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Chemical properties of peat in 7 mires with balneological potential in Estonia

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Natural processes of organic matter transformation in peat lead to the formation of humic substances. Chemical composition of organic matter of peat is depended on genetic peculiarities of peatlands and depth of sampling. Peat bogs are very important as carbon sinks. Peatlands in several regions revealed actively sequestering carbon. Peat organic matter regulates long-term C storage and nutrient availability to plants and microbes. Peat and various peat preparations have been successfully used in the balneological practice of clinical medicine. Many factors as a chemical component may contribute to the clinical success of cutaneous peat treatment because several pharmacological effects have been found which cannot be contributed to the well-established physic-thermal effects. Fulvic, humic and hymatomelanic acids, all of which have been isolated from peat, have been found to be of particular importance when considering the biological effects of peat.

The balneological peat has special restrictions. It should be ecologically clean, do not contain trace elements, which are hazardous for human health. Previous studies in Estonia have shown essential increase of concentrations of trace elements in the lower layers of peat, what is driven from the bedrock (Devonian sandstone in South, Dictyonema argillite in North Estonia) by the groundwater.

Seven study areas were chosen according to the research and mapping of Estonian peatlands. The samples were taken from the middle layers of peat, where the environmental influence is minimal. The genesis of peat deposit was mainly lake paludification, mineral subsoil sand-clay, vegetation pine forest, nutrition precipitation, degree of humification 40-50% and moisture content 85-90%. Peat type varied, but cotton grass and sphagnum were dominating. Isolation of humic compounds was achieved using standard International Humus Substance Society procedure. The content of humic, fulvic, and especially hymatomelanic acids varied significantly between peatlands and even in different layers in the same peatlands. In Parika peatland the concentration of humic acids was equal to 39,3%, hymatomelanic acids 19,3% and fulvic acids 1,3%.

The content of 23 trace elements was determined in 4 peatlands. It was observed that the concentrations were lower than Estonian average and also the average in middle layers in peatlands in Estonia. The correlation coefficients between the contents of humic substances and trace elements were very different among the metals – some cases positively, some cases negatively correlated. The correlation coefficients were significant and stronger with fulvic acids compared to humic acids.

The peat suitable for balneological purposes is mainly well humified (40-50%, von Post 6-8) raised bog peat. It was revealed that the content of bioactive substances in sampled layers is high and the quantity of trace elements is lower than on average. The investigations have shown that humic substances have a high affinity for metal ions. Functional groups of the humic substances (-COOH, -OH, $-NH_2$,=NH, $-SO_3OH$, $-SO_2OH$, SH, -S=O and aromatic heterocyclic rings) major constituents of peat, are responsible for the cation exchange capacity of peat. The selectivity or preference of peat for several metal ions has no well-established order. The ordering apparently depends on the type of peat being investigated.