SIMILARITIES AND DIFFERENCES OF PHYSICO-CHEMICAL CHARACTERISTICS OF VOLCANIC AND LAKE HEALING MUDS OF GEORGIA

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Abstract

The formation of mud, or peloids, is a complex natural process influenced by various geological-hydrogeological, climatic, physical-chemical, and biological factors. This article aims to provide a comprehensive understanding of volcanic and lake muds, specifically assessing their potential medicinal application and comparing their properties.

Keywords: Elements, Infrared spectrum, Microbiology, Mud, Peloid

1. Introduction

Mud, also known as peloids, is a naturally occurring substance that results from intricate interactions among geological, climatic, physical-chemical, and biological elements. These complex processes give rise to diverse types of mud with distinct properties and characteristics. This study focuses on exploring the potential medicinal benefits of mud, particularly investigating volcanic mud deposits in the Dedoplistskaro region and comparing them to lake mud from Kumisi. The main objective is to bridge the existing knowledge gap by thoroughly examining and comparing various aspects of these mud types, including their physical and chemical parameters, elemental composition, infrared spectra, and microbiology.

Through comprehensive analysis and in-depth characterization, this research aims to provide a comprehensive understanding of the medicinal possibilities and therapeutic applications of volcanic and lake muds. By shedding light on the unique properties and potential uses of these mud types, the study contributes to the field of balneology, which involves the therapeutic use of natural mineral-rich waters and muds. Additionally, the findings of this investigation may also support the development of new medicinal preparations derived from volcanic and lake muds.

2. Methods

The study aimed to assess the potential of volcanic mud deposits in the Dedoplistskaro region and compare them with lake mud from Kumisi. Various physical and chemical parameters were analyzed to evaluate the composition and characteristics of the mud samples.

The physical parameters measured included moisture content, volumetric weight, stickiness, plasticity, and heat content. The moisture content was determined by drying a known weight of mud at a specific temperature until a constant weight was achieved. Volumetric weight was calculated by dividing the weight of the mud sample by its volume. Stickiness and plasticity were assessed through tactile observations and consistency tests. The heat content was determined using calorimetry to measure the energy released upon combustion.

Chemical parameters analyzed included organic content, pH, mud solution mineralization, and the presence of chemical elements. The organic content was determined by measuring the loss on ignition after heating the mud sample to remove organic matter. The pH of the mud was measured using a pH meter. Mud solution mineralization was determined by analyzing the concentration of dissolved minerals in the mud extract. Chemical elements were identified through elemental analysis using techniques such as X-ray fluorescence (XRF) and infrared spectroscopy (IR).

Microbiological analysis was conducted to identify and compare the physiological groups of microorganisms present in the volcanic and lake muds. This involved sampling the mud and culturing it on specific media to isolate and identify different microbial groups. The number of microorganisms in each group was quantified using colony counting methods.

3. Results

The results of the study indicated that both volcanic and lake muds possess balneological potential and contain biologically active substances. The physical parameters of both mud types, including moisture content, volumetric weight, stickiness, plasticity, and heat content, were within the expected range for medicinal muds.

Table 1.Physico-chemical properties and Chemical composition of Volcanic and lake muds

Indicator	Measurment	volcanic	lake
Humidity	%	52	48
Volume weight	g/cm^3	1,43	1,36
Stickeness/ Adhesiveness	Din/cm^2	2734	6638
Plasticity	Din/cm^2	1087	3597
Heat capacity	Kal/G. grad	0,62	0,55
pH		7,3	7,7
Ashiness	%	86	89
SiO_2	%	42,6	53,1
$Al_2\ O_3$	%	11,6	16,1
Cao	%	11,0	7,0
$Fe_2\ O_3$	%	3,8	5,7
MgO	%	2,1	3,0
$Na_2\ O$	%	3,2	2,0
$K_2\ O$	%	2,5	2,6
SO_3	%	0,6	1,0
crystalline skeleton	%	38	44

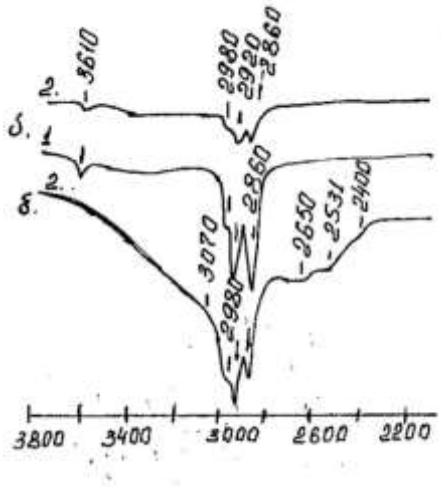
organic Content of substances	%	6.8	3.9
Particles > 0.25 mm in size	%	0.3	0.3
Particles<0,001mm in size	%	21.9	24.3

Chemical analysis revealed that both mud types contained a variety of organic and inorganic substances. Volcanic mud was found to have higher mineralization compared to lake mud, making it exceptional among the sediments of other deposits in Georgia. The mud samples exhibited a range of chemical elements, including sodium, potassium, calcium, magnesium, iron, sulfur, copper, zinc, lead, and others. The elemental composition of the volcanic and lake muds was found to be similar.

