

The therapeutic effects of mud

Chadzopulu A.^{1*}, Adraniotis J.¹, Theodosopoulou E.²

¹ General Hospital of Kavala, Greece

² University of Athens, Faculty of Nursing, Greece

ABSTRACT

Mud baths have been known and used for thousands of years, but their mechanism is not fully understood. Mud therapy has been successfully used in the treatment of neurological, rheumatologic (osteoarthritis) and cardiovascular disorders, gynecological conditions (inflammatory

and menstrual cycle disorders) and skin pathology (eczema, acne, psoriasis, dermatitis). We present recent data on the mechanism of mud baths and their clinical application.

Key words: mud, therapeutic properties, clinical application

***Corresponding author:**

General Hospital of Kavala

Agios Silas 65-500 Kavala

Greece

E-mail: antygonah@interia.pl (Chadzopulu Antigoni)

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The benefits of mud therapy

Mud baths have been known and used for thousands of years, but their mechanism is not fully understood. These treatments are enjoyable and are a relaxing and luxurious experience. Mud baths are also used in the treatment of rheumatism and various skin conditions. The use of natural occurring mud baths in these ailments is known as fangotherapy, within the spectrum of balneotherapy [1].

In May 1996, the National Greek Institute of Health declared Krinides mud baths to be medicinal, putting it in the category of mineral springs of local importance (Tab.1; Fig 1, 2) [2].

Mud, according to a generally accepted definition, is a mixture of inorganic and organic matter with water, which has undergone geological and biological processes under the influence of various physicochemical factors. Mud has been used empirically in musculoskeletal and inflammatory joint diseases [3-5]. Mud-pack application alone or in combination with balneotherapy has been found to be effective in painful arthritic processes. It has been shown to induce anti-inflammatory activity and influence the anti-oxidant system in patients with osteoarthritis [5,6].

Antiseptic and substances interchange capacity are attributed to (mainly) the inorganic components of mud [2]. The mud can be applied locally or totally. Effects of mud-application include: increase in membrane electrical conductance, absorption phenomena, hyperemia, hydro-poietic glands, enzymes and hormones activation (Tab.1). Scientific studies revealed that bath therapy increases skin temperature, impacts on cardiovascular systems, water-electrolytes balance, neurotransmission (central nervous system, neural conductivity), immune system, enzymes activation and metabolism [2,4,5].

Chemistry of mud

Natural organic compounds with biological activity are extensively used in treatment of many diseases and are of great interest both as natural products and precursors for synthetic compounds [7].

Sal'nikova et al. [8] studied the therapeutic effects of mud from the saline Lake Tinaki-1 (Russia). In the therapeutic mud from this lake, the decomposition of the organic matter was performed by bacteria, (250 million/g). The high carbon content of the microbial biomass (0.06 mg/g) was characteristic of the therapeutic mud, which can be interpreted as an organic horizon of the soil profile studied. The share of carbon of the microbial biomass in the carbon of the mud organic matter varied from 0.5 to 1.4%

Semaghiul and Dobrinas [9] investigated the therapeutic value of water and mud from the Salt Lake (*Lacu Sarat*) in Romania. They analyzed the total content of Fe, Cu and Cr in the sapropelic mud. The results prove the existence of ionic exchange between the therapeutic mud and human organism at the epithelial level.

Ognean et al. [10] studied the correlation between the mud's three enzymatic activities and the therapeutic effect in various seasons of the year by estimating the phosphatase, dehydrogenase and catalase activities in the eight lakes mud. The samples were collected in February and June. The experimental results showed a seasonal variation in dehydrogenase and catalase activities (greater activity in summer) and phosphatase (greater activity in winter).

Mud, which contains organic and mineral ingredients, has been used in the treatment of several degenerative diseases [11]. It has been proposed that beneficial effects of mud are not only related to its local thermal effects, but also to its chemical components. Unlike hydrophilic components, the lipophilic components of the mud extract have not been precisely described thus far. Three different mud species (e.g., krenogen, tone, and fango) were analyzed by using gas chromatography-mass spectrometry. The chemical analysis of mud does not only reveal hydrophilic organic substances, such as humic, fulmic, and ulmic acids, but also organic substances composed of fatty acids.

