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Peculiarities of the composition of acids in Sphagnum species of the percolation bog of the Kolkheti lowland

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ABSTRACT

This paper focuses on the chemical composition of the *Sphagnum* species such as *Sph. palustre, Sph. Papillosum, Sph. rubelum, Sph. imbricatum, Sph. cuspidatum* belonging to the unique, virgin, relict, percolation bog "Ispani 2". The determination of the content of biologically active substances in species was carried out using gas chromatography (GC-MS/MS). As it turned out, the Sphagnum contains biologically active substances such as the hexadecanoic acid - palmitic acid, fatty acid - oleic acid – Cis-9-Octadecenoil acid, and the carbohydrates such as Alpha-D-Glucopyranoside, ribofuranose and phenolic compounds - phenolic acid - Methyl 4-O-benzyl-á-D-xylopyranoside; phthalic acid or 1,2- Benzenedicarboxylic acid.

Introduction

Polysaccharides, phenols, hexadecanoic acid, fatty acids produced by some plants have recently attracted the attention of scientists because of their good antiseptic, immunomodulator, mycotoxic and cytotoxic effects. Over the past decade, biotechnology methods have been based on an innovative and interesting method - their use as an antimicrobial agent [1,2].

Today, scientists considered Sphagnum as a source of many biologically active substances that have antibacterial, antiviral, antifungal effects. Their chemical analysis for the content of biologically active substances, namely secondary metabolites is important. It has been found that Sphagnum species contain a large number of glycosides, phenols, and lipids [3,4]. Biologically active substances found in some species have the cytotoxic effect on cancer cells [5,6].

Sphagnum has long been used in ethnopharmacology for the treatment of infected wounds, eye diseases and intestinal infections [2,7,8].

The high content of polysaccharides was found in five species such as *Sphagnum balticum, Sph. fallax, Sph. fuscum, Sph. Lenense, Sph. Girgensohnii.*

As a result of the research, it was found that the content of polysaccharides was 10% in the studied species, except one. *Sph. girgensohnii* was the exception, which contained 26% of polysaccharide content. This difference between species is associated with the growth of these species in different environmental conditions. Oligotrophic, sun-loving sphagnum species such as *Sphagnum balticum, Sph. fallax, sph. fuscum, sph. Lenense* contain 9,5–10,7% of polysaccharides, whereas mesotrophic species such as *Sph. Girgensohnii* spreading to swamp forests and living under low lighting, contains 26% of polysaccharides [9]. Phenolic compounds extracted from leaves of *Sphagnum papillosum* were tested for antibacterial activity of *Staphylococcus aureus* 50084 [10,11]. It was found that sphagnum species belonging to oligotrophic peat are rich in $C_{16} - C_{30}$ esters, and mesotrophic peats contain a relatively low concentration of esters [12].

Georgia, namely the South Kolkheti lowland are characterized by an abundance of peat, but the most important thing in the world is the unique, virgin, percolation bog "Ispani 2", formed during the tertiary ice age, and its ecosystem is relict [13–15]. Therefore, it is important to determine the content of the chemical composition of some Sphagnum species that spread to Ispani 2 mire in the Kolkheti peatland.

Objectives and methods

The study was conducted on five sphagnum species, such as *Sph. palustre, Sph. Papillosum, Sph. rubelum, Sph. imbricatum, Sph. cuspidatum*. Hence, Sph. Imbricatum is rare and sensitive species to air pollution [16], which has been preserved by the virgin, percolation bog of "Ispani

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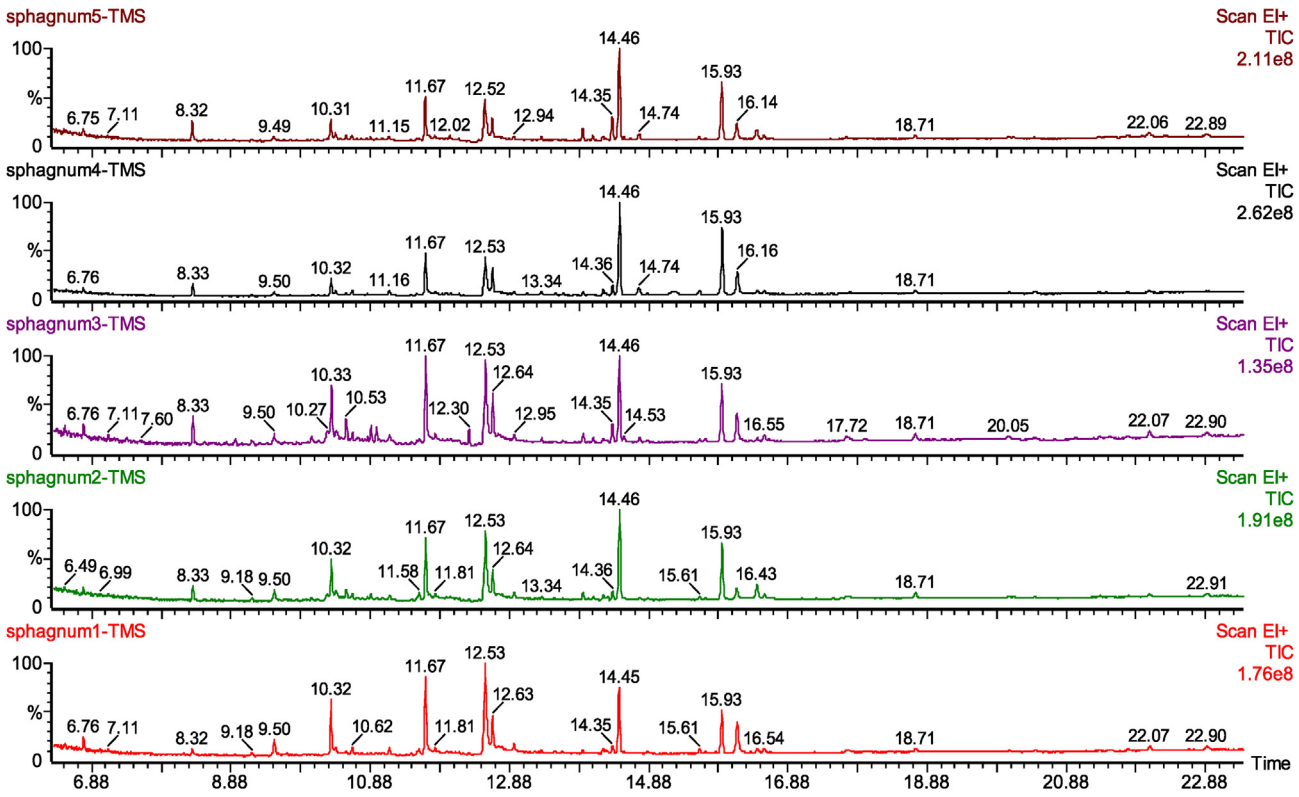

