Determination of Carbohydrates in Water Extract of Balsamic Poplar Leaves with Use of HPLC

Olga O. Mamaeva* and Elena V. Isaeva

Reshetnev Siberian State University of Science and Technology, 660037 Krasnoyarsk, Russia

* Correspondence: olga07_95@mail.ru

Abstract. In this work, the composition of carbohydrates in the aqueous extract of green leaves of balsam poplar was studied with use of high-performance liquid chromatography. Among the carbohydrates identified are glucose, fructose, mannose, galactose and arabinose.

Keywords: poplar, leaves, water extract, carbohydrates, HPLC

Introduction

Carbohydrates are the main nutrients and the main support material of plant cells and tissues. Carbohydrates are a group of natural organic compounds. There are mono-, oligo- and polysaccharides, as well as complex carbohydrates - glycosides, glycoproteins, glycolipids, etc. Carbohydrates are the primary products of photosynthesis and the main starting compounds for the biosynthesis of other substances in plants. They are part of cell membranes and other structures involved in the protective reactions of the body (immunity). In technological and biopharmaceutical terms, carbohydrates are of interest, as they contribute to the dissolution and penetration of biologically active substances into the cells of the body, enhance their effect, and reducing the negative impact on the body. Of particular importance are colloidal polysaccharides – water-soluble carbohydrates.

There is information in the literature about the prospects of using poplar buds and leaves as a source for obtaining effective antibacterial and antifungal drugs [1-3].

Balsamic poplar (*Populus balsamifera* L.), grows in almost all climatic regions of Russia, is frost-resistant and undemanding to the soil, is widely used for landscaping. The tree has a fairly large amount of foliage, which gives the prospect of its study.

The work carried out at the SIBGU named after M.F. Reshetnev has established the growth-regulating activity of aqueous extracts of balsamic poplar leaves in relation to seeds of coniferous and cereal crops [4, 5]. Carbohydrates are among the biologically active compounds that enhance flowering and help the plant develop much faster [6].

One of the most popular instrumental methods for the analysis of carbohydrates from vegetable raw materials is high-performance liquid chromatography (HPLC).

The purpose of this study was to use HPLC to identify carbohydrates from aqueous extracts of balsamic poplar leaves of the Krasnoyarsk Territory.

