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REQUIREMENTS FOR WATER INTENDED FOR THE TECHNOLOGICAL PRODUCTION OF BEVERAGES AND CONCENTRATES

During the study, the main requirements for drinking water quality were examined, including sanitary-chemical, radiological, and epidemiological safety indicators. Various types of water and their qualitative characteristics were analyzed. It was proven that the quality of drinking water plays a key role in producing safe food products, particularly beverages and concentrates. Compliance with sanitary and hygienic standards ensures the minimization of health risks for consumers, while the use of effective purification methods allows for the removal of undesirable impurities that may affect the chemical composition and organoleptic properties of the final product. The application of methods such as mechanical, chemical, biological, and physical purification contributes to maintaining the optimal mineral composition of water, which is important not only for safety but also for enhancing the flavor characteristics of beverages. In addition, regular monitoring of water quality at all stages of its use in the production process helps prevent potential contamination and ensures the consistency of the final product's characteristics.

Thus, strict compliance with drinking water quality standards, the implementation of modern purification technologies, and the monitoring of all safety indicators are essential conditions for the production of high-quality beverages and concentrates that meet high safety requirements and consumer demand.

Key words: *sanitary and chemical indicators of drinking water quality, radiation indicators of drinking water safety, organoleptic indicators, and epidemic safety indicators of drinking water, beverages, concentrates, and maximum permissible concentration (MPC).*

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ВИМОГИ ДО ВОДИ, ПРИЗНАЧЕНОЇ ДО ВИКОРИСТАННЯ ПРИ ВИГОТОВЛЕННІ НАПОЇВ ТА КОНЦЕНТРАТІВ

У ході дослідження були розглянуті основні вимоги до якості питної води, що включають санітарно-хімічні, радіаційні та епідемічні показники безпечності. Проаналізовано різновиди води, її якісні характеристики. Доведено, що якість питної води відіграє ключову роль у виробництві безпечних харчових продуктів, зокрема напоїв та концентратів. Відповідність санітарно-гігієнічним нормам гарантує мінімізацію ризиків для здоров'я споживачів, тоді як використання ефективних методів очищення дозволяє усунути небажані домішки, які можуть впливати на хімічний склад та органолептичні властивості кінцевої продукції. Застосування таких методів, як механічна, хімічна, біологічна та фізична очистка, сприяє збереженню оптимального мінерального складу води, що є важливим не лише для безпеки, а й для покращення смакових характеристик напоїв. Окрім цього, регулярний контроль якості води на всіх етапах її використання у виробничому процесі дозволяє запобігти можливим забрудненням та забезпечити стабільність характеристик кінцевого продукту.

Таким чином, суворе дотримання стандартів якості питної води, впровадження сучасних технологій очищення та моніторинг усіх показників безпечності є необхідними умовами для виробництва якісних напоїв та концентратів, що відповідають високим вимогам безпеки та споживчого попиту.

Ключові слова: *санітарно – хімічні показники безпечності якості питної води, радіаційні показники безпечності питної води, органолептичні показники, показники епідемічної безпеки питної води, напої, концентрати, гранично допустима концентрація (ГДК).*

Relevance. The relevance of the research is that water is one of the most important elements of the environment. It plays a key role in the physiological processes of the human body and has sanitary-hygienic, industrial, and epidemiological significance. The consumption of low-quality water can lead to violations of the sanitary regime at enterprises, the production of substandard goods, as well as cause infectious diseases, food poisoning, helminth infections, and more (Andrusyshyna, 2015).

Requirements for water used in the production of beverages and concentrates. The requirements for water used in the production of beverages and concentrates correspond to the requirements for drinking water intended for human consumption. Since beverages and concentrates are food products in which water is the main component, it is important to examine these requirements in detail.

Purpose of the article. The study of the requirements for water quality used in the production of beverages and concentrates. In particular, the article examines sanitary-chemical, radiation, and epidemic safety indicators, as well as methods of water purification and quality control. Their impact on the final characteristics of the products is analyzed, including organoleptic properties, compliance with sanitary standards, and stability of composition.

