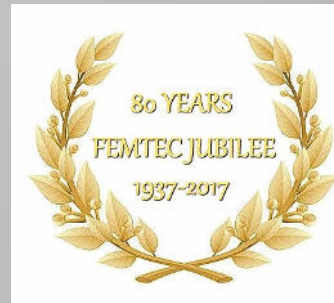




**T. Masiukovich, A. Gaprindashvili, N. Kakulia, N. Antelava, R. Sumanidze, D. Berashvili, A. Bakuridze,
Tbilisi State Medical University, Department of Pharmaceutical Technology**

**Study of mineral resources of Adjara (peloids, clays, waters) with
the purpose of their application in medical (balneological) and
pharmaceutical practice**

**International Scientific Congress of The World Federation of
Hydrotherapy and Climatotherapy (FEMTEC)**

**Ischia Porto, Naples
15.10–20.10.2017 year**

Actuality



In the 21st century, the rapid growth of medicinal products nomenclature is associated with the large consumption of raw materials. Therefore, searching for new raw materials is becoming an actual issue !

Despite the diversity and abundance of mineral resources, only their insignificant part has been assimilated so far, and their subsequent research and study is one of the most topical problems for modern medicine and pharmacy!

From mineral raw materials with the purpose of application in medical and pharmaceutical practice the special interest gain:

- **Clays**
- **Peloids**
- **Mineral waters**

The history of treatment with clays, muds and mineral water begins from the ancient times:

Galen (130-200 y.y. AD)

Italy XVI century

France XVII century

Russia XIII century

Georgia XVIII century

Adjara is one of the regions of Georgia, rich in peloids, clays, fresh and mineral waters resources, which can be found on the seacoasts, as well as in the mountains. These resources have been known to the local population since the ancient times and widely used for treatment of various diseases.

Clay



Peloid



A map showing the distribution of mineral resources (peloids, clays) in Georgia



➤ **In the available literature** there is scarce information regarding the study and application of some hydromineral recourses in medical practice and there is found no data on the research of the clays and peloids spread in Adjara with the purpose of their application in balneological and pharmaceutical practice.

The aim of the research was to study the mineral resources of Adjara with the purpose of the application in balneological and pharmaceutical practice.

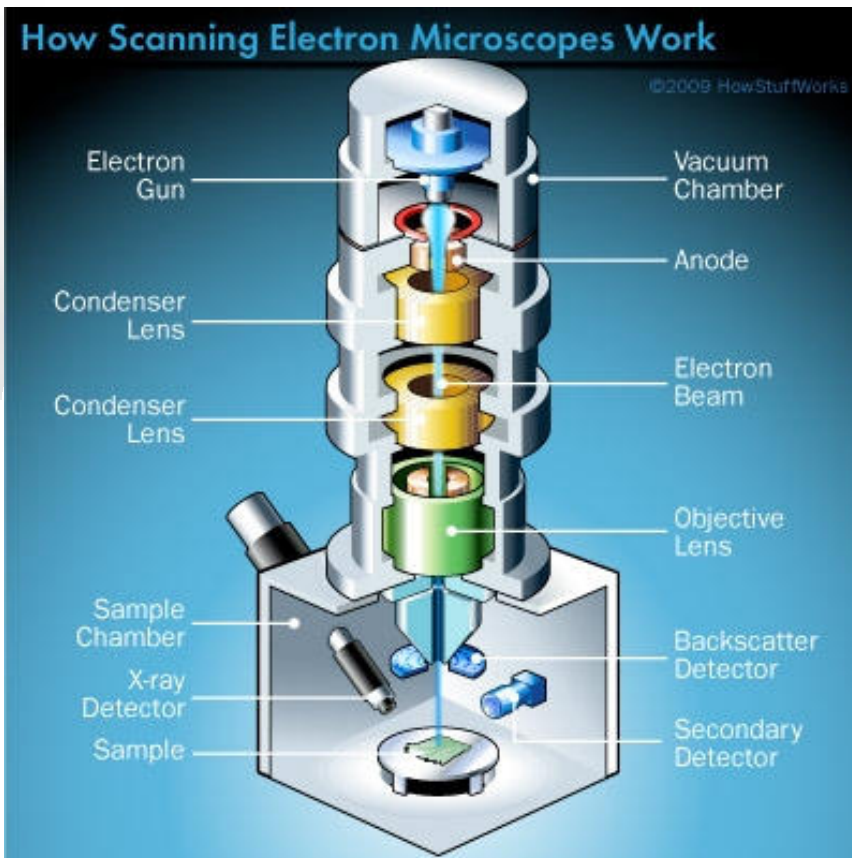
The research objects: the objects of the research were the peloids, clays and mineral waters, taken on the territory of the Autonomous Republic of Adjara.

The research methods: we used the following research methods: physical, chemical, technological, biopharmaceutical (Franz diffusion cells), the instrumental methods of analysis (Epsilon 5 EDXRF - Energy Dispersive X-ray Fluorescence spectrometry, etc.); Disc Diffusion Method (DDM) and Agar Well Diffusion method – for evaluation of antibacterial action.

The contents of minerals have been determined by using X-Ray phase analysis method and X-Ray diffractometer DRON-3 M. The copper Cu K α radiation was used as a source of X-rays.



Scanner el. Microscope



**Spectrometer
*Epsilon 5 EDXRF***

The results of the chemical research of mineral recourses (peloids, clays)

Shuakhevi Municipality (14)



1. Gasaliani			2. Shratiani		
Element	Concentration	Unit	Element	Concentration	Unit
Mg	2.728531	%	Mg	2.405194	%
Al	21.83766	%	Al	23.14544	%
Si	64.40293	%	Si	67.93019	%
P	0.806884	%	S	623.7252	ppm
S	0.278691	%	K	0.526033	%
K	1.317189	%	Ca	1.777429	%
Ca	1.799249	%	Ti	0.510318	%
Ti	0.891621	%	V	212.7092	ppm
V	290.1008	ppm	Cr	39.35156	ppm
Cr	73.53287	ppm	Mn	368.8946	ppm
Mn	878.8562	ppm	Fe	3.482073	%
Fe	5.689618	%	Ni	25.27522	ppm
Cu	52.60001	ppm	Cu	41.95691	ppm
Zn	72.85121	ppm	Zn	42.87581	ppm
Ga	10.43489	ppm	Ga	11.6331	ppm
As	1.953658	ppm	As	1.578926	ppm
Br	3.426199	ppm	Br	1.390348	ppm
Rb	26.86822	ppm	Rb	15.46421	ppm
Sr	390.5547	ppm	Sr	342.8535	ppm
Y	10.50739	ppm	Y	7.106406	ppm
Zr	138.239	ppm	Zr	111.6207	ppm
Nb	18.60636	ppm	Nb	11.16662	ppm
Ba	419.063	ppm	Ba	305.0163	ppm
La	28.54036	ppm	La	21.29937	ppm
Ce	55.30406	ppm	Ce	31.94078	ppm
Pr	12.6666	ppm	W	85.58455	ppm

Khulo Municipality (23)



