Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 24, Issue 4, 2024
PRINT ISSN 2284-7995, E-ISSN 2285-3952

VARIATION OF QUALITATIVE PARAMETERS OF DRINKING WATER PROVIDED BY THE COMPANY ECOAQUA S.A. CĂLĂRAȘI IN 2023

Cecilia NEAGU, Andrei Radu IOVA, Daniela CREȚU

University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăști Blvd, District 1, Bucharest, Romania. E-mails: neagu.cecilia@managusamv.ro; iova.andrei@managusamv.ro; cretu.daniela@managusamv.ro

Corresponding author: neagu.cecilia@managusamv.ro

Abstract

The aim of the paper is to compare the most important physico-chemical parameters of the drinking water supplied by the company ECOAQUA S.A. in Călăraşi municipality, taken from monthly average analysis bulletins carried out within the company in 2023, both at the entrance to the treatment plant and at the exit - to be able to evaluate the degree of water treatment and the quality of drinking water supplied to consumers. The parameters analyzed in the paper are: pH, turbidity, residual free chlorine (only analyzed for drinking water), nitrates, total hardness and aluminum. They were represented graphically, and the values of the parameters at the exit from the station were compared with the maximum limit provided in the Government Ordinance 7/2023 and Government Decision 971/2023, in order to be able to estimate the qualitative level of drinking water. We found exceedances of a maximum of 22% only in the case of free residual chlorine in November 2023, due to the water disinfection process. The other physico-chemical parameters did not exceed the legal limits.

Key words: *consumption, drinking water, physical-chemical parameters, raw water, quality*

INTRODUCTION

Supplying the population with drinking water is an essential aspect of water resource management, having a direct impact on the health and well-being of communities [1, 13]. Access to safe, potable water is fundamental to meeting people basic needs and preventing diseases associated with drinking contaminated water [18].

In order to ensure water supply for the population, it is crucial to have a well-developed infrastructure that includes all stages from water capture and treatment to its distribution to homes and communities [9]. This activity frequently requires the maintenance and construction of water distribution networks and treatment systems [11]. Also, the application of strategies to protect water sources against pollution and degradation [3].

Launched during a session of the European Parliament on 15th February 2000, the White Paper on European governance introduced a new concept: democratic partnership between the different levels of government in Europe. It addresses the issue of public services of general economic interest, including water supply and sanitation, considering them of particular importance for social cohesion, improving the quality of life in Europe and promoting sustainable development [4]. Romania territory is rich in fresh water sources, including rivers, lakes and underground sources [2]. The main sources of water are the Danube and inland rivers, and natural lakes, although abundant, have a minor contribution to the total volume of water resources in the country [14].

In Călăraşi municpiality, drinking water supply is provided by EcoAqua SA, through Chiciu Water Pretreatment Station and Călăraşi Drinking Water Treatment Station [4].

Chiciu Water Pretreatment Station has the role of collecting raw water from the Danube with the help of the pumps located at the station or with the help of the pumps from the Floating Station when needed (drought, frost, etc.). After capture, the raw water goes through the pretreatment processes and is transported through the two DN 1,000 mm pipes to Călărași Drinking Water Treatment Plant.

Călăraşi Drinking Water Treatment Plant has the role of receiving pre-treated water and passing it through the treatment processes, ensuring that it is potable for human consumption, and then distributing it to consumers through the distribution network [12].

An analysis of the water networks replaced in the last 25 years reveals that most of them were modernized through two programs funded by the European Union. The SAMTID program, initiated in 2008, generated the replacement of 42.9 km of network, representing 27% of the total distribution network. At the same time, SOP Environment program, started in 2016, involved the replacement of 23.2 km of network, constituting 14.6% of the entire network [4].

With all the network replacements done, networks older than 30 years (19.3 km) and even older than 40 years (24.2 km) are still in operation which together represent 27.3% of the total network. Most of these networks, about 30 km, were planned to be replaced by POIM program, the works contract CL1 Extension and rehabilitation of water networks and the expansion of sewerage networks in Călărași municipality.

In this context, the goal of the paper is to assess the most important physico-chemical parameters of the drinking water supplied by the company EcoAqua S.A. in Călăraşi municipality, using the information presented in the monthly analysis bulletins carried out in 2023, both at the water entrance to the treatment plant and at the exit. In this way, we could be able to evaluate the degree of water treatment and the quality of drinking water supplied to consumers.

MATERIALS AND METHODS

In order as water to be suitable for human consumption, it is necessary for be supposed through a whole treatment process, including: water capture, pretreatment, transport to the treatment plant, treatment of pretreated water, storage, pumping and repumping of drinking water [10].

