The properties of Estonian balneological peat

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Summary

Balneological peat is widely used because of its curative effects. For the present study seven study areas were chosen according to the research and mapping of Estonian peatlands. The studied peat deposit has mainly been formed by lake paludification. The mineral subsoil is represented by sand-clay, the vegetation consists of pine forest, the bog derives its nutrients from precipitation; the degree of humification is 40–50% and moisture content 85–90%. The peat types varied, but cottongrass sphagnum peat predominated. The content of trace elements was lower than on average in Estonian peatlands peat. The content of humic, fulvic, and especially hymatomelanic acids varied largely between peatlands and even in different layers in the same peatlands. In Parika peatland the concentration of bioactive substances was the highest, including 39.3% humic, 19.3% hymatomelanic and 1.3% fulvic acids.

Medical tests with Parika peat were performed on 23 patients. Peat was heated up to 42 °C and the patients kept their hands in a plastic bag filled with peat for 25 min. The procedure was repeated 10 times. Clay will be used as the control treatment for 27 patients. Balneological peat improved the strength of hands and flexibility of fingers and reduced pain.

Key index words: balneology, humic acids, fulvic acids, hymatomelanic acids, humification

Introduction

Peat and various peat preparations have been successfully used in the balneological practice of clinical medicine because of their curative effects (Beer *et al.*, 2007). According to the experience of other countries, the peat suitable for balneology has to be well humified (40–50%). The natural moisture content of peat has to be at least 85% and the peat layer has to lie under the peat water level (Korhonen, 2004).

Balneological peat exerts physical effect through temperature and biochemical effect through bioactive substances (Lukanov *et al.*, 2002). As several pharmacological effects cannot be explained by physico-thermal effects alone, the chemical component has to be responsible for the clinical success of cutaneous peat treatment. 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 (Beer *et al.*, 2003). Balneological peat has to be ecologically clean and contain trace elements in amounts that are not hazardous to human health (Orru and Orru, 2006).

Materials and methods

Seven study areas were chosen for the study (Fig. 1) according to the research and mapping of Estonian peatland. Through geological survey the natural conditions, especially vegetation and water regime were investigated. It was established that in two peatlands (Armiko and Epa-Vassaare) well-humified peat was below the water level due to drainage and they were excluded from further analysis.

First the thickness and positions of the suitable layers for balneological peat, and the depth of the peat layers were measured using a borer. Afterwards, 14 peat samples were taken from the middle layers of peat where the environmental influence is minimal, in order to determine the contents of humic, hymatomelanic and fulvic substances and trace elements.

Natural peat was treated with 0.2M NaOH. Humin was isolated as precipitate in centrifugation and was washed repeatedly with distilled water to separate humic substances. Humin – the insoluble part of peat – was dried. Humic substances stayed in the solution. Concentrated HCl was added to the solution until pH value was 2, and soluble

