BOTANICAL RESOURCES OF SPONTANEOUS AND CULTIVATED FLORA, WITH APPLICATIONS IN THE TEXTILE DYES INDUSTRY

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Abstract

This work presents a synthesis of the information found in the specialized literature regarding the tinctorial plants and the usefulness of painting the textile materials with plant pigments, considering the importance and the share that will be paid in the future to the natural dyes in food, cosmetics, pharmaceutical and textile industries.
We are strongly convinced that the synthetic dyes will not be completely removed from the above mentioned areas, but we believe, with the same firmness, that in the future the choice will be more and more the one for natural dyes, environmentally friendly, biodegradable. This is the natural way, in the present context of returning more and more conscious of the human being towards the nature, towards a healthy life. The richness and the variety of spontaneous and cultivated flora, which presents tinctorial features for textile materials, have been continually explored since ancient times, transforming this area in one of the oldest occupations.
Painting with vegetable dyes suggests those refined, alive colours, closer to the nature nuances to what a number of unitary colors is used. There is a great number of plants that contain coloring juices, some in the leaf, flowers, strain, root, others in flower buds and fruits. But out of these, few are the ones that can fix on the wool, flax, hemp, cotton, silk (gossamer) fibers, or even on the collagen fibers at the painting of leathers, so as the resistances of the paintings be good, resistant to the external factors such as: light, humidity etc.
From the specialized literature, we conclude that, based on the made researches, it has been found that, in general, the paintings of the textile materials with vegetal dyes do not have good tinctorial resistances and as a consequence it was chosen the use of some fixative agents named mordants (Păsculescu et al 1986, Jolin et al, 1994, Glover, 1995).

Key words: textile industry, plant pigments, spontaneous flora, cultivated flora

Located on the verge between craft and art, dyeing, especially vegetable extracts dyeing, has its resources back in human history's ancient times.

The first information regarding the use of vegetable dyes date back around the year 2650 B.C. in China. Until nowadays, man has been permanently preoccupied by the use of these natural resources, at hand, with the purpose of dyeing and decorating textile materials both for functional purposes, as well as aesthetic reasons, and in some way for breaking the monotony of every day life (Peptu, 2000).

The colour palette used by the ancient Chinese, for the wonderful embroideries, was composed of shades of purple, brown, red, dark green and lime green, where the red resembled the coral, violet red reminded of the amethyst, yellow brings amber before your eyes, green – the emerald and blue seemed as if it were from peacock feathers. These colourful fabrics are telling evidence of the extraordinary performance achieved by the Chinese in using dyes and creating a rich palette of hues.

Vegetable pigments are natural dyes of plant flowers, leaves, fruit and tissues. Some are spread all over the plant kingdom, while others are found only in some plants or certain organs of plants. In plants, pigments may appear in a free state or combined with holoproteins and carbohydrates, forming heteroproteins and glycosides (Bâtcă et al, 1984).

According to their chemical structure, generally extremely varied, vegetable pigments may be divided in several groups: porphyrin pigments, carotenoid pigments, quinine pigments, flavonoids pigments, indolic pigments. (Bechtold et al., 2009)

MATERIAL AND METHOD

In order to write this paper, I consulted an extensive specialized literature, from the field of textile industry and vegetable pigments used in the textile industry, as well as internet pages and

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specialized data bases and scientific papers presented in various symposiums in the country and abroad.

Unfortunately, most of the specialized literature found refers only to the extraction of the dye and its application on textile support using only traditional, popular methods.

RESULTS AND DISCUSSIONS

From ancient times until the end of the XIX[th] century, nature was the most important source for dyes.

Scientific progress registered in chemical engineering, organic and analytical chemistry lead to the separation and knowledge of the chemical structure of natural products. This success gave a great impetus to the synthesis of substances which would replace natural products. Thus "identical natural products" with similar properties appeared, but not identical to natural products. (Bâtiu, 1999).

Dyeing with vegetable dyes suggests those refined, vivid colours, closer in tones to the natural colours to which a number of unitary dyes are used.

The following table comprises some of the plants which present tinctorial potential and the optimal harvest period together with the plant organ to be harvested (Peptu, 2000, Şofransky, 2008, Pop et al., 2007, Ibrian, 1993).

Table 1

Vegetable plants with tinctorial potential

Scientific name	Common name	Dye group	Plant organ and optimal harvest period
Carthamus tinctorius L. *(Asteraceae family)*	Safflower	dehydroflavones derivates: -carthamin, $C_{21}H_{22}O_{11}$ (red pigment) -carthamon, $C_{21}H_{20}O_{11}$	- flowers at sunrise or sunset (July-August)
Vaccinium myrtillus L. *(Ericaceae family)*	Bilberry	-flavonoids (10-25%); -anthocyanin	-leaves: May-September; -leaves: July-August
Sambucus ebulus L. *(Caprifoliaceae family)*	Dwarf elder	- anthocyanin -flavones	-ripe fruit (September-Octomber)
Achillea millefolium L. *(Asteraceae family)*	Milfoil	- flavones (0,15%) -coumarin (0,35%) - beta-carotene	- flowers (July-August)
Ocimum basilicum L. *(Lamiaceae family)*	Basil	-flavones -carotenes - chlorophylls	- the entire plant in the period of maximum flowering
Salvia officinalis L. *(Lamiaceae family)*	Sage	-flavones -carotenes - chlorophylls	-leaves
Taraxacum officinale Waber et F.H. Wigg. *(Asteraceae family)*	Dandelion	carotenoid: lutein, violaxanthin, taraxacin, neoxanthin, flavoxanthin (80-160 mg for 3 kg of dry flowers)	-flowers (April)
Sambucus nigra L. (*Caprifolioceae family)*	Elderberry	-flavonoids (rutoside) - anthocyanin	-flowers (June) Ripe fruit (August-October)
Papaver-rhoeas L. *(Papaveraceae family)*	Red poppy	-carotenoids - anthocyanin	- red petals (May-June)
Euphorbia cyparissias L. (Euphorbiaceae family)	(Cypress Spurge	-flavones - anthocyanin	The entire plant (May-June for yellow and July-August for brown)
Juglans regia L. *(Juglandaceae family)*	Walnut	-flavones -black dye from the pericarp (seed vessel)	-pericarp (July-August)

