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Physico-chemical characteristic of the medical peloids in Bulgaria

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Abstract. The goal of this article is to summarize available data for medical peloid deposits in Bulgaria and analyze their physicochemical components. There are 8 deposits of medical peloids in Bulgaria. Six of them are located in the lagoon-firth lakes along the Black Sea coast and the others are inland of the country. The content of hydrogen sulphide, water binding capacity, degree of swelling, the volume of sludge, heat capacity, pollution, mineralization of the liquid phase, pH, content of chlorides, sulphates, hydrocarbons, bromide, Ca, Mg, and Na are studied. Classification is done on the lagoon-firth peloids on the Black Sea coast, in view of physiology, therapeutic ingredients that are of significance for medical practice - prevention and medical treatment.

Keywords: medical peloids, balneology, peat, physical-chemical components.

Introduction

The term "peloid" has Greek origins and means earth, soil. Peloid treatment (healing mud and peat) has been used for centuries. The healing properties of the peloids were known to the ancient Egyptians, Romans, Greeks and Indians. This type of procedure is mentioned as early as the 10th century BC. in an Egyptian papyrus from the town of Kahun. It tells how people along the Nile used mud to heal their joint pain. During the Middle Ages, this therapeutic method was hardly used. It was popular in Italy (15th-16th centuries), where the mud was of volcanic origin. Later, mud therapy spread to France, Russia (seventeenth century), Germany and the Czech Republic (eighteenth century). In Bulgaria this type of treatment was widely used only in the XIX century, although there are many archaeological finds proving the use of estuarine mud in the area of Lake Pomorie since ancient times. In 1925 the first mud hospital in the country

was built in the region of Pomorie. To this day, it remains the largest center for peloidotherapy in Bulgaria. The healing mud also serves to fight many gynecological diseases. Similar therapeutic methods are also recommended by Ayurveda (a medical system practiced in India, Sri Lanka and Nepal, which means "science of life").
The mechanism of action of peloids on the body has been the subject of long-term and multifaceted studies in recent decades. They are a compound complex of organic and inorganic ingredients. . They are composed of a liquid phase (water and dissolved salts), a crystalline skeleton (carbonates, sulfates and phosphates of Ca, Mg, etc.) and a colloidal complex (oxides of Fe, Al and Si, acids, S, etc.). This complex determines their physical properties - their water holding capacity, sediment volume and degree of swelling, which together with the chemical ingredients have an effect on the body.
One of the main characteristics of peloids is their water content, which determines their thermal properties, their ability to absorb water and swell. Their redox potential and pH play an important role in their external application on the human body.
In general, the healing mud has an analgesic and anti-inflammatory effect. It has a positive effect on metabolism and tissue nutrition and enhances tissue regeneration. Mud therapy affects not only a given suffering, but also the protection of the whole organism.

Deposits of medicinal peloids in Bulgaria

Deposits of medicinal peloids in Bulgaria
Bulgaria is rich in natural healing factors (mineral water, healing mud and peat), which are a favorable prerequisite for the development of complex resort treatment, prevention and rehabilitation.
According to some authors, the mineral water deposits in Bulgaria are ~ 230 (Shterev, 1964), and according to others - ~ 170 (Petrov et al., 1970). As for the deposits of medicinal peloids, most authors are unanimous that the main ones are eight. Six of them are located in the lagoon-estuarine lakes along the Black Sea coast: Shablenska Tuzla, Rusalka, Balchishka Tuzla, Varna (Varna Lake), Pomorie, Burgas (Atanasovsko Lake). In the interior of the country the spring peloids are known and used, in combination with mineral waters (Marikostinovo and Banya, Plovdiv region) (Fig. 1). There are peat deposits in our country in the village of Baikal (Pernik region), the village of Dobri dol (Vidin region) and Sadovo (Plovdiv region).
The deposits with healing mud in our country have been studied by many researchers - P. Stoyanov, V. Kusitaseva, J. Melamed, G. Zadgorski (Gigov, 1967; Stoyanov, Vladeva, 1971; Ivanova et al., 1972; Stoyanov, 2004 ; Benderev, 2010; Hibaum, 2010, etc.). Physicochemical studies of peat, in view of its application in medical practice, have not been done. Detailed studies on medicinal peloids and peat in Bulgaria have been conducted and summarized in a dissertation (Vladeva, 1981), and they have been the subject of research by the same author, presented in a number of articles (Vladeva et al., 1966, 1970; Vladeva, 1972 , 1976, 1977, 1979).