Analysis of key terms and requirements. Water used in the production of beverages and concentrates must meet the requirements for drinking water intended for human consumption. Since beverages and concentrates are food industry products containing a significant amount of water, their quality directly affects the safety, organoleptic properties, and consumer characteristics of the final product. Drinking water intended for human consumption must meet the following hygienic requirements: it must be safe in terms of epidemiology and radiation, have favorable organoleptic properties, and contain a harmless chemical composition.

For the production of drinking water, preference should be given to water from underground sources of drinking water supply for the population, reliably protected from biological, chemical, and radiation contamination.

The hygienic assessment of the safety and quality of drinking water is conducted based on epidemic

safety indicators. These include microbiological, parasitological, sanitary-chemical, organoleptic, physicochemical, sanitary-toxicological, and radiation indicators.

When selecting a water source and water treatment technology during the construction or reconstruction of a public drinking water supply facility, preference should be given to sources and technologies that ensure the production of drinking water with an optimal content of mineral substances according to the indicators of the physiological adequacy of the mineral composition of drinking water (Vymohy do yakosti pytnoi vody, 2025; Pro zatverdzhennia Derzhavnykh sanitarnykh norm ta pravy, 2022).

Considering the sanitary-chemical requirements for water quality, it can be stated that it must comply with the established hygienic standards regarding the content of chemical substances. (tabl. 1).

It is important to note that if the level of dry residue in drinking water after its artificial desalting is less than 100 mg/dm³, it is subject to demineralization. If disinfection is carried out during the production of drinking water, the manufacturer must take measures to minimize contamination of the drinking water with disinfection by-products.

When considering the microbiological parameters of water for the production of beverages and concentrates, it must meet the following requirements: it should not contain (Escherichia coli) – absence in a 100 cm^3 sample; total microbial count (TMC) at 37 °C – no more than 100 colony-forming units (CFU) per 1 cm^3; pathogenic microorganisms (including Salmonella, Vibrio cholerae) – absence in a 1 dm^3 sample; enterococci – absence in a 100 cm^3 sample. As for organoleptic parameters (Table 2), the water must be colorless, transparent, free of sediment, with no foreign odor or taste (Malyna, Liasota, Hryshko, 2014; Malyna, Liasota, 2020).

The radiological component is also considered when analyzing water. The permissible levels of natural and artificial radionuclides in water must comply with sanitary standards. The content of harmful substances in drinking water that are not specified in the sanitary standards must not exceed their Maximum Allowed Concentrations (MACs), as defined by the sanitary standards for surface waters. In the presence of several substances in drinking water with the same limiting harmful property, belonging to hazard classes I and II, the sum of the ratios of the concentrations of each substance to its corresponding MAC must not exceed one (Table 3).

In the case of exceeding the specific total alpha activity in drinking water from underground water sources, it is necessary to determine the specific

Table 1

Sanitary and chemical water quality requirements

Indicator	pH	Total hardness, mmol/dm^3	Total mineralization, mg/dm^3	Chloride content, mg/dm^3	Sulfate content	Nitrate content, mg/dm^3	"Iron content, mg/dm^3	Manganese content	Fluoride content, mg/dm^3	Permanganate oxidation, mg O_2/dm^3
MAC	6,5–8,5	7,0	1000	250	250	50	0,3	0,1	0,5–1,5	5

Table 2

Organoleptic water parameters

Parameter	Odor, score	Taste and aftertaste, score	Turbidity, mg/dm^3	Coloration, degrees
Requirements	no more than 2	no more than 2	no more than 1,5	no more than 20

Table 3

Radiation parameters of water

Parameter	MAC
Total activity of alpha emitters, Bq/dm³	Not more than 0.1
Total activity of beta emitters, Bq/dm³	Not more than 1,0

total activity of the natural mixture of uranium isotopes (U), the specific activities of radium (Ra-226, Ra-228), and radon (Rn-222). In the case of exceeding the specific total beta activity in drinking water from both surface and underground water sources, the specific activities of cesium (Cs-137) and strontium (Sr-90) should be determined.

