

THE ALLOCATION OF ANTHOCYANIDIN DYES FROM FOREST WASTES

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The article presents experimental study of excretion of natural anthocyanidin dyes from waste of wood industry. Total mass fraction of anthocyanidin compounds in bark in the bound state are determined. Kinetic parameters of the process of obtaining anthocyanidin chlorides from tree bark are indicated.

Introduction. In order to broaden the raw material basis and ensure reasonable consumption of plant raw material, much attention is paid within the recent years to processing of various plant wastes. One of large-scale wastes of wood processing is bark. Bark is rich in valuable biologically active compounds. Coniferous bark contains large amount of phenolic compounds of various classes possessing biological activity. The best studied and most widely used in Pharmacia, perfume and cosmetics manufacture, food and other industrial branches are flavo-noid compounds and flavilium salts. Anthocyanidin dyes, one of the groups of flavylum salts, are widely used in food industry. Anthocyanidin dyes for food industry are obtained from flowers, seeds, berries, vegetables, and wastes of their processing, the so-called mill cakes [1]. Each type of raw material gives both anthocyanes (dyes containing saccharide residues) and anthocyanidins (aglycones, or pigments containing no saccharides).

Anthocyanidins occur in nature usually as glycosides with one or two glucose residues or groups of other simple saccharides attached to the hydroxyl in 3, or 3 and 5 positions, as well as in the form of leucoanthocyanidins (reduced anthocyanidins) [2]. Oxidation of catechins gives Anthocyanidins, too [3]. Because of this, it is possible to obtain anthocyanidin dyes from plant raw material by several methods, including acid hydrolysis of the corresponding glycosides, treatment of colourless leucoanthocyanidins with acids, and oxidation of catechins in acid medium.

At present, the conditions and methods of quantitative determination of anthocyanidin dyes in fruit and vegetable raw materials are mastered best of all [3]. The most widely used method of obtaining anthocyanidins from the fruit and vegetable raw material is hydrolysis of anthocyanes (glycosides) by hydrochloric acid (2 M) at 100 °C for 40 min, or by 6 M hydrochloric acid at the same temperature for several minutes.

However, the same compounds can be obtained by the appropriate treatment of coniferous bark or its extracts. Anthocyanidins can be present in bark of different species both in the free state and bound in lignocarbhydrate complex. For example, the major part of leucoanthocyanidins is present in the free state in the bark of leaf-bearing trees, for example, in birch [4]. Leucoanthocyanidins of birch bark are analyzed by transferring them into the corresponding coloured anthocyanidin chlorides; the concentration of hydrochloric acid is 6–7 %, and exposure is 30 min. The processes involved in obtaining anthocyanidin dyes from the bark of Siberian coniferous trees are insufficiently investigated.

Anthocyanidins are natural colorants which occur in a wide variety of flowers and fruits [5–7]. The general structure of anthocyanidins is displayed in Figure 1.

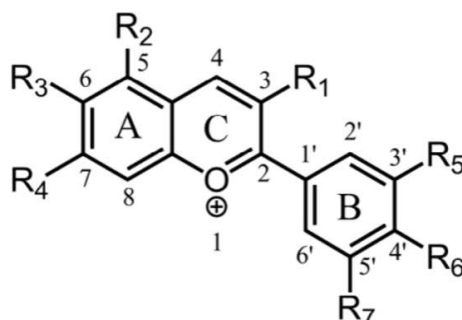


Fig. 1. General structure of anthocyanidins

Up to now, 23 different anthocyanidins were identified. The most common of them are pelargonidin, cyanidin, peonidin, delphinidin, petunidin and malvidin which differ in the substitution pattern of the B-ring including the number of hydroxyl and methoxy groups.

In the present work, the optimal conditions for obtaining anthocyanidins from the tree bark were selected.

Methodology. The initial raw material was the bark of freshly cut tree bark (birch *Betula pendula*, pine *Pinus silvestris*, spruce *Picea abies*, chestnut *Castanea sativa*, Cedar Lebanese *Cedrus libani*, Siberian fir *Abies sibirica* Ledeb, Siberian larch (*Larix sibirica*)) selected in the vicinity of Novopolotsk. The tree bark was sampled at a distance of 1-2 m from the base. Bark was dried in a drying chamber at a temperature of 105 °C for 5-6 h, ground, sieved. Tar substances were extracted from the larch and fir bark using the Soxhlet apparatus. A weighed portion of bark was extracted with hexane in Soxhlet apparatus.

Total mass fraction of anthocyanidins present in tree bark was determined using the following procedure. A weighed portion of bark, extracted preliminarily with hexane (to remove tar), ethanol was added, then hydrochloric acid. Then volumetric flasks were filled till the volume mark with ethanol, closed with reflux condensers and heated in thermostat at 70–75 °C. After the necessary time interval, the flasks were cooled to 20°C, the solution was filtered through the Schott filter.

Results, discussion and conclusion. The output of the dye and the content of resinous substances are given in table 1.

The extraction of alcohol in the presence of mineral acid (HCl) contributes to the conversion of related dyes in free state, cleavage of sugars and oxidation of substances that are in leuco form, to colored anthocyanidins.

Table 1. – The content of resinous substances and the output of dyes

| Kind of bark | The output of dyes, % wt. | The content of resinous substances, % wt. |
|----------------------------------|---------------------------|---|
| The bark of the chestnut | 8,6 | 0,5 |
| The bark of the cedar of Lebanon | 9,8 | 4,9 |
| The bark of the silver birch | 10,1 | 1,6 |
| Pine bark | 10,5 | 5,9 |
| Spruce bark | 13,3 | 6,0 |
| The bark of the Siberian fir | 16,2 | 9,5 |
| The bark of Siberian larch | 18,7 | 5,1 |



Fig. 2. An aqueous solution of anthocyanidin dyes from wood waste processing

The output of natural anthocyanidin dyes from the bark of different wood species can be 8,6...18,7% wt. for raw materials. Minimum output of the dyes is characteristic of hardwood timber, and the maximum is characteristic for conifers.

Thus, a promising direction of utilization of wood waste from wood debarking of various species is getting from the bark anthocyanidin dyes.

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