Fig. 1. Location scheme of the medical peloid deposits and peat in Bulgaria

Shabla Tuzla
Шабла тузла

The lake has an area of ~ 0.25 km2 and is located ~ 6 km east of the town of Shabla. It is completely separated from the Black Sea with sandy hair, ~ 100 m wide. It is a salt lake-lagoon, formed mainly by the infiltration of salty seawater under the sand dunes that separate it from the sea. Its average depth is ~ 0.6 m.
The lake waters are mixed sea and fresh groundwater from the Sarmatian aquifer, represented by limestone limestones. Thanks to the underground feeding, even in many waterless years, the

water "cover" over the mud, although shortened in area, is retained, protecting it from oxidation. The conditions for mud formation in Shabla Tuzla are very favorable. For thousands of years, aquatic flora and fauna have contributed to the formation of healing mud with very good qualities. The great erosion susceptibility of the west coast provides the mud with the necessary amounts of fine-grained clay material. On the other hand, the small size of the lake basin does not allow strong disturbances and the associated oxidation of the upper layer of the mud layer. Its reserves of healing mud amount to ~ 200,000 t.
The mud is black, greasy, fine to the touch and creamy in structure, with a very strong odor of hydrogen sulfide. In some areas, not far from the beach area, the mechanical particles make the mud inhomogeneous and it is necessary when using it to remove those impurities that have a different degree of heat transfer compared to the mud.
The physical parameters of the healing mud such as moisture, water holding capacity, sediment volume, degree of swelling and heat transfer are extremely favorable for balneotherapy. Contamination with mussels, sand particles, etc. up to 0.25 mm in size do not exceed 3 to 4% and are not typical for the whole deposit. The liquid phases are sodium chloride with mineralization, which depends on the hydration of the lake. There were times when the whole lake was covered with algae. After the introduction of mineralized sulfide water from drilling C-134 in the lake, the conditions of sludge formation are changed and the refreshment of the mud becomes known - the amount of dissolved minerals in the liquid phase decreases, which generally does not adversely affect the healing mud.
The value of the dissolved salts in the liquid phase of the mud during the different periods reaches 51 g / kg, and the average mineralization is ~ 27 g / kg. The relatively low concentration of sulfate ions (~ 0.6 g / kg) allows for an active process of sulfate reduction. Rapeseed is similar in composition to the sea water that feeds the lake, and their salt concentration varies from 14 to 108 g / kg depending on the season and place of sampling, feeding with mineral water and more. The healing mud from Lake Shabla belongs to the medium-mineralized (from 15 to 35 g / kg), strongly sulfide, with a significant content of chlorides, sulfates and magnesium in soluble form. The healing mud has very good physical and physico-mechanical indicators. In certain areas, the mud has significant mechanical impurities that must be removed before it can be used for spa treatment.
The healing mud from Shabla is located and produced in a lake, far from industrial areas, which determines the absence of heavy metals and other chemical contaminants.

Rusalka Lake
Езеро русалка

The locality is located north of Cape Kaliakra, ~ 6 km from the village of Kamen Bryag, near the sea resort Rusalka. It has an area of ~ 0.02 km2. The total reserves of healing mud on Lake Rusalka amount to ~ 28,500 t. The healing mud from Rusalka is brown to black in color, oily, with coarse-grained particles in some of the areas, with a strong smell of hydrogen sulfide and a structure from creamy to fibrous. In some areas, mechanical particles make the mud inhomogeneous and it is necessary when using it to remove those impurities that have a different degree of heat transfer compared to the mud.