1. Beshumi, 1km above, mud taken from the bottom of the bath, Sulfurous			2. Beshumi, 1km above, 1 st mud on the riverside		
Element	concentration	Unit Status	Element	concentration	Unit Status
Mg	1,4437	%	Mg	0,97561	%
Al	20,923	%	Al	18,5917	%
Si	60,7872	%	Si	51,8925	%
S	8,58101	%	S	21,1509	%
K	1,30427	%	K	1,10852	%
Ca	1,46841	%	Ca	0,8427	%
Ti	0,79951	%	Ti	0,62778	%
V	260,574	ppm	V	195,699	ppm
Cr	63,8122	ppm	Cr	48,6575	ppm
Mn	171,343	ppm	Mn	323,191	ppm
Fe	4,39463	%	Fe	4,64051	%
Ni	34,6011	ppm	Ni	28,8993	ppm
Cu	100,122	ppm	Cu	54,1209	ppm
Zn	85,2683	ppm	Zn	90,4758	ppm
Ga	28,8916	ppm	Ga	20,1372	ppm
As	58,8916	ppm	As	40,2729	ppm
Rb	47,6191	ppm	Br	7,12337	ppm
Sr	736,821	ppm	Rb	37,0972	ppm
Y	10,7624	ppm	Sr	380,42	ppm
Zr	301,7	ppm	Y	12,099	ppm
Nb	27,9774	ppm	Zr	161,394	ppm
Ag	3,15567	ppm	Nb	15,2563	ppm
Ba	753,343	ppm	I	24,5288	ppm
La	52,0561	ppm	Ba	228,522	ppm
Pb	29,647	ppm	Pb	28,8158	ppm

Keda Municipality (16)



1. Lower Merisi, at the Meriakhevi river, for rheumatosis			2. Merisi, Saretskhela river, for rheumatism		
Element	concentration	Unit Status	Element	concentration	Unit Status
Al	3,84388	%	Mg	1,87884	%
Si	5,49295	%	Si	40,6637	%
S	14,1796	%	P	851,631	ppm
Cl	141,824	ppm	S	0,71097	%
K	1921,31	ppm	K	2,75029	%
Ca	1143,64	ppm	Ca	0,56833	%
Ti	618,898	ppm	Ti	1,42195	%
V	473,578	ppm	V	916,551	ppm
Cr	44,05	ppm	Cr	75,0134	ppm
Fe	75,8964	%	Mn	582,7	ppm
Co	126,042	ppm	Fe	32,7784	%
Zn	33,4975	ppm	Co	340,965	ppm
Rb	15,9075	ppm	Cu	205,61	ppm
Sr	24,3617	ppm	Zn	212,862	ppm
Mo	9,34274	ppm	As	75,7778	ppm
Pd	3,59169	ppm	Rb	124,528	ppm
Ag	5,52447	ppm	Sr	236,924	ppm
Cd	2,41745	ppm	Y	23,8789	ppm
In	6,09386	ppm	Zr	239,362	ppm
I	13,7107	ppm	Nb	12,5836	ppm
Cs	31,7007	ppm	Mo	11,6297	ppm
Ba	138,587	ppm	Pd	0,80235	ppm
La	52,5869	ppm	Ag	7,94776	ppm
Ce	70,3917	ppm	Cd	4,57787	ppm
Pr	191,37	ppm	In	8,32665	ppm
Nd	143,865	ppm	I	94,4326	ppm
Sm	51,5722	ppm	Cs	43,0574	ppm
Yb	410,078	ppm	Ba	1028,58	ppm
Pb	95,9158	ppm	La	58,2843	ppm
Sum	100	%	Ce	122,753	ppm
			Pr	241,883	ppm
			Nd	168,568	ppm
			Sm	36,6564	ppm
			Yb	426,395	ppm
			Pb	118,522	ppm

Khelvachauri Municipality (2)



1. Khelvachauri Thkhilnari			
Dark brown, almost black, liquid, with characteristic sulfur smell			
Element	Conc.	Unit	% Unit
Mg	1,367	%	1,367
Al	9,629	%	9,629
Si	29,092	%	29,092
P	0,696	%	0,696
S	0,249	%	0,249
K	0,662	%	0,662
Ca	1,021	%	1,021
Ti	0,501	%	0,501
V	366,268	ppm	0,036627
Cr	91,498	ppm	0,00915
Mn	812,981	ppm	0,081298
Fe	13,547	%	13,547
Ni	36,276	ppm	0,003628
Cu	139,730	ppm	0,013973
Zn	98,688	ppm	0,009869
Ga	7,137	ppm	0,000714
Br	0,871	ppm	8,71E-05
Rb	29,463	ppm	0,002946
Sr	237,270	ppm	0,023727
Y	13,270	ppm	0,001327
Zr	103,823	ppm	0,010382
Ba	429,071	ppm	0,042907
Nd	53,912	ppm	0,005391

2. Village Masauri near Batumi, from the bottom of skin water			
Dark brown, rusty, viscous, with slightly noticeable smell.			
Element	Conc.	Unit	% Unit
Mg	2,376	%	2,376
Al	9,345	%	9,345
Si	30,763	%	30,763
P	0,358	%	0,358
S	583,351	ppm	0,0583351
K	1,579	%	1,579
Ca	0,858	%	0,858
Ti	0,427	%	0,427
V	221,662	ppm	0,0221662
Cr	179,186	ppm	0,0179186
Mn	1053,831	ppm	0,1053831
Fe	6,350	%	6,35
Cu	76,388	ppm	0,0076388
Zn	42,745	ppm	0,0042745
Ga	12,242	ppm	0,0012242
As	2,820	ppm	0,000282
Br	6,962	ppm	0,0006962
Rb	61,429	ppm	0,0061429
Sr	243,758	ppm	0,0243758
Y	21,746	ppm	0,0021746
Zr	150,482	ppm	0,0150482
Ba	895,039	ppm	0,0895039
Nd	48,142	ppm	0,0048142
Yb	115,344	ppm	0,0115344
Pb	17,917	ppm	0,0017917
sum	52.429	%	

Kobuleti Municipality (5)



1. Kobuleti lake soil, Niphi

Element	concentration	Unit Status
Al	24,3289	%
Si	51,4509	%
P	2053,59	ppm
S	4,93198	%
Cl	187,335	ppm
K	1,57244	%
Ca	2,09228	%
Ti	1,17674	%
V	745,029	ppm
Cr	235,429	ppm
Mn	1102,93	ppm
Fe	12,0002	%
Ni	160,984	ppm
Cu	358,99	ppm
Zn	1022,55	ppm
Ga	36,9006	ppm
Br	132,421	ppm
Rb	104,43	ppm
Sr	326,969	ppm
Y	37,3144	ppm
Zr	244,688	ppm
Nb	19,8728	ppm
Pb	121,719	ppm
Sum	100	%

2. Chakhati

Element	concentration	Unit Status
Mg	2,72082	%
Al	20,3326	%
Si	62,933	%
S	3,42434	%
K	0,9628	%
Ca	1,27425	%
Ti	0,74463	%
V	303,491	ppm
Cr	126,838	ppm
Mn	1368,71	ppm
Fe	7,19492	%
Ni	80,4626	ppm
Cu	119,131	ppm
Zn	190,788	ppm
Ga	20,6868	ppm
As	3,06705	ppm
Rb	53,3224	ppm
Sr	653,784	ppm
Y	20,9018	ppm
Zr	193,161	ppm
Nb	14,6633	ppm
Ba	862,35	ppm
Pb	41,0573	ppm
sum	100	%