In the case of contamination of drinking water with unknown toxic compounds and chemicals, for which no testing methods are available, it is recommended to use an auxiliary integral (express) indicator of drinking water quality – the drinking water toxicity index, calculated based on the results of biological tests (biotesting).

The drinking water toxicity index, which does not contain unidentified components, should not exceed 50 %, regardless of the test objects used.

The storage time of drinking water from distribution points, wells, and source captures in consumer containers should not exceed 24 hours, provided it is stored in a clean, sealed container at a temperature between 5 °C and 20 °C in places protected from direct sunlight.

The requirements for a centralized drinking water supply (tap water) for the population are as follows. When studying the microbiological indicators of tap drinking water, the total microbial count, total coliforms, E. coli, and enterococci are determined in its samples. In tap drinking water from surface water sources, at the points where it enters the distribution network from treatment facilities, the presence of coliphages should also be determined.

In case of detecting total coliforms, E. coli, or enterococci in samples of drinking water from underground water sources, or total coliforms, E. coli, enterococci, or coliphages in samples of drinking water from surface water sources, their determination should be carried out in re-sampled tests.

In the presence of deviations from the established standards in re-sampled tests, within 12 hours, research should be initiated to detect coliphages and bacterial pathogens of infectious diseases in drinking water from underground water sources, and to detect bacterial and viral pathogens of infectious diseases in drinking water from surface water sources. In case of detecting coliphages in samples of drinking water from underground water sources, investigations should be carried out to identify viral pathogens of infectious diseases (DSTU 7525:2014. Voda pytna, 2014).

Based on laboratory studies' results, measures are taken to identify and eliminate the causes of drinking water contamination.

During the disinfection of drinking water, residual concentrations of reagents are determined at least once per hour and should be as follows: – in the case of water disinfection using chlorine during a period of favorable sanitary and epidemiological conditions, the residual free chlorine content in the water at the outlet of the clean water reservoir (CWR) – should be within the range of 0.3–0.5 mg/dm^3 after 30 minutes of contact with chlorine, while the residual combined chlorine content – should be within the range of 0.8–1.2 mg/dm^3 after 60 minutes of contact with chlorine. Suppose both free and combined chlorine are present in the water. In that case, monitoring can be conducted for one of these indicators: residual free chlorine (when its concentration is above 0.3 mg/dm^3) or residual combined chlorine (when the residual free chlorine concentration is less than 0.3 mg/dm^3);

– During a deterioration of the sanitary and epidemiological situation, it is allowed to chlorinate water with increased doses of active chlorine (5–20 mg/dm^3), provided that excess chlorine is removed from the water before it is supplied to the distribution network;

– In the case of water disinfection using ozone, the residual ozone concentration at the outlet of the mixing chamber should be within the range of 0.1–0.3 mg/dm^3 after 4 minutes of ozone contact with the water;

– In the case of water disinfection using chlorine dioxide, the residual chlorine dioxide content in the clean water reservoir (CWR) after 30 minutes of contact should be no less than 0.1 mg/dm^3, and the chlorite concentration should be no more than 0.2 mg/dm^3 (Hihiienichni vymohy do vody pytnoi, pryznachenoi dlia spozhyvannia liudynoiu, 2010; Prokopov, 2012; DSTU 4107-2002. Yakist vody, 2009).

Before using underground and potable water, institutions and establishments of the state sanitary and epidemiological service conduct preliminary laboratory studies of the source water. For underground water, the requirements of the Sanitary Norms must be taken into account.

Preliminary laboratory studies of the source water are carried out following the Sanitary Norms, based on a list of indicators considering local natural conditions.

Water samples are taken throughout the year at least once a month to determine microbiological, organoleptic, physicochemical, and sanitary-toxicological indicators. For drinking water from surface sources, parasitological indicators are also determined.