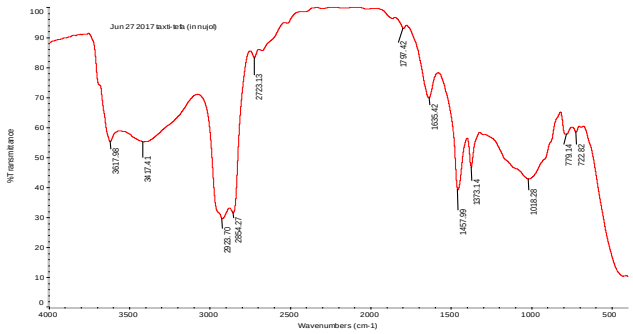
Table2. Content of elements of volcanic mud, %

	Volcanic	Lake
Co	$1{,}2.10^{-3}$	$1{,}8'10^{-3}$
Ni	$5{,}6.10^{-3}$	$6{,}0'10^{-3}$
Ti	0,21-0,26	0,12- 0,46
J	$2{,}12.10^{-2}$	
Br	$4{,}43.10^{-2}$	
Pb	$1{,}1.10^{-3}$-$1{,}5.10^{-3}$	$1{,}4'10^{-3}$ -$1{,}8'10^{-3}$
Sr	$4{,}7.10^{-3}$-$5{,}5.10^{-2}$	$3{,}5\cdot10^{-2}$-$3{,}7'10^{-2}$
Ca	8,16	
Zn	$7{,}2.10^{-3}$	$2{,}1'10^{-3}$
Rb	$1{,}8.10^{-2}$	$9{,}7'10^{-3}$
Fe	2,8-3,6	4,2-4,5
Mn	$8{,}0.10^{-2}$	$4{,}5'10^{-2}$
Ag	$1{,}0.10^{-4}$	$4{,}0'10^{-5}$
Cr	$4{,}0.10^{-3}$	$2{,}8'10^{-3}$
Ba	$13{,}0.10^{-2}$	

Infrared spectroscopy analysis demonstrated the presence of both organic and inorganic compounds in the mud samples. Volcanic mud exhibited distinctive absorption bands indicating the presence of alcohols, phenols, and acids. Lake mud also showed similar absorption bands, suggesting the presence of these compounds.



Lake mud IR Spectogram



Volcanic mud IR Spectogram

The microbiological analysis revealed differences in the physiological groups of microorganisms present in the volcanic and lake muds. Volcanic mud had a higher number of aerobic-saprophytes, anaerobes, putrefying anaerobes, bitum-decomposing bacteria, fatty acid bacteria, actinomycetes, and thionic acid bacteria compared to lake mud. On the other hand, lake mud had a higher number of ammonia-producing rotting aerobes, denitrifying bacteria, and mold fungi compared to volcanic mud. Some microbial groups, such as cellulose-decomposing anaerobes and sulfate-reducing bacteria, were not found in either mud sample.

Table 3. Microbiological analysis of muds

Physiological group of microorganisms	Volcanic	Lake
The Total number of aerobic-saprophytes	102-103	93-96
Total number of anaerobes	104	97
Ammonia-producing rotting aerobes	103	118
Humin destroyer	10	-
Anaerobes of putrefying	102	99
Bitum-decomposing bacteria	102-104	35-40

ammonified bacteria	-	2-3
Denitrifying bacteria	10-12	15-17
fatty acid bacteria	103	78
Cellulose-decomposing aerobes	10	-
Cellulose-decomposing anaerobes	-	-
Sulphate-reducing bacteria	-	3-5
Thionic acid bacteria	10	4
Actinomycetes	102-104	80-85
mold fungi	-	-

4. Discussion

The discussion section explores the potential medicinal properties of the muds based on their physical and chemical characteristics. Humic substances found in the mud are known for their strong absorption action, which can eliminate toxins responsible for allergic diseases. Both mud types contain biologically active substances with similar chemical compositions, indicating their potential as balneological agents and sources of medicinal preparations. The IR spectroscopy analysis revealed the presence of organic and inorganic compounds in both volcanic and lake muds. The lake mud extract showed the presence of aliphatic hydrocarbons, acids, and aromatic compounds, while the volcanic mud contained layered water-changing silicates.

Furthermore, the microbiological analysis highlighted differences in the physiological groups of microorganisms present in the volcanic and lake muds. The volcanic mud exhibited a higher number of aerobic-saprophytes and anaerobes, while the lake mud had a higher number of ammonia-producing rotting aerobes and denitrifying bacteria.

5. Conclusion

In conclusion, the study demonstrates that Georgian volcanic and lake muds possess potential medicinal properties. The biologically active substances present in the muds, along with their physical and chemical characteristics, support their use as balneological agents. However, further research is required to better understand the effects of these muds on the human body. The elemental composition and microbiological profiles of the muds provide valuable insights into their therapeutic potential. Overall, this study contributes to the understanding of volcanic and lake muds and their potential applications in the field of medicine.

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