4. The results of the determination of micro and macroelements in Ispani peat peloid

%						
	55 cm	60 cm	65 cm	55 cm (ash)	60 cm (ash)	65 cm (ash)
Mg	0.09865	0.35912	0.25826	1.30679	1.21369	1.30569
Al	3.33335	5.40753	3.8372	12.44836	10.66672	10.75721
Si	6.3564	8.70467	6.81299	14.9673	13.28822	13.95671
P	0.02054	0.02371	0.02857	0.15776	0.11322	0.10968
S	0.9024	0.60066	0.75768	0.08876	0	0.07038
K	0.51141	0.9375	1.20395	1.06145	1.2117	1.70489
Ca	0.05895	0.05151	0.28751	0.28081	0.16177	0.31886
Ti	0.53387	0.82634	0.61575	1.17347	1.16956	0.9421
Cr	0.00294	0.0102	0.00938	0.00969	0.01242	0.01339
Mn	0.16346	0.10822	0.17485	0.16156	0.11149	0.22967
Fe	2.15161	3.31259	3.57262	2.68879	4.22375	4.67549
Ni	0.01532	0.02813	0.03226	0.02519	0.02707	0.03516
Cu	0.03592	0.02995	0.02721	0.47074	0.0186	0.01904
Zn	0.13027	0.10151	0.10513	0.04787	0.06518	0.06094
As	0.00789	0	0	0	0	0
Zr	0.02038	0.06268	0.04163	0.01662	0.07274	0.05738
Ag	0.11778	0.12021	0.1302	0	0.02342	0.03427
Sb	0.01231	0	0.00073	0.01139	0.00374	0.00517
Pb	0.01989	0.00127	0.00074	0.02005	0.0156	0.00172

Other Regions of Georgia (4)

1. Akhtala #1-2-3-4 16 hours			2. Zhinvali water reservoir		
Element	Conc,	Unit	Element	Conc,	Unit
Mg	2,984596	%	Mg	3,09758	%
Al	20,60677	%	Al	18,51862	%
Si	68,03034	%	Si	61,29582	%
S	0,381578	%	K	1,498415	%
Cl	0,294785	%	Ca	12,58816	%
K	1,469231	%	Ti	0,348043	%
Ca	3,039331	%	V	158,4565	ppm
Ti	0,347173	%	Cr	80,33009	ppm
V	114,9488	ppm	Mn	575,1791	ppm
Cr	71,0251	ppm	Fe	2,461944	%
Mn	595,7448	ppm	Ni	23,91603	ppm
Fe	2,677301	%	Cu	31,89628	ppm
Ni	27,3657	ppm	Zn	52,48393	ppm
Cu	29,54179	ppm	Ga	8,046198	ppm
Zn	49,71851	ppm	As	4,695829	ppm
Ga	8,823207	ppm	Rb	45,5936	ppm
As	2,824302	ppm	Sr	378,7795	ppm
Br	12,1972	ppm	Y	14,23586	ppm
Rb	45,50004	ppm	Zr	120,8093	ppm
Sr	204,9073	ppm	Nb	8,549028	ppm
Y	13,37947	ppm	Ba	330,0068	ppm
Zr	128,494	ppm	La	24,70737	ppm
Nb	8,879506	ppm	Ce	45,15763	ppm
I	25,34287	ppm	Hf	5,023722	ppm
Ba	268,0608	ppm	Pb	13,11938	ppm
La	21,37696	ppm			
Ce	40,60677	ppm			
Hf	4,282587	ppm			
Pb	13.87833	ppm			

We studied the contents of minerals in the samples of clays and peloids, by X-Ray phase method of analysis.

In Gasaliani sample there have been detected the minerals such as: Ca-Na feldspar (the main characteristic peaks d - 4.03Å, 6.39Å...), Ca-montmorillonite (the main characteristic peaks d - 15.0Å, 4.49Å...), Hematite Fe_2O_3 in small quantities (the main characteristic peaks d - 2.695Å, 2.520Å...) and Quartz SiO_2 (the main characteristic peak d - 3.34Å...) is in trace amounts (Fig. №1).

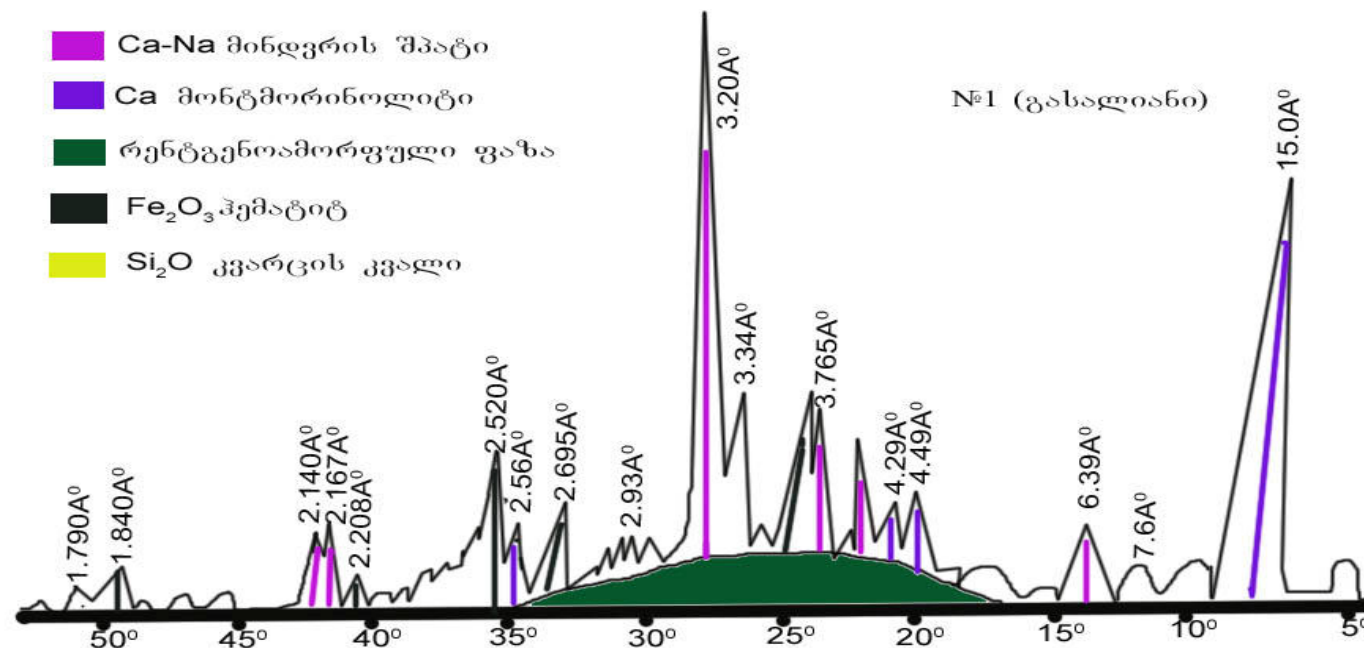


Fig. №1 Diffractogram of the Gasaliani sample

In the sample of Mtsvane lake there have been detected the minerals such as: Ca-Na feldspar (the main characteristic peaks d – 2.55Å, 4.49Å...), Ca-montmorillonite, Quartz, Amphiboles in small quantities, Mica and Chlorite in trace amounts (Fig. №2).