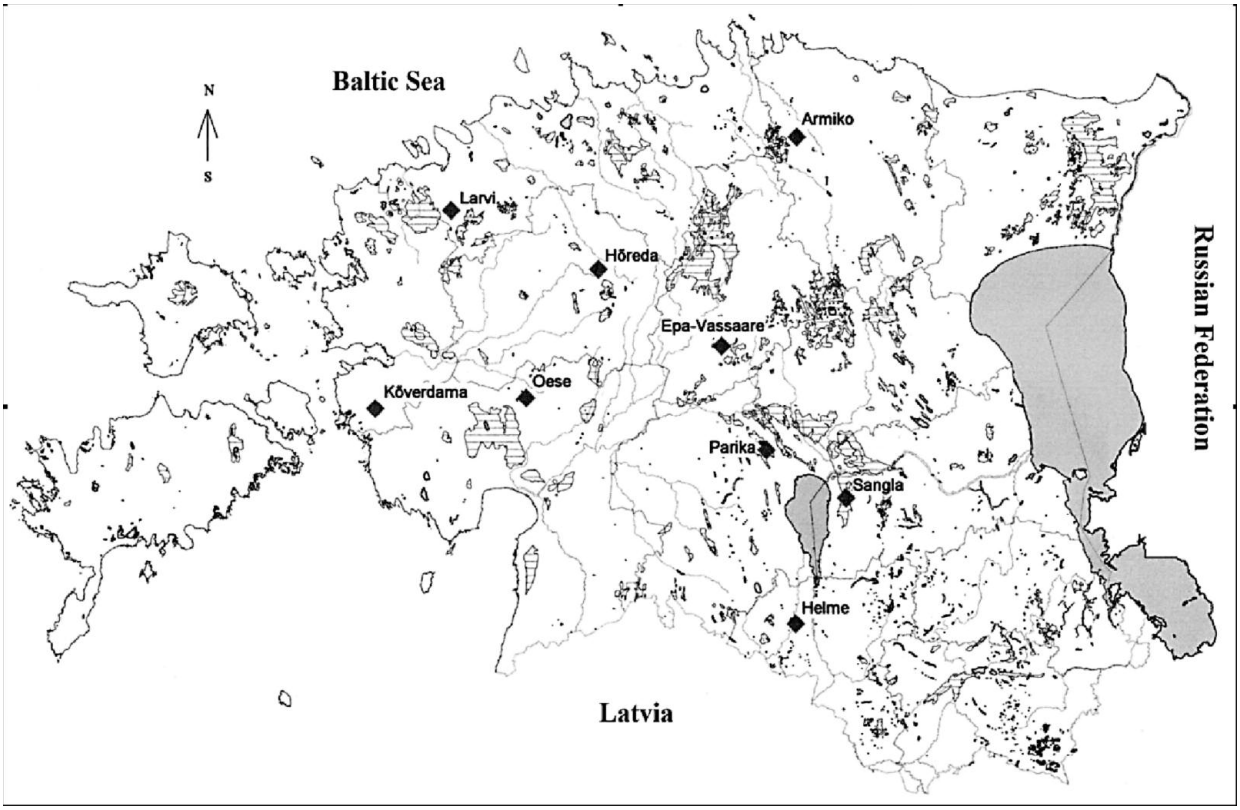

Figure 1. Study areas.

fulvic acid and insoluble humic and hymatomelanic acids were separated. The precipitate was repeatedly treated with ethanol to isolate soluble hymatomelanic acid and insoluble humic acid. Both fractions where dried. The fulvic acid solution was poured through XAD-7 gum for desalination. By treating the gum with 0.1M NaOH, the pure fulvic acid fraction was separated, which was transmitted to acidic form with the ion exchanger IR-120. The obtained fraction was dried.

Eight samples were analysed in the Biotech Ltd. laboratory in Finland. Peat was dried and mineralised with HCl and HF acids at pH value 0.7. Next, the solution was filtrated and the precipitate was washed with 0.1 M NaOH. pH value was regulated with 1M HCl. Subsequently the mixture was centrifuged and the concentrations of fulvic and humic acids were measured.

The contents of 34 trace elements were analysed in the laboratory of the Geological Survey of Finland. The following methods were used:

- the IPC-MS method – for As, Ag, B, Ba, Be, Bi, Cd, Cr, Cu, Li, Mo, Ni, Pb, Rb, Sb, Se, Sr, Th, Ti, U, V, Zn;
- the IPC-AES method – for Al, Ca, Fe, K, Mg, Mn, Na, P, S, Si, Ti;
- the sulphur analyser – for sulphur.

Medical tests with Parika peat were performed on 50 patients suffering from the Heberden–Bouchard disease (*Osteoarthrosis deformans*) in fingers. The peat was heated up to 42 °C and the patients kept their hands in a plastic bag filled with peat for 25 minutes. This procedure was repeated 10 times with 23 patients. Clay will be used as the control treatment for the other 27 patients – these tests are still in progress. The improvement in the strength of hands and flexibility of fingers, and decrease in pain as a result of the treatment with balneological peat were assessed according to the International Classification of Functioning, Disability and Health (ICF).

