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CHLORIDE-CALCIUM MINERAL WATER "MUKHURI"

LUGELA

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ABOUT THE MINERAL WATER "MUKHURI", LUGELA

(General Overview)

Due to its richness and variety of mineral waters and climatic therapeutic locations, Georgia rightfully holds one of the honored places in the entire Soviet Union.

In Georgia therapeutic waters representing almost all classes and groups according to existing classifications of mineral waters can be found. Some of them, due to their unique physical and chemical properties, do not fit within these classifications. Prof. S. A. Shchukarev could not find an equivalent to the Tskaltubo water, not only in the USSR but also among foreign waters. Other waters of Georgia, due to the distinct qualitative and quantitative characteristics of individual components, are rare examples of mineral waters. Among these is the water from the Mukhuri mineral springs.

The water sources are located in Georgia, in the Chkhorotsku district, in the gorge of the upper reaches of the Khobis-Tskali River, in an area called "Lugela," at an altitude of 360-370 meters above sea level. The distance to the Mukhuri settlement is about 5.5 km. The village of Mukhuri itself is located 45 km from the city and railway junction of Senaki, which is connected by a good highway.

The slopes of the valley in the Lugela area are covered with dense deciduous forest. This lush vegetation, among which some species of subtropical flora are abundantly represented, combined with the relatively gentle relief and beautiful mountain landscapes, makes Lugela a very picturesque place. The climate of the area, located in the mid-mountain zone, is warm and moderately humid.

The geological outlets of the Mukhuri mineral water are associated with fractures in the porphyritic series of the Bayos, which occupies the basin of the upper part of the Khobis-Tskali River. Lithologically, the porphyritic series is represented by a complex of massive volcanic-clastic accumulations, cover lava flows, and subordinate them more or less clearly stratified tuffaceous and tuff-genic deposits (Chikhelidze "On the hydrogeology of the Mukhuri mineral water").

The initial yield of Mukhuri water was far from sufficient, not exceeding 500 liters per day. As a result of hydrogeological work carried out by the Resortology Institute of the Georgian SSR in 1934-1936 and the installation of a capped borehole, the water yield increased to 21-22,000 liters per day. From the moment of capping to the present, i.e., for 8 years, this figure has remained unchanged, indicating the exceptional stability of the well's regime. It should be noted that, according to hydrogeologists, there is a full possibility of significantly increasing the water yield by drilling additional wells (Chikhelidze).

By its chemical composition, the Mukhuri mineral water is a highly mineralized chloride-calcium water; according to Prof. V. A. Alexandrov's classification, it belongs to the 2nd class, second group.

The Kurlov formula is: M-53, Cl 89/Ca 99*, t-11°, D-21,600 liters per day. The dry residue of the water exceeds 53 grams per liter, with 88% of the mineralization attributed to calcium chloride, making the water in its natural form equivalent to a 9.5% solution of calcium chloride (crystalline). It should be added that all chemical analyses conducted over these 8 years indicate the invariability of the physicochemical properties of this water.

It should be noted that there are no references in the literature to the existence of similar mineral water anywhere else. Therefore, Mukhuri water, holding great potential for various uses, arouses exceptional interest and requires comprehensive study of its pharmacodynamics, therapeutic properties, and the development of its application in industrial, technical, and other purposes. It must be admitted that in the study and utilization of this very valuable water, there has been some lag, perhaps not corresponding to the enormous significance that Mukhuri has in therapeutic and preventive terms.

Despite this, the Georgian Institute of Resortology timely conducted hydrogeological and physicochemical works. Then, even before the outbreak of the 2nd World War, a series of experimental and partially clinical works was initiated; part of the experiments was completed, and another part, along with the clinical part, was temporarily conserved.

The hydrogeological outline of the Mukhuri mineral water by S. Chikhelidze, presented in this brief collection, sufficiently describes the main features of the hydrogeological structure, offers preliminary hypotheses about the genesis of this interesting mineral water, and outlines the prospects for fully increasing the mineral water resources through additional wells in the area of its outlets.

The physicochemical properties of the Mukhuri mineral water have been thoroughly studied through periodic analyses, as mentioned above. Based on this, some authors (Kuchaidze) have found ways to use Mukhuri water in the form of hemostatic cotton wool, impregnated with its chemical composition, or as a fire-fighting agent and others.

As for experimental works, they were conducted under the assignment of the State Institute for the Improvement of Physicians and the Georgian Institute of Resortology by Candidate of Medical Sciences M. Lezhava in various directions. To clarify the effects of Mukhuri mineral water on the secretory and evacuatory functions of the stomach, experiments were conducted on dogs, with 305 experiments, including 150 control ones. This work by Dr. Lezhava is fully included in this collection.

The results of these experiments led to the following conclusions:

1. Mukhuri mineral water, given to experimental animals in large doses, causes toxic effects.
2. Mukhuri mineral water, given in a dose calculated at 0.5 grams per kilogram of animal weight, no longer causes toxic effects. Mukhuri mineral water, given either orally or intravenously, without a food irritant, causes a decrease in gastric secretion.
3. Mukhuri mineral water, given with food, both orally and intravenously, lengthens the latent and secretory periods and reduces the amount of total and free hydrochloric acid.
4. Mukhuri mineral water, given an hour before meals, either orally or intravenously, causes a decrease in the amount of gastric juice. As for the amount of total and free hydrochloric acid, this water does not cause significant fluctuations.
5. Mukhuri mineral water, given with food, in a smaller amount of the produced dose, increases the amount of gastric juice, total and free hydrochloric acid.
6. Mukhuri mineral water, given both orally and intravenously, with food, accelerates the evacuatory function of the stomach.

Furthermore, given the great importance of various hemostatic agents in medicine, both in peacetime and especially in wartime, it became a natural necessity to test the Mukhuri chloride-calcium water for its hemostatic properties, specifically its effect on parenchymatous bleeding. For this purpose, the same author, Dr. M. Lezhava, conducted experiments on rabbits in Moscow according to the methodology of the Central Institute of Resortology, but following the author's dosage calculated at 0.5 Mukhuri water per kilogram of animal weight.

The objects of parenchymatous bleeding were the liver, kidneys, and spleen. Based on the data obtained from this experiment, the author finds it possible to make the following preliminary conclusions:

1. Mukhuri mineral water significantly affects blood coagulation and viscosity.
2. Mukhuri mineral water significantly affects the cessation of parenchymatous bleeding from the liver and kidneys. As for its effect on spleen bleeding, this effect is insignificant.
3. For stopping bleeding, tampons soaked in Mukhuri mineral water are more effective than intravenous administration of the same water.
4. Mukhuri mineral water should be considered a hemostatic agent, applicable both locally and intravenously, and in this respect, it should be preferred over a 10% calcium chloride solution.

Thus, based on the aforementioned experimental studies on Mukhuri mineral water, it has been found to possess a variety of strong pharmacodynamic properties. Furthermore, preliminary data from limited clinical observations on the therapeutic properties of Mukhuri mineral water in treating certain internal organ diseases and some nervous system disorders are of interest.

For example, the staff of the Department of Clinical Pharmacology at the Tbilisi Medical Institute preliminarily concluded from their clinical observations that Mukhuri mineral water exerts a therapeutic effect in cases of acute nephritis with hematuria; in these cases, the kidney's excretory function improves, diuresis increases, and overall, the inflammatory process subsides. In pulmonary forms of tuberculosis with hemoptysis, exudative pleuritis, and polyserositis, Mukhuri mineral water showed better results than a 10% calcium chloride solution.

Then, Professor Gersamia from the Institute of Functional Nervous Diseases used Mukhuri mineral water to treat epileptic seizures, administering the water internally by a tablespoon three times a day. During the treatment course, patients consumed two liters of Mukhuri water with a 10-day break. The author reported generally encouraging results. Patients felt better. For example, before treatment, a patient typically experienced two seizures with loss of consciousness and 559 minor seizures (Petit mal) per month; a month after starting treatment with Mukhuri mineral water, the patient had one major seizure and only 10 minor ones. In the second month of treatment, there were no major seizures and only 8 minor ones.

In a second case, where there were 17 major seizures per month before treatment, after three months of treatment with Mukhuri mineral water, there were no seizures at all. The same effect was observed in a third case.

Thus, although the research and resulting conclusions mentioned above cannot be considered entirely sufficient, at this stage of studying these waters, based on the conducted studies, it is possible to draw some undeniable conclusions:

1. Mukhuri mineral water, due to its chemical composition and exceptionally high concentration of calcium chloride, is a rare, if not unique, example of chloride-calcium mineral waters.
2. Mukhuri mineral water possesses sufficiently active biological, pharmacodynamic, and therapeutic properties.
3. Mukhuri mineral water should be considered a therapeutic agent and is currently recommended for use in the following diseases:
   - acute and subacute kidney inflammations with hematuria,
   - pulmonary tuberculosis with hemoptysis,
   - exudative pleuritis and polyserositis,
   - hyperacid gastritis,
   - chronic stomach and duodenal ulcers,
   - certain forms of epileptic seizures,

- various types of bleeding, especially parenchymal bleeding.

4. At the same time, it is necessary to continue scientific research to comprehensively study Mukhuri mineral water.

Short review on the Hydrogeology of Mukhuri Mineral Water

Professor S. Chikhelidze

Among the studied mineral springs of Georgia, a relatively recent addition is the Mukhuri mineral water, remarkable for its original salt composition and high mineralization, named after the nearest large settlement, "Mukhuri," although according to the name of the area where the water springs are located, it should be called "Lugela."

The water springs are located in northern mountainous Megrelia, in the gorge of the upper reaches of the Khobis-Tskali River (Chkhorotsku district).

The distance to the village of Mukhuri, located downstream in the Khobis-Tskali valley, is about 5.5 km; communication with it is maintained via a pack trail along the right bank of the river. The village of Mukhuri itself is approximately 45 km from the city and the railway junction on the main ZKD (Zugdidi-Kutaisi) highway and is connected to the latter by a good highway.

Although the water from Lugela, due to its unusual nature, likely attracted the attention of local residents for a long time, it only recently became the subject of wide practical application and study—about 12–15 years ago.

The first chemical analysis, revealing a very original, almost unknown composition of the water, was conducted by chemist R.D. Kuptsis.

In 1933–34, there was a great interest in the water from the Pharmacochemistry Institute of the People's Commissariat of Health of Georgia. At the initiative of the latter, the Main Directorate for Resorts of the Georgia commissioned its Institute of Resort Studies to survey the spring and draft a plan for its study.

In June 1943, the author of this article conducted the first hydrogeological survey of the water springs, performed a repeat chemical analysis, and drafted a hydrogeological work program to increase the water output and secure it. The plan was initiated that same year. It should be noted that the natural output did not exceed 300–400 liters per day.

A small expedition organized by the Hydrogeological Sector of the Institute of Resort Studies, consisting of chemist V. Khukhia (group leader), hydrogeologist Sh. Tsitsilashvili, and necessary support staff, conducted a preliminary stage of hydrogeological research in the summer and fall of 1934 to clarify some basic questions and develop a plan for detailed exploration work.

In 1935, the same expedition conducted mechanical drilling at the point we identified, creating a 50-meter deep well. The well increased the output of mineral water from 300–400 liters to 21,000–22,000 liters per day.

The expedition's significant contribution in overcoming the great difficulties associated with transporting equipment and drilling in the challenging terrain cannot be overlooked.

In 1936, the well was capped by lowering and cementing thick-walled cast-iron pipes into the bedrock at a shallow depth.

Thus, as a result of the hydrogeological work carried out by the Institute of Resort Studies of the Georgian SSR in 1934–36, we now have a capped well that produces 21,000–22,000 liters per day.

In terms of composition, Mukhuri mineral water is a highly mineralized chloride-calcium water.

The dry residue exceeds 53 grams per liter, with about 88% of the total mineralization being calcium chloride; therefore, in its natural form, the water corresponds to a 9.5% calcium chloride solution (crystalline).

It should be noted that the literature contains no references to the existence of similar mineral water elsewhere. At least within the Soviet Union, outside

Georgia, such water is unknown, which arouses exceptional interest in it from both practical and scientific perspectives.

The Lugela area is located in the upper reaches of the Khobis-Tskali River, originating in the Svaneti mountains (the ridge between Upper Svaneti and Megrelia).

Almost the entire basin of the upper part of Khobis-Tskali is composed of the intensely dislocated Jurassic porphyry series, which, due to its tectonic and lithological nature, gives this area a unique geomorphological character, sharply distinct from the rest of Megrelia.

Its characteristic feature (above Lugela) is its strong dissection: narrow deep gorges with steep rocky slopes and turbulent mountain streams within them, and high sharp ridges with rocky cliffs. They reach their highest intensity in the watershed areas with the rivers Tekhuri, Kheledula, and Enguri, except for the areas of leias shales, which considerably soften the relief of this mountainous region.

The high ridge parts with peaks up to 3,000 meters, and sometimes even higher (above sea level), are covered with alpine meadows.

To the south and towards the main river artery, the relief gradually lowers. Mountain pastures on the valley and gorge slopes give way to dense coniferous forests.

In the Lugela area, the Khobis-Tskali gorge widens somewhat, and the relief, especially on the right side, becomes considerably smoother. The valley slopes are covered with dense deciduous forest. Due to the protection from winds, they are often entirely covered with boxwood thickets. Boxwood grows exceptionally well here, providing excellent woodworking and even construction material in the form of large blocks.

The lush mixed vegetation, including not only boxwood but also many other subtropical plants, combined with the relatively mild relief and beautiful mountain landscapes, makes Lugela very picturesque. The area's climate is quite healthy. The elevation above sea level is about 400–600 meters.

Soon after the expansion in Lugela, where the Khobis-Tskali River turns from an east-west to a southwest direction, the valley narrows again, and the gorge sometimes takes on a nearly canyon-like character.

This is due to the river cutting through the massive Cretaceous limestones in this part of its course.

But after about 3 kilometers, the picture changes dramatically. Near the Mukhuri Bridge, the river emerges from the narrow gorge into a wide valley. The character of the relief quickly changes: a wide, densely populated hilly plain with gentle valley slopes and slow-flowing rivers opens up.

The geological literature on this area is quite limited and is almost entirely exhausted by the works of geologists S. Simonovich and B. Meffert. The latter's work, being the most recent (1929), provides a relatively complete picture of the area's geological structure.

In 1934, in connection with hydrogeological work, a detailed survey of the Mukhuri-Lugela district was conducted by engineer-geologist Sh. Tsitsilashvili. The geological map attached to this article is taken from him with some changes made by us.

The most ancient geological formation is the powerful porphyritic series of the Bajocian period, occupying the basin of the upper part of the Khobis-Tskali River. Lithologically, the porphyry series is represented by a complex of massive volcanic clastic deposits, lava flows, and associated more or less well-layered tuffs and tuffaceous sediments. Powerful volcanic accumulations with lavas are morphologically marked by high rocky ridges and steep slopes of gorges.

In the Lugela area, the series includes noticeable greenish-gray tuffaceous sandstones.

Based on data from various researchers, the affiliation of the series to the Bajocian period is currently beyond doubt.

The thickness of the porphyry series in this area is not less than one kilometer.

The series is complexly dislocated, but the elements of its structure, due to its lithological uniformity (the absence of distinct marker horizons), massive nature, and poor exposure, are difficult to decipher.

The porphyry series is overlain unconformably by a variegated suite representing a lagoon formation, consisting of brick-red (often quartz) sandstones and clays. The suite contains gypsum deposits. The thickness ranges from a few meters to several tens of meters. In the Khobis-Tskali gorge itself, the suite is entirely wedged out. This phenomenon, as well as the variability in thickness, is mainly due to the Neocomian transgression.

According to Meffert, the variegated suite is Tithonian, but according to academician A. Dzhanelidze, it should most likely be attributed to the Kimmeridgian, marking the emergence of the Upper Jurassic sea by its facies nature.

Mathuri Mineral Water and Prospects for its Use

Professor V. Khukhiya.

Introduction

Among the natural resources with which Georgia is abundantly endowed are mineral waters, which exhibit a great diversity in their chemical composition. According to incomplete data, the number of mineral springs in the country reaches about 600.

A number of research institutes, notably the Georgian Institute of Resortology, have done significant work on studying the mineral waters of Georgia.

As mentioned above, almost all types of mineral waters are found in Georgia. Among them, the Mukhuri spring, briefly described in this article, holds a unique position as one of the world's most extraordinary in terms of its chemical composition. The renowned West European mineral water, **Soolquelle,** which surpasses other natural waters in quality, contains 3.5 grams of calcium chloride per liter, while Mukhuri water, extraordinarily rich in minerals, contains over 46 grams of calcium chloride per liter.

In the United States (Pennsylvania), highly mineralized waters associated with oil deposits contain, alongside a significant amount of calcium chloride, a considerable amount of magnesium chloride and other compounds, making these waters quite different from those at Mukhuri.

In Georgia, we can mention the Okumi spring (Gali district), which is also a very interesting and significant object, but is still not well-studied hydrogeologically. The Kekhvi spring, with 10 grams of calcium chloride per liter and a higher sodium chloride content compared to Mukhuri, is also noteworthy.

Location of Mukhuri Mineral Springs.

The Mukhuri mineral springs are located in Northern Mingrelia, in the village of Lugela, Mukhuri Village Council, Chkhorotsku District. From Mukhuri, a 5.5-kilometer pack trail leads to the springs, winding along the gorge of the Khobis-Tskali River. The slopes of the gorge are densely covered with boxwood, and the upper part of the gorge is home to valuable redwood.

The landscape here is extraordinarily attractive. A light, gentle breeze (locally known as "maskuri"), usually blowing in summer, lends a softness and uniqueness to the climate of Mukhuri and its surroundings.

The Mukhuri springs are situated at an elevation of 370 meters above sea level. All the springs are associated with the solid rocks of the porphyry series, which, according to preliminary data, have a thickness of up to one kilometer.

Historical Background.

It is difficult to determine precisely when the use of the exceptional Mukhuri spring by the local population began. One thing is certain: the Mukhuri water, known for its healing properties, has long enjoyed well-deserved fame far beyond the location of the spring. According to the old residents, disputes and conflicts frequently arose between local nobles and peasants over the Mukhuri water, often escalating into hand-to-hand fights and bloody confrontations. Further, the legend suggests that not long ago, the flow rate of this water was significantly higher and that, due to the aforementioned disputes, the spring completely disappeared for some time.

A 96-year-old resident of the village of Zani in the Senaki region, named Tkebuchava, shared with me memories from his youth. He recalled that his father used to travel to Lugela almost every summer, staying there for 2-3 days for treatment. Upon returning home, he would bring a jug of Mukhuri water, using it as a remedy against severe itching from which he suffered. We received similar accounts from peasants in other regions, located far from Senaki.

It is noteworthy that in treating the mentioned mineral water, it was used only externally, avoiding internal consumption. It is also worth mentioning that despite the popularity of Mukhuri water in Megrelia, no one in the past took the time to study its natural properties.

The first survey of the spring, conducted in 1928, was carried out by the chemist R. Kupcis, who also performed the first chemical analysis. The results of this analysis were published in 1929.

In 1932 a new analysis was conducted by Professor I. Kutateladze and his team.

In 1934, the Georgian Institute of Resortology sent engineer-geologist S. Chikhelidze to the area to examine the spring and the geology of the region; the results formed the basis for subsequent work plans.

In the spring of 1934, the study of Mukhuri mineral water was entrusted to the Georgian Institute of Resortology, with funding provided by the Main Pharmacy Administration of Georgia. An expedition was sent from Tbilisi to study the Mukhuri mineral water, consisting of engineer-geologist Sh. Tsitsilashvili, a lab technician, and a collector, under the author of this article, who also served as a chemist. The expedition stayed at the site for one and a half months, conducting a series of hydrogeological and hydrochemical studies. Through the use of drilled holes, the daily water flow was increased from 500 liters to 1,200 liters per day. Additionally, new springs were discovered. The results clearly demonstrated that there was a full potential for further increasing the water flow.

In the summer of 1935, we organized a new expedition. In addition to a more in-depth study of hydrogeological and hydrochemical issues, the main objective of the expedition was to increase the water flow. This task required drilling in hard rocks using diamond drilling techniques. As a result, the expedition ensured the extraction of mineral water with unchanged mineral content, amounting to up to 22,000 liters per day. The success achieved dispelled all doubts among skeptics who did not recognize the exploitation potential of Mukhuri mineral water due to its initially low flow rate.

In 1936, the expedition converted the exploratory well into a collection well.

Thus, by working on-site for three seasons (with subsequent office processing of materials), the expedition achieved the following results:

1. The daily flow of mineral water increased from 500 liters to 22,000 liters.
2. The geology of the area was studied.
3. The behavior of the mineral water and its physical and chemical properties were studied.
4. Five new springs were identified.
5. Relevant hydrogeological and hydrochemical materials were collected and analyzed to determine the genesis of the mineral water and more.
6. To determine the healing properties of the spring under study and to conduct experiments on the therapeutic effectiveness of the water, we supplied sufficient quantities of mineral water to the clinic of the Red Cross hospital, the Georgian Institute of Resortology, and other interested parties. The results of the experiments were promptly reported to the Georgian Medical Society.

To explore the possibility of using mineral water in the field of national economy, we conducted numerous experiments at Tbilisi State University.

The results clearly confirmed the potential for successfully using mineral water as a substitute for artificial calcium chloride (for more details, see below).

Hydrochemical Data

As mentioned above, the flow rate of mineral water in its natural conditions did not exceed 500 liters per day. The water seeped through cracks in porphyritic rock, flowing out of a primitively constructed gutter.

In the first year of expedition work (1934), thanks to a borehole that intersected several cracks near the natural outlet of the spring, we obtained 1200 liters of water per day.

Below, we present the results of the chemical analysis of water taken from the natural outlet (Table 1), as well as the water obtained from the borehole (Table 2).

Table 1.

Results of chemical analysis of Mukhuri mineral water from a natural outlet.

- ✓ **Sample Collection Date:** 18.11.1934
- ✓ **Temperature:** 12°C
- ✓ **Flow Rate:** 570 liters per day
- ✓ **Dry Residue at 170°C:** 52.61

Ions	Grams per liter	mg-equiv.	mg-equiv. (%)
Na* (+K)	2.623	111.10	12.24
Ca**	16.3	815.00	8.19
Mg**	0.0312	2.56	0.27
Total Cations		931.66	100.00
Cl*	32.69	921.95	99.04
SO**	0.384	7.99	0.845
Br*	0.0829	1.025	0.112
J*	0.00072	0.0056	---
Total Anions		930.95	100.00
Al2O3	0.0092		
SiO2	0.0125		

Table 2.

Results of Chemical Analysis of Mukhuri Mineral Water from a Borehole.

- ✓ **Sample Collection Date:** 18.08.1935
- ✓ **Temperature:** 12°C
- ✓ **Flow Rate:** 1200 liters per day
- ✓ **Dry Residue at 170°C:** 62.38

Ions	Grams per liter	mg-equiv.	mg-equiv. (%)
Na*(+K)	2.5116	119.20	11.66
Ca**	16.37	818.5	88.06
Mg**	0.0335	2.74	0.28
Total Cations		930.44	100.00
Cl*	32.73	923.08	99.05
SO**	0.391	8.14	0.87
Br*	0.061	0.76	0.08
J*	0.0008	0.006	---
Total Anions		931.98	100.00
Al2O3	0.0085		
SiO2	0.011		

A comparison of these analyses shows that the physicochemical properties of the water did not change at all with the increase in its flow rate.

Over one and a half months in the first year of work, and then over a sufficiently long period in subsequent years, we periodically studied the regime of the mineral water in relation to other factors, such as atmospheric conditions, changes in river levels, and so on. Due to technical constraints, we cannot present all this material here; we limit ourselves to stating that, as confirmed by our long-term observations, the physicochemical nature of the water is not subject to changes under the influence of the factors mentioned above.

Since the mineral water obtained from the borehole had already reached an operationally significant flow rate, we conducted three complete analyses of the water at different times, and analyses of some of its main ingredients were carried out annually until 1944.

Table 3.

Results of Chemical Analysis of Mineral Water from a Borehole.

- ✓ **Sample Collection Date:** 23.11.1936
- ✓ **Temperature:** 12°C
- ✓ **Flow Rate:** 21,800 liters per day
- ✓ **Dry Residue at 170°C:** 57.685
- ✓ **pH:** 6.87

Ions	Grams per liter	mg-equiv.	mg-equiv. (%)
Sodium - Na*	2.1170	92.05	9.95
Potassium - K*	0.7341	18.78	2.20
Lithium - L**	0.0006	0.036	---
Barium - Ba**	Trace amounts	---	---
Calcium - Ca**	16.4922	8313.17	87.58
Magnesium - Mg**	0.0301	2.47	0.27
Total Cations		926.56	100.00
Chloride - Cl*	32.4524	915.93	98.86
Sulfate - SO**	0.4037	8.24	0.89
Bromine - Br*	0.1928	0.40	0.25
Iodine - J*	0.00114	0.009	---
Total Anions		926.57	100.00
Al2O3	0.0099		
SiO2	0.0118		

We present the results of the chemical analysis of mineral water taken in 1938 from a borehole (see Table 3).

The analysis results indicate that despite the significant increase in the mineral water flow rate, its chemical nature has practically not changed.

In 1944, an additional chemical analysis was conducted on mineral water obtained from a borehole.

The results of the analysis are shown in the Table 4.

Table 4.
Results of chemical analysis of Mukhur mineral water from a borehole

- ✓ **Sample Collection Date:** 15.07.1944
- ✓ **Temperature:** 12°C
- ✓ **Flow Rate:** 21,800 liters per day
- ✓ **Dry Residue at 170°C:** 52.59
- ✓ **pH:** 6.9

Ions	Grams per liter	mg-equiv.	mg-equiv. (%)
Potassium - K*	0.013	0.333	0.03
Sodium - Na*	2.656	119.53	12.49
Calcium - Ca**	16.41	808.86	87.37
Magnesium - Mg**	0.012	0.937	0.11
Iron - Fe**	None	---	---
Total Cations		925.71	100.00
Chloride - Cl*	32.57	918.47	99.27
Sulfate - SO**	0.2139	4.49	0.48
Bromine - Br*	0.1835	2.296	0.24
Iodine - J*	0.00113	0.009	0.01
Total Anions		925.26	100.00
Al2O3	0.0047		
SiO2	0.0098		

In terms of potassium content, this table's data differs from both our previous analysis and, especially, from R. Kuptsis' analysis (Table 5). It is difficult to believe that such a discrepancy is due to changes in the nature of the water, as its other main components have remained almost unchanged over the years.

It would be more accurate to determine the potassium content with more thorough analyses.

To illustrate the consistency of the composition of Mukhur mineral water (excluding the above-mentioned potassium), we present the results of the analysis conducted by R. Kuptsis in 1928 (Table 5).

Table 5.
Results of chemical analysis of mukhuri source by R.D. kuptsis

- ✓ **Sample Collection Date:** 1928
- ✓ **Temperature:** 14°C
- ✓ **Flow Rate:** 500 liters per day
- ✓ **Dry Residue at 160°C:** 54.945

Ions	Grams per liter	mg-equiv.	mg-equiv. (%)
Chloride - Cl*	33.1326	933.31	49.49
Iodine - J*	---	---	---
Bromine - Br*	0.0162	0.20	0.01
Sulfate - SO**	0.428	9.43	0.50
Total Cations		942.94	50.00
Sodium - Na*	1.5743	68.45	3.63
Potassium - K*	1.1640	29.85	1.58
Magnesium - Mg**	0.0294	2.45	0.13

Presence of chlorine and properties of porphyrite

The presence of a small amount of chlorine found during the analysis is likely due to mechanical mixing with mineral water. Porphyrite, being a less compact mass compared to minerals, is characterized by greater hygroscopicity. This explains the comparatively higher chlorine content in it than in the vein mineral.

Prospects for using Mukhuri mineral water

Calcium chloride, currently widely used in medicine to treat tuberculosis, pleurisy, bleeding, etc., has become one of the most important chemotherapeutic agents due to its effectiveness. The main component of Mukhuri water, calcium chloride, constitutes over 82% of its total mineralization.

The study of Mukhuri mineral water in medicine, primarily as a substitute for artificial calcium chloride, began in 1934. Experiments were conducted in the therapeutic department of the Red Cross Hospital in Georgia. In the same year, Professor V. Gersamia studied the effects of the mineral water on epileptics. Unfortunately, further clinical studies were not conducted, except for experimental work by Dr. M. Lejava.

In 1942, due to a severe shortage of calcium chloride, the Georgian Main Pharmacy Directorate, on its own initiative, imported a quantity of Mukhuri water to Tbilisi. During this period, Mukhuri water was used by several medical institutions as a substitute for official calcium chloride.

Although this water mainly consists of a calcium chloride solution, with the same maximum concentration (9.2% $CaCl_2 \cdot 6H_2O$) as used in treatment, it would be a mistake to equate mineral water solely with a solution of artificial calcium chloride of the same concentration, even in terms of physiological effects.

Due to space limitations, we cannot elaborate on all the data indicating the complex chemical nature of mineral water, so we will provide only a few examples.

The water contains elements (in ionic form) for which several isotopes are known. Their physiological effects are not yet fully understood, and based on available information, they are believed to be different. Recently, the exceptional role of iodine in biochemical processes in the body has been recognized, where iodine, when introduced in small doses, acts as a catalyst. Some researchers assign a similar role to bromine (in ionic form). Both of these substances are present in Mukhuri water, with bromine in relatively higher quantities.

Further, the discovery of so-called heavy water (D_2O) and the study of its physiological effects revolutionized science. Organisms that can only survive in ordinary water die in heavy water, but at an appropriate concentration, the latter, on the contrary, stimulates vital activity. In such water (with the appropriate concentration), the behavior of dissolved substances is completely different. Although the concentration of heavy water in natural waters is usually insignificant, Mukhuri water, due to its entirely different chemical nature, does not completely rule out the possibility of containing heavy water.

In addition to all this, if we consider the highly favorable combination of ingredients in the mineral water from a medical perspective (e.g., calcium, sodium, potassium, chlorine, sulfate, bromine, and iodine), whose activities should be considered in conjunction, it becomes clear the enormous difference (including in terms of physiological effects) between Mukhuri mineral water and a solution of artificial calcium chloride.

As is known, the factors contributing to the balneotherapeutic effectiveness of some important mineral waters have not yet been sufficiently clarified. In this case, it is well established that when ingested, Mukhuri water replaces artificial calcium in treatment.

Further study should also consider its use as an external remedy, as has been successfully practiced by the population for many years (for skin diseases).

In our opinion, for therapeutic purposes, Mukhuri mineral water should be used in its natural form without any processing, as any processing inevitably leads to changes to some extent.

There are wide prospects for using Mukhuri water as a raw material for preparing a whole range of products. It is well known that the production of products cannot do without chemically pure calcium chloride, which requires scarce material—hydrochloric acid; secondly, the removal of some impurities is a complex and lengthy procedure.

Considering all this, we conducted experiments using Mukhuri mineral water to prepare the following products:

1. **Calcium carbonicum ($CaCO_3$).**

   The starting material, instead of chemically pure calcium chloride, was Mukhuri mineral water in its pure form, with the addition of a stoichiometric amount of soda (relative to $CaCl_2$). The yield of the product obtained was 95% relative to the theoretical.

2. **Calcium sulfonicum ($CaSO_4$).**

   This product was also prepared from Mukhuri water by the following method. To the concentrated 20% $CaCl_2$ Mukhuri water, 20% sulfuric acid was added. After sedimentation, the precipitate was washed by decantation, first with cold water to a weakly acidic reaction, then on a filter with preheated water to remove chlorine ions, and finally with alcohol. The precipitate was dried at a temperature of 40°C. From one liter of mineral water, 68 grams of $CaSO_4 \cdot 2H_2O$ pure preparation was obtained.

3. **Calcex**, prepared from this water, has the same properties and action as from artificial calcium chloride.

The experiments conducted on the preparation of these products led us to the conclusion that Mukhuri mineral water can be successfully used to obtain all the products for which pure artificial calcium chloride is the starting material. This is understandable since the water does not contain components requiring special preliminary removal during the preparation of any product. This is especially true for iron, which is completely absent in Mukhuri water.

Since for our intended purposes we are only interested in calcium chloride contained in Mukhuri mineral water, it would be more appropriate and profitable to transport it in a dry form by evaporating the water on-site.

As is known, calcium chloride has a wide range of applications in various industries. Instead of the technical calcium chloride currently in use, the dry residue obtained by evaporating Mukhuri mineral water, containing about 85% calcium chloride, can be used.

As a result of the experiments, we obtained all three types of technical preparation: hexahydrate ($CaCl_2 \cdot 6H_2O$), dihydrate ($CaCl_2 \cdot 2H_2O$), and fused ($CaCl_2$). The production of dihydrate was carried out by the Erdmann method. By pouring the molten hydrate, heated to 800°C, into a water-cooled nickel dish, we obtained molten calcium chloride.

The latter meets all the requirements of OST-4100 for the first-grade technical preparation, with the advantage that the calcium chloride content is 77%, whereas according to OST it should be no less than 72%.

Let us move on to the industries where the technical preparation obtained by evaporating Mukhuri water can be used:

1. **Calcium chloride is widely used as a hygroscopic agent in both laboratory practice and industry.**
   Calcium chloride obtained from Mukhuri mineral water is fully suitable for this purpose. It can be used on a larger scale as a means against dampness in rooms, which causes significant damage during the processing and storage of products.
2. **As is known, impregnating wood with calcium chloride gives it fire resistance.**
   With this in mind, a solution of 100 parts calcium chloride and 300 parts calcium hydroxide was also used. In 1941-1942, to ensure safety during the transportation of one of the weapons we manufactured in large quantities, we used sawdust, which was first soaked in Mukhuri water

and then dried. Ammunition in glass ampoules was placed in tin boxes, with treated sawdust as padding between them.

3. **There is a reference in the literature to the use of calcium chloride for extinguishing fires.**

   For example, a so-called Pyro-Extinetor Rommel, representing a concentrated solution of calcium chloride, was used for this purpose. The best result is given by a 10% solution. Since the freezing temperature of this solution is -25°C, it can also be successfully used in severe winter frosts.

4. **Alongside zinc chloride, Mukhuri water can also be used (though with less efficiency) to make wood more resistant after treatment in solution.**

   Extending the service life of telegraph poles, railway sleepers, and other wooden materials, and replacing scarce preservatives with affordable and cheap means, is one of the pressing issues. In this regard, studying Mukhuri water is an urgent task.

5. **For enhancing visibility during cloudiness, American civil aviation has successfully used calcium chloride, both in dehydrated form and as dihydrate.**

   Spraying and spraying were carried out by a special device installed in the aircraft. During the war, this means has even greater significance.

6. **Calcium chloride has recently found increasing use in road construction.**

   Adding this substance to road material increases the hardness and durability of the mass, which is explained by the fact that the solution formed as a result of calcium chloride absorbing moisture from the air displaces air formations among other ingredients.

7. **Finally, it should be noted that considering the parasiticidal properties of this water,**
   the population has long successfully used it to destroy harmful insects, such as bedbugs. It is necessary to conduct experiments to study these properties, as there may be a possibility of successfully replacing scarce agents used in agriculture with Mukhuri water in the fight against pests.

Corrosive Properties of Mukhuri Mineral Water

In 1944, when the question of exploiting Mukhuri mineral water was raised, one of the options was to supply this water from the source to the village of Mukhuri via a pipeline. This proposal, for various technical reasons, as well as due to potential changes in the water's medicinal properties, was not considered feasible. However, we deemed it necessary to study the corrosive properties of this water. This issue remains relevant, despite the unacceptability of the pipeline option, as during the exploitation of the water, some metallic materials, primarily water pipes, will have to be used.

The corrosive action of Mukhuri mineral water was studied on ordinary iron water pipes (two grades), cast iron water pipes, and aluminum.

Experiments were carried out under the following conditions. Plates were made from the pipes of the mentioned metals. Each of these plates, tied to a glass rod, was immersed in a separate glass rectangular jar containing 900 grams of Mukhuri water. The aluminum plate was made from technical sheet aluminum. The plates immersed in the water had the following surface areas: iron I — 48.63 cm^2, II — 47.7 cm^2, cast iron — 44.63 cm^2, aluminum — 44.62 cm^2. The mixture was stirred twice a day with an electric stirrer. The experiment was conducted at a temperature of 25-26°C. After a certain number of days, the plates were removed, washed under a stream of water from a tap, rinsed first with distilled water, then with alcohol and ether, and finally dried and weighed. The difference in weight indicated the corrosion of the metal by Mukhuri mineral water. In these experimental conditions, a significant amount of iron hydroxide, which gradually precipitated at the bottom and walls of the vessel, dissolved in the first day due to corrosion. In the case of the aluminum plate, a precipitate, presumably hydroxide, was released.

The corrosion of the iron pipe plates was quite significant, which practically makes it impossible to use such pipes for the exploitation of Mukhuri mineral water. The corrosion of the cast iron pipe plates was less significant, but from the perspective of preserving the properties and chemical nature of the mineral water, it cannot be disregarded. The corrosion of the aluminum plate is the least significant, but using this material for the exploitation of mineral water is not advisable. Special attention should be paid to the aluminum corrosion graph. The graph shows that from the 8th day, the weight of the plate increases; this is explained by the partial deposition of the formed hydroxide on the plate itself, in the form of a tightly adhered layer, which causes the passivation of the metal. It should be noted that under dynamic conditions, the pattern of the conducted corrosion experiments is likely to be different.

The Influence of Mukhuri Water on the Secretory and Evacuatory Functions of the Stomach

Dr M. Lezhava, MD.,PhD

In the Chkhorotsku district of the Georgian SSR, 5.5 km from the village of Mukhuri, in the gorge of the Khobis-Tskali River, in the Lugela area, there is the chloride-calcium water of Mukhuri. On both banks of the Khobis-Tskali River, Mukhuri mineral water had five outlets. Before exploration, the flow rate of this water did not exceed 500 liters per day. As a result of hydrogeological expedition work carried out by the Georgian Institute of Resortology in 1934-36, the flow rate was increased to 21,600 liters per day. The outlets of Mukhuri water are associated with fractures in the porphyritic series of Bayos. According to Professor Alexandrov's classification, this mineral water belongs to the 2nd class of chloride-calcium waters.

Kurlov's formula:

$$\text{M. } 53\text{ g} \qquad \frac{\text{C1 } 89}{\text{Ca } 99} = \text{T } 110 \quad \text{D} = 21{,}600 \text{ l/day}$$

The result of the 1936 analysis of Mukhuri (Lugela) mineral water (analyst Khukhiya) is provided below. Due to its chemical composition, mainly the large amount of calcium chloride, Mukhuri water is extremely interesting and quite rare, even unique.

Calcium salts are of great importance in medicine, both in terms of dietary hygiene and therapeutic prevention. Calcium deficiency in the body leads to sluggishness of vital functions and weakening of immunobiological properties. According to Rubinstein's observations, flies experiencing calcium deficiency lost the ability to reproduce. This is also significant for pregnant and nursing women and for the development of the bone system in a growing organism.

Calcium acts on cells and their protoplasm, contributing to increased turgor, reducing conductivity resistance, in contrast to the effects of sodium and potassium. The exceptional influence of calcium and potassium on the autonomic nervous system should not be forgotten. The electrolytes present in the blood have a significant impact on the tone of the vagus nerve center. Calcium and magnesium act both on the center of these nerves and on their peripheral endings. Calcium is important for maintaining the body's acid-base balance. Deviation from this balance affects the autonomic nervous system and, undoubtedly, the endocrine organs. Calcium affects the circulatory system and blood clotting, which is why it is used during various types of bleeding as a hemostatic agent. In the digestive system, calcium in large doses slows down secretion, while in small doses, it increases it, accelerates peristalsis, and affects the urinary organs as a diuretic and anti-inflammatory agent. Calcium has the best effect on respiratory tract diseases, metabolism, wound healing, and is finally used as an antiseptic and bactericidal agent. Given the great importance of calcium, it is quite natural to study chloride-calcium mineral water, which is a significant natural resource, and its advantage over an ordinary 10% calcium chloride solution lies in the fact that it represents, in Professor Alexandrov's words, a living active substance with significant biological properties and greater therapeutic effectiveness. First of all, we aimed to determine the dosage for both oral intake and intravenous administration. The second goal was to identify the influence of Mukhuri water on the secretory and motor functions of the stomach when administered orally and intravenously. We conducted experiments on gastric secretion in 7 dogs and on motor function in 2 mixed-breed dogs. For gastric secretion, we conducted 305 experiments, of which 150 were control experiments with water and 155 with mineral water. For motor function, 80 experiments were conducted, with 40 being control experiments. Observations on gastric secretion were made on dogs with surgically modified stomachs using Pavlov's well-known method, and motor function was studied using the method adopted by the Pyatigorsk Balneological Institute.

Table 1.
Results of the analysis of Mukhuri (lugela) mineral water from 1938 (By Analyst: Khukhiya)

- ✓ **Temperature:** 110°C
- ✓ **Flow Rate:** 21.6 liters per day
- ✓ **Solid Residue:** 53 grams

Ions	Grams per 1 liter	In milliequivalents	Equivalent Percentage
Sodium	2.1170	92.05	9.95%
Potassium	0.7341	18.78	2.20%
Lithium	0.0006	0.086	—
Barium	Trace Amounts	—	—
Calcium	14.4922	813.17	87.53%
Magnesium	0.0301	2.47	0.27%
Total	19.3740	926.56	100.0%
Chloride	32.4524	915.93	98.86%
Bromide	0.1928	2.4	0.25%
Sulfate	0.4037	8.24	0.89%
Iodine	0.00114	0.009	—
Total	33.00997	926.58	100.0%
Alumina	0.0099		
Silicic Acid	0.0118		

Table 2.
Jack L. P. 8' 2' (Average Data) Given 200.0 ml of milk*

Time in Hours	Amount of Gastric Juice	Free Hydrochloric Acid	Total Acidity
1	6.0	53.9	73.8
2	1.7	52.5	75.9
3	1.3	27.7	43.1
4	0.3	0.0	0.0
Total 3h 30m	9.3	134.1	192.8
—	43.3		54.2

Table 3.
Dog "Tetra" (Average Data) Given 200.0 ml of milk

Time in Hours	Amount of Gastric Juice	Free Hydrochloric Acid	Total Acidity
1	14.1	105.0	125.0
2	5.9	72.5	107.5
3	3.7	72.5	97.5
4	1.4	45.0	72.5
5	0.3	36.0	30.0
Total 5h	25.4	325.0	452.5
—	65.0		90.5

Table 4.
Dog "Chrela" (Average Data) L. P. 7* 20* Given 200.0 ml of milk

Time in Hours	Amount of Gastric Juice	Free Hydrochloric Acid	Total Acidity
1	6.9	74.4	96.8
2	4.8	85.0	103.5
3	1.7	48.7	79.8
4	1.4	25.0	45.0
5	0.8	18.7	43.7
Total 5h	15.6	251.8	359.8
—	50.1		71.9

Table 5

Dog "Rizha" (Average Data) L. P. 30 Given 200.0 ml of boiled milk*

Time in Hours	Amount of Gastric Juice	Free Hydrochloric Acid	Total Acidity
1	7.7	93.3	119.5
2	1.6	61.0	90.8
3	0.2	35.0	80.0
4	—	—	—
Total 3h	9.5	189.3	290.3
—	63.1		96.7

Table No. 6

Dog "Kuda" (Average Data) L. P. 18' 2' Given 100.0 g of meat

Time in Hours	Amount of Gastric Juice	Free Hydrochloric Acid	Total Acidity
1	7.1	93.0	116.7
2	3.3	94.9	116.2
3	0.9	36.1	65.1
4	0.2	25.0	40.0
Total 4h	11.5	249.0	338.0
—	62.2		84.5

Table 7.

Dog "Mtskhemsi" (Average Data) L. P. 10' 24' Given 100.0 g of meat

Time in Hours	Amount of Gastric Juice	Free Hydrochloric Acid	Total Acidity
1	9.5	97.2	103.3
2	3.8	87.0	117.7
3	1.0	43.5	75.0
4	0.5	30.6	61.2
Total 4h	14.8	258.3	352.2
—	64.6		88.0

Table No. 8

Dog "Mukhtar" (Average Data) L. P. 13' 10 Given 100.0 g of raw chopped meat*

Time in Hours	Amount of Gastric Juice	Free Hydrochloric Acid	Total Acidity
1	11.0	92.0	113
2	3.6	91.5	113
3	1.0	44.0	61
4	0.3	0	45
Total 4h	15.9	227.5	332
—	56.8		83.0

After obtaining a specific type of secretion in dogs under the influence of milk and meat, we proceeded with the experiments. The average values in the tables were derived from 5 experiments. To illustrate the obtained figures, a characteristic curve is provided (see tables No. 1, 2, 3, 4, 5, 6, 7, 8).

Our work is divided into 4 series. The comparative influence of Mukhuri water, both ingested and intravenously administered, on gastric secretion was determined as follows:

1. On an empty stomach,
2. Simultaneously with food,
3. One hour before eating,
4. The effect of Mukhuri water on the gastric evacuation function, both when ingested and when administered intravenously, simultaneously with food.

In control experiments, distilled and boiled tap water were given; as physiological stimulants, milk and meat were used. To refine the dosage, it was necessary to vary the dose of Mukhuri water starting from 100, 70, 50, and 25–20 grams.

Table 9

"Chrela"	"Kuda"
Given 100.0 grams of Mukhuri water	Given 70.0 grams of Mukhuri water
Vomiting began 2 minutes after water intake, with shortness of breath, increased breathing, and in some cases, shock.	Vomiting began 17 minutes after water intake, with shortness of breath and increased breathing.

Table 10

"Rizha"	"Chrela"
Given 50.0 grams of Mukhuri water	Given 50.0 grams of Mukhuri water
Vomiting began 5 minutes after water intake, with shortness of breath, increased breathing, and intestinal activity.	.Vomiting began 10 minutes after water intake, with shortness of breath and increased breathing.

Table 11

Dog "Jack" (Average Data) L. P. 10 40*.*
Given 50.0 grams of Mukhuri water

Time in Minutes	Amount of Gastric Juice	Free Hydrochloric Acid	Total Acidity
9 - 15	0.1	15	35
9 - 30	0.2	15	35
9 - 45	0.1	15	35
10 - 00	0.2	15	35
10 - 15	0.5	20	45
10 - 30	0.3	20	45
10 - 45	0.3	20	45
11 - 00	0.3	20	45
11 - 15	0.2	10	30
11 - 30	0.2	10	30
Total 2h 30m	2.4	160	380
—	16		38

When given 100 g on an empty stomach, the dog "Chrela" vomited within 2 minutes after ingesting the water, with accelerated breathing, and in some experiments, shock symptoms developed. The dog "Kuda" began vomiting 17 minutes after taking 70 g of Mukhuri water. When given 50 g, in most cases, vomiting developed again within 5–10 minutes in the dogs "Chrela" and "Rizha". Regarding gastric secretion, in some cases, significant inhibition of secretion was observed. After taking Mukhuri water, the dog "Jack" produced an average of 2.4 cubic centimeters of gastric juice, 16 of free hydrochloric acid, and 38 of total acidity (Tables 9, 10, and 11).

The next stage of mineral water dosage, specifically 25.0 g, revealed the following: the dog "Rizha" produced 2.2 cubic centimeters of gastric juice, with 0 free hydrochloric acid and 16 total acidity.

Notably, there was a significant amount of mucus. As for the 20.0 g dose of Mukhuri water, it generally resulted in inhibited secretion. For example, in the dog "Mukhtar," it prolonged the latent period, with a secretion duration of 1 hour and 15 minutes, producing 1.7 grams of gastric juice, 10.0 of free hydrochloric acid, and 12.0 of total acidity. In two cases, the dog "Mtskhemsi" vomited 7 minutes after receiving the same dose (see tables 12 and 13).

Table 12

Dog "Rizha" (Average Data) L. P. 15 30*.*
Given 25.0 grams of Mukhuri water

Time in Minutes	Amount of Gastric Juice	Free Hydrochloric Acid	Total Acidity
9 - 15	0.3	0	20
9 - 30	0.6	0	20
9 - 45	0.5	0	20
10 - 00	0.3	0	20
10 - 15	0.2	0	10
10 - 30	0.2	0	10
10 - 45	0.1	0	10
Total 1h 40m	2.2	0	110
—	16		

Table 13

Dog "Mukhtar" (average data) L. II. 25. Given 20.0 Mukuri water

Dog "Mtskhmsi" (average data) Given 22.0 Mukuri water

Time in minutes	Amount of gastric juice	Free hydrochloric acid	Total acidity	Notes
9-15	0.9	25	50	In 3 experiments, no gastric juice was produced. In two cases, vomiting occurred 7 minutes after drinking water.
9-30	0.2	25	50	
9-45	0.4	0	20	
10-00	0.1	0	20	
10-15	0.1	0	20	
Total 1 hour 15 min	1.7	50	160	In two cases, the dog vomited 7 minutes after drinking water. In 4 cases, we did not get a drop of gastric juice.

As can be seen from these experiments, large doses of "Mukuri", taken internally, in most cases, cause severe suppression of the stomach's secretory function, sometimes even toxic effects, which corresponds to the pharmacological data of the calcium chloride preparation. Simultaneously, the question arose of how diluted Mukuri water, mixed with milk, affects gastric secretion. To investigate this, medium doses of 50.0 Mukuri water combined with 200.0 boiled milk were given. In cases with dogs "Jack," "Tetra," and "Chrela," a lengthening of the latent period, secretory period, a decrease in the amount of gastric juice, free hydrochloric acid, and total acidity were observed. In contrast, in the case of the dog "Chrela," there was a slight increase in free hydrochloric acid and total acidity (see Tables 14, 15, and 16).

Table 14

Dog "Jack" (average data)

Given 50.0 Mukuri water + 200.0 milk | Given 50.0 tap water + 200.0 milk

L.P. 15 58* | L.P. 9**

Time in hours	Amount of gastric juice	Free hydrochloric acid	Total acidity	Time in hours	Amount of gastric juice	Free hydrochloric acid	Total acidity
1	4.4	64.5	83.3	1	6.5	80.0	102.5
2	1.9	66.7	86.5	2	1.5	53.2	71.8
3	1.2	38.0	56.5	3	0.4	37.5	58.0
4	0.3	20.0	40.0	4			
Total 4 hours	7.8	189.2	266.3	Total 3 hours	8.4	170.7	232.3

Table 15.

Dog "Tetra" (average data)

Given 50.0 Mukuri water + 200.0 milk | Given 50.0 tap water + 200.0 milk

L.P. 14 | L.P. 9**

Time in hours	Amount of gastric juice	Free hydrochloric acid	Total acidity	Time in hours	Amount of gastric juice	Free hydrochloric acid	Total acidity
1	7.0	62.5	91.2	1	12.1	100.0	125.0
2	2.3	65.0	85.0	2	4.5	72.5	107.5
3	1.0	65.0	85.0	3	3.7	72.5	97.5
4	1.6	62.5	87.0	4	1.2	45.0	72.5
5	0.7	-	-	5	0.2	30.0	50.0
Total 5 hours	12.6	255.0	348.2	Total 5 hours	21.7	325.0	425.5

Table 16.
Dog "Chrela" (average data) L.P. 12*
Given 50.0 Mukuri water + 200.0 milk

Time in hours	Amount of gastric juice	Free hydrochloric acid	Total acidity	Time in hours	Amount of gastric juice	Free hydrochloric acid	Total acidity
1	5.7	80.0	97.5	1	5.7	52.5	72.5
2	2.6	60.0	87.5	2	4.4	80.0	110.0
3	1.8	60.0	80.0	3	2.5	50.0	70.0
4	1.1	50.0	80.0	4	1.8	15.0	40.0
5	0.4	50.0	80.0	5	1.0	10.0	30.0
Total 15 hours	11.6	300.0	425.0	Total 4 hours	15.4	207.5	322.5

Since 50.0 mineral water + 200.0 milk did not produce toxic effects, the dose was increased to 100.0 mineral water diluted with 200.0 milk; in this case, the following results were obtained.

In the case of the dog "Jack," 100.0 Mukuri water caused some increase in gastric juice, a decrease in free hydrochloric acid, and total acidity. In the case of "Tetra," we observed an increase in gastric juice, free hydrochloric acid, and total acidity. Thus, 100.0 Mukuri water, given together with 200.0 milk, does not cause toxic effects (see Tables 17, 18).

From our experiments, it is evident that Mukuri mineral water, given in the same doses to different animals, does not produce the same effect, which we attribute to the different weights of the animals. Therefore, to clarify the dosage of Mukuri water, we proceeded to administer the water at a rate of 0.5 grams of Mukuri mineral water per kilogram of the experimental animal's weight. The first experiment was conducted on the dog "Kuda" weighing 20 kg, and the dog "Mtskhmsi" weighing 19 kg

Table 17

Dog "Jack" (Average data) Given 100.0 Mukuri water

Given 100.0 tap water + 200.0 milk. L.P. 11' 20" | + 200.0 milk. L II. 10'

Time in hours	Amount of gastric juice	Free hydrochloric acid	Total acidity	Time in hours	Amount of gastric juice	Free hydrochloric acid	Total acidity
1	3.5	70.8	89.8	1	3.0	61.2	81.2
2	1.7	67.5	4.5	2	1.0	67.5	87.5
3	0.9	45.0	64.5	3	0.2	-	-
4	0.6	35.0	57.5	4			
Total 4 hours	6.7	218.3	296.3	Total 3 hours	4.2	128.7	168.7

Table 18

Dog "Tetra" (Average data)

*Given 200.0 milk | Given 200.0 milk + 100.0 Mukuri water L.P. 8' 3**

*+100.0 Mukuri water | Given 200.0 milk + 100.0 tap water L II. 7' 20**

Time in hours	Amount of gastric juice	Free hydrochloric acid	Total acidity	Time in hours	Amount of gastric juice	Free hydrochloric acid	Total acidity
1	6.8	75.0	90.0	1	6.9	74.4	96.8
2	5.0	101.2	123.2	2	4.8	85.0	103.5
3	3.2	37.5	118.7	3	1.7	48.7	70.8
4	2.8	81.2	98.7	4	1.4	25.0	45.0
5	1.0	67.5	86.8	5	0.8	18.7	43.7
6	0.3	40.0	80.0	6			
Total 6 hours	19.1	402.4	597.4	Total 5 hours	15.6	251.8	359.8

In one case, 10.0 grams of Mukuri water was given, and in the other, 9.5 grams, both orally and intravenously. Neither dog produced any gastric juice. In the same amount, Mukuri water administered intravenously in 3 cases did not produce any gastric juice, while in two cases, 2.0 mucus with a weak acidic reaction was observed. The dog "Mukhtar," weighing 20 kg, was given 10.0 Mukuri water in the same order. In most cases, no gastric juice was produced, sometimes 3.0 mucus with a weak acidic reaction was released (see Tables 19, 20, 21).

Table 19.

Dog "Kuda" (average data). Weight 19 kg.

Given 10.0 Mukuri water orally	Administered 10.0 Mukuri water intravenously.
Over the course of one hour, no gastric juice was produced.	Over the course of one hour, no gastric juice was produced.

Table 20.

Dog "Mtskemsi" (average data). Weight 19 kg

Given 9.5 Mukuri water orally	Administered 9.5 Mukhuri water intravenously
No gastric juice was produced.	Over the course of one hour, 2.0 mucus with a weak acidic reaction. In 3 cases, no reaction was observed.

Table 21.

Dog "Mukhtar." Weight 20 kg.

Given 10 Mukuri water (at 0.5 g per kg of weight) **orally**	Administered 10.0 Mukuri water intravenously
In most cases, in 4 out of 6, no gastric juice was produced. In 2 cases — mucus with a weak acidic reaction. On average, 2.5 cm3 of mucus was produced over 1 hour 30 minutes.	In 3 out of 4 experiments, no gastric juice was produced, and in 3 cases, after 35', 2.0 mucus with a weak acidic reaction was observed.

The second series of work, which I have already noted, concerned the comparative action of Mukuri water, given together with food both orally and intravenously.

In this series, the dogs "Kuda," "Mtskemsi," and "Mukhtar" showed a decrease in the amount of gastric juice and a slight difference in the reduction of free hydrochloric acid and total acidity, and in the case of "Mukhtar," a decrease in both gastric juice and free hydrochloric acid and total acidity was observed.

In all 3 cases, the latent period duration was compared to distilled water. In the cases of the dogs "Mukhtar" and "Mtskhmsi," the secretory period duration was obtained, and in the case of "Kuda,

" the secretory period duration was equal to the amount in experiments with control water (see Tables 22, 23, 24).

Table No. 22

Dog "Kuda," (average data) Weight 20 kg.

Given 10.0 Mukuri water + 100.0 meat | Given 10.0 distilled water + 100.0 meat

L.P. 20" | L.P. 14'

Time in hours	Amount of gastric juice	Free hydrochloric acid	Total acidity	Time in hours	Amount of gastric juice	Free hydrochloric acid	Total acidity
1	5.7	100.0	100.0	1	5.7	88.1	109.6
2	1.3	60.0	80.0	2	3.0	78.1	105.0
3	0.2	40.0	60.0	3	0.5	56.6	90.0
Total 3 hours	7.2	200.0	240.0	Total 3 hours	9.2	222.8	304.6

Table 23.

Dog "Mtskemsi," (average data) Weight 19 kg.

Given 9.5 Mukuri water + 100.0 meat | Given 9.5 distilled water + 100.0 meat

L.P. 14" 30 | L.P. 13' 3**

Time in hours	Amount of gastric juice	Free hydrochloric acid	Total acidity	Time in hours	Amount of gastric juice	Free hydrochloric acid	Total acidity
1	6.0	79.3	105.3	1	6.3	61.2	87.4
2	3.2	83.7	108.7	2	3.8	82.7	105.6
3	1.8	61.2	90.0	3	2.4	57.5	82.7
4	0.5	41.6	73.1	4	0.5	35.0	60.0
5	0.3	30.0	60.0	5			
Total 5 hours	11.8	295.8	437.1	Total 4 hours	13.0	236.4	335.7

Table 24.

Dog "Mukhtar," (average data) Weight 20 kg.

Given 10.0 Mukuri water + 100.0 meat | Given 10.0 distilled water + 100.0 meat

*L.P. 21" | L.P. 18' 3**

Time in hours	Amount of gastric juice	Free hydrochloric acid	Total acidity	Time in hours	Amount of gastric juice	Free hydrochloric acid	Total acidity
1	5.3	77.8	108.0	1	7.5	80.0	110.0
2	2.3	76.1	89.6	2	2.0	62.5	90.5
3	1.1	65.1	74.0	3	1.0	50.0	80.0
4	1.0	50.0	82.5	4	0.6	40.0	70.0
5	0.6	-	-	5	0.5	40.0	60.0
Total 5 hours	10.3	269.0	354.1	Total 4 hours	11.6	272.5	410.5

In all cases, the intravenous administration of Mukuri water reduced the amount of gastric juice; in the cases of "Kuda" and "Mukhtar," both total and free acidity decreased, and "Mtskemsi" showed a slight increase in free hydrochloric acid compared to the action of distilled water (see Tables 25, 26, 27).

The intravenous administration of Mukuri water at a dose of 0.5 grams per kilogram of the experimental animal's weight, together with food, gave the following results: the dogs "Kuda," "Mukhtar," and "Mtskemsi" showed the duration of the latent period, and in "Mtskemsi," the duration of the secretory period was equal to that of distilled water.

Table 25.

Dog "Kuda," (average data) Weight 20 kg.

Administered intravenously 10.0 Mukuri water; Administered intravenously 10.0 distilled water,

After 5 minutes, 100.0 meat was given L.P. 14 | after 5 minutes, 100.0 meat wasgiven L.P. 12' 30**

Time in hours	Amount of gastric juice	Free hydrochloric acid	Total acidity	Time in hours	Amount of gastric juice	Free hydrochloric acid	Total acidity
1	6.5	88.7	104.6	1	8.1	101.2	121.2
2	3.6	66.8	115.6	2	4.1	103.7	125.0
3	1.4	73.1	121.6	3	0.9	70.0	95.0
4	0.5	44.1	61.0	4	0.3	60.0	80.0
5	0.4	44.1	61.0	5			
Total 5 hours	12.4	316.8	463.8	Total 5 hours	13.4	334.9	421.2

Table 26

Dog "Mtskemsi," (average data) Weight 20 kg.

Administered intravenously 10.0 Mukuri water; Administered intravenously 10.0 distilled water,

After 5 minutes, 100.0 meat was given L.P. 17 | after 5 minutes, 100.0 meat was given L.P. 11' 15**

Time in hours	Amount of gastric juice	Free hydrochloric acid	Total acidity	Time in hours	Amount of gastric juice	Free hydrochloric acid	Total acidity
1	14.0	101.0	125.0	1	17.4	123.6	147.5
2	6.6	113.6	137.5	2	8.8	115.5	139.9
3	3.8	95.2	121.5	3	2.4	95.0	114.5
4	1.4	78.7	101.8	4	0.7	80.5	107.0
5	0.4	73.3	96.0	5	0.3	-	-
Total 5 hours	26.2	462.8	581.8	Total 4 hours	29.6	414.6	508.9

Table 27

Dog "Mukhtar," (average data) Weight 18 kg.
Administered intravenously 9.0 Mukuri water; Administered intravenously 9.0 distilled water,
After 5 minutes, 100.0 meat was given L.P. 15 | after 5 minutes, 100.0 meat was given L.P. 13' 30**

Time in hours	Amount of gastric juice	Free hydrochloric acid	Total acidity	Time in hours	Amount of gastric juice	Free hydrochloric acid	Total acidity
1	6.5	62.2	87.5	1	9.7	95.0	117.5
2	4.4	72.5	102.5	2	7.9	118.3	138.0
3	4.2	77.5	103.7	3	4.5	109.1	128.7
4	3.5	78.5	103.7	4	2.6	89.1	106.3
5	2.4	68.7	99.7	5	1.1	70.8	87.5
6	1.3	48.7	68.7	6	0.3	60.0	80.0
7	1.0	27.5	47.5	7			
Total 7 hours	23.3	485.6	613.3	Total 6 hours	26.1	542.3	658.0

Since Mukhuri water, together with food, has the same effect whether given orally or intravenously, we attempted to administer mineral water in one case in a reduced dose and in another case in an increased dose. For example, the dog "Kuda" weighing 20 kg was given 8.5 grams of Mukhuri water together with food, i.e., 0.4 grams per kilogram of body weight. In this case, a reduction in the latent period, an extension of the secretory period, an increase in the amount of gastric juice, free hydrochloric acid, and total acidity were observed. In the case of the dog "Mtskemsi," an increase in the amount of gastric juice, free hydrochloric acid, and total acidity was observed; regarding the latent period and the duration of secretion, in both cases, they were identical (see Tables 28, 29 Compare with Tables 22 and 23).

Table 28

Dog "Kuda," (average data) Weight 20 kg.
Given 8.5 cm³ Mukuri water + 100.0 meat. L.P. 10 30**

Time in hours	Amount of gastric juice	Free hydrochloric acid	Total acidity
1	7.9		116.6
2	3.2	92.5	110.6
3	1.2	75.0	97.0
4	0.4	72.5	92.5
5	0.2	-	-
Total 4 hours 30 min	12.9	334.1	416.7

Table 29

Dog "Mtskemsi," (average data) Weight 19 kg.
Given 8.0 Mukuri water + 100.0 meat. L.P. 14 30**

Time in hours	Amount of gastric juice	Free hydrochloric acid	Total acidity
1	7.3	88.1	107.5
2	4.3	91.7	119.0
3	1.6	73.7	96.8
4	11.1	55.0	76.2
5	0.3	-	-
Total 4 hours 30 min	14.6	308.5	399.5

With increased doses, the dog "Kuda," weighing 20 kg, was administered intravenously 12 grams of Mukhuri water, i.e., 0.6 grams per kilogram of body weight.

Three minutes later, vomiting occurred, i.e., toxic effects. Thus, Mukhuri water, with a slight difference in dose, produces certain changes in gastric secretion. The third series of work is related to identifying the action of

Mukhuri water given an hour before eating, both orally and after intravenous administration.

Table 30

Dog "Kuda," (average data) Weight 16 kg. Given 8 cm³ Mukuri water an hour before eating / Given 8 cm³ distilled water an hour before eating

Time in hours	Amount of gastric juice	Free hydrochloric acid	Total acidity	Time in hours	Amount of gastric juice	Free hydrochloric acid	Total acidity
1	6.8	93.3	117.5	1	9.0	102.5	127.5
2	1.6	70.8	92.9	2	1.5	70.0	95.0
3	0.3	60.0	80.0	3	0.3	60.0	90.0
4	-	-	-	4	0.1	-	-
5	-	-	-	5	-	-	-
Total 3 hours	8.7	224.1	290.4	Total 3 hours 15 min	10.9	232.5	312.5

Table 31.

Dog "Mstkemsi," (average data) Weight 22 kg. Given 11 cm³ Mukuri water an hour before eating / Given 11 cm³ distilled water an hour before eating

Time in hours	Amount of gastric juice	Free hydrochloric acid	Total acidity	Time in hours	Amount of gastric juice	Free hydrochloric acid	Total acidity
1	10.2	98.1	129.7	1	12.9	100.6	124.5
2	9.5	100.6	137.2	2	8.0	115.0	138.1
3	4.7	90.0	113.1	3	5.0	105.6	126.2
4	1.5	77.5	102.5	4	2.3	85.6	107.5
5	0.1	59.0	70.0	5	0.9	81.6	101.6
6	-	-	-	6	0.6	60.0	90.0
Total 5 hours	26.0	445.2	552.5	Total 6 hours	29.7	548.4	687.9

Table 32

Dog "Mukhtar," (average data) Weight 18 kg.

Given 9 cm³ Mukuri water an hour before eating | Given 9 cm³ distilled water an hour before eating

Time in hours	Amount of gastric juice	Free hydrochloric acid	Total acidity	Time in hours	Amount of gastric juice	Free hydrochloric acid	Total acidity
1	10.3	72.7	88.7	1	12.3	80.0	103.1
2	9.9	120.0	140.0	2	9.8	106.8	131.8
3	3.9	107.5	127.5	3	3.8	96.2	118.1
4	2.0	85.0	105.0	4	2.3	72.5	96.3
5	0.6	65.0	85.0	5	0.5	55.0	75.0
Total 5 hours	26.7	450.2	546.2	Total 5 hours	29.7	410.5	524.3

In the cases of the dogs "Kuda" and "Mtskemsi," a reduction in the duration of secretion was observed, while in "Mukhtar," the duration of secretion was identical compared to distilled water. In all three cases, we also observed a decrease in the amount of gastric juice; free hydrochloric acid and total acidity did not show significant differences. For example, the dog "Kuda" showed a decrease in acidity, in "Mtskemsi," free hydrochloric acid did not fluctuate in both cases, while total acidity decreased; in the case of "Mukhtar," a slight increase in both free hydrochloric acid and total acidity was observed (Tables 30, 31, 32).

Mukhuri water, administered intravenously one hour before a meal, reduces the amount of gastric juice. In experiments with "Mtshemsi" and "Muhtar," the duration of secretion was the same. In "Kuda," the secretion duration was prolonged. In "Kuda," "Mtshemsi," and "Muhtar," the secretion of free hydrochloric acid and overall acidity decreased (see tables 33, 34, 35,).

Table 33

Dog "Kuda," (Average Data) Weight 18 kg. 9.0 ml of Mukhuri water administered intravenously one hour before a meal 9.0 ml of distilled water administered intravenously one hour before a meal

Time (hours)	Amount of Gastric Juice	Free Hydrochloric Acid	Total Acidity	Time (hours)	Amount of Gastric Juice	Free Hydrochloric Acid	Total Acidity
1	2.0	66.2	112.5	1	5.1	56.2	79.1
2	3.0	97.5	123.7	2	4.3	97.5	117.5
3	0.8	87.5	111.2	3	1.3	87.5	108.1
4	0.6	85.0	110.0	4	0.4	70.0	95.0
5	0.3	-	-	5	-	-	
Total 5 hours:	6.7	336.2 84	457.4 114.3	Total 4 hours	11.1	311.2 77.8	399.7 99.6

Table No. 34

Dog "Mtshemsi," (Average Data) Weight 20 kg. 10.0 ml of Mukhuri water administered intravenously one hour before a meal 10.0 ml of distilled water administered intravenously one hour before a meal

Time (hours)	Amount of Gastric Juice	Free Hydrochloric Acid	Total Acidity	Time (hours)	Amount of Gastric Juice	Free Hydrochloric Acid	Total Acidity
1	9.0	91.8	118.7	1	13.3	112.5	132.5
2	7.6	114.9	135.6	2	10.2	130.0	147.5
3	4.0	105.6	126.8	3	5.4	111.2	130.0
4	2.3	86.2	110.0	4	1.7	90.0	110.0
5	0.2	-	-	5	0.3	80.0	100.0
Total 5 hours	23.1	398.5 99.6	491.1 122.7	Total 5 hours	30.9	523.7 108.7	620.0 124

Table 35

Dog "Muhtar," (Average Data) Weight 18 kg. 9.0 ml of Mukhuri water administered intravenously one hour before a meal 9.0 ml of distilled water administered intravenously one hour before a meal

Time (hours)	Amount of Gastric Juice	Free Hydrochloric Acid	Total Acidity	Time (hours)	Amount of Gastric Juice	Free Hydrochloric Acid	Total Acidity
1	7.8	97.3	115.8	1	9.7	89.1	114.1
2	6.8	110.8	128.3	2	8.6	115.8	135.8
3	3.2	79.1	100.8	3	4.6	104.1	127.5
4	1.7	55.0	76.4	4	2.6	87.5	109.1
5	0.8	46.6	66.6	5	0.9	60.8	88.3
6	0.2	-	-	6	0.2	56.0	83.6

The fourth task of our work, as noted above, was to determine the effect of Mukhuri water, administered both orally and intravenously, on the motor function of the stomach. We used the method adopted by the Pyatigorsk Balneological Institute. Here, Mukhuri water was administered according to the weight of the animal, i.e., 0.5 g of Mukhuri water per 1 kg of body weight. The dog "Grippa," weighing 16 kg, was given 8 g of Mukhuri water. As a physiological irritant, 150 g of egg white was given. The results were as follows: we observed an acceleration of the evacuator function compared to the action of control distilled water. Mukhuri water given with food resulted in an average of 83.7 ml of stomach content remaining after 35 minutes, whereas distilled water with food left 33.7 ml of stomach content (Table 36).

The dog "Nadira," weighing 22 kg, was given 11 g of Mukhuri water and 150 g of egg white. Here, we also observed an acceleration of the stomach's evacuator function compared to distilled water. On average, Mukhuri water with 150.0 g of egg white resulted in 66.6 ml of stomach content after 35 minutes, whereas the same amount of distilled water with egg white resulted in 78.7 ml of stomach content. The minimum and maximum values showed a typical pattern as described above.

Table 36.

Dog "Grippa" (Average Data) Weight 16 kg.
Given 150.0 g of egg white + 8.0 ml of Mukhuri water Given 150.0 g of egg white + 8.0 ml of distilled water

Time (minutes)	Stomach Content (ml)	Free Hydro chloric Acid	Total Acidity	Time (minutes)	Stomach Content (ml)	Free Hydro chloric Acid	Total Acidity
After 30-35'	83.7	0	29	After 30-35'	133.7	0	48
Maximum Value	After 30-35'	21.0	0	3	After 30-35'	110.0	0
Minimum Value	After 30-35'	130.0	0	30	After 30-35'	170.0	0

Table 37

Dog "Nadira" (Average Data) Weight 22 kg.
Given 150.0 g of egg white + 11.0 ml of Mukhuri water Given 150.0 g of egg white + 11.0 ml of distilled water

Time (minutes)	Stomach Content (ml)	Free Hydrochloric Acid	Total Acidity	Time (minutes)	Stomach Content (ml)	Free Hydrochloric Acid	Total Acidity
After 30-35'	66.6	0	28.3	After 30-35'	78.7	0	39.7
Maximum Value	After 30-35'	45.0	0	15.0	After 30-35'	60.0	0
Minimum Value	After 30-35'	90.0	0	40.0	After 30-35'	130.0	0

The same amount of Mukhuri water administered intravenously resulted in an acceleration of the stomach's evacuator function compared to distilled water. However, it is noteworthy that the intravenous administration of Mukhuri water along with food caused a slight delay in the evacuator function compared to the same amount of Mukhuri water given orally with food. For example, in the case of the dog "Grippa," 8 ml of Mukhuri water given orally with food resulted in 83.7 ml of stomach content after 35 minutes, whereas the same amount of Mukhuri water administered intravenously resulted in 108.4 ml of stomach content. Similar patterns were observed in experiments with the dog "Nadira" (see tables 38 and 39).

Table 38.

Dog "Grippa" (Average Data) Weight 16 kg. 8.0 ml of Mukhuri water administered intravenously along with 150.0 g of egg white 8.0 ml of distilled water administered intravenously along with 150.0 g of egg white

Time (minutes)	Stomach Content (ml)	Free Hydro chloric Acid	Total Acidity	Time (minutes)	Stomach Content (ml)	Free Hydro chloric Acid	Total Acidity
After 30-35'	108.4	0	47.8	After 30-35'	141.5	0	33.5
Maximum Value	After 30-35'	68.0	0	55.0	After 30-35'	198.0	0
Minimum Value	After 30-35'	140.0	0	44	After 30-35'	143	0

Table 39.

Dog "Nadira" (Average Data) Weight 22 kg. 11.0 ml of Mukhuri water administered intravenously along with 150.0 g of egg white 11.0 ml of distilled water administered intravenously along with 150.0 g of egg white

Time (minutes)	Stomach Content (ml)	Free Hydrochloric Acid	Total Acidity	Time (min)	Stomach Content (ml)	Free Hydro chloric Acid	Total Acidity
After 30-35'	70.0	0	11.6	After 30-35'	80.2	0	28.3
Maximum Value	After 30-35'	50.0	0	10.0	After 30-35'	38	0
Minimum Value	After 30-35'	110.0	0	10	After 30-35'	130.0	0

CONCLUSIONS:

Based on our experiments, we can draw the following general conclusions:

1. Mukhuri mineral water in large doses causes toxic effects.
2. Mukhuri mineral water at a dose of 0.5 g per kilogram of animal weight does not produce toxic effects.

3. Mukhuri mineral water, administered both orally and intravenously without food stimulation, suppresses gastric secretion.
4. Mukhuri mineral water, administered both orally and intravenously along with food, prolongs the latent and secretory periods, and reduces the levels of free hydrochloric acid and total acidity.
5. Mukhuri mineral water, administered one hour before a meal, either orally or intravenously, reduces gastric juice secretion. However, in terms of the amount of free and total hydrochloric acid, no significant fluctuations are observed compared to the control water.
6. Mukhuri mineral water, administered in smaller amounts (i.e., 0.4 g per kilogram of animal weight) along with food, increases the amount of gastric juice, free hydrochloric acid, and total acidity.
7. Mukhuri mineral water in the aforementioned dose (i.e., 0.6 g per kilogram of animal weight), when administered intravenously along with food, causes toxic effects.
8. Mukhuri mineral water in large doses, diluted with milk: a) Does not cause toxic effects; b) Prolongs the latent and secretory periods, reduces the amount of gastric juice, free hydrochloric acid, and total acidity.
9. Mukhuri mineral water, administered both intravenously and orally along with food, accelerates the stomach's evacuator function.
10. Based on the data from our experiments, it can be tentatively concluded that Mukhuri water may be used as a therapeutic agent in hyperacidic gastritis, chronic stomach ulcers, and in cases of reduced evacuator function of the stomach. In small doses, it may be used for reduced secretion.
11. It is necessary to translate the data we obtained into clinical practice for confirmation.

The Effect of Mukhuri Water on Parenchymal Hemorrhage

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In medicine, hemostatic agents are of immense importance, both in peacetime and especially during war, whether dealing with traumatic hemorrhage, perforative, hemophilic, pulmonary, uterine, and others. Hemostatic agents, whether local or external, general or internal, are numerous, including chemical agents such as heavy metal salts (30% Fe Cl2), potassium permanganate, hypertonic NaCl solution, calcium, and biological agents such as tissue extracts, vivacol, adrenaline, histamine, and finally, blood transfusions.

Among all these agents, calcium, in the form of calcium chloride, calcium lactate, and calcium acetate, is the most widely used. Hemostatic agents either cause constriction of blood vessels or accelerate blood clotting processes. Abderhalden notes that calcium plays a significant role in this process, with the critical factor being not the calcium ion itself, but its complex compounds.

In light of this, we set out to study the effect of the chemical complex of calcium chloride in Mukhuri water on parenchymal hemorrhage. For our study, we chose the liver, kidneys, and spleen as models of parenchymal hemorrhage.

The experiments were conducted according to the method provided by the Moscow Institute of Balneology, using our own developed dosage calculations—0.5 ml of Mukhuri water per kilogram of the animal's body weight.

For this study, we used rabbits. Observations were conducted on 25 rabbits, with 5 rabbits serving as the control group, in which we applied a 10% calcium chloride solution. During the experiments, we investigated blood viscosity, clotting time, color index, red blood cell count, erythrocyte sedimentation rate (ESR) before and after anesthesia. After performing laparotomy, we inflicted injuries of specific length and depth to the mentioned organs and observed the duration of bleeding using the Duke method, both before and after intravenous administration of Mukhuri water.

Observations were made every 5, 30, and 60 minutes. Our experiments showed that after the intravenous injection of Mukhuri water, blood clotting significantly increased compared to the action of the 10% calcium chloride solution (see Table 1).

Table 1.

Blood clotting average indicators with "Mukhuri" water vs. control 10% calcium chloride solution.

Blood clotting		**Average values**
	"Mukhuri"	Control solution 10% calcium chloride
Blood clotting before anesthesia without "Mukhuri"	4*35*	4*17*
After anesthesia	4*31*	-
After intravenous administration of "Mukhuri"	1*3	1*21

Blood clotting was also examined 24 hours later, where the increase in clotting was less pronounced than 30 minutes after the administration of Mukhuri water (see Table 2).

Table 2.

Blood clotting 24 hours after administration of "Mukhuri."

Before «Mukhuri»	After «Mukhuri»	24 hours after the introduction of "Mukhuri"
4*	33'	3‘

Following this, it naturally raised the question of the need to study the levels of calcium and potassium in the blood 24 hours after the intravenous injection of Mukhuri mineral water.

For this, experiments were carried out on dogs. Within 30 minutes after the administration of Mukhuri water, calcium and potassium levels increased; the calcium level remained elevated even after 24 hours, but potassium decreased significantly. This explains why blood retains its clotting ability 24 hours later, and the decrease in potassium is due to its rapid excretion from the body (see Table 3).

Table 3.

Calcium and potassium levels after administration of 10.0 ml "Mukhuri" in a 20 kg dog.

No	Name of elements	Before «Mukhuri»	30 min After «Mukhuri»	24 hours After «Mukhuri»
1	Ca*	10,7 mg %	12,10 mg %	11,70 mg %
2	K*	38,408 mg %	47,64 mg %	29,98 mg %

Regarding blood viscosity, Mukhuri water also increases it, and its effect is comparable to that of a 10% calcium chloride solution in terms of blood clotting.

The color index of the blood, red blood cell count, and ESR showed no significant changes under the influence of Mukhuri water (see Table 4).

We monitored the duration of bleeding from the liver wound both before and after intravenous administration of Mukhuri water at intervals of 5, 10, 15, 20, 25, and up to 60 minutes in some cases.

Table 4.

Average indicators before and after "Mukhuri" water and 10% calcium chlorid

Indicator	Before "Mukhuri"	After "Mukhuri"	Indicator	Before the introduction of 10.0% calcium chloride	After the introduction of calcium chloride
Hb level	71%	70%	Hb level	52%	51%
Red blood cells	4,730,000	5,370,000	Red blood cells	3,700,000	3,790,000
ESR	6 mm. 1 h.	8 mm. 1 h.	ESR	-	-

The results of these observations showed that Mukhuri water significantly reduces bleeding duration compared to the control 10% calcium chloride solution (see Table 5).

Table 5.

Liver bleeding duration with "Mukhuri" vs. control 10% calcium chloride solution

Before "Mukhuri"	After "Mukhuri"	Before calcium chloride	After calcium chloride
3* 8*	1* 21*	2* 30	1* 49*

The best results were obtained with kidney injuries. Bleeding stops relatively faster than with liver injuries, and compared to calcium chloride, it shows similar results to those in the liver, i.e., better (see Table 6).

Table 6:
Kidney bleeding duration with "Mukhuri" vs. control 10% calcium chloride solution.

Before "Mukhuri"	After "Mukhuri"	Before calcium chloride	After calcium chloride
1* 12*	31*	1* 21*	59*

As for spleen bleeding, no significant results were obtained. After heavy and prolonged bleeding, a slight slowdown in bleeding was observed after 20 minutes (see Table 7).

Table 7.
Spleen bleeding duration before and after "Mukhuri"

Duration of bleeding in minutes	**Before "Mukhuri"**	**After "Mukhuri"**
5	Profuse bleeding	Profuse bleeding
10	Profuse bleeding	Profuse bleeding
15	Profuse bleeding	Profuse bleeding
20	Profuse bleeding	The bleeding slowed down.
25	Profuse bleeding	The bleeding slowed down
30	Profuse bleeding	The bleeding slowed down

In this case, we tried applying Mukhuri water-soaked tampons, which gave better results in slowing down the bleeding. The tampon was more effective in liver and kidney injuries. We did not keep the tampon for long; instead, we moistened the wound, then sutured the abdominal cavity and monitored the animal's condition. It's worth noting that such test rabbits did not die (see Table 8).

Table 8.

Bleeding duration with intravenous "Mukhuri" vs. Mukhuri water-soaked tampon

	Duration of bleeding when introducing Mukhuri into a vein	**Duration of bleeding when using a Mukhuri tampon**
Name of organ	Duration of bleeding after 15 minutes of intravenous administration of "Mukhuri"	Duration of bleeding after 15 minutes of using a tampon
Liver	4*	2*
Kidney	1* 45*	35*
Spleen	The bleeding has not stopped.	With tampons it slows down significantly.

The advantage of the Mukhuri water-soaked tampon can be explained by the fact that this water, as a hypertonic solution, causes a flow of tissue fluid to the wound surface, which is known to enhance blood clotting.

Based on the conducted experiments, the following conclusions can be drawn:

1. Mukhuri mineral water has a significant effect on blood clotting and viscosity.
2. Mukhuri water has a negligible effect on increasing hemoglobin, red blood cells, and ESR.

3. Mukhuri mineral water has a significant effect on stopping parenchymal hemorrhage from the liver and kidneys. Its effect on spleen bleeding is minimal.
4. For stopping bleeding, Mukhuri water-soaked tampons give better results than intravenous administration.
5. Mukhuri mineral water should be considered a hemostatic agent, both for local and intravenous use, and should be preferred over a 10% calcium chloride solution.
6. The results we obtained should be considered preliminary and require further clinical and experimental studies.

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