

СТАТЬИ

УДК 663.646:614.31

METHODS AND MEANS OF QUALITY CONTROL OF MINERAL WATER

Kucherkova A.D.

Don State Technical University, Rostov-on-Don, e-mail: ku4erkova@mail.ru

At present, due to global environmental problems, the problem of the availability of drinking water is particularly acute. Water resources are usually classified as renewable, but not all waters can be suitable for human use. Clean drinking water requires extraction, special purification technologies, production and transportation rules. This determines the relevance of research in the field of water resources, requires new methods of analysis and assessment of quality, technologies and developments. Mineral water is considered as an example of studying the properties and assessing the quality of water. Since the feature of mineral water is its composition, i.e. the presence of various elements, special attention in the article is given to the consideration of the main types of mineral water, its classification, useful properties. The article lists the most famous brands, their mineralization. The main components included in the composition of mineral waters are given. The main stages that mineral water goes through before reaching the consumer are described. Particular attention is paid to the quality and composition of water – the formula of water is given M.G. Kurlov, describing its composition, lists the components whose concentration is subject to control, discloses methods for monitoring and analyzing the quality of mineral water. GOSTs are given, on the basis of which control over the quality of mineral waters is carried out by chemical indicators and technochemical and microbiological control. The testing of mineral water by weight and express method is described.

Keywords: mineral water, water quality, mineral water control methods, mineral water analysis, mineral water quality control

A person is 60–70% water, which determines his need for clean drinking water on a regular basis. However, in modern conditions, given the state of the environment, a person often does not have free access to drinking water of adequate quality. In this regard, the water industry is of particular importance, which provides the consumer with clean drinking water and natural mineral water. The latter, in turn, is widespread, as it can not only quench thirst, but also has a healing effect: helps to strengthen the immune system, restore acid-base balance, increase the level of hemoglobin in the blood, strengthen teeth and bones (with a normal fluorine content), improve thinking and memory, strengthen the nervous system, etc. The benefits of mineral water determine its demand and popularity.

Currently, more than 400 mineral water deposits are being exploited in Russia [1]. According to the State Statistics Committee, more than 700 types of mineral water have been recorded in the Russian Federation today. Of these, about 100 brands are mined in the North Caucasus, where a third of all explored reserves of Russian mineral water are located. Of particular importance is the region of the Caucasian Mineral Waters, where the most popular and sought-after brands of mineral water, known since Soviet times, such as Essentuki and Narzan, are bottled. The key subsoil users in the region of the Caucasian Mineral Waters are OJSC “Kavminkurortresursy”, as well as the enterprise OJSC “Stavropol Mineral Waters”. These two companies own more

than 80% of all operating resources in the Stavropol Territory.

The more famous varieties of mineral water include [1]:

- Narzan – medicinal table water from Kislovodsk with a mineralization of 2-3 g / l. Its mining began in 1894;

- Essentuki No. 17 – water with a mineralization of 10–14 g / l. The wells are located in Essentuki, Stavropol Territory;

- Borjomi – medicinal water from Georgia with mineralization from 2,5 to 7,5 g / l.

The most purchased non-carbonated mineral waters [1]:

- Arkhyz – medicinal table water with low mineralization from the Teberdinsky district of the Karachay-Cherkess Republic;

- Pnatural drinking water “Silver Key” – table water Bekhtemirskoye deposit, Altai Territory with low mineralization. Contains silver ions;

- Chernogolovskaya – table water with a mineralization < 1 g / l from the city of Chernogolovka near Moscow.

Mineral waters are natural underground waters and are formed in the thickness of the earth’s crust with certain geological-structural, geothermal, hydrogeological and geochemical conditions that determine the patterns of their spatial localization, gas, ion-salt and microelement composition, temperature and other indicators [1]. Please note that these figures are subject to change. In this regard, it is very important to improve the methods and means of quality control and safety of produced packaged mineral drinks.

Materials and methods of research

The classification and systematization of mineral waters are based on finding a set of some characteristics and the most significant properties that make it possible to emphasize varieties in a single system of the underground hydrosphere, as well as the main categories of mineral waters according to their intended purpose and hydrogeochemical distinctive features.

Mineral waters, the effect of which is determined by the ionic composition and mineralization, are divided [2]:

- on carbonic waters;
- hydrogen sulfide waters;
- ferruginous waters;
- bromine, iodine, iodine-bromine water;
- siliceous thermal waters;
- arsenic waters;
- radon (radioactive) waters;
- boron-containing waters;
- water enriched with organic matter.