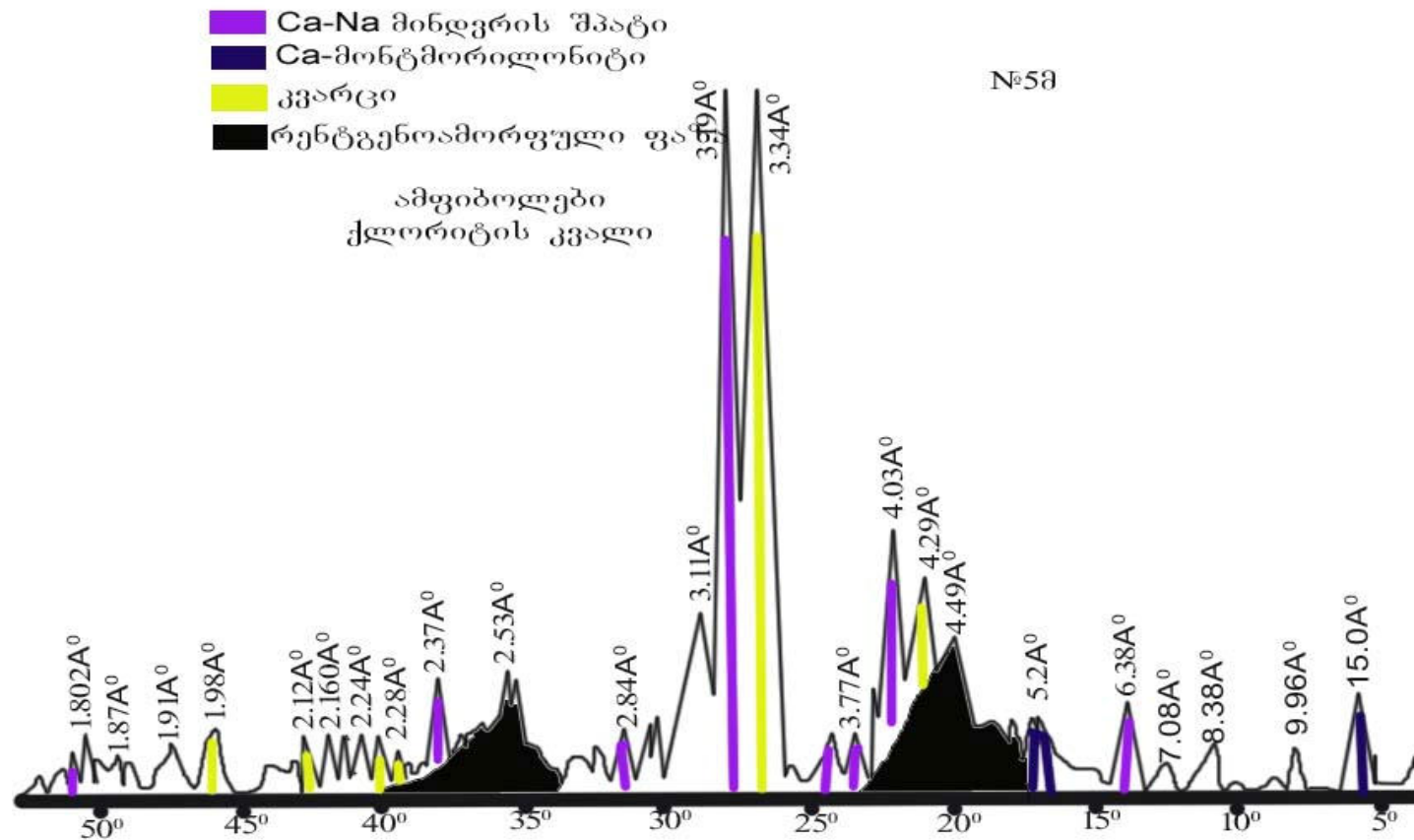


Fig. №2 Diffractogram of the Mtsvane Lake sample

The results of the chemical research of hydromineral recourses

Khulo Municipality (22)



#	Indicators	Unit	1. Beshumi Sulfur bath	2. Danisparauli, bath water
1	2	3	4	5
	Organoleptic properties			
1.	Taste	bali	3,0	4,0
2.	Odor	bali	4,0	0,0
3.	Color	degree	19,2	27,5
4.	Turbidity	mg/dm ³	1,8	1,25
5.	Transparency	cm	>310	>310
	Chemical composition			
1.	pH		6,22	6,49
2.	Cl ⁻	mg/dm ³	11,6	16,5
3.	HCO ₃ ⁻	mg/dm ³	109,8	4575,0
4.	F ⁻	mg/dm ³	0,0	0,0
5.	ClO ⁻	mg/dm ³	0,0	0,0
6.	PO ₄ ³⁻	mg/dm ³	0,35	2,4
7.	NO ₂ ⁻	mg/dm ³	0,0	0,0
8.	NO ₃ ⁻	mg/dm ³	2,05	2,5
9.	Ca ²⁺	mg/dm ³	16,3	100,2
10.	Mg ²⁺	mg/dm ³	17,0	449,92
11.	Fe ³⁺	mg/dm ³	0,24	0,23
12.	Cu ²⁺	mg/dm ³	0,14	0,142
13.	Al ³⁺	mg/dm ³	0,0	0,0
14.	Ni ²⁺	mg/dm ³	0,752	0,672
15.	NH ₄ ⁺	mg/dm ³	1,98	0,0
16.	hardness	mg.equiv./dm ³	2,2	42,0
17.	NaCl	mg/dm ³	19,2	27,2
18.	H ₂ S	mg/dm ³	2,55	0,85
19.	O ₂	mg.O ₂ ./dm ³	8,0	1,6
20.	SO ₄ ²⁻	mg/dm ³	38,4	34,4
21.	Dry residue	mg/dm ³	195,6	3408,0
22.	Floating substances	bali	0,0	0,0

Shuakhevi Municipality (14)



Number 1. Chirukhi, twisted waters, bath

Co 228.616 0.002 mg/L
Pb 220.353 0.037 mg/L
Ni 231.604 0.012 mg/L
Cr 267.716 0.004 mg/L
Cu 327.393 0.013 mg/L
Fe 238.204 1.673 mg/L
Zn 206.200 0.225 mg/L
B 249.677 0.047 mg/L
Mn 257.610 0.169 mg/L
Al 396.153 0.206 mg/L
Sr 407.771 0.136 mg/L

Number 2 Tetrmitsa

Co 228.616 0.001mg/L
Pb 220.353 0.041 mg/L
Ni 231.604 0.012 mg/L
Cr 267.716 0.001 mg/L
Cu 327.393 0.013 mg/L
Fe 238.204 0,248 mg/L
Zn 206.200 0.132 mg/L
B 249.677 4.930 mg/L
Mn 257.610 0.061 mg/L
Al 396.153 0.417 mg/L
Sr 407.771 3.569 mg/L

Number 3 Kutauris qveda

Co 228.616 0.002 mg/L
Pb 220.353 0.045 mg/L
Ni 231.604 0.104 mg/L
Cr 267.716 0.007 mg/L
Cu 327.393 0.160 mg/L
Fe 238.204 1.507 mg/L
Zn 206.200 0.174mg/L
B 249.677 0.103 mg/L
Mn 257.610 0.829 mg/L
Al 396.153 17.13 mg/L
Sr 407.771 0.164 mg/L