The water capture step is carried out by means of two methods. Normally the pumps in the Pretreatment Station suck the raw water and direct it to the first stage of treatment through a network of screens (pipes). In drought situations, the Floating Station comes into action, having specialized pumps that extract water from the surface of the Danube River, ensuring the supply in periods when water collection from the cribs is limited. After this stage, the raw water is directed to Chiciu Water Pretreatment Station, where a complex treatment process takes place. Here, the water undergoes several operations, including chlorine oxidation, coagulation, flocculation and decantation. The decanted water is then transported through a network of pipes (approximately 6,625 m) to Călărași Treatment Plant, where it is subject to a second treatment process. Here, the water is filtered through sand filters, then through granular activated carbon (GAG), chlorinated (liquefied chlorine gas) and stored in tanks (2 x 10,000 m^3 and 1 x 3,000 m^3). The treated water is then distributed to consumers through the distribution network, being pumped at various pressure levels through the pumping station, repumping and hydrophore.

The company goal was and is to obtain drinking water (which corresponds from a physico-chemical and bacteriological point of view to Government Ordinance 7/2023 and Government Decision 971/2023 [7] [8], transposing into national law Directive 2184/2020[5])

Particular attention was paid to equipping the laboratories for physical-chemical and bacteriological analyses. At the moment, they are equipped to the standards, at the laboratory in Călărași, the attestation being renewed by the Ministry of Health through the registration certificate no. 341 of 04.12.2018 and there is also an ERA laboratory competence attestation certificate (laboratory competence scheme company).

The laboratory is equipped with: Centrifuge-ROTOFIX 32 A; Thermoreactor CR 4200; NABERTHERM calcination furnace; Pharo UV/VIS spectrophotometer; Raypa water bath; Laboratory oven POL-ECO; Thermoreactor COD ECO 6-Velp; Kjeldal-Velp apparatus - Digestive system (Neutralization unit, distillation unit, gas

suction pump); pH-meter Vario; Incubator POL-ECO; Raypa sand bath; Sampler PB-6-1 (mobile); Cyclon type bidistillator; Autoclave Raypa; Analytical balance Kern ABT; Talassi chemical hood; Atomic absorption spectrophotometer NOVA 400; pHoto Flex portable photometer.

In this paper, we aimed to study the quality of water supplied to Călărași municipality by the company ECOAQUA SA in 2023, comparing the physico-chemical parameters evaluated in the analysis reports carried out: pH, turbidity, free residual chlorine, nitrates, total hardness and the aluminum. For this purpose, the raw and drinking water analysis reports were analyzed. (The values of the analyzed parameters represent the arithmetic mean of the parameters in the daily analysis bulletins of the respective month). The values of the drinking water parameters were compared with the maximum permissible limits stipulated by the legislation in force, in order to be able to observe possible deviations, which could affect the quality of the water and, consequently, the health of its consumers.

RESULTS AND DISCUSSIONS

In 2023, the main indicators of the quality of raw and drinking water recorded the following average monthly values:

The hydrogen potential of water, known as **pH**, indicates how acidic or basic it is. The closer the water is to 7, the more beneficial it is considered for human health and consumption [16].

In accordance with the provisions Government Ordinance 7/2023 and Government Decision 971/2023, the pH level of drinking water should be in a recommended range between 6.5 and 9.5, according to established legal standards [7] [8].

The tests were conducted based on the national standard SR EN ISO 10523:2012[4].

Table 1. Value of pH in raw water and drinking water in 2023 - Călărași Treatment Plant

Month	Value of raw water pH (Unit)	Value of drinking water pH (Unit)	Admited limit (Unit)
JAN.	7.92	7.457	6.5-9.5
FEB.	7.96	7.452	6.5-9.5
MAR.	7.929	7.451	6.5-9.5
APR.	8.03	7.565	6.5-9.5
MAY.	7.93	7.490	6.5-9.5
JUNE.	7.359	7.334	6.5-9.5
JULY.	8.268	7.429	6.5-9.5
AUG.	8.137	7.479	6.5-9.5
SEP.	8.18	7.531	6.5-9.5
OCT.	8.11	7.504	6.5-9.5
NOV.	8.10	7.648	6.5-9.5
DEC.	8.163	7.744	6.5-9.5

Source: According to analysis bulletin provided by the company [4].