The physical parameters of the healing mud such as moisture, water holding capacity, sediment volume, degree of swelling, heat transfer are very favorable. Contamination with mussels, sand particles, etc. with a size of up to 0.25 mm reaches 6-8%.
In general, the healing mud has the highest organic content, respectively moisture, which should have an impact on the indications for treatment. The liquid phases are sodium chloride with mineralization, which depends on the watering of the lake and the season, the method of sampling and others. The value of dissolved salts in the liquid phase of the mud reaches 55 g / kg, and the average mineralization is ~ 37 g / kg. The significant concentration of sulfate ions (~ 3 g / kg) allows for an active process of sulfate reduction. Rapeseed is similar in nature to the composition of the seawater that feeds the lake, and their salt concentration varies from 14 to 107 g / kg depending on the season and place of sampling.
The healing mud from Lake Rusalka belongs to the highly mineralized (> 35 g / kg), medium sulfide, with a significant content of chlorides, sulfates and magnesium in soluble form.
The healing mud has good physical and physico-mechanical indicators. In certain areas, the mud has significant mechanical impurities that must be removed before it can be used for spa treatment. On the territory of the resort complex Rusalka is located the thermal sulfide-chloride-sulfate-sodium mineral water, with relatively high concentrations of calcium and magnesium ions and proven therapeutic efficacy.
Mineral water and healing mud can be supplemented in the treatment of a number of chronic diseases.

Balchishka тuzla
Балчишка тузла

Lake Balchishka Tuzla is located ~ 5 km from the town of Balchik. The total reserves of Balchik Tuzla from healing mud amount to 11,300 t. The mud is gray to gray-black, oily, with coarse particles, with the smell of hydrogen sulfide. In some areas, especially in summer, the mechanical particles, mainly from gypsum crystals, make the mud inhomogeneous and it is necessary to use a treatment to remove these impurities. The physical parameters of the healing mud such as moisture, water holding capacity, sediment volume, degree of swelling, heat transfer are not always complete for use in balneotherapy. Contamination with mussels, sand particles and crystals up to 0.25 mm in size reaches 8-9%. Healing mud, especially during the summer months, is characterized by high concentrations of sulfates in the mud skeleton. This is expressed in the formation of gypsum crystals and poses a risk of burns due to the difference in heat capacity. The liquid phases are chloride-sodium-magnesium with mineralization, which depends on the hydration of the lake. The value of the dissolved salts in the liquid phase of the mud reaches 83 g / kg, and the average mineralization is different in different studies and varies from 37 to 66 g / kg. The significant concentration of sulphate ions (~ 8 g / kg) causes saturation of the solution and formation of crystals. Rapeseed is similar in nature to the composition of the seawater that feeds the lake, and their salt concentration varies from 43 to 64 g / kg depending on the season and place of sampling.

The healing mud from Lake Balchishka Tuzla belongs to the highly mineralized (> 35 g / kg), medium sulfide, with a significant content of chlorides, sulfates and magnesium in soluble form. The healing mud without purification has satisfactory physical and physico-mechanical indicators.

Varna lake
Варненско езеро

The healing mud, deposited in Varna Lake, is gray-black to black, oily, fine to the touch, with the smell of hydrogen sulfide. The physical indicators of the healing mud such as moisture, water holding capacity, sediment volume, degree of swelling and heat transfer are complete for use in balneotherapy. Contamination with mussels, sand particles, etc. with a size of up to 0.25 mm is the lowest compared to other peloid deposits and does not exceed 2%. The liquid phases are sodium chloride with mineralization, which is very little affected by the hydration of the lake and the seasons. This is due to the great depth from which it is extracted. The concentration of sulfate ions is very low and shows a slow process of peloidogenesis, which is associated with significant depletion of these ions and attenuating sludge formation. The lake has been the subject of various pollution by enterprises in the area of the port of Varna. Changes in the pH of the healing mud and in some areas the presence of mercury in measurable concentrations have been found. Rapeseed is similar in composition to the seawater that feeds the lake, and their salt concentration varies from ~ 14 g / kg, regardless of the season and sampling location. The healing mud from Lake Varna belongs to the low-mineralized (up to 15 g / kg), medium sulfide, with a content close to sea water. The healing mud has good physical and physico-mechanical indicators.