Number 4. Kildiabano

Co 228.616 0.000 mg/L
Pb 220.353 0.037 mg/L
Ni 231.604 0.014 mg/L
Cr 267.716 0.008 mg/L
Cu 327.393 0.004 mg/L
Fe 238.204 0.196 mg/L
Zn 206.200 0.193mg/L
B 249.677 5.552 mg/L
Mn 257.610 0.008 mg/L
Al 396.153 0.209 mg/L
Sr 407.771 4.770 mg/L

Number 5. Shuakhevi, Kldisubani

Co 228.616 0.000mg/L
Pb 220.353 0.041 mg/L
Ni 231.604 0.012 mg/L
Cr 267.716 0.006 mg/L
Cu 327.393 0.001 mg/L
Fe 238.204 1.871 mg/L
Zn 206.200 0.101 mg/L
B 249.677 4.604 mg/L
Mn 257.610 5.452 mg/L
Al 396.153 2.197 mg/L
Sr 407.771 3.883 mg/L

Number 6. Shuakhevi, Shubani, Birknala

Co 228.616 0.009 mg/L
Pb 220.353 0.045 mg/L
Ni 231.604 0.036 mg/L
Cr 267.716 0.030 mg/L
Cu 327.393 0.066 mg/L
Fe 238.204 14.45 mg/L
Zn 206.200 0.257 mg/L
B 249.677 0.095 mg/L
Mn 257.610 0.192 mg/L
Al 396.153 2.974 mg/L
Sr 407.771 0.286mg/L

Number 7. Shuakhevi, Tomasheti

Co 228.616 0.001 mg/L
Pb 220.353 0.051 mg/L
Ni 231.604 0.002 mg/L
Cr 267.716 0.047 mg/L
Cu 327.393 0.003 mg/L
Fe 238.204 0.086 mg/L
Zn 206.200 0.102 mg/L
B 249.677 2.750 mg/L
Mn 257.610 0.346 mg/L
Al 396.153 0.046 mg/L
Sr 407.771 0.121 mg/L

Number 8. Kutauris zeda

Co 228.616 0.004 mg/L
Pb 220.353 0.048 mg/L
Ni 231.604 0.024 mg/L
Cr 267.716 0.009 mg/L
Cu 327.393 0.011 mg/L
Fe 238.204 1.742 mg/L
Zn 206.200 0.160mg/L
B 249.677 0.116 mg/L
Mn 257.610 0.346 mg/L
Al 396.153 9.216 mg/L
Sr 407.771 0.359 mg/L

Keda Municipality (17)



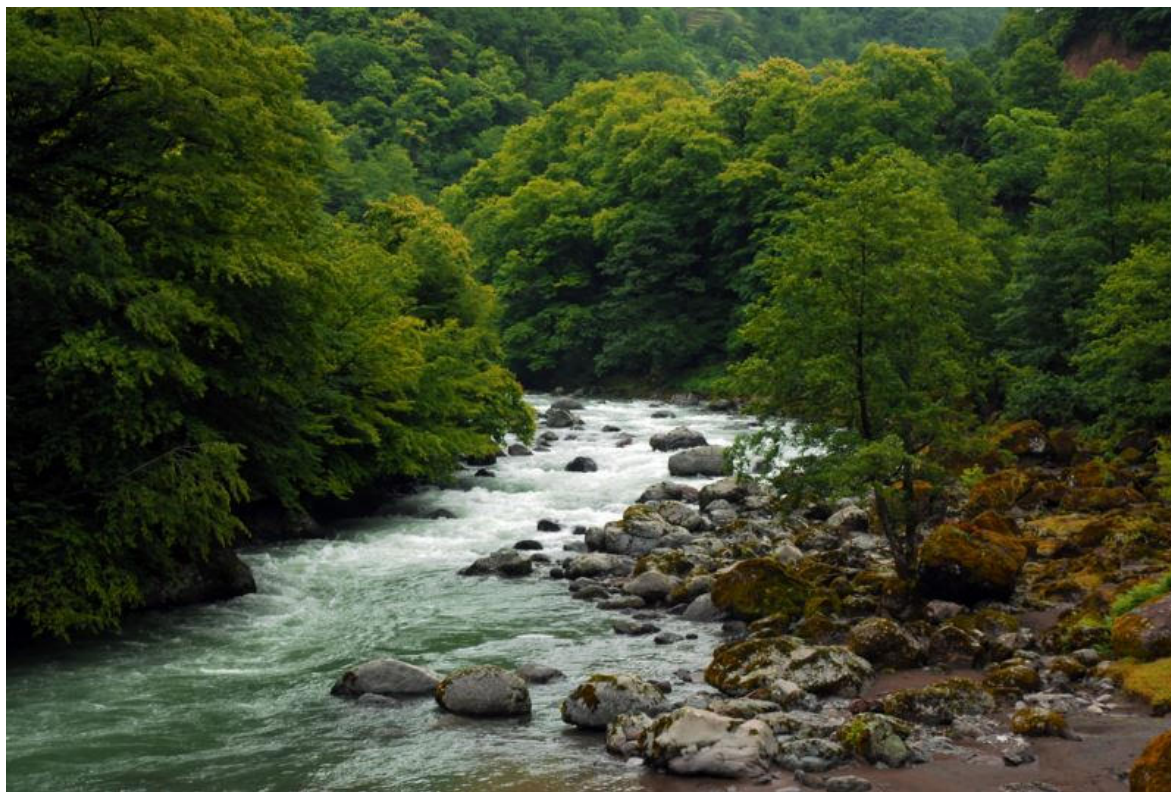
#	Indicators	Unit	Ghoma, Didlashe, Sakiaji entrance I	Keda, village Gegelidzeebi
1	2	3	6	7
	Organoleptic properties			
1	Taste	bali	0,0	0,0
2	Odor	bali	0,0	0,0
3	Color	degree	0,0	38,5
4	Turbidity	mg/dm ³	0,0	1,7
5	Transparency	cm	>310	>310
	Chemical composition			
1	pH		4,57	4,42
2	Cl ⁻	mg/dm ³	3,88	0,97
3	HCO ₃ ⁻	mg/dm ³	12,2	6,1
4	F ⁻	mg/dm ³	0,0	1,45
5	ClO ⁻	mg/dm ³	0,0	0,0
6	PO ₄ ³⁻	mg/dm ³	0,065	traces
7	NO ₂ ⁻	mg/dm ³	0,0	0,0
8	NO ₃ ⁻	mg/dm ³	3,0	30,0
9	Ca ²⁺	mg/dm ³	4,0	220,44
10	Mg ²⁺	mg/dm ³	1,2	12,16
11	Fe ³⁺	mg/dm ³	0,0	4,48
12	Cu ²⁺	mg/dm ³	0,1	0,46
13	Al ³⁺	mg/dm ³		
14	Ni ²⁺	mg/dm ³	0,0	0,48
15	NH ₄ ⁺	mg/dm ³	0,2	0,72
16	hardness	mg.equiv./dm ³	0,3	12,0
17	NaCl	mg/dm ³	6,4	1,6
18	H ₂ S	mg/dm ³	0,0	0,0
19	O ₂	mg.O ₂ ./dm ³	1,36	10,4
20	SO ₄ ²⁻	mg/dm ³	7,5	575,0
21	Dry residue	mg/dm ³	30,2	720,8
22	Floating substances	bali	0,0	0,0