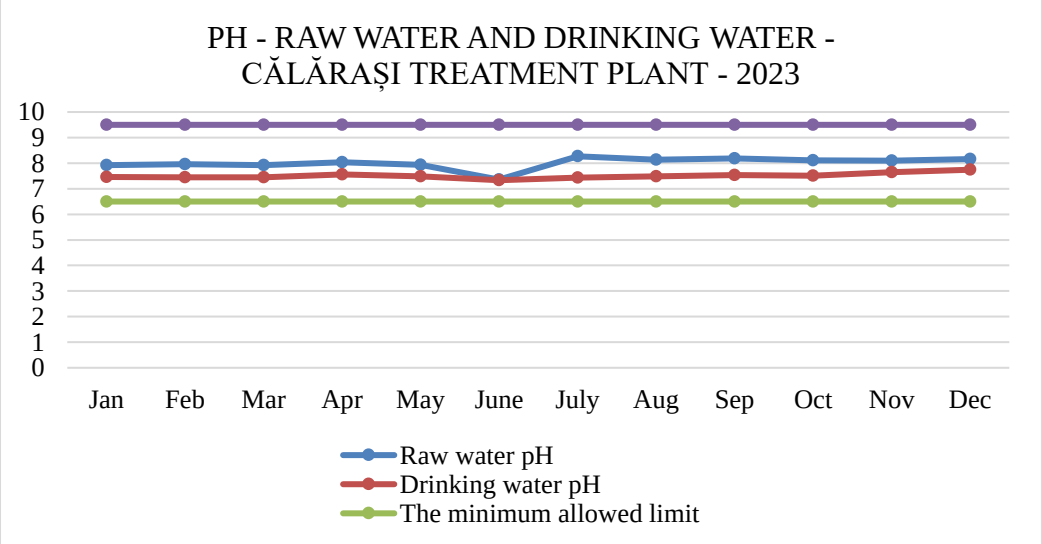

Fig. 1. Variation of pH of raw water and drinking water in 2023- Călărași Treatment Plant
Source: Elaborated by authors in accordance with the analysis bulletins.

Figure 1 shows that the raw water has a pH between 7 and 8. It is observed that in 7 of the 12 months the values are over 8 Units, the highest recorded being 8.268 Units in July, while that in the other 5 months the values are below 8 Units, the lowest being registered in June, with a value of 7.359 Units.

Water leaving the treatment plant has a pH between 7 and 8 Units, without ever exceeding this limit.

The highest value is recorded in December, with 7.744 Units, and the lowest in June, with 7.334 Units.

Analyzing the data, we notice that the treated water has an average value of 79% of the legal limit allowed.

After treatment, the pH value approaches the neutral value of 7, making it safe for human consumption.

Turbidity is a physical-chemical property that measures the level of water clarity, it shows how cloudy or opaque the water is due to the presence of suspended particles in it. The level of particles in water directly influences the level of turbidity in that water: the higher the number of particles, the higher the turbidity of the water [17]. Water turbidity is determined using an electronic turbidimeter and is expressed in NTU.

In accordance with the provisions of Government Ordinance 7/2023 and Government Decision 971/2023, the maximum limit admitted for turbidity of drinking water is 1NTU [7] [8].

The tests were carried out based on national standard SR EN ISO 7027/2001 [4].

Table 2. Value of Turbidity in raw water and drinking water in 2023 - Călărași Treatment Plant

Month	Value of raw water (NTU)	Value of drinking water (NTU)	Admitted limit (NTU)
JAN.	38.5	0.17	1
FEB.	44.625	0.19	1
MAR.	20.68	0.17	1
APR.	29.08	0.162	1
MAY.	22.18	0.142	1
JUNE.	45.36	0.155	1
JULY.	21.39	0.14	1
AUG.	28.03	0.135	1
SEP.	12.9	0.152	1
OCT.	9.21	0.163	1
NOV.	26.89	0.164	1
DEC.	40.79	0.15	1

Source: According to analysis bulletins provided by the company [4].