Water samples from new wells or those temporarily not in use are taken after the water has been pumped out until a stable dynamic level and clear water are achieved. The pumping rate should be equal to or greater than the design rate (Hryhorenko, 2019; Babienko, 2021).

The results of laboratory studies on the quality of source water and the sanitary-epidemiological survey of the area where the water intake is located, conducted by institutions and establishments of the state sanitary and epidemiological service, are taken into account during the state sanitary and epidemiological expertise of the technological regulations or other documents describing the technological process of bottled drinking water production and from filling points.

For the preservation of bottled drinking water and water from filling points, substances such as carbon dioxide, silver, etc., may be used.

Bottled drinking water and water from filling points must not contain flavorings, sweeteners, or other food or food flavoring substances, except for those regulated by these Sanitary Norms (Zapolsky, 2005; Dehazatsiya vody, 2025).

The indicators of total alkalinity, color, and turbidity in carbonated drinking water are determined before carbonation or after degasification.

The transportation of water from the water intake points to the bottling locations at the raw drinking water production plants must be carried out exclusively through pipelines.

The storage time of drinking water at filling points in stationary containers should not exceed 24 hours, while in transport containers (tank trucks) it should not exceed 6 hours. The storage time of drinking water may be extended based on the results of sanitary-epidemiological studies, provided that it undergoes additional disinfection before being bottled for consumers, using methods that do not contaminate the drinking water with residual concentrations of reagents.

It is prohibited to fill containers with drinking water that contain remnants of drinking water.

The shelf life and storage conditions of bottled drinking water are established based on the results of the state sanitary and epidemiological expertise of the water. Bottled drinking water must be stored in places protected from direct sunlight.

Reusable polymer containers and containers that arrive at the filling line from the storage warehouse must be washed, disinfected, and rinsed with the drinking water intended for bottling in these containers, according to the technological regulations or other documents describing the technological process of bottled drinking water production, which specifies the usage period for reusable containers.

The release of bottled drinking water that has been treated with ozone during water preparation from the finished goods warehouse must take place no earlier than 8 hours after the water has arrived at the warehouse (Honcharuk, 2016; Kovaliova, 2014; Honcharuk, 2015; Dytrieva, 2015; Hryhorenko, 2019).

During the design and construction of new drinking water production facilities or the reconstruction of existing ones, separate filling lines for bottling drinking water and non-alcoholic beverages must be provided.

At existing plants that use a single filling line, before changing the type of product, the filling line must undergo a sanitary treatment using cleaning and disinfecting agents, followed by rinsing with water at a temperature not lower than 80°C and drinking water intended for bottling, following the technological regulations or other documents describing the technological process of drinking water production.

After sanitary treatment, production control of the first batch of products is carried out according to the full production control program.

At the drinking water filling points, an informational sheet must be available, containing details about the type of water (treated, untreated (natural), artificially mineralized, artificially fluoridated, artificially iodized, with optimal mineral content, carbonated or non-carbonated, etc.), its composition ("drinking water" and a list of added substances, including preservatives, macro- and microelements), storage conditions, manufacturing date, the name, address, and phone number of the manufacturer and the place of production, the type of source water, the location of the underground drinking water source, the well number and depth, and references to the normative document under which the drinking water was produced.

The location for the sale of drinking water from filling points should be situated on an area with a solid surface, which is organized and well-maintained, and is located at least 50 meters away from sources of contamination such as waste bins, toilets, major roads with heavy traffic, parking lots, etc. It should have a counter with a metal faucet connected to a pipeline for dispensing drinking water (the faucet should be positioned above the counter at a height of at least 0.5 meters).

It is prohibited to lay a bypass pipeline from the drinking water supply network to the water dispensing faucet for consumers.