Khelvachauri Municipality (12)



#	Indicators	Unit	Kapnisthavi	“Kapnisi”, above village	Kapnisthavi, taken in the village	Makhinjauri Sulfur bath
1	2	3	7	8	9	10
	Organoleptic properties					
1	Taste	bali	0,0	0,0	0,0	2,0
2	Odor	bali	0,0	0,0	0,0	3,0
3	Color	degree	89,1	76,0	71,5	99,0
4	Turbidity	mg/dm ³	0,75	2,5	0,0	3,25
5	Transparency	cm	<310	<310	>310	<310
	Chemical composition					
1	pH		6,05	5,55	6,38	6,55
2	Cl ⁻	mg/dm ³	6,79	10,7	5,8	2,9
3	HCO ₃ ⁻	mg/dm ³	48,8	21,35	36,6	64,05
4	F ⁻	mg/dm ³	0,0	0,0	0,0	0,0
5	ClO ⁻	mg/dm ³	0,0	0,0	0,0	0,0
6	PO ₄ ³⁻	mg/dm ³	0,1	0,3	0,25	0,0
7	NO ₂ ⁻	mg/dm ³	0,1	0,15	0,0	0,0
8	NO ₃ ⁻	mg/dm ³	11,75	32,75	29,25	4,1
9	Ca ²⁺	mg/dm ³	6,76	3,0	8,0	5,0
10	Mg ²⁺	mg/dm ³	3,6	3,04	1,2	0,85
11	Fe ³⁺	mg/dm ³	0,195	1,38	0,13	0,0
12	Cu ²⁺	mg/dm ³	0,026	0,4	0,026	traces
13	Al ³⁺	mg/dm ³				
14	Ni ²⁺	mg/dm ³	0,0	0,2	0,0	0,0
15	NH ₄ ⁺	mg/dm ³	0,12	0,39	0,0	0,82
16	hardness	mg.equiv./dm ³	0,75	0,4	0,5	0,32
17	NaCl	mg/dm ³	11,2	17,6	9,6	4,8
18	H ₂ S	mg/dm ³	0,0	0,0	0,0	3,4
19	O ₂	mg.O ₂ ./dm ³	5,6	3,52	0,8	5,68
20	SO ₄ ²⁻	mg/dm ³	4,0	5,3	0,0	2,0
21	Dry residue	mg/dm ³	85,0	76,6	71,5	75,6
22	Floating substances	bali	0,0	0,0	0,0	0,0

Kobuleti Municipality (1)



#	Indicators	Unit	Kvirike water
1	2	3	4
	Organoleptic properties		
1	Taste	bali	0,0
2	Odor	bali	0,0
3	Color	degree	0,0
4	Turbidity	mg/dm ³	0,0
5	Transparency	cm	>310
	Chemical composition		
1	pH		6,57
2	Cl ⁻	mg/dm ³	18,4
3	HCO ₃ ⁻	mg/dm ³	109,8
4	F ⁻	mg/dm ³	0,15
5	ClO ⁻	mg/dm ³	0,0
6	PO ₄ ³⁻	mg/dm ³	0,1
7	NO ₂ ⁻	mg/dm ³	1,27
8	NO ₃ ⁻	mg/dm ³	0,0
9	Ca ²⁺	mg/dm ³	6,0
10	Mg ²⁺	mg/dm ³	0,0
11	Fe ³⁺	mg/dm ³	0,0
12	Cu ²⁺	mg/dm ³	0,0
13	Al ³⁺	mg/dm ³	
14	Ni ²⁺	mg/dm ³	0,71
15	NH ₄ ⁺	mg/dm ³	0,15
16	hardness	mg.equiv./dm ³	0,3
17	NaCl	mg/dm ³	30,4
18	H ₂ S	mg/dm ³	0,0
19	O ₂	mg.O ₂ ./dm ³	0,64
20	SO ₄ ²⁻	mg/dm ³	0,0
21	Dry residue	mg/dm ³	124,5
22	Floating substances	bali	0,0

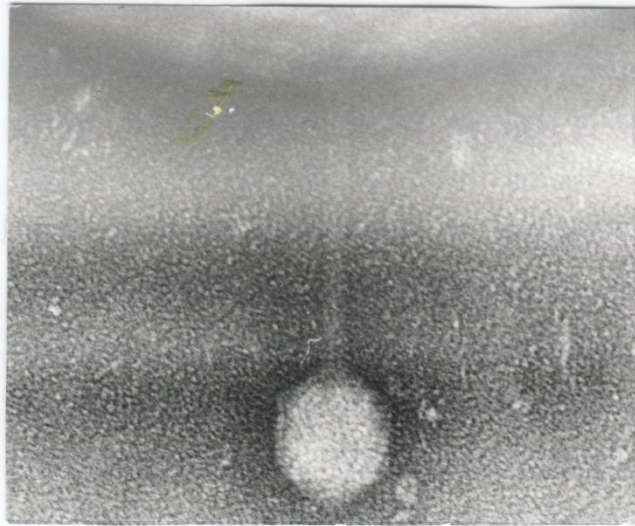
The study of the clay widespread in Khulo municipality for the purpose of using as auxiliary substance - base-carrier, in soft pharmaceutical products

There have been studied:

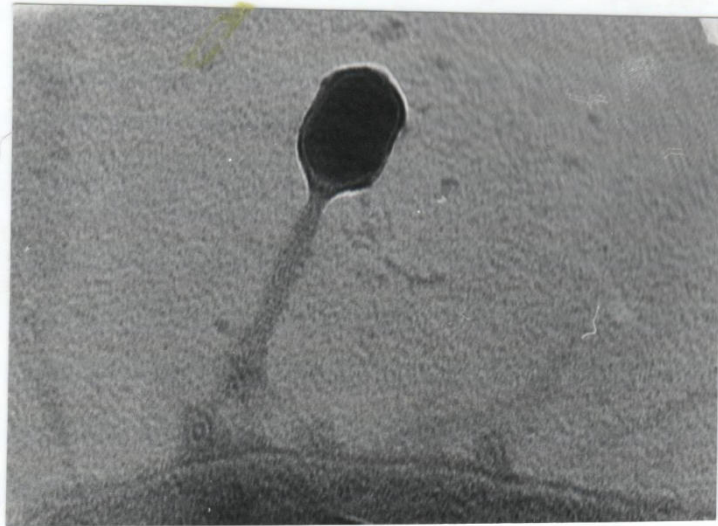
- **The physical-chemical and technological properties of Beshumi clay;**
- **The biopharmaceutical studies of the Teimurov paste prepared by the officinal and provided recipe have been conducted.**