Clinical mud therapies

Despite the lack of a meta-analysis to evaluate the use of mud therapy in knee osteoarthritis (OA), several studies exist in the literature reporting favorable results following mud therapy. Odabasi et al. [12] studied the efficacy of mud pack treatment in patients with knee OA and contribution of chemical factors. Patients were randomly assigned to the directly applied mud pack (study) group or to nylon-covered mud pack (control) group. Patients were evaluated before and after (end of 15th application) the intervention and followed up for 24 weeks at 4-week intervals. Mud pack treatment significantly improved the pain and functional status of patients with knee OA.

Güngen et al. [13] evaluated the efficacy of treatment with mud pack in knee OA and to determine whether mud pack effects serum levels of YKL-40 (chitinase-3-like protein-1) and high-sensitivity C-reactive protein (hsCRP) which are reported to be biological markers for articular damage or inflammation in patients with OA. Treatments were applied for six days a week for two weeks as a total of 12 sessions. Pain intensity and joint stiffness decreased in both groups at all



Figure 1. Patients in Krinides mud baths, Municipality of Filippoi Greece



Figure. 2. Patient in Krinides mud baths, Municipality of Filippoi Greece

follow-ups. Physical activity status was found to persist for three months after treatment only in the mud pack group. Serum mean YKL-40 and hsCRP levels of the patients were higher compared to the healthy control group. Serum YKL-40 level increased significantly only in the hot pack group three months after the treatment. No significant change was observed in hsCRP levels in both groups during the whole follow-up periods. Mud pack and hot pack therapy were both demonstrated to be effective in symptomatic treatment of the knee OA until the end of the 2-week treatment period, whereas only mud pack therapy was shown to be effective in functional status over time.

The short-term effects of mud-pack therapy on pain relief and functional improvement in knee OA were compared with intra-articular hyaluronic acid injections [14]. Patients received mud therapy bilaterally. Eleven patients received a total of three bilateral intra-articular hyaluronic acid injections, each interspersed by weekly intervals. No significant differences were found between the studied groups. The authors suggested that treatment of the knee OA with intra-articular

hyaluronic acid injections or mud-pack therapy yielded similar results in the short-term in terms of functional improvement and pain relief.

In similar study, Fraioli et al. [15] evaluated the efficacy of mud-bath therapy with mineral water from the Sillene Spring at Italy's Chianciano Spa in patients with knee OA. They compared: physical examination of the knee joint, visual analogue scale (VAS) assessment of pain, and Lequesne-Algo functional Index. The group A underwent three full cycles of mud-bath therapy over one year's time, the group B did not. An observational longitudinal study was also conducted on the patients of the group A, before and after completion of the treatment protocol. The percentage of patients with no symptoms or mild symptoms was higher in the group A than in group B; the mean value of VAS and the overall Lequesne index mean score reported in the group A was significantly lower than that reported in the group B. No adverse effects were reported by patients. The mud-bath therapy at Chianciano Spa significantly improved the clinical conditions of patients with knee OA.

Forestier et al. [16] determined whether spa therapy, plus home exercises and usual medical treatment provides any benefit over exercises and usual treatment, in the management of the knee OA. Large multicentre randomized prospective clinical trial of patients (n=195) with knee OA attending French spa resorts as outpatients was used. All patients continued usual treatments and performed daily standardized home exercises. The spa therapy group also received 18 days of spa therapy (massages, showers, mud and pool sessions). For patients with knee OA a 3-week course of spa therapy together with home exercises and usual pharmacological treatments offered a benefit after six months compared with exercises and usual treatment alone.

Sea mud has been popularly used as an effective base in cosmetic preparations. Kim et al. [17] isolated humic substances as the major organic substance of the sea mud from a tidal flat in Korea. Among the three isolated humic substances, humic acid showed the highest water retentive property (approximately 50% mass increase from water uptake). They examined the anti-inflammatory property of the sea mud on UVB-irradiated human keratinocytes (HaCaT cells) by measuring PGE2 levels produced by keratinocytes in the presence of either the total water or methanol extracts of the mud. They found that the minerals in the mud inhibited PGE2 production, which is comparable with the inhibitory effect of 1 microM indomethacin. Researchers suggested the potential use of the organic and inorganic substances from the sea mud in various skin products as safe biological substances for skin protective purposes [14,15].

