devies, K. D., 2004).

Their colour is due to the degree of hydroxylation or methoxylation. Those with hydroxyl groups have a ruby red colours and those with methoxyl groups have a blue colour (Țârdea, C., 2007).

The daily dosage authorised by European Union for E163 is of 200 ppm pure pigment (Pascal, S.M., Veronique, C., 2006).

The industrial sources for obtaining the E163 dye are: peel and mash of red grapes, cabbage and beet, cranberries, blackberries, cherries, raspberries etc.

E163 dye is used for colouring alchoholic and non-alchoholic drinks, natural juices, in pastry.

Xantophyll (E161) are a group of yellow dyes, except E161(g) which is orange. They are obtained from plants by extraction with the help of hexane. In this category are: flavoxanthin (E161a), lutein (E161b), cryptoxanthin (E161c), rubixanthin (E161d), violaxanthin (E161e), rodoxanthin (E161f) and canthaxanthin (E161g). Excepting lutein and canthaxanthin, they are not found on market, but they are part of a normal diet. They are harmless, except canthaxanthin which damages retina.

Chalcone dyes (curcumin E100)

It's a yellow-orange dye, obtained from the root of Curcuma longa (*indian saffron*), insoluble in water, but soluble in ethanol and acetic acid. It can be obtained synthetically also.

It is used as polysorbate of curcumin or curcumin powder disolved in alcohol.

It is used for pickles, mustard, cheese, margarine, sweets or fish products, meat products, jam, marmelade.

For the purpose of protecting population's health, food dyeing should be realised only with dyes accepted by current laws.

Conditions for a dye:

- should not be toxic or carcinogenic at different levels of use;
- should not contain toxic contaminants;
- should have solubility adapted to its incorporation in watery phase and/or in lipid phase from food product;
- should not give the food product where is introduced a particular taste or smell;
- should be stable at light when it is introduced in product;
- should not be affected by the temperatures at which it is made the termal treatment (pasteurization, boiling, sterilisation);
- should be stable during the storage of the product where it was introduced;
- can be emphasized in the food product by adequate analytic techniques;
- should be available and rather economical price wise;
- should be approved by the current health legislation.

Practically, the dyes are chosen according to affinity because generally food contains both hydrophilic and lipophilic components. That's why it was opted for initiation of studies for the purpose of obtaining food dyes with mixt function, hydrophilic-lipophilic with tinctorial polyphasic effect.

The industrial sources of obtaining natural dyes for use in food industry are:

- ✓ from peel and mash of red grapes, beet and red cabbage, blueberries,cranberries, blackberries, cherries, raspberry (anto-cyanin);
- ✓ cayenne (capsanthin);
- ✓ tomatoes (lycopene).

CONCLUSIONS

Despite many challenges, the inanimate nature continues to represent the main supplier of phytochemical compounds used both in food industry and in other industries.

Despite the disturbance of natural balance and unlimited exploitation of these resources, a rise of work force cost and technical or economical difficulties of plant cultivation from spontaneous flora, in some developed countries they are more and more interested in obtaining natural pigments by unconventional methods through new biotechnologies and modern techniques of cell and vegetal tissues cultures.

Obtaining positive results represents the first step in elaborating applicable methods on an industrial scale in food, pharmaceutical, textile or cosmetic industries.

Until now, in Romania, the production of natural dyes on an industrial scale has been completely neglected by concerns which have as object of activity vegetable and fruit processing, from their residues, like it is done in most of the developed countries from Europe and in the world.

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