Drinking mineral underground waters are subdivided into medical-table, medicinal and table waters (Table 1) [2].

Table 1

Classification and mineralization of underground mineral drinking waters

Group name	General mineralization
Therapeutic table water	from 1,0 to 10,0 g/dm ³
Therapeutic	from 10,0 to 15,0 g/dm ³
Canteens	to 1 g/dm ³

Depending on the prevailing salts, water has various benefits [2]:

- Bicarbonate water prevents the accumulation of lactic acid in the muscles. She is advised to drink with diabetes, kidney disease and certain types of infectious diseases;
- Magnesium water has a sedative effect, is effective in dealing with stress and nervous strain;

- Sulfate water is useful for the liver, treatment of gallstone disease and intestinal obstruction;

- Chloride water has a choleric effect, is useful for normalizing the functioning of the digestive tract (contraindicated in people with hypertension).

According to the value of total mineralization, mineral waters are subdivided [2]:

- For low-mineralized from 1 to 5 g/dm³;
- Medium mineralized from 5 to 10 g/dm³.

Mineral waters, regardless of the degree of mineralization, include waters containing the components presented in Table 2 [3].

Since the composition of mineral water includes various active components, including harmful ones, the production process requires filtration as one of the stages. Suspended substances contained in water cause cloudiness of water and reduce the effectiveness of bactericidal treatment. Mineral water may contain coarse and finely dispersed suspended elements. In order to remove the latter, mineral water is filtered on ceramic candle filters, where microporous ceramics with a pore size of 1 mkm or more are used as a filter material. In this way, suspensions and bacteria larger than 1 to 2 mkm are removed.

Mineral water goes through a series of stages when it reaches the market. Namely:

- capturing of a mineral spring;
- transportation of mineral waters;
- acceptance;
- storage;
- filtration;
- disinfection;
- cooling;
- saturation.

When bottling mineral waters and corking bottles, the following operations are provided [4]:

- washing of bottles;
- bottle quality control (grading when using inspection devices to check the product for foreign inclusions: pieces of cork, glass, etc.);

Table 2

Components in the composition of medicinal table mineral water

Biologically active component	The content of the component mg per 1 liter of water	Name of the mineral water group
Free carbon dioxide (contained in the source)	≥ 500	carbon dioxide
Iron	≥ 10	glandular
Boron (in terms of orthoboric acid)	35,0–60,0	Bornaya
Silicon (in terms of metasilicic acid)	≥ 50	Siliceous
Iodine	5,0–10,0	Iodine
Organic matter (calculated as carbon)	5,0 – 15,0	Contains organic matter

- labeling (manufacturer's name, mineralization, water purpose, indications for therapeutic use, storage recommendations, bottling dates, shelf life, rejector or brigade number, standard designation);
 - packaging (according to GOST 13085-79) [5];
 - shipment (performed according to GOST 18 477-79) [6].

It is also necessary to control the production of products, the so-called technochemical and microbiological control.

Technochemical and microbiological control is the main parameter for monitoring the accuracy of the technological processes of mineral water production. A well-structured continuous production control ensures the release of a product that meets current standards. Quality control of products, as well as compliance with the accuracy of the implementation of the modes, is implemented by the factory laboratory.

Control over the quality of mineral waters in terms of chemical parameters must comply with the requirements of GOST 13273-88 "Mineral drinking medicinal and medicinal table waters" [7]. The mass concentration of the components should not exceed the values specified in table. 3 [8]. A complete chemical analysis is performed once a year, a short one – at least once a quarter for waters of deep formation and reliably protected from anthropogenic impact, monthly – for waters of shallow occurrence and weakly protected.

To check the quality of the composition, mineral waters are taken at the wellhead, or directly from the capturing of sources (wells, galleries, etc.). The cyclicity of sampling is determined by the technological scheme for

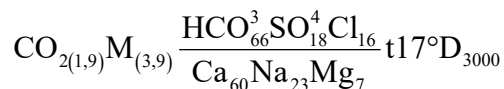
the exploitation of the mineral water deposit, approved in the prescribed manner. In case of detection of deviations from the introduced norms, sampling is carried out along the entire technological line in order to identify the causes that affect the change in the quality of mineral water and eliminate them.