Results

The study showed that in this case the depth of the balneologically usable peat layers were 0.85-1.50 meter. This layer can be separated in mining and one can be sure that the peat comes from the right depth interval. Layers at depths less than 0.7 m are technically and economically difficult to use. In all study areas balneological peat is positioned in the middle of the peat layers, being thus least affected by atmospheric pollution, anthropogenic activities and entry of trace elements from the bedrock with groundwater and springs. There, the concentration of trace elements was lower than the average of Estonian peatlands (Orru and Orru, 2006).

The peat suitable for balneological purposes is mainly well humified (40-50%, von Post H6-H8) raised bog peat, mostly represented by cottongrass sphagnum, wood-cottongrass sphagnum and heath-cottongrass spaghnum types. All areas in peatlands where balneological peat can be found are in the natural virgin mire state. The water level is 0.3-0.6 m beneath the ground level, so the moisture content (85-92%) is greater than the minimum permitted value (85%) (Table 1).

The laboratory analyses showed that all studied layers contained humic, hymatomelanic and fulvic acids, which

Table 1. Characteristics of research areas

	Genesis of peat deposit	Mineral subsoil	Vegetation	Nutrition	Depth of the peat layer, m	Peat type	Degree of humification, %	Ash content, %	pH	Moisture content, %
Hõreda	Lake paludification	Sand-clay, sand	Pine forest	Precipitation	0.60-1.70	Cottongrass, pine-cottongrass peat	45-50	2.1	4.4	86
Kõverdama	Paludification	Clay-sand	Pine forest, mosses	Precipitation	1.30-2.80	Heath-sphagnum, heath cottongrass peat	40-45	4.5	4.55	88
Larvi	Lake paludification	Gyttja, sand-clay	Pine forest, open mire	Precipitation	0.50–1.35	Cottongrass, cottongrass-sphagnum peat	40-45	3.2	4.7	88
Oese	Lake paludification	Gyttja, sand-clay	Pine forest	Precipitation	0.75-1.60	Heath-cottongrass, pine-sphagnum peat	40-50	4.9	5.1	85
Parika	Lake paludification	Sand	Pine forest	Precipitation	0.70-1.60	Pine-sphagnum, forest-cottongrass peat	50	2.8	4	87
Sangla	Basin paludification	Gyttja, sand-clay	Pain, birch forest	Precipitation	0.70-2.00	Heath-sphagnum, heath-cottongrass peat	40-45	4.8	4.8	88
Helme	Basin paludification	Sand	Open mire	Precipitation	0.50-1.40	Wood-cotton-grass, cottongrass sphagnum peat	40-45	1.8	3.3	90

are good for human organisms due to their healing properties (Figs. 2, 3). Most of these substances can be found in the Kõverdama, Parika, Hõreda and Larvi peatlands. The content of humic substances in Estonian peat is high (up to 60%).

Nineteen of the 23 patients tested finished balneological peat treatment successfully. The results on the ICF scale showed that

- pain decreased in 95% of the patients;
- mobility of finger joints improved in 74% of the patients;
- the minimal distance between the 3rd finger and the centre of the palm improved in 35% of the patients;
- the catching ability improved in 42% of the patients.