The application of naftalan and therapeutic muds was shown to reduce activity of inflammatory processes, improve airway patency and the state of the bronchial mucosa [18].

Cozzi et al. [19] in a randomized study evaluated the effects and the tolerability of mud packs and thermal baths in a group of patients affected with spondylitis and Crohn's disease or ulcerative colitis. Twenty-four patients, treated with mesalazine or sulfasalazine, were randomized and assessed by an investigator independent from the spa staff: 12 were submitted to a cycle of mud-bath treatment (12 mud packs and 12 thermal baths over a period of two weeks), and 12 were enrolled as controls. Spondylitis Disease Activity Index and intensity of low back pain before, at the end of a cycle of mud-bath treatment, and after 12 and 24 weeks were evaluated. A significant reduction of clinical evaluation indices of spondylitis was observed at the end of the cycle of mud-bath treatment. No patient referred any gut symptom exacerbation. Researchers concluded that mud-bath treatment in patients with spondylitis associated with the inflammatory bowel disease is well tolerated and may improve spinal symptoms and function for several months.

Suárez et al [7] determined the organic composition of San Diego de los Baños peloid (Cuba). More than 50 compounds were identified. Among them were alkanes, 4 phenyl valeric acid, 5 isopentyl picolinic acid, 3 hydroxylauric acid, (5 α , 3 β) 3-hydroxy-11-androstanone, 5 α -2-en-11 androstenone, squalene, terpinol (α terpineol), menthol derivatives, palmitic, oleic and eicosanoic acids, and isoprenoid phytane. These compounds have shown biologic activity in their isolated form as antioxidants, analgesics, anti-inflammatories, immune stimulants, antineoplastics, detoxicants, membrane regulators, and hormones.

Dead Sea (DS) minerals have been used in a wide range of dermatological conditions, especially psoriasis, atopic dermatitis, vitiligo and eczema and several papers [20].

Ma'or et al. [21] performed a detailed microbial and chemical analysis of DS mineral mud. Low numbers of colony-forming microorganisms have been found. The highest counts (up to 20,000 colonies per gram, mostly consisting of endospore-forming bacteria) were grown on sheep blood agar. Test microorganisms (*Escherichia coli*, *Staphylococcus aureus*, *Propionibacterium acnes*, *Candida albicans*) rapidly lost their viability when added to the mud. Zones of growth inhibition were observed around discs of DS mud placed on agar plates inoculated with *Candida* or with *Propionibacterium*, but not with *Staphylococcus* or *Escherichia*. Authors stated that the antibacterial properties of DS mud are probably due to chemical and/or physical phenomena.

CONCLUSIONS

Mud therapy can be successfully used in the treatment of musculoskeletal disorders, gynecological conditions (inflammatory and menstrual cycle disorders) as well as neurological, cardiovascular and skin pathology (eczema, acne, psoriasis).

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Table 1. Chemical composition and characteristics of puddle from Krinides of Phillippi Minicipality (Puddle Infirmary)

Total exchange capability					
Na+(CEC)		33.3 meq Na+/100g sample			
Average water content		38% k.β			
Specific gravity of solid ingredients . p:		2.44 g/cm ³			
Specific heat of solid ingredients . c:		0.2 cal/g °C			
Substance heat capacity		0.79 cal/cm ³ °C			
Heat conduction, k:		1.5 x 10 ⁻³ cal/cm s °C			
Substance grain size		1.4 -176 μm			
Substance average grain size		16 μm			
ph		7.8			
Ingredients soluble in H₂O (k.β.%)		Ingredients soluble in 2 N HCl (k.β.%)		Clays (k.β.%)	
Na ⁺	0.12	CaCO ₃	3.1	NaO ₂	0.9
K ⁺	0.04			K ₂ O	2.7
Ca ⁺⁺	0.02	MgCO ₃	0.4	CaO	0.3
Mg ⁺⁺	0.01			MgO	0.9
Cl	0.15	Fe ₂ O ₃	0.6	Al ₂ O ₃	14.8
NO ₃	0.00			Fe ₂ O ₃	2.8
SO ₄	0.04			SiO ₂	60.4
Loss of incandescence		14.8%	Crystalline water		8%
Organics		5.2%	Solid residue		85.2%