A CASUISTIC STUDY ABOUT BEHAVIOUR OF HUMIC SUBSTANCES IN A PATIENT'S EXPOSURE TO WHOLE BODY BATH

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***Abstract**:*

Humic substances represent the essence of the chemical impact of peloid baths, e.g. baths in peat and mud, and eventually in their extracts. This chemical effect is beneficially associated with flotation, compressive and thermic effects. Whether, and at which level the transition of humic substances has an effect on the patient's body, has been a subject of an ongoing debate for years. In this context, the importance of the application of the bath temperature, the degree of ionization and current pH are all highlighted. In a simple formula, we have followed the behaviour of humic substances to the patient's exposure to the whole-body bath. The concentration of humic substances in the bath was monitored after the addition of 100 ml of aqueous extract containing 54 g/l placed into the bath with warm water (39°C) with or without a patient/client. 250 ml samples were taken at the following time intervals 0 = start, 15 min., 20 min. and 30 min. After making adjustments for evaporation, the concentrations of humic substances in samples from the baths with or without a patient/client, were compared. The concentration differences were recalculated per 1 m^2 of the body surface of the exposed person. The results lead us to the assumption that in a selected system it can be expected that the concentrations decrease (and therefore likely extraction to the skin of an exposed person) by 4 mg/m^2 of the body surface of the exposed person. Expressed quantitatively, it is a minimum of 477.27 mg/m^2 of the body surface of an exposed person.

***Key words**: Peloids, peloid extracts, humic substances, transfer of humic substances to human organism.*

1 Introduction

Humic substances according solubility are divided into: Humins, Humic acids and Fulvon acids. Humins are completely insoluble in water and at any pH. They are characterized by a black colour, the highest degree of polymerization, high molecular weight (about 100 times higher than fulvon acids). They also contain the most carbon (62%) and the oxygen (30%) Humic acids are insoluble in water at pH 2 or less, while at higher pH dissolve. A typical coloor is brown to brown-black. Fulvon acids are soluble in water regardless of pH. They are the lightest of humic substances, but the least intense coloration feature the lowest molecular weight and lowest degree of polymerization. They contain a higher percentage of oxygen (48%) than carbon (45%). It is evident that humic substances exist in heterogeneous combination with components and that cannot be separated.

Humic substances are the main chemical agent at therapeutic application pelloids (Ascheim, Holweg 1933; Taugner 1963; Brožek 1981; Flaig et al. 1988; Amosova et al. 1990; Jurcsik 1994; Iubitskaya, Ivanov 1999; Petr 2004; Kloecking, Helbig 2005; Petr et al. 2009, 2012). Their importance was presented like entirely new one in physiotherapy by Zeman (2013). Humic substances in organic systems and their eco-toxicological aspects are described in detail by Bittner (2007). Benefit and effect of humic and peloids compounds on quality of life as hydro-mineral interventions are described by Petr (2004).

Entry of humic substances in the target tissue in an experimental arrangement can be “in vitro” (Vašková et al. 2011) or “in vivo” using lower vegetal and animal organisms reckoned and does not iniciate any questions or discussion (Schultz, 1962; Boland, 1995; Schneider et al., 1996; Hoess et al., 2002; Steinberget al., 2004).

Questions and discussions are encouraged about the possibility of peloid and humic substances transfer to the organism in higher organisms, especially human organism (Schultz, 1962 Taugner 1963; Brozek, 1981; Flaig et al., 1988; Kolarik, 1988; Amos et al., 1990; Mesrogli et al., 1991; Jurcsik, 1994; Bellometti et al. 1997; Iubitskaya, Ivanov, 1999; Kloecking, Helbig, 2005; Janda, 2008, 2010; Vačkářová, 2011; Petr et al., 2012; Zezulková, 2012). Honest, but somewhat provocative statement of Prof. Dr. Renate Kloecking, namely that: "... questions, if and in which degree a transfer of humic substances leads to the transfer of humic substances to a patient during peloid baths, are still waiting for their response…" led the authors attempted to find such an experimental arrangement, which would help in the experiments to find an answer to this question (Kloecking, Helbig, 2005).

2 Objective

Objective of the present study is declaration: Whether, and at which level the transition of humic substances has an effect on the patient’s body.

3 Methodology

The concentration of humic substances in the bath was monitored after the addition of 100 ml of aqueous extract containing 54 g/l placed into the bath with warm water (38°C), with or without a patient/client. After the pouring of the named dose of the extract in water in the bath, the water was mixed to ensure homogeneity of extract concentration in water baths.

3.1 Experimental monitoring of humid substances concentration changes during the bath of participant

Healthy volunteer, a participant with a body surface area (BSA - Body Surface Area) 2.2 m^2 was placed in a stainless steel bathtub, containing 150 l of water with 100 ml of aqueous peat extract in the concentration of 54 g/l = 54 000 mg/l. Additive baths batch was 5 400 mg. The air temperature in the room was at the level of the upper edge if the application tubs, i.e. 28°C. The water temperature in the bath has been 39°C. In time intervals 0 = start, 15 min., 20 min. and 30 min. were collected composite samples of 250 ml in the 380 ml tubes with a screw cap. Samples were stored in the refrigerator at 4°C and were transported next day (by a car-courier) to be analysed in laboratory. The concentration of humic substances (HL) was determined in mg/l (by UV absorbance at 254 nm).