The requirements for drinking water from wells, boreholes, and water intakes (decentralized drinking water supply for the population) are as follows. The construction of wells, boreholes, and water intakes must be carried out based on the results of laboratory studies on the safety and quality of the underground water to be used, as well as the sanitary-epidemiological survey of the area where these structures are located, conducted by institutions and establishments of the state sanitary and epidemiological service.

The results of geological and hydrogeological studies, as well as laboratory studies on the safety and quality of underground water (if available), should be submitted to the state sanitary and epidemiological service of the respective administrative territory. These results must include information on the depth of underground water, the direction of its flow within the area of the settlement, the approximate thickness of the water-bearing layer, the potential interaction with existing or planned water intakes at neighboring sites, and with surface water bodies (such as ponds, swamps, reservoirs, rivers, etc.), as well as actual values of safety and quality indicators for the underground water (Babienko, 2021; Honcharuk, 2016; Kovaliova, 2014).

The results of the sanitary-epidemiological survey of the area must include information about the local natural conditions, a description of the area where the water intake is located, indicating existing and potential sources of microbial, parasitic, and chemical contamination.

The locations for the construction of wells, boreholes, and water intakes should be situated on clean and protected land, located upstream of the groundwater flow, at least 30 meters away from roads with heavy traffic and at least 50 meters (for individual wells, at least 20 meters) from toilets, cesspits, sewage facilities and networks, fertilizer and pesticide storage sites, livestock enclosures, and other places of soil and groundwater contamination.

The area around the well, water intake, or public well should be kept clean, and surface runoff should be properly managed.

Within a 50-meter radius of wells, boreholes, and water intakes, it is prohibited to wash vehicles, allow animals to drink water, create ponds for waterfowl, or place devices for preparing pesticides, as well as engage in any activities that could lead to soil and water contamination.

It is also forbidden to construct wells, boreholes, and water intakes in areas that are prone to flooding, erosion, landslides, or other forms of deformation, as well as in low-lying and swampy areas.

It is prohibited to use containers brought by consumers for raising water from wells or water intakes meant for public use, as well as to draw water with common-use buckets or utensils belonging to consumers.

For insulating and protecting wells and water intakes from freezing, materials such as foam concrete, clean straw mats, hay, shavings, etc., can be used, but these materials should not come into contact with the water intake. The use of manure, compost, or other similar substances for this purpose is prohibited.

Newly constructed wells, boreholes, and water intakes can only be put into operation after inspection by an official from the state sanitary and epidemiological service of the respective administrative territory and after completing the Sanitary Passport.

The Sanitary Passport is filled out by the owner of the well, borehole, or water intake, together with the official from the state sanitary and epidemiological service of the respective administrative territory, in two copies, both of which are signed. One copy of the Sanitary Passport is kept at the state sanitary and epidemiological service of the respective administrative territory, and the second copy remains with the owner of the facility. The extension of the Sanitary Passport's validity is registered annually in both copies (Khilchevsky, 2015; Prokopov, 2016; Zasypka, 2018).

High levels of turbidity can protect microorganisms from the action of disinfectants, promote bacterial growth, and cause significant chlorine consumption. Therefore, in all disinfection processes, to ensure their effectiveness, turbidity must always be kept low (Kovaliova, 2014; Malyna, Liasot, 2020).

Conclusions. This work examines the main requirements for drinking water, including sanitary-chemical and radiological safety indicators, as well as epidemic safety parameters. The types of water, its quality, and methods for improvement are analyzed. It has been established that adherence to regulated water quality requirements is a key factor in producing safe and high-quality beverages and concentrates. The use of effective water purification and control methods not only ensures compliance with sanitary and hygiene standards but also preserves the organoleptic properties of the product at a high level.