Pomorie lake
Поморийско езеро

Lake Pomorie has an area of ~ 6 km2, part of which is occupied by salt pans. The total stocks of peloids amount to 115,000 t. There are two layers of healing mud in the lake: black - upper and gray - lower. The healing mud from the gray layer is not used for balneotherapy due to its significantly unfavorable indicators. This does not apply to black healing mud, which is known and recognized. Here is built one of the best spa resorts in the country, which uses the healing mud of the black layer. Regeneration areas have been built, in which the indicators of the used healing mud are restored. The physical indicators of the healing mud from the black layer such as moisture, water holding capacity, volume sediment, degree of swelling and heat transfer are complete for use in balneotherapy. Contamination with mussels, sand particles and crystals up to 0.25 mm in size in some limited areas reaches 5-8%, which poses a risk of burns if the mud is not homogenized. The liquid phases are chloride-sodium-magnesium with mineralization, which

depends on the hydration of the lake. The value of the dissolved salts in the liquid phase of the mud reaches 63 g / kg, and the average mineralization is different in different studies and varies from 37 to 63 g / kg. The significant concentration of sulfate ions (~ 4 g / kg) is the basis for active processes of sulfate reduction, which is very limited due to low concentrations of organic matter. Rapeseed is similar in nature to the composition of the seawater that feeds the lake, and their salt concentration varies from 43 to 64 g / kg depending on the season and place of sampling.

Atanasovsko Lake
Атанасовско езеро

Atanasovsko Lake is located in the northeastern part of Burgas. The pools with healing mud and lye are located in the southern part of the lake. It is a super-salty coastal lake, divided into two parts by the Burgas-Varna road. The northern part is a maintained reserve, and the southern part is a buffer zone, later re-categorized as a protected area. The lake is surrounded by smaller reservoirs and a system of canals overgrown with swamp vegetation. The lake is nearly 9 km long, 4.3 km wide, and its area is ~ 17 km2. It is located 1.5 m below sea level, which makes it highly vulnerable. Its average depth is 0.30 m.
Along the Bulgarian Black Sea coast, salt mining has a centuries-old tradition, dating back to the third century BC. The salt pans of Atanasovsko Lake have existed since 1906. At present, the evaporators of 'Chernomorski Solnitsi' JSC are located on the territory of the lake - owners of the lake, which extract ~ 40,000 t of sea salt per year. The lye is a product of salt production and contains only inorganic substances - NaCl, Mg, K, S and others. It is obtained after evaporation and concentration of salts in the lake water.
Black Sea lye has a proven medical effect - it is used in the treatment and prevention of diseases related to the musculoskeletal system, skin inflammation and wounds, varicose veins, colds and colds. Recommended for arthrosis, arthritis, tendovaginitis, discopathy, sprains and sciatica. It is good to stay in the lye for no more than 20-30 minutes so as not to overload the heart.
Healing mud is a sedimentary product of the closed salt lake, it is clean and homogeneous, with dark gray to black color and the smell of hydrogen sulfide from many rotting microorganisms. It contains inorganic components such as silicates, sands, gypsum, iron and aluminum compounds, various hydroxides and salts. This composition has been formed for millennia by the decay of unicellular organisms, algae, fish, crabs, mussels.
The essence of mud therapy is a complex effect on the entire peripheral nervous system. Its thermal properties dilate the vessels and open new capillaries. This reduces swelling and pain, heals and erases scars from wounds, improves metabolic and regenerative processes. Mud cures almost the entire range of skin diseases, arthritis, disc herniation, gynecological problems, plexitis.