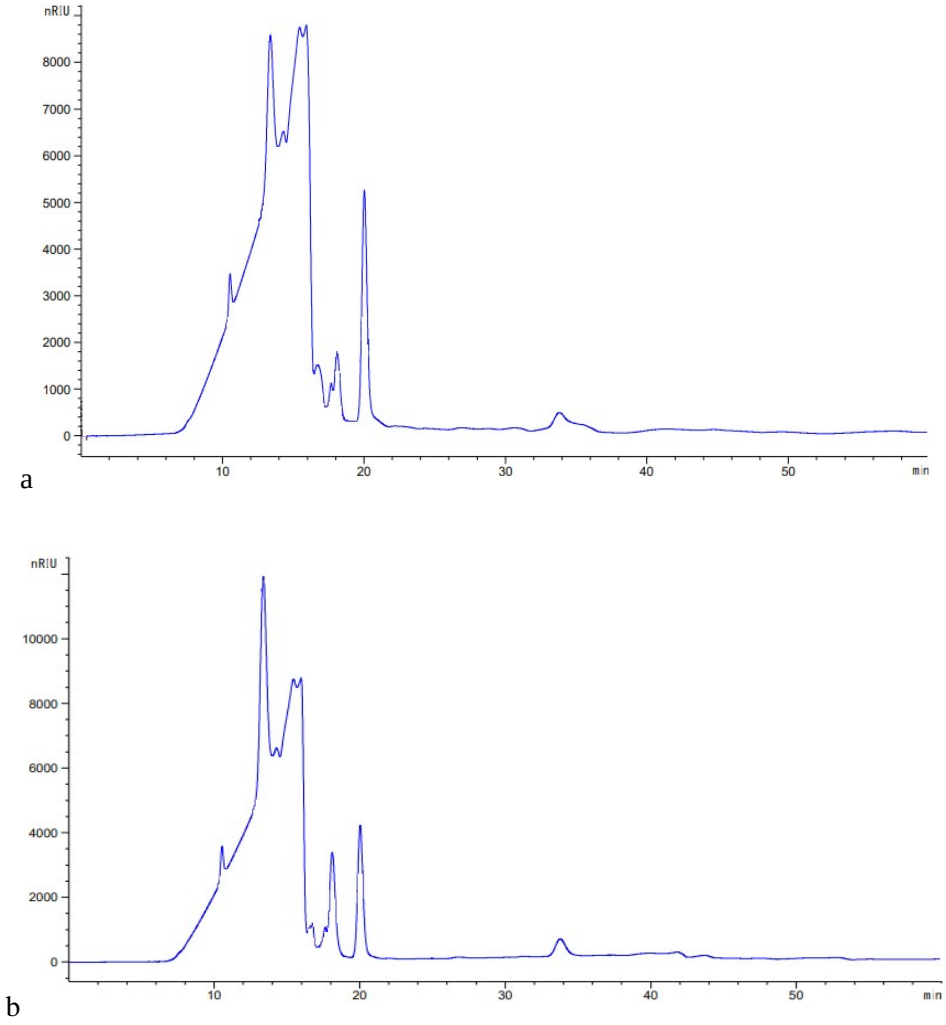
Research methods

Samples of balsamic poplar leaves were taken in the summer period in the middle of each month (June, August) from poplars growing in Krasnoyarsk. A necessary condition of the sample was the quality of appearance: fresh, green, without damage. After harvesting, the leaves were dried to an air-dry state, crushed to 3-5 mm and stored at constant humidity in closed vessels.

The qualitative and quantitative composition of monosaccharides in an aqueous extract of balsamic poplar leaves was determined using the Agilent 1260 Infinity II high-performance liquid chromatography complex. Chromatographic column: Rezex HPLC RPM Monosaccharide Pb2+ (8%) 300 × 7.8 mm, refractometric detection (RID), UV detection (registration at λ = 190, 210, 230, 260 nm), isocratic mode, eluent deionized water, temperature 70 °C, elution rate 0.6 ml/min. The samples were subjected to filtration on a membrane (0.45 microns) and injected into a chromatograph.

Research results

Chromatograms of monosaccharides of aqueous extracts of balsamic poplar leaves after inversion are shown in Fig. 1. Inversion was performed using concentrated sulfuric acid during boiling for 3 hours [7].



a – leaves harvested in June, b – leaves selected in August

Figure 1. Chromatogram of monosaccharides of aqueous extracts of leaves after inversion

The quantitative composition of sugars of the aqueous extract of poplar leaves is presented in Table.1.

Table 1. Composition of sugars of water extract of poplar leaves

Monosaccharide	Holding time, min	Sugar concentration, mmol/l	
		June	August
Glucose	13.376	0.621	13.038
Galactose	15.186	0.770	0.787
Arabinose	16.776	1.120	0.385
Mannose	17.328	1.134	0.257
Fructose	18.109	1.558	0.151

Studies have shown that the composition of carbohydrates changes during leaf development (Table 1). The composition of sugars of aqueous extracts in June leaves is dominated by fructose (about 30 % of the sum of sugars), mannose (21.8 %) and arabinose (21.5 %). In August, glucose predominates in the aqueous extracts of poplar leaves (89 %).

Conclusion

Thus, in aqueous extracts of balsamic poplar leaves, the following were identified by HPLC: glucose, fructose, mannose, galactose and arabinose.

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Conflicts of Interest

The authors declare no conflict of interest. The funders had no role in the design of the study; interpretation of data; in the writing of the manuscript and in the decision to publish the results.

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