# AMOUNTS OF THE MAJOR COMPOUNDS IN NEEDLES OF Pinus sylvestris FROM VARIOUS GROWTH SITES

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In a study of the composition of the extractive substances of the needles of Scotch pine, Pinus sylvestris, growing in Leningrad province it was found that the main components of the extract were monomethyl pinifolate, isoabienol, and polyprenols [1, 2]. The needles of Scotch pine from the Minsk region contained (epimannoyl oxide)-19-oic acid [3], which has not been found in the needles of the pine growing in Leningrad province. In order to study the amounts of these compounds in Scotch pine needles we have made an analysis of pine needles from various growth sites (Table 1).

We determined the amounts of free acids and neutral substances in extracts of the samples of needles, as described in [1]. The amounts of these groups of substances differed according to the growth site: extracts of pine needles from the northwestern regions of the USSR contained the largest amounts of neutral substances (47.7% in the Riga region; 44.5% in Leningrad province), while those from Czechoslovakia contained the largest amounts of free acids (64.6 and 62.8%, respectively from the Šumperk and Czeske-Budeevitse regions).

From the acids were isolated fractions containing monomethyl pinifolate and (epimannoyl oxide)-19-oic acid, and from the neutral substances an isoabienol fraction. The amounts of the acids were determined from the weights of the compounds isolated, and that of isoabienol by the GLC method with an internal standard (Table 1).

The compositions of the compounds from the needles differed according to the site of collection of the samples. As a hypothesis it may be suggested that in the period of the glaciation of the continent the glaciers forced plant life to the south, which could have led to the development of an area of the growth of the Scotch pine from the Urals to Carpathia and to the formation of two main populations – to the southwest of Carpathia and to the southeast of the Urals. In the process of development of the isolated populations, depending on the local growth conditions, changes could have taken place in the gene pools of these populations that found their reflection in the biosynthesis of compounds. On the retreat of the glaciers to the north, the populations of pines, moving after them, could have joined up in the Baltic region, and this, likewise, was in time reflected in the chemical composition of the compounds of the needles.

Deeper and wider investigations are necessary to elucidate the causes of such anomalies in chemical composition, and this will permit a deeper understanding of the history of the

TABLE 1

| Growth site of the pine | Amount, on the weight of the dry needles | | |
|---|---|---|---|
| | monomethyl pinifolate | (epimannoyl oxide)-19-oic acid | isoabienol |
| Krasnoyarsk | 2,2 | 0 | 1,2 |
| Ufa | 2,0 | 0 | 1,0 |
| Leningrad | 2,3 | 0 | 1,1 |
| Riga | 2,0 | 0,2 | 1,2 |
| Šumperk | 1,5 | 0,5 | 0 |
| Czeske-Budeevitse | 1,5 | 0,8 | 0 |

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formation of the areas and of the distribution of the Scotch pine on the continental territory.

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# TRITERPENOIDS IN LEAVES OF URALS AND ALTAI BIRCHES AND QUESTIONS OF THEIR CHEMOTAXONOMY


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We have studied the triterpene fraction of the unsaponifiable part of ethereal extracts of the leaves of three species of birch growing in the Urals and in Zaural'e ["Trans-Uralia"], and three species of Altai birch. For analysis we took mixed samples from 5-10 and more (in the case of bushes) individual specimens. The treatment of the leaves and the isolation and identification of the triterpenoids contained in them were performed by methods described previously [1]. The following triterpenoids were identified: betulafolienetriol (I), betulafolienetriol oxide (II), 12β,20(S)-dihydroxydammar-24-en-3-one (III), betulafolienetetraol (IV), dammar-23-ene-3α,12β,20(S),25-tetraol (V), dammar-25-ene-3α,12β,20(S),24(R)-tetraol (VI), dammar-25-ene-3α,12β,20(S),24(S)-tetraol (VII), 12β,20(S),25-trihydroxydammar-23-en-3-one (VIII), 20(S),24(R)-epoxydammarane-3β,11α,25-triol (IX) and its 11-acetate (X), 20(S), 24(R)-epoxydammarane-3α,11α,25-triol (XI) and its 11-acetate (XII), epiocotillol (XIII), ocotillol (XIV), betulafolienetriol 3,12-diacetate and 12-acetate (XV) and (XVI), respectively, and 11α,25-dihydroxy-20(S),24(R)-epoxydammaran-3-one (XVII). All these compounds have been isolated from various birch species previously.

Information on the amounts of triterpenoids in the leaves is given in Table 1. In its qualitative and quantitative triterpenoid content Betula krylovii is practically identical with B. pendula [1], which confirms the evaluation of B. krylovii as a variety of B. pendula that was made on the basis of biosystematic studies [3].

The results of the comparative chemical analysis of the leaves of B. nana and B. rotundifolia show that these bushy birches are very close species. An individual group readily distinguished from the others in terms of its triterpene alcohols is formed by B. microphylla, B. kelleriana, and B. kirghisorum. From the point of view of systematics, the results obtained objectively show that these species belong to a single cycle of races of B. microphylla.

Among the birch species studied, particular interest is attached to B. kelleriana, in which the triterpene alcohols amount to 1.52% of the weight of the air-dry leaves – i.e., considerably more than in other species and almost twice as much as that generally found in birches hitherto [2]. Also characteristic is the fact that the overwhelming bulk of the total triterpenoids content in this species consists of a single compound, (IX), which shows that the leaves of B. kelleriana are a promising source of a triterpene alcohol of the dammarane series.


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