BIBLIOGRAPHY:

1. Андрусишина І. М. Вплив мінерального складу питної води на стан здоров'я населення: Вода і водоочисні технології : Навчальний посібник. Київ : Інститут медицини праці імені Ю. І. Кундієва. 2015. 31с.
2. Вимоги до якості питної води. URL: https://ecosoft.ua/ua/blog/trebovaniya-k-kachestvu-pitevoy-vody/ (дата звернення 25.03.2025)
3. Про затвердження Державних санітарних норм та правил «Гігієнічні вимоги до води питної, призначеної для споживання людиною» Закон України від 12.05.2010 № 400. Міністерство охорони здоров'я України. 2022. С. 18–40.
4. Методичні вказівки до проведення практичних занять зі студентами біолого-технологічного факультету. Фізичні, хімічні та біологічні показники якості води / Розробники Малина В. В, Лясота В. П., Гришко В. А. Біла Церква : Білоцерківський національний аграрний університет, 2014. 45 с.
5. Методичні вказівки до проведення практичних занять зі студентами біолого-технологічного факультету. Фізичні, хімічні та біологічні показники якості води / Розробники Малина В. В, Лясота В. П. Біла Церква : Білоцерківський національний аграрний університет, 2020. 56 с.
6. ДСТУ 7525: 2014. Вода питна. Вимоги та контролювання якості. [Чинний від 2014-10-23]. Київ, 2014. 25 с. (Інформація та документація).
7. Гігієнічні вимоги до води питної, призначеної для споживання людиною: ДСаНПіН 2.2.4-171-10. Оф. вид. Київ : М-во охорони здоров'я України, 2010. 74 с.
8. Прокопов В. О. Оцінка якості питної води з підземних вододжерел України з погляду впливу на стан здоров'я населення. Київ. *Науковий вісник НМУ*. 2012. № 3. 126–132 с.
9. ДСТУ 4107-2002 Якість води. Відбирання проб. Настанови щодо біотестування проб (ISO 5667-16:1998, MOD). [Чинний від 04.12.2009] Вид. офіц. Київ : «УкрНДІЕП», 2009. 53 с.
10. Григоренко Л. В. Еколого-гігієнічна оцінка впливу питної води з централізованих, децентралізованих джерел водопостачання та доочищеної питної води на здоров'я сільського населення Дніпропетровської області. Київ : Інститут громадського здоров'я ім. О. М. Марзєєва НАМН України», 2019. 342 с.
11. Бабієнко В. В. Гігієна води та водопостачання населених місць : Навчальний посібник. Одеса : Прес-кур'єр, 2021. 372 с.
12. Запольський, А. К. Водопостачання, водовідведення та якість води : підручник. Київ : Вища шк., 2005. 671 с.
13. Дегазація води. URL: https://studfile.net/preview/5725871/page:18/ (дата звернення 20.03.2025).
14. Гончарук В. В., Скубченко В. Ф., Чернявская А. П., Мешкова Клименко Н. А. Джерела централізованого водовідведення, гігієнічні і екологічні вимоги к якості води : Матеріали науково-практичного семінару «Актуальні питання якості води в Україні». Київ, 2016. 56 с.
15. Методичні вказівки до практичних занять з дисципліни «Санітарногігієнічні основи спеціальності» до спеціальності «Водопостачання та водовідведення» / уклад.: О. О. Ковальова, О. В. Булгакова. Харків : ХНУМГ ім. О. М. Бекетова, 2014. 46 с.
16. Гончарук В. В., Жупинский В. Н., Чернявская А. П., Скубченко В. Ф. Розробка еколого-гігієнічної класифікації якості поверхневих вод України. Київ : ІКХХВ НАН України, 2015. 157 с.
17. Дмитрєва О. О., Ігнатенко Л. Г., Колдоба І. В. Соціально-екологічні проблеми якості води : Навч. посіб. Харків : Техніка, 2015. 50 с.
18. Хільчевський В. К. Основні засади управління якістю водних ресурсів та їхня охорона: Навчальний посібник. Київ : ВПЦ Київський університет. 2015. 154 с.
19. Прокопов В. О. Питна вода України: медико-екологічні та санітарно-гігієнічні аспекти. Київ : ВСВ «Медицина», 2016. 400 с.
20. Засипка, А. М., Кільдишева, О. В Актуальні питання санітарногігієнічної регламентації у водопостачанні. Київ : *Науково-практичний журнал*. 2018. № 4. 208–212 с.