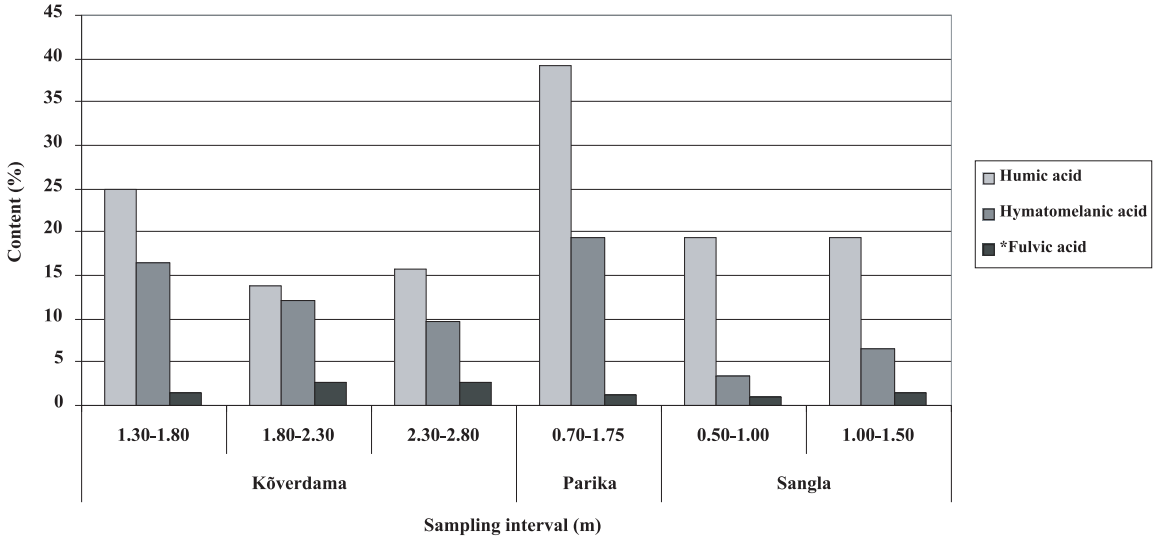

Figure 2. The content (%) of humic, hymatomelanic and fulvic acids in the Kõverdama, Parika and Sangla peatlands. Analyses made in the Pärnu College Laboratory, University of Tartu.

* Pure fulvic acid, where during the analysis low molecular fractions and soluble salts are separated

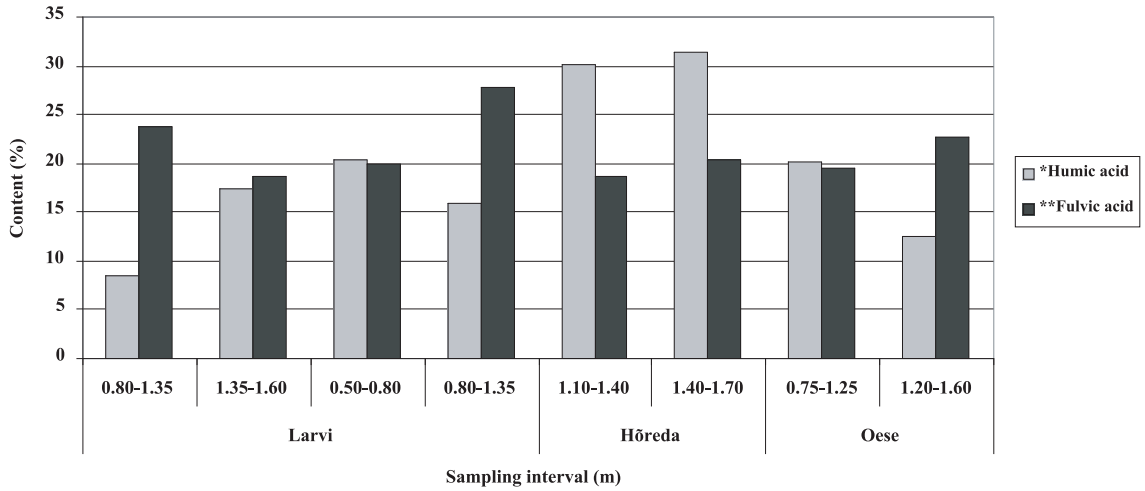

Figure 3. The content (%) of humic and fulvic acids in the Larvi, Hõreda and Oese peatlands. Analyses made in CRS - Biotech OY in Finland during cooperation between the Geological Surveys of Estonia and Finland.

*The content of humic acid includes also hymatomelanic acids, which was not measured separately

** The fulvic acid contains also low molecular fraction and soluble salts

The feedback from patients was positive. Even if in two cases there was no improvement on the ICF scale, the patients were still satisfied and said that they were feeling better. Four patients had to stop the clinical tests, which shows that balneological treatment with peat does not suit everybody. Clinical tests with clay as the control group are in progress.

Conclusions

The study shows that Estonian peat can be successfully used for balneological purposes. The content of bioactive substances in peat is very high (up to 60%). The treatment with balneological peat had good effect on most patients with the Heberden–Bouchard disease (*Osteoarthrosis deformans*) in fingers. Some patients had to stop the treatment because of hypersensibility. The utilisation of domestic peat in balneology is in progress in Estonia.

Acknowledgements

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