Marikostinovo
Марикостиново

Marikostinovo Mud Resort is located 2 km from the village of Marikostinovo, 13 km from Petrich and 1 km from the Struma River. Located at altitude 80 meters above sea level. The combination of mineral water and healing mud is a kind of natural wealth, which is close to the healing factors in the Hevis deposits in Hungary and Piestany in Czechoslovakia. These natural features of the spring have been known since ancient times. The old Turkish bath was built on the remains of Roman foundations and today has been turned into a modern SPA center. The spring mud in the peloid deposit is formed by the deposition of fine clay substance, carried by the mineral water with the participation of a number of favorable natural factors - high temperature of the spring water and the presence of organic substances. One of the advantages of the mud deposit is determined by the naturally gushing mineral water, which dilutes the mud and creates conditions for continuous movement of the layers. The medical institution specializes in the treatment of diseases of the musculoskeletal system, peripheral nervous system and gynecological diseases.

Bath Karlovo
Баня Карловско

Banya Karlovo is a popular and effective balneological center due to the appropriate combination of specific mineral water and healing mud. The healing mud in Banya is similar in composition to that of the water that passes through the same layers. However, in the mud, in addition to sulfur and hydrogen, there are many minerals that are used in food supplements. The mud deposit is located next to the old sanatorium. It is a swamp with rushes. The swamp has an area of ~ 0.03 km2. It is a peat deposit impregnated with mineral water. The thickness of the peat layer varies: from 30–50 cm to 1.5 m. Peat is organic, of plant origin, enriched with elements of mineral water. It has a dark brown color, oily to the touch, with a faint odor of hydrogen sulfide, contains gases, hormones, antibiotics, vitamins. The mud is removed, purified, diluted and applied in the form of applications. The problem area is smeared and wrapped with nylon, which maintains the temperature. It stays for 15-20 minutes.

Results and interpretation

In order to clarify the differences of the healing mud in the Black Sea deposits, samples from Shabla, Rusalka, Balchishka Tuzla, Varna, Atanasovsko and Pomorie lakes near Bourgas were studied. The focus of this article is on the study of physicochemical parameters in water-soluble form, the total hydrogen sulfide content of the healing mud, the complex of physical properties, ie. of all indicators that are important in peloidotherapy. The following were studied: hydrogen sulfide content, water holding capacity, degree of swelling, sediment volume, heat capacity, pollution, liquid phase mineralization, content of chlorides, sulfates, hydrocarbons, bromides, Ca, Mg, Na and pH. The main physicochemical parameters (average values) for our Black Sea

lagoon-estuarine muds are presented in Table 1 (Vladeva, 1981). The processing of the results obtained in different years and seasons gives grounds for grading the peloid deposits. Moisture, water retention capacity, sediment volume, degree of swelling and heat retention capacity have the highest values in the healing mud of Pomorie Lake (black layer) and Mermaid. The healing mud from Pomorie Lake (gray layer), Varna Lake and the two sections of Atanasovsko Lake have very good indicators. The indicators of the samples from the healing mud from Balchishka Tuzla and Shabla are significantly lower.

The amount of particles> 0.25 mm, accepted as contamination, is insignificant in Lake Pomorie (Fig. 2). The healing mud in the northern part of Atanasovsko Lake, the gray layer of Pomorie Lake and Rusalka have low pollution. The highest pollution of the healing mud is in Shabla Lake and Balchik Tuzla. In our Black Sea lakes, in general, the contamination of the healing mud exceeds 1% only in isolated areas, which is favorable for the direct use of peloids for healing procedures. In some cases, such as in Pomorie or Shabla Lake, there are whole areas with a very high content of mussels or sand particles, so when using these resources, pre-treatment is a mandatory requirement.

With regard to the content of chemical ingredients with proven chemical effects, attention is paid to the hydrogen sulfide content. The healing mud from Shabla Lake has very high concentrations of hydrogen sulfide. They are up to 6 times higher than in other lakes. The healing mud from the gray layers of Lake Pomorie has the lowest hydrogen sulfide content. The healing mud from Balchik Tuzla also has a relatively low hydrogen sulfide content. Intermediate position is occupied by the healing mud from the localities in Varna Lake, Atanasovsko Lake, the black layer of Pomorie Lake and Rusalka.