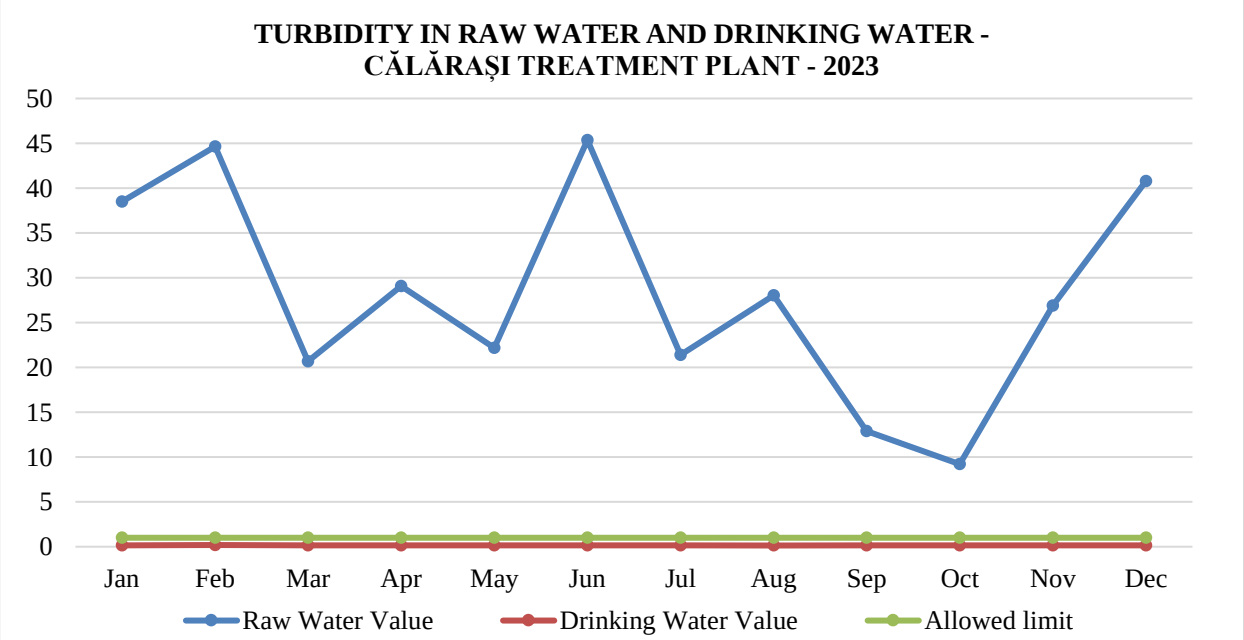

Fig. 2. Variation of Turbidity in raw water and drinking water in 2023 - Călărași Treatment Plant
Source: Elaborated by authors in accordance with the analysis bulletins.

In Figure 2, raw water has the highest turbidity of 45.36 NTU in June, and the lowest value of 9.21 NTU in October. The largest difference in raw water turbidity is observed between June and July, a difference of 23.97 NTU. The water leaving the

treatment plant has a turbidity between 0 and 1 NTU, never exceeding the legal limit.
The highest value is recorded in February, with 0.19 NTU, and the lowest in August, with 0.135 NTU. Analyzing the data, we notice that the treated water has an average value of 16% of the legal limit allowed.
Following its treatment, the turbidity values are greatly reduced, making it safe for the population.
Free residual chlorine is a physico-chemical element that remains in the water following the water disinfection process and has the role of destroying the existing microorganisms in the water and reducing the spread of diseases caused by them [19]. This process takes place in the chlorination plant and is carried out using the automatic liquefied chlorine gas plant. Disinfection is done before water pretreatment, as well as before the storage station.
In accordance with the provisions of Government Ordinance 7/2023 and Government Decision 971/2023, the maximum limit allowed for the amount of free residual chlorine in drinking water must not exceed 0.5 mg/l [7] [8].
The tests were carried out based on national standard SR EN ISO 7393-2/2018 [4].

Table 3. Value of Free Residual Chlorine in drinking water in 2023 - Călărași Treatment Plant

Month	Value of drinking water (mg/l)	Admitted limit (mg/l)	Exceedances of maximum allowable limits for drinking water (%)
JAN.	0.52	0.5	4%
FEB.	0.51	0.5	2%
MAR.	0.53	0.5	6%
APR.	0.45	0.5	0%
MAY.	0.44	0.5	0%
JUNE.	0.39	0.5	0%
JULY.	0.42	0.5	0%
AUG.	0.46	0.5	0%
SEP.	0.43	0.5	0%
OCT.	0.48	0.5	0%
NOV.	0.61	0.5	22%
DEC.	0.49	0.5	0%

Source: According to analysis bulletin provided by the company [4].