3.2 Control monitoring of humid substances concentration changes without presence of the participant in bath

In the same bathtub were dissolved 100 ml of the aqueous extract containing 5 400 mg at a concentration of HL 54 g/l = 54 000 mg/l. Other viewing conditions were the same as in the experimental monitoring of humid substances applications, but without a human body (principle of “ceteris paribus” condition).

4 Results and discussion

After making adjustments for evaporation, the concentrations of humic substances in samples from the baths with or without a participant, were compared. The concentration differences were recalculated per 1 m^2 of the body surface of the exposed person. During the Experimental monitoring of humid substances concentration changes during the bath of participant, followed changes in the humin substances concentration were found, see Table 1.

***Table 1** Humin Substances Concentration Changes during the Experimental Monitoring*

Time	Humin Substances Concentration, mg / l
0	36
1	29
2	31
3	33

Explanations: 1 = 15 minutes 2 = 20 minutes 3 = 30 minutes since the Time 0.

During the Control monitoring of humid substances concentration changes without presence of the participant in bath were found, see Table 2.

Between time 0 and 1 occurred in the application in human to a decrease of the humin substances concentration of 36 mg/l to 29 mg/l, difference is about 7 mg/l. Quantitatively expressed, it is about 1050 mg. Very likely, this phenomenon cannot explain otherwise than the humin substances transition into the participant. It is about 477.27 mg/m^2 of body surface of the exposed person 2.2 m^2.

Table 2 *Humin Substances Concentration Changes during the Control Monitoring*

Time	Humin Substances Concentration, mg/l
0	18
1	19
2	20
3	21

Explanations: 1 = 15 minutes 2 = 20 minutes 3 = 30 minutes since the Time 0.

When monitoring the concentration of humin substances a configuration without application in humans does not decrease the concentration humin substances can be ruled adsorption on the walls of application bathtub. Contrary that, concentration of humin substances slightly but steady raised. This phenomenon requires a thorough discussion. It cannot be explained otherwise than by taking account of water evaporation from the bathtub (Whitehouse et al., 1932).

4.1 Discussion

The fact that the concentration of humic substances during the herbal bath without the presence of exposed person rises, can be hardly interpreted otherwise than through the evaporation of water as a solvent. To evaluate this evaporation when applying full-body bath or predict it in advance, it is important in terms of technological, economic and the therapeutic. In evaluation of vaporization of installations intended for bathing/swimming of patients/clients located inside buildings are interesting many authors (Bowen, 1926; Shah, 2003; Asdrubali, 2009). Evaporation general or installation of water surfaces outdoor stationed, is also involved of numerous authors (Sartori, 2000; Tang, Etzion, 2004). For assessment situation in our chosen configuration there is the most especially beneficial work of Franscesco Asdrubali (2009). But by their working team created nomogram – Scala – is processed only to a temperature of water untill 30°C. Under conditions of 50% relative humidity, ambient temperature environment - air 28°C and the speed of air movement in room is below 0.05 m/sec indicates, that the expected evaporation can be about 0.190 kg/m^2 of water bath in 1 hour. Taking into consideration that we used the temperature of the water bath 39° C, it is necessary to expect (substantially) higher evaporation.

When calculating the loss of water by evaporation in our chosen arrangement, if we divide the dose batch 5 400 mg of the sought concentration, we find really water losses considerably higher. This phenomenon we will try to explain in our next planned work, taking into account the performance of installed climate and other factors (ATPS - actual temperature, pressure, saturation, i.e. room temperature, air pressure, saturation – relative humidity).

To estimate the actual reduction of humic substances and to anticipate changes in the body of exposed person is therefore necessary to create a model, which described reduction of water as a solvent will take in account.

In expressing of the relationship - Absolute Humin Substances Reduction in mg during the bath to the body surface of the exposed person 2.2 m^2 and the time factor we are coming to the following results (Table. 3).

Table 3 *Model of humic substances reduction according transfer from bath into participant*

Time/Min.	**Absolute Humin Substances Reduction (mg)**	**Surface Humin Substances Reduction (mg/m^2)**	**Surface Humin Substances Reduction/Min. (mg/m^2)**
0	0	0	0
15	1 508,2	685,45	45,703
20	171,2	77,818	15,546
30	176,0	80,00	8,00

5 Conclusions

Presented pilot study reflects the search for appropriate methods and effective technologies for the evidence of absorption of humic acids in skin. The authors´ team is aware that the problematic is very challenging.

In the selected arrangement can be expected that in the bath with humic substances to the transfer of these substances into the human body, in grade minimally of 477.27 mg/m^2 of the body surface.

The speed of this transfer can be expected at least of 31,818 mg/m^2/min. The transfer takes place with the maximum intensity apparently in the first fifteen minutes.

The changes recorded later, i.e. in 20 and 30 minutes are almost negligible. Expressed a decrease in concentration in the bath application may be expected to fall by 4.06, 4.07 and 4.08 mg/m^2 surface body exposed, at times 15, 20 and 30 minutes of applications. Submitted statements we present as justified expectations.

To this problematic we plan to give a strong attention, especially according the conditions and parameters of water evaporation from bath for the baths with herbals in application rooms of mud baths in the City SPA Třeboň.

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