REFERENCES:

1. Andrusyshyna, I. M. (2015). *Vplyv mineralnoho skladu pytnoi vody na stan zdorovia naselennia: Voda i vodoochysni tekhnolohii: Navchalnyi posibnyk. [Influence of the Mineral Composition of Drinking Water on the State of Public Health: Water and Water Purification Technologies].* Kyiv : Instytut medytsyny pratsi imeni Yu. I. Kundieva [in Ukrainian].

2. Vymohy do yakosti pytnoi vody [Requirements for Drinking Water Quality]. (n.d.). *base.garant.ru*. Retrieved from: https://ecosoft.ua/ua/blog/trebovaniya-k-kachestvu-pitevoy-vody/ [in Ukrainian].

3. *Zakon Ukrainy pro zatverdzhennia Derzhavnykh sanitarnykh norm ta pravyl "Hihiienichni vymohy do vody pytnoi, pryznachenoi dlia spozhyvannia liudynoiu": pryiniatyi 5 tr. 2010 roku № 400 [Law of Ukraine on the Approval of State Sanitary Norms and Rules "Hygienic Requirements for Drinking Water Intended for Human Consumption": Adopted May 5, 2010, No. 400]*. (2022). Ministerstvo okhorony zdorovia Ukrainy, 400, pp. 18–40 [in Ukrainian].

4. Malyna, V. V., Liasota, V. P., & Hryshko, V. A. (2014). *Metodychni vkazivky do provedennia praktychnykh zaniat zi studentamy bioloho-tekhnolohichnoho fakultetu. Fizychni, khimichni ta biolohichni pokaznyky yakosti vody [Methodological Guidelines for Conducting Practical Classes with Students of the Faculty of Biology and Technology. Physical, Chemical, and Biological Indicators of Water Quality]*. Bila Tserkva: Bilotserkivskyi natsionalnyi ahrarnyi universytet [in Ukrainian].

5. Malyna, V. V., & Liasota, V. P. (2020). *Metodychni vkazivky do provedennia praktychnykh zaniat zi studentamy bioloho-tekhnolohichnoho fakultetu. Fizychni, khimichni ta biolohichni pokaznyky yakosti vody [Methodological Guidelines for Conducting Practical Classes with Students of the Faculty of Biology and Technology. Physical, Chemical, and Biological Indicators of Water Quality]*. Bila Tserkva : Bilotserkivskyi natsionalnyi ahrarnyi universytet [in Ukrainian].

6. Voda pytna. Vymohy ta kontroliuvannia yakosti [Drinking Water. Requirements and Quality Control]. (2014). *DSTU ISO 7525:2014 from 23th October 2014*. Kyiv : Derzhstandart Ukraine [in Ukrainian].

7. *Hihiienichni vymohy do vody pytnoi, pryznachenoi dlia spozhyvannia liudynoiu: DSANPIN 2.2.4-171-10 [Hygienic Requirements for Drinking Water Intended for Human Consumption: DSANPIN 2.2.4-171-10]*. (2010). Kyiv : M-vo okhorony zdorovia Ukrainy [in Ukrainian].

8. Prokopov, V. O. (2012). Otsinka yakosti pytnoi vody z pidzemnykh vododzherel Ukrainy z pohliadu vplyvu na stan zdorovia naselennia [Assessment of Drinking Water Quality from Underground Water Sources in Ukraine from the Perspective of Impact on Public Health]. *Naukovyi visnyk NMU – Scientific Bulletin of NMU*, 3, 126-132 [in Ukrainian].

9. Yakist vody. Vidbyrannia prob. Nastanovy shchodo biotestuvannia prob. [Water Quality. Sampling. Guidelines for Biotesting of Samples]. (2009). *DSTU ISO 4107-2002 from 04th December 2009*. Kyiv : "UkrNDIEP" [in Ukrainian].