Fig. 1. A range of substances of Sphagnum moss detected by using GC-MS/M. Figures on the diagram describe the retention time of the listed substances as indicated in Table 1.
(The sample Sphagnum 1 corresponds to Sph.rubelum, the sample sphagnum 2 corresponds to Sph. papillosum, the sample sphagnum 3 corresponds to Sph.palustre, the sample sphagnum 4 corresponds to Sph. cuspidatum and the sample sphagnum 5 corresponds to Sph. imbricatum).

Table 1
Biologically active substances detected in Sphagnum species using GC-MS/MS.

	Retention time	Chemical name	Molecular weight
1	8,32	Malic acid	134,08744
2	9,5	1,2- Benzenedicarboxylic acid	166.13084
3	10,32	Dimethyl 1.4-cyclohexanedicorboxylate	200,23
4	10,53	Glucofuranosa	220.21974
5	10.62	Myristic acid	228.37
6	10.88	D-xylose	150.1299
7	11.16	Methyl 4-O-benzyl-beta-D-xylopiranoside	254.27
8	11,24	Ascorbic Acid	176.12412
9	11.67	Cis-9-Palmitoleic Acid	326
10	12,53	Cis-9- Octadecenoil Acid	282,46136
11	13,93	3-O-Alpha-D-glucopyranosyl-D-fructose	342,29648
12	14,0	Arabinose	150,1299
13	14,23	Glycerol-3-palmitate	330,50262
14	14,36	Alpha-D-glucopyranoside	918
15	14.35	Ribitol	152,14578
16	16.55	1-(4-Methyl-6-methoxy-2-quinolyl)1′-phenyl-3,3′-dimethyl-(4,5′-bipyrazol)-5-ol	425

2". *Sph. imbricatum* is associated with the remaining 4 species (*Sph.palustre, Sph. Papillosum, Sph. rubelum, Sph. cuspidatum)* in the percolation bog of the Kolkheti lowland. The determination of their chemical composition and the care of conservation are important for the preservation of species.

The objects of research were made in February 2016. Samples were taken from the buffer and dome zones of the percolation bog of "Ispani 2" of the Kolkheti lowland.

Experimental section

The study material was at a room temperature for 24 h and was dried at 30–70 °C in Termo scientific. After evaporating the organic solvent of samples presented in the chemical studies, 50-50µ BSTFA/ EtAc (40:10) was added separately to dry compounds, heated to 70 °C. for 20 min 1-1 µl was studied after cooling using the method of Gas chromatography tandem-mass spectrometry (GC-MS) under the following conditions:

For analysis of methanol extracts, we used the tool – Agilent Technologies 7000 GC/MS/MS Triple Quad, the pipe – Eline 5-MS; 30m × 250µm × 0.25 µm, the heater temperature - 60°C–310 °C (Mode software), the injector temperature - 250 °C and carred gas Helium – 1 ml/m.

Multilateral processing of the material was carried out after the development of the mass spectrum.

Results and analysis

16 biologically active substances were detected in 5 species of Sphagnum (*Sphagnum austinii Sull.* (*Sphagnum imbricatum ssp. Aus*tinii), *Sph. papilosum Lindb., Sph. palustre L., Sph. cuspidatum Ehrh.ex Hoffm., Sph. rubellum Wilson.*) by using the gas chromatography - The Agilent Technologies 7000 Series Triple Quad GC/MS/MS. The qualitative difference in the detected range of substances was observed in the investigated objects (Fig. 1). In spite of the fact that the species of one genus were studied, the difference was found between their chemical composition, which is due to the peculiarity of the spread.

Sphagnum austinii Sull. - spreads to the dome;

Sph. papilosum Lindb., – spreads to the dome;

Sph. rubellum Wilson – spreads to the dome and its margin. *Sph.*