In our country, there is a very large number of plants from the spontaneous and cultivated flora which contain dyeing juices, some in their leaves, roots, bark and others in their flower buds or fruit. Of these, a number of approximately 48 species can provide pigments which can fix on wool, flax, hemp, cotton, and natural silk (silk) textile fibers or textile fibers or even on collagen fibers when leather is dyed. (Flora RSR, 1976)

The large number of hues, found especially in flowers, has three basic groups of dyes: flavones which are yellow, carotenoids which range from yellow to red and anthocyanins which are blue or red and violet. (Cercasov et al, 2005)

The quantity of plant dye, as well as its quality is strongly influenced by the conditions of the outdoor environment: temperature, light (sun, shadow or cloudy weather), the air and soil humidity, soil composition and acidity etc. Thus, excessive heat prevents the formation of dyes (for example purple lilac flowers *Syringa vulgaris* turn colourless because of too much heat), and sometimes temperature growth determines colour modification (at low temperatures, *Myosotis intermedia* forget-me-not flowers are red, and at higher temperatures they turn blue). Atmospheric humidity also influences the quantity of dye (a dry atmosphere favours a more vivid colour of the flowers, due to increased dye concentration).

From the aspects shown above, it results that the picking the moment to harvest the plant must be correlated with the season, climatic conditions and even with choosing the time interval when the amount of dye is at a maximum level, and the colour is the desired one (Șofransky et al., 1994). From *Isatis tinctoria L.*, woad, the entire plant is harvested in the moment of full flowering between 10 and 12 o'clock or from the chamomile, *Matricaria chamomilla*, only the flowers are harvested around 12 o'clock. In the case of the Black Elderberry, *Sambucus nigra L.*, whose fruit harvested in early ripening, a green dye is extracted and when they are well-ripped, a black dye is extracted (Pop et al., 2007).

Following research, it was found that generally speaking, textile materials dyes with natural (plant) dyes do not have good tinctorial resistance to external factors such as: light, humidity etc., thus raising the issue of using some bonding agents called mordants, which have the role of forming chemical bonds between the dye molecules and the textile fiber by forming a chelate, that is a three-component system: textile fiber/metallic salt/dye. For example, madder roots (*Rubia tinctorium*) contain approximately 1,5-2,0% alizarin, which is a bright-red dye part of the aromatic hydrocarbons class and which is used only after mordanting with various mordants such as: alum or Potassium dichromate (Ibrian, 1993).

Other sources of plant dyes are some vegetables and fruit such as: beetroot, red cabbage, red grapes, cherries, onion peel or green walnut shell, rose petals etc.

Using these tinctorial resources wisely and with ingenuity, constitutes a means of exploitation of natural, unpolluted products, in accordance with the new global trends of the green finished products for the consumer market and the growth of the quality of life.

Currently, at a global level an annual textile consumption is estimated around 33-35 million tons and an increase of around 3% per year is expected to occur once countries get out of recession.

Dyeing these textiles require approximately 75000 tons of synthetic dyes. In other words, the current textile industry is a great dye consumer. The reasons for which this issue is emphasized is that everybody wants to dye their textiles and decorate them both for functional purposes, as well as aesthetic reasons, and in some way to break the monotony of every day life.

CONCLUSIONS

As a first conclusion, it is worth mentioning that currently all these natural dyes are not a viable alternative for dyeing textiles on the present global market, but they will always be used for textile dyeing either on a small scale, or by the large commercial corporations.

Research concerning the natural dyes continues namely: research will be done so that they cover a larger colour palette, to shorten the dyeing process, to increase resistance to temperature variations.

The position of synthetic dyes enterprises and users is that the alternative of natural dyes is not so expensive, but the use of these products represents a strong development potential because obviously there will exist market segments where people due to various reasons consider textile dyeing with natural dyes a superior dyeing process. Thus, we can state that developing this sector will mainly depend on the existence of centralized resources of tinctorial plants and their processing.

To the above-mentioned, the advantages and disadvantages of using plant dyes may be added:

Advantages:

- Possibility of exploiting the pigment-containing spontaneous and cultivated flora;
- It does not have carcinogenic or allergic effects;
- It has no harmful effects on the terrestrial and aquatic fauna and flora by wastewater discharges;

Disadvantages:

- The costs for obtaining plant dyes is approximately 10-40% higher than those of synthetic dyes;

- Limited colour reproducibility for large-scale dyeing;
- Smaller colour palette;
- Limited performances of tinctorial resistance and hue modifications under the action of light (the so-called photo-chromism).

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