10. Hryhorenko, L. V. (2019). *Ekoloho-hihiienichna otsinka vplyvu pytnoi vody z tsentralizovanykh, detsentralizovanykh dzherel vodopostachannia ta doochyshchenoi pytnoi vody na zdorovia silskoho naselennia Dnipropetrovskoi oblasti. [Ecological and Hygienic Assessment of the Impact of Drinking Water from Centralized and Decentralized Water Supply Sources and Purified Drinking Water on the Health of the Rural Population of the Dnipropetrovsk Region]*. Kyiv : Instytut hromadskoho zdorovia im. O. M. Marzieieva NAMN Ukrainy [in Ukrainian].

11. Babienko, V. V. (2021). *Hihiiena vody ta vodopostachannia naselenykh mists [Water Hygiene and Water Supply of Human Settlements]*. Odesa : Pres-kurier, [in Ukrainian].

12. Zapolskyi, A. K. (2005). *Vodopostachannia, vodovidvedennia ta yakist vody [Water Supply, Wastewater Disposal, and Water Quality]*. Kyiv : Vyshcha shk. [in Ukrainian].

13. Dehazatsiya vody [Water Degasification] (n.d.). *base.garant.ru*. Retrieved from: https://studfile.net/preview/5725871/page:18/ [in Ukrainian].

14. Honcharuk, V. V., Skubchenko, V. F., Cherniavska, A. P., & Meshkova Klymenko, N. A. (2016). *Dzherela tsentralizovanoho vodovidvedennia, hihiienichni i ekolohichni vymohy k yakosti vody [Sources of Centralized Wastewater Disposal, Hygienic and Ecological Requirements for Water Quality]*. Kyiv [in Ukrainian].

15. Kovaliova, O. O., & Bulhakova, O. V. (2014). *Metodychni vkazivky do praktychnykh zaniat z dystsypliny "Sanitarnohihiienichni osnovy spetsialnosti" do spetsialnosti "Vodopostachannia ta vodovidvedennia" [Methodological Guidelines for Practical Classes in the Discipline "Sanitary and Hygienic Fundamentals of the Specialty" for the Specialty "Water Supply and Wastewater Disposal"]*. Kharkiv : KhNUMH im. O. M. Beketova [in Ukrainian].

16. Honcharuk, V. V., Zhupynskyi, V. N., Cherniavska, A. P., & Skubchenko, V. F. (2015). *Rozrobka ekolo-hohihienichnoi klasyfikatsii yakosti poverkhnevykh vod Ukrainy [Development of an Ecological and Hygienic Classification of the Quality of Surface Waters of Ukraine*]. Kyiv : IKHHV NAN Ukrainy [in Ukrainian].

17. Dytrieva, O. O., Ihnatenko, L. H., & Koldoba, I. V. (2015). *Sotsialno-ekolohichni problemy yakosti vody [Socio-Ecological Problems of Water Quality]*. Kharkiv : Tekhnyka [in Ukrainian].

18. Khilchevskyi, V. K. (2015). *Osnovni zasady upravlinnia yakistiu vodnykh resursiv ta yikhnia okhorona [Basic Principles of Water Resource Quality Management and Their Protection]*. Kyiv : VPTs Kyivskyi universytet [in Ukrainian].

19. Prokopov, V. O. (2016). *Pytna voda Ukrainy: medyko-ekolohichni ta sanitarno-hihiienichni aspekty [Drinking Water of Ukraine: Medico-Ecological and Sanitary-Hygienic Aspects]*. Kyiv : VSV "Medytsyna" [in Ukrainian].

20. Zasypka, A. M., & Kildysheva, O. V. (2018). Aktualni pytannia sanitarno-hihiienichnoi rehlamentatsii u vodopostachanni [On Current Issues of Sanitary and Hygienic Regulation in Water Supply]. *Naukovo-praktychnyi zhurnal – Scientific and Practical Journal*, 4, 208–212 [in Ukrainian].