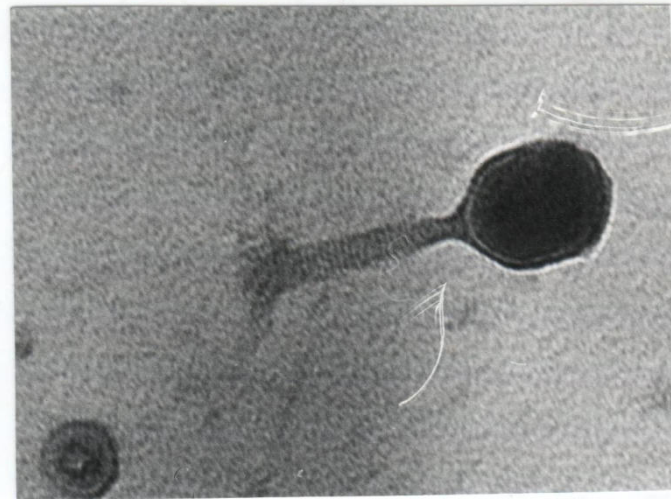
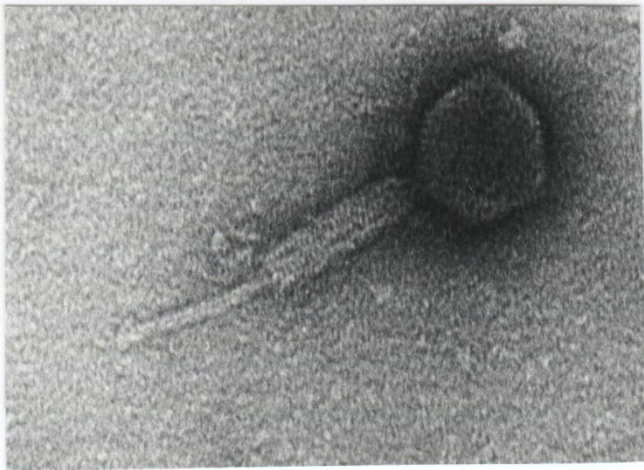
- ◆ In water extracts of Jakhati and Kvirike peloids there has been detected the content of bacteriophages with Adams method, by using the standard samples.
- ◆ By experimental studies there has been established, that the studied samples containing bacteriophages have ability of lyses of *E. Coli*, *Staphylococcus aureus*, *Proteus spp.*
- ◆ The results are shown on the following pictures.



Staphylococcus



E. Coli



The antibacterial effects indicators of the samples studied towards *Staphylococcus aureus*

№	Sample Name	Average values of inhibition zones (M) and middle standard deviations (SD) for the following dilutions:								
		Starting sample		1:10		1:100		1:1000		Remark
		M	SD	M	SD	M	SD	M	SD	
1	Beshumi rock	0	0	0	0	0	0	0	0	
2	Beshumi bath	1.1	1.1	0.5	0.4	0	0	0	0	
3	Chakhati	0.6	0.5	0	0	0	0	0	0	
4	Kvirike	0	0	0	0	0	0	0	0	
5	Chirukhi	0	0	0	0	0	0	0	0	
6	Positive control	3.1	0.3							
7	Negative control	0	0							

The antibacterial effects indicators of the samples studied towards *Escherichia Coli*

№	Sample Name	Average values of inhibition zones (M) and middle standard deviations (SD) for the following dilutions:								
		Starting sample		1:10		1:100		1:1000		Remark
		M	SD	M	SD	M	SD	M	SD	
1	Beshumi rock	0	0	0	0	0	0	0	0	
2	Beshumi bath	0.5	0.4	0	0	0	0	0	0	
3	Chakhati	2.1	1.5	1.1	1.1	0	0	0	0	
4	Kvirike	1.9	1.7	0.9	0.8	0	0	0	0	
5	Chirukhi	0	0	0	0	0	0	0	0	
6	Positive control	2.9	0.4							
7	Negative control	0	0							

The antibacterial effects indicators of the samples studied towards *Proteus spp.*

№	Sample Name	Average values of inhibition zones (M) and middle standard deviations (SD) for the following dilutions:								
		Starting sample		1:10		1:100		1:1000		Remark
		M	SD	M	SD	M	SD	M	SD	
1	Beshumi rock	0	0	0	0	0	0	0	0	
2	Beshumi bath	0.3	0.2	0	0	0	0	0	0	
3	Chakhati	2.6	2.2	1.8	1.5	0	0	0	0	
4	Kvirike	2.1	1.9	1.2	0.7	0	0	0	0	
5	Chirukhi	0	0	0	0	0	0	0	0	
6	Positive control	3.5	0.6							
7	Negative control	0	0							



	Sample Name	<i>E.coli</i>		<i>Acinetobacter spp.</i>		<i>s.aureus</i>		<i>Klebsiella Pneum.</i>	
		Conc entra ted	Diluti on 1:1	Concent rated	Dilutio n 1:1	Conce ntrate d	Diluti on 1:1	Conc entra ted	Diluti on 1:1
1	Peat peloid 65.0	neg	neg	neg	neg	neg	neg	neg	neg
2	Peat water 55.0	neg	neg	neg	neg	neg	neg	neg	neg
3	Peat peloid 55.0	neg	neg	neg	neg	neg	neg	neg	neg

The impact of mineral water (Shubani, Shuakhevi) on the functional conditions of the stomach of white rats

№	Test conditions	Volume of gastric juice, mL/100g	Total acidity, Michaelis unit	Free HCl content, Michaelis unit	Debit-hrs HCl, mg/100g	Pepsin content, mg %
1.	Control (distilled water)	$0,7 \pm 0,33$	$46,5 \pm 3,2$	$20,8 \pm 1,9$	$0,11 \pm 0,01$	1016 ± 57
2.	Loading of body weight by 1%	$1,22 \pm 0,11$ $P < 0,01$	$61,2 \pm 4,1$ $P < 0,05$	$33,2 \pm 2,7$ $P < 0,01$	$0,24 \pm 0,02$ $P < 0,001$	2550 ± 237 $P < 0,001$
3.	Loading of body weight by 2%	$1,40 \pm 0,08$ $P < 0,01$	$53,5 \pm 3,6$	$28,6 \pm 2,3$ $P < 0,05$	$0,20 \pm 0,02$ $P < 0,01$	1350 ± 87 $P < 0,05$

The impact of mineral water on the peripheral blood indicators of the white rats

Indicators Groups	Control (H ₂ O)	Loading of body weight by 1%	Loading of body weight by 2%
Leukocytes, · 10 ^{9/L}	9,00 ± 1,10	7,00 ± 0,03	8,50 ± 2,24
Erythrocytes, · 10 ^{12/L}	6,05 ± 0,66	6,97 ± 0,12	5,44 ± 0,24
Hemoglobin, g/L	141,00 ± 10,58	146,00 ± 9,85	127,00 ± 6,00
Thrombocytes, · 10 ^{9/L}	560,00 ± 29,69	614,67 ± 66,79	582,00 ± 28,00
Remark: in all cases P > 0,05			

The impact of mineral water on the bile secretion speed of the white rats

№	Test conditions	Bile secretion speed during 5 hours, mg/min at 100 g				
		1 hour	2 hour	3 hour	4 hour	5 hour
1.	Control (H2O)	5,1 ± 0,6	4,4 ± 0,2	4,3 ± 0,2	4,0 ± 0,4	3,9 ± 0,05
2.	Loading of body weight by 1% (one-time)	5,1 ± 0,5	5,3 ± 0,3 P < 0,05	5,2 ± 0,3 P < 0,05	5,0 ± 0,4	4,7 ± 0,4 P < 0,05
3.	Loading of body weight by 2% (one-time)	4,9 ± 0,1	4,4 ± 0,4	3,9 ± 0,4	3,7 ± 0,4	3,4 ± 0,4
4.	Loading of body weight by 1% during 10 days	5,2 ± 0,4	5,3 ± 0,1 P < 0,01	5,1 ± 0,1 P < 0,05	4,3 ± 0,1	4,1 ± 0,2