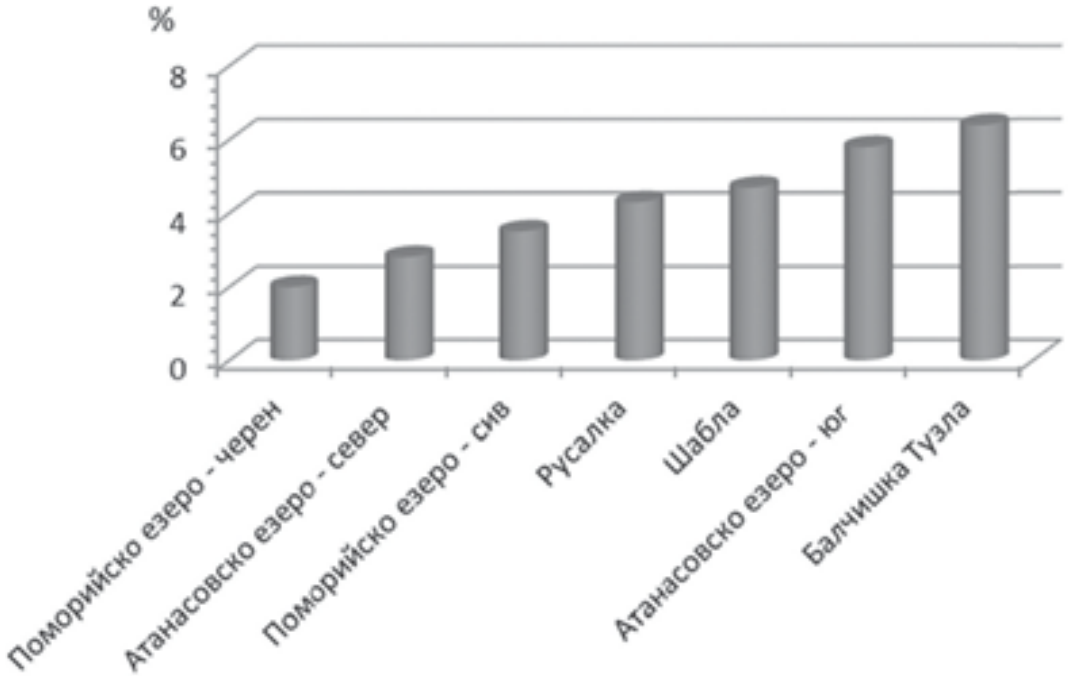


Fig. 2. Quantity of mussels and sand particles larger than > 0,25 mm

Physico-chemical parameters of the Black Sea medical peloide deposits (Vladeva, 1981

Objects	Moisture%	Pollution %	Relative weight	Water holding capacity	Sludge volume	Degree of swelling	Sulphates in the liquid phase	Hydrocarbons in the liquid phase	Na (+ K) c the liquid phase
				g/100 g	cm3/100 g		g/kg	g/kg	g/kg
Pomorie Lake - black layer	73,83	2,02	1,20	362	8,1	3,3	2,086	1,376	9,36
Pomorie Lake - gray layer	63,28	3,51	1,34	212	5,5	2,3	3,400	1,709	17,08
Rusalka	73,74	4,26	1,20	344	7,0	2,9	2,940	1,840	11,68
Atanasovsko Lake - North	64,55	2,78	1,31	180	4,9	1,4	6,380	2,285	24,11
Atanasovsko lake - south	61,12	5,78	1,36	196	4,0	1,9	2,980	0,859	11,84
Varna lake	62,78	1,75	1,31	195	3,8	1,8	0,087	1,015	4,16
Balchishka tuzla	57,44	6,35	1,41	155	3,6	1,6	8,321	0,822	17,97
Shabla	53,22	4,78	1,45	160	3,3	1,6	0,678	2,008	8,99