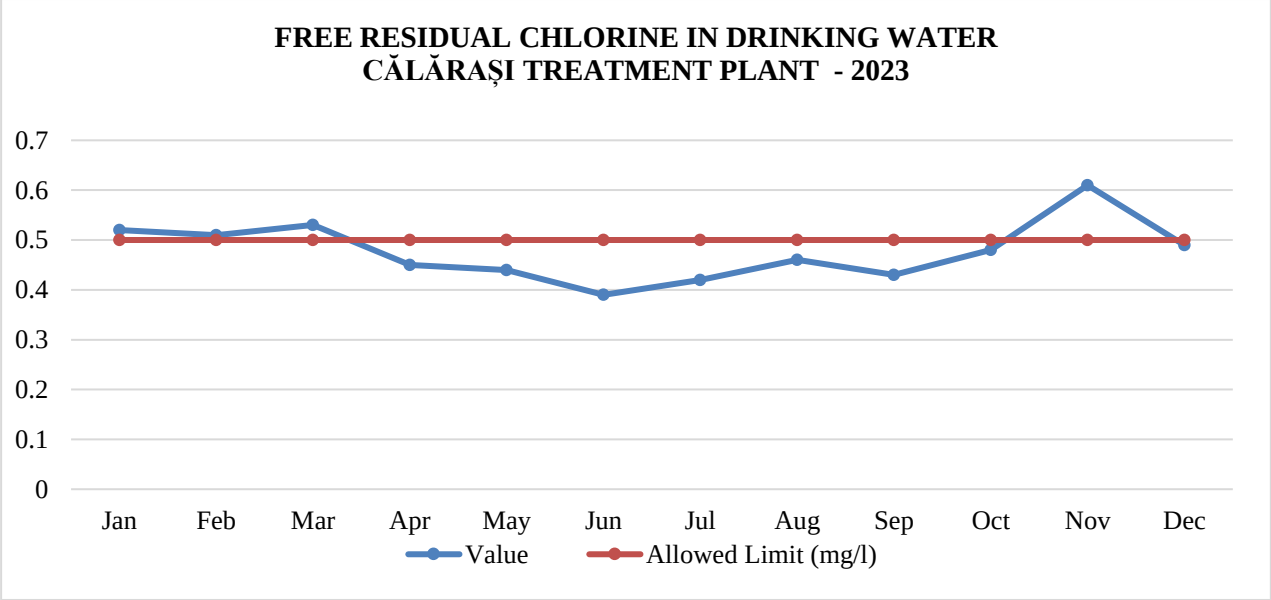

Fig. 3. Variation of Free Residual Chlorine in drinking water in 2023 - Călărași Treatment Plant
Source: Elaborated by authors in accordance with the analysis bulletins.

In Figure 3, the water at the exit from the treatment plant has a free residual chlorine level between 0.39 mg/l and 0.61 mg/l, exceeding in 4 of the 12 months the allowed legal limit. The highest value is recorded in November, with 0.61 mg/l, i.e. approximately 22% more than the legal limit, and the lowest value in June, with 0.39 mg/l, approximately 78% of the legal limit. The exceedance may be due to the use of a larger amount of liquefied chlorine gas in the water disinfection process, probably caused by the higher flow of the Danube. The same has been observed by other authors [3].

Residual chlorine can react with organic matter in water, forming disinfection by-products such as trihalomethanes and haloacetic acids. In high concentrations, these substances can cause liver problems, kidney issues, and bladder cancer [3].

We observe that in the other eight months of the year even if legal limits are sometimes exceeded, the quality of the water is ensured following the disinfection process, making it safe for consumption.

Nitrites can appear in water from various sources, such as: decay of organic matter, erosion of rocks and soils, nitrogen oxidation processes, industrial pollution and agricultural pollution through excessive use of nitrogen [22]. A high concentration can affect the taste and smell of drinking water.

Drinking water with nitrites leads to serious health problems, such as: acute or chronic poisoning, difficulty breathing, increased risk of heart disease and stroke. However, the most serious is infantile methemoglobinemia or "blue baby disease", as it is also known by the population. This disease affects the blood ability to carry oxygen throughout the body [6].

In accordance with the provisions of Government Ordinance 7/2023 and Government Decision 971/2023, the maximum allowed limit for the amount of nitrites in drinking water must not exceed 0.5 mg/l [7] [8].

The tests were performed based on the standard SR EN ISO 26777:2002.

Table 4. Value of Nitrites in raw water and drinking water in 2023 - Călărași Treatment Plant

Month	Value of raw water (mg/l)	Value of drinking water (mg/l)	Admitted limit (mg/l)
JAN.	0.057	0	0.5
FEB.	0.066	0	0.5
MAR.	0.068	0	0.5
APR.	0.055	0	0.5
MAY.	0.053	0	0.5
JUNE.	0.048	0	0.5
JULY.	0.051	0	0.5
AUG.	0.042	0	0.5
SEP.	0.043	0	0.5
OCT.	0.046	0	0.5
NOV.	0.061	0	0.5
DEC.	0.053	0	0.5

Source: According to analysis bulletin provided by the company [4].