The impact of mineral water on the bile main ingredients of the white rats

№	Test conditions	The total amount of the secreted bile	Bile acids	Bilirubin	Cholesterin	Cholate-cholesterin
		during 4 hours				coefficient
		mg/100 g	mg/100 g : mg %			
1.	Control (H ₂ O)	996 ± 64	4,65 / 1859	0,089 / 36	0,069 / 27,5	67,6
2.	Loading of body weight by 1% (one-time)	1212.± 67 P <0,05	6,01 / 1971	0,114 / 38	0,084 / 28	70,4
3.	Loading of body weight by 2% (one-time)	934 ± 90	4,44 / 1887	0,067 / 30	0,064 / 28	64,7
4.	Loading of body weight by 1% during 10 days	1194.±4,6 P <0,05	7,08 / 2332	0,152 / 57	0,078 / 28,5	83,3

On the basis of the conducted researches the following conclusions can be made:

- ❖ By using the modern instrumental methods of analysis, there have been studied the chemical compositions (micro and macroelements) of 58 peloids, 8 clays and 38 mineral waters located in Adjara region.
- ❖ Especially noteworthy, that peloids are saturated with micro and macroelements. **Calcium, Magnesium, Sulfur, Iron** are identified in relatively large quantities. **Potassium, Sodium, Phosphorus, Chlorine, Copper, Cobalt, Zinc, Nickel, Manganese, Chromium, Boron and Barium** are in small quantities. **Iodine** is identified in 3 peloids samples – Beshumi, Kvirike and Merisi. The content of **Selenium** is confirmed in 2 and 3 peloids located on the territories of Shuakhevi and Keda (accordingly).
- ❖ **Silver** is identified in 9 peloids: Beshumi, Merisi, Tbethi, Zvare, Mtsvane lake, Korthkhmela, Phatskhebi, Kvirike and Ispani.

❖ X-ray phase analysis showed, that the peloids of Chakhati, Kvirike, Niphi lake, Mtsvane lake, Gasaliani and Shratiani represent as X-Ray amorphous mass. The contents of the following minerals have been established in them: Ca-Na feldspar, K feldspar, Ca-montmorillonite, Quartz (SiO_2), Hematite (Fe_2O_3), Chlrotie, Magnetite (Fe_3O_4), Amphiboles, Mica and Chlorite in trace amounts.

❖ With a complete chemical analysis of mineral waters and the study on the composition of micro and macro elements, it is clear that:

- **Danisparauli bath water of Khulo Municipality** contains hydrocarbonate ($\text{HCO}_3^- = 4575,0$) at high quantities. The pH of water is 6.49. Flavoring properties of the water is acidic, which is conditioned by free carbonic acid ($\text{H}_2\text{CO}_3 = \text{H}_2\text{O} + \text{CO}_2$). At the same time the water contains at high quantities the elements with high biological value: **Calcium (100.2 mg/dm³)** and **Magnesium (499.92 mg/dm³)**. Except for that, it is rather hard water and belongs to mineral waters.
- **Water of the village Chao “Phatskhebi” of Khulo Municipality** – almost 90% of the water composition is hydrocarbonates, which causes particular interest for further study with the purpose of application in medical practice.
- **Water of Phukharagverdebi, of Khulo Municipality** - the mentioned water belongs to the clean sulfate table water, which is also interesting for further research with the purpose of using in medical practice.

❖ **Keda, Merisi-Nakona`s Kldis Abano** - is distinguished as calcium-sodium-sulfate-hydrocarbonate mineral water with low mineralization. It contains sufficient amount of sulfates. There is a large amount of **Calcium (421.0 mg / dm³)** in the water, the content of **Fluorine (1.25 mg / dm³)** is also established in it;

❖ **Keda, Merisi, the bath above Namonastrevi Rock** - it is calcium-sodium-sulfate-hydrocarbonate mineral water, with relatively high mineralization. The water contains a large amount of **Calcium (400.8 mg / dm³)**, the **Fluorine (1.25 mg / dm³)** is also identified in it.

❖ In the water of the village Gegelidzeebi, Keda, there is identified the high content of Calcium (220.44 mg/dm^3), as well as the content of Fluorine ($1,45 \text{ mg/dm}^3$). The mentioned water is sulfate, acid in nature. High content of Calcium (421 mg/dm^3) and Fluorine (1.45 mg/dm^3) is also established in Merisi and Gundaure waters.

❖ Keda, Merisi - below the river Meriakhevi - the water is distinguished by high content of Sodium Chloride and Sodium Sulfate.

❖ From the studied objects, **Ghoma waters have sharply expressed acid reaction. Also the following 8 mineral waters have acid nature:** Chao “Phukhara Gverdebi (3,37), Meriisi – below Meriakhevi River I (2,95), Merisi – below Meriakhevi River II (3,65), Merisi, Photholdlebi (2,52) Merisi-Miqaltsminda (3,1), Keda Khabizis Qedi (3,38), Keda Gegelidzeebi (4,42), Khulo Khidistavi (4,98); **the following 8 mineral waters have neutral nature:** the village Chao “Phatskhebi” (6,65), Keda, October (6,45), Kelvachauri Kapnisthavi (6,05, 6,38), Merisi Nakonas Kldis Abano (6,02), Merisi Gundauri water (6,47), Kvirike water (6,57), Beshumi (6,22), Danisparauli water (6,49); **2 waters have weak alkaline reaction** - Khulo village Chao "Naflate" (7,28), village Chao “Korthkkmela" (7,45); **Alkaline reaction**

❖ On the basis of **the pharmacological studies** it has been established that the mineral water **Shubani, of Shuakhevi Municipality** significantly stimulates the acid and enzyme-producing function of stomach, while not affecting the peripheral blood composition; it stimulates: the synthesis and release of bile acids, bilirubin secretion, cholesterol excretion with the bile and increases a cholate-cholesterol coefficient. By loading of the body weight by 2% (one-time) the mineral water mildly reduces the secretion of bile and bilirubin.

❖ There is revealed, that **Ispani peat peloid** and **water** have high antibacterial effect towards about 20 strains sensitive, as well as resistant to antibiotics.

❖ In water extracts of Chakhati and Kvirike peloids there is identified the content of bacteriophages, which has the ability of lysis of Staphylococcus.

❖ Based on **the pharmacological studies** there is established, that the research objects (Beshumi clay, Kvirike and Chakhati peloids), have no general-toxic, cumulative, local irritant, allergic, internal organs damaging and systemic actions.

❖ At present there are developed the instructions of **4 natural recourses** (Kobuleti, Keda, Shuakhevi and Khulo municipalities) for using in balneological practice .

❖ **The further development and practical realization of the conducted studies results will promote the development of medical tourism in Adjara region, arrangement of healthful, balneological resorts, besides, the possibility of using mineral resources as auxiliary substances in pharmaceutical**

Thanks For Your Attention!

*The presented studies have been carried by the financial support of the grant PHDF
2016_156 of Shota Rustaveli National Scientific Funding*