Objects	They are in the liquid phase	Mg in the liquid phase	Mineralization of the liquid phase	Heat capacity	H_2S in natural mud	Chlorides in the liquid phase	pH of the healing mud	pH of the liquid phase	Bromides in the liquid phase
	g/kg	g/kg	g/kg	Cal	g/kg	g/kg			mg/kg
Pomorie Lake - black layer	0,277	1,315	30,725	0,791	0,769	16,93	7,28	8,15	77,6
Pomorie Lake - gray layer	0,296	2,275	54,888	0,705	0,281	29,99	7,13	7,80	82,1
Rusalka	0,150	1,572	37,196	0,786	0,909	20,55	7,26	8,37	59,9
Atanasovsko Lake - North	0,426	4,133	74,800	0,718	1,061	40,64	7,31	8,28	97,2
Atanasovsko lake - south	0,430	1,805	40,368	0,689	0,871	21,66	6,95	8,35	109,8
Varna lake	0,291	0,469	13,654	0,703	1,061	7,59	7,03	8,31	17,7
Balchishka tuzla	1,068	3,350	65,853	0,659	0,619	33,46	6,95	8,08	91,9
Shabla	0,117	1,040	26,916	0,618	1,713	15,17	7,23	8,46	60,6

These results make it possible to differentiate the indications for treatment according to the hydrogen sulfide content of the healing mud, as is done with sulfide mineral waters.
The total content of dissolved salts in the liquid phases of the healing mud also defines a lake mud as more or less healing, as the diffusion through the skin of the individual ions, as well as the formation of "salt mantle", is based on dissolved chemicals. . The highest mineralization of the liquid phase is the healing mud from the northern part of Atanasovsko Lake, Balchishka Tuzla, as well as from the gray layer of Pomorie Lake, where the mineralization is between 75 and 54 g / kg. Low mineralization, close to the composition of seawater, has the liquid phase of the healing mud from Varna Lake.
When grading the individual chemical components in the liquid phases of the different deposits, the results are the following:
• The liquid phase of the healing mud from Balchik Tuzla has a very high sulphate content - 8 g / kg. The sulphate content of the liquid phases of the healing mud from the two sections of Atanasovsko Lake, the gray layer of Pomorie Lake and Rusalka is high. The liquid phase of Varna Lake and Shabla has insignificant sulphate content.
• The highest concentration of chlorides is determined in the liquid phase of the healing mud from Atanasovsko Lake, Balchik Tuzla and the gray layer of Pomorie Lake, and the lowest - in Varna mud, where their concentration is close to that in sea water, as well as their mineralization. The other liquid phases have a chloride concentration between 16 and 22 g / kg.
• High concentrations of bromides have the liquid phase of the healing mud from Atanasovsko Lake - northern and southern sections and Balchik Tuzla. Varna's liquid phase is the poorest in bromide ions.

Classification by physicochemical parameters

The physicochemical parameters of the healing mud show that the healing muds in the different localities are very different.
By hydrogen sulfide content:
• Sulfide - over 1.5 g / kg total hydrogen sulfide (Shabla healing mud).
• Medium sulfide - 0.6 to 1.5 g / kg of natural mud (Varna Lake, Atanasovsko Lake - northern and southern section, Pomorie Lake - black layer, Rusalka and Balchik Tuzla).
• Slight sulfide - up to 0.6 g / kg of natural mud (Pomorie Lake - gray layer).
By mineralization of the liquid phase:
• Low-mineralized - up to 15 g / kg (healing mud from Varna Lake).

• Medium-mineralized - from 15 to 35 g / kg (healing mud from Pomorie Lake - black layer and Shabla).
• Highly mineralized - over 35 g / kg (healing mud from Pomorie Lake - gray layer, Balchik Tuzla and Atanasovsko Lake - north).

According to the content of the individual ingredients in the liquid phases of the healing mud:

• Healing mud containing significant amounts of magnesium ions in water-soluble form - over 2.0 g / kg (healing mud from Lake Pomorie
- gray layer, Atanasovsko lake - northern and southern section, Shabla, Balchik Tuzla).
• Healing mud with a high content of sulfate ions - over 3.0 g / kg (healing mud from Pomorie Lake - gray layer, Atanasovsko Lake - northern and southern section, Balchik Tuzla).
• Healing mud with high content of chloride ions - over 20 g / kg (healing mud from Atanasovsko lake - northern and southern section, Balchik Tuzla, Pomorie lake - gray layer, Rusalka).
• Healing mud with high content of sodium ions in water-soluble form - over 15 g / kg (healing mud from Balchik Tuzla, Pomorie Lake - gray layer).
• Healing mud with high content of calcium ions - over 1.0 g / kg (healing mud from Balchik Tuzla).
The physicochemical differentiation of the healing mud in the individual deposits allows for a scientifically based forecast for the development of indications for peloid treatment according to effective chemical factors - hydrogen sulfide content, liquid phase mineralization, soluble sulfates, magnesium, calcium, etc., for a more complete and rational use of this useful natural factor.

Estimation of balneological stocks of peat on their ash content

Experience gained from the study of peloid resources shows that there are some dependencies between the individual ingredients. In characterizing a peat deposit suitable for balneological use, the essential indicators (humic acid content, moisture, sediment volume, water holding capacity) as well as the relationships between them were studied.
The studies were conducted on 19 samples of peat from the Sadovo deposit according to the following indicators: moisture, water holding capacity, relative weight, sediment volume, degree of swelling, particles> 0.25 mm, humic acids, pH. The linear regression method was used to interpret the obtained results, and the regression coefficients were determined by the method of least squares. The correlation coefficient between the ash content and humic acids is 0.909; between the ash content and the water holding capacity is 0,920; between the ash content and the volume of the sludge is 0.764; between the ash content and moisture is 0.894. The found correlations between the ash content and the other quantities are of great practical importance, as when sampling the deposits it is enough to know only the ash content, which is one of the indicators included in the industry standard for sampling of peat for agricultural needs. The ash is determined in all laboratories that analyze peat. Once the correlation coefficients are known, the indicator of interest can be determined mathematically.
The studies are the basis for calculating the industrial stocks of peat in the field near Sadovo, based on the ash content of individual samples as a value that gives an overall assessment of the field due to the high correlation coefficients between the ash content and other values significant for the balneological application of peat.

Conclusions

The healing mud from the seaside lakes, according to studies by specialists from NIKFR (now - National Specialized Hospital for Physical Therapy and Rehabilitation), is suitable for the treatment of the following diseases: musculoskeletal system (degenerative and inflammatory joint diseases, traumatic orthopedic diseases), · diseases of the nervous system (neuritis, radiculitis, cerebral palsy, conditions after polio), gynecological diseases, skin diseases, gastrointestinal and liver-bile diseases, metabolic diseases. In all cases, treatment depends on the stage and degree of the disease after individual consultation with a balneologist and is carried out under strict medical supervision. The following summary conclusions can be drawn:

• The Bulgarian Black Sea coast has rich composition and with various properties mud healing resources, suitable for balneotherapy.
• In general, the physico-mechanical and chemical parameters of the healing mud are favorable for application for balneotherapy.
• In certain, limited areas, in order to improve the parameters of the mud for balneotherapy, preliminary preparation of the healing mud (sifting) is necessary, due to the presence of mechanical impurities with different thermophysical characteristics.
• The production of healing mud in the lakes is a long process (~ 1 mm of healing mud is deposited per year). The use of the mud should be done on site (with the exception of Varna Lake), using mainly the Egyptian, and if possible the application method of treatment, with subsequent regeneration of the used mud.
• The healing mud from the coastal lakes is a valuable natural phenomenon that can be successfully used in our resorts, against the background of the favorable climate, the sea and the unique Bulgarian mineral waters, for the wide development of balneological tourism.
In the present article, a gradation of the lagoon-healing medicinal muds along the Black Sea coast is made, in view of the physiological-therapeutic ingredients, which are important for the medical practice, for substantiation of the scientific indications for mud therapy according to the predominant chemical components. The effect of hydrogen sulfide, mineralization of the liquid phase and the amount of sulfates, chlorides, Mg, Ca, Na, as well as the general set of factors determining the physical parameters of the healing mud can be graded as its specific therapy. The balneological stocks of peat are evaluated according to their ash content on the example of the Sadovo deposit, which can find its place as a balneological raw material. It has been established that after deriving the correlation coefficients, the ash content of a deposit can be allowed to characterize the peat, in view of its application for medical purposes.

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