The most complete chemical composition is taken into account in the formula, which at the beginning of the 20th century developed by the Russian scientist M.G. Kurlov. In addition to the elements and their concentration, the formula indicates some physical characteristics and performance of the source from which it is obtained [4].

$$S, M \frac{\text{анионы}}{\text{катионы}} \text{pH, } t, D,$$

where S – indicates microelements and free gases (for example, CO₂), their amount, mg/l; M is the total mineralization of the drink, g/l; pH is the acidity of water; anions and cations – chemical formulas and the number of ions in equivalent percentages, the most significant ions come first, then descending; t is the temperature at the exit from the well; D is the volume in m³ that the source (well) produces per day.

Kurlov's formula is sometimes called a water passport, so accurately it describes its composition [4]. For example:



Paying attention to the total mineralization, determine the level of impact of the drink on a person.

Table 3

Maximum allowable concentration of components in mineral water

Name of components	Maximum allowable concentration of components, mg/ dm ³
Nitrates (by NO ₃)	50,0
Nitrites (by N)O ₂	2,0
Lead (Pb)	0,1
Selenium (Se)	0,05
Arsenic (As) per metallic arsenic: in healing waters in medicinal table waters	2,0 1,5
Fluorine (F): in healing waters in medicinal table waters	15,0 10,0
Phenols	0,001
Other organic substances (calculated as carbon,): C _{opr} in healing waters in medicinal table waters	15,0 10,0
Radium (Ra)	5,0 · 10 ⁻¹⁰ Ki / dm ³

Control over the quality of mineral water in terms of sanitary and microbiological indicators is characterized by the following indicators: coliform bacteria containing mesophilic, mesotrophic aerobes and facultative anaerobes, *Pseudomonas aeruginosa* [8].

Sanitary and microbiological control of the quality of the water of the source and the balneological system is carried out by the territorial institutions of the State Sanitary and Epidemiological Service, as well as bacteriological laboratories accredited for these purposes.

Analysis of sanitary and microbiological mineral waters is carried out in accordance with the requirements of GOST 18963-73 "Drinking water. Methods of sanitary-microbiological analysis" [9]. Determination of microbiological indicators in waters saturated with carbon dioxide is carried out after their degassing.

The mineral water test can be carried out:

- by express method;
- by weight method.

For the first case, it is necessary to collect 100 ml of bottled water in a clean glass. She needs to stand for 10 minutes. Next, the trace of a drop of this liquid on the glass is considered. Mineral water will give a vague outline of the trace, but the inside will be filled with a whitish coating. The trail of a drop near medicinal table waters should be more densely filled with white coating, while for medicinal waters the trail will be completely white [10].

The second method, the weight method, allows in laboratory conditions to determine the concentration of mineral salts in grams per cubic decimeter.

To analyze mineral water, it is necessary to conduct a series of experiments.

For the first analysis, it is necessary to apply a small amount of water from a bottle to a clean glass or mirror and allow the liquid to dry. If after that no traces remain on the surface, then the water is clean. A dry whitish spot will speak of an excess of chlorine, and circular stains in place of a drop will speak of an excess of salts.

The second analysis requires bottled mineral water to stand in a jar. To do this, a sample of water must be poured into a clean three-liter jar and placed in a dark place for several days. High-quality water should remain the same clean and transparent, odorless and sediment. If the water turned cloudy, turned green, there was a precipitate or an unpleasant odor, then bacteria were present in it. The presence of harmful chemicals will be indicated by an oil film on the surface of the water.

The most reliable analysis of mineral water can only be obtained in specially accredited

testing laboratories or using express methods and automated control tools [11].

Conclusion

In conclusion, the author would like to draw attention to the fact that mineral water is a good source of drinking water, but it contains various elements that improve health, but in large doses (or with certain diseases in the consumer) can be harmful. It is necessary to carefully read the instructions and the composition indicated on the bottle label, which the manufacturer must indicate after all the necessary analyzes and tests have been carried out. The general recommendation says that medicinal and table mineral water should be consumed no more than a couple of glasses, dining room – no more than 2 liters per day. Since tests at home are not highly accurate, it is necessary to be guided by the information provided by the manufacturer. With the right choice and use of mineral water, it is possible to achieve a healing and healing effect. for quality control of mineral water using express analysis of liquid packaged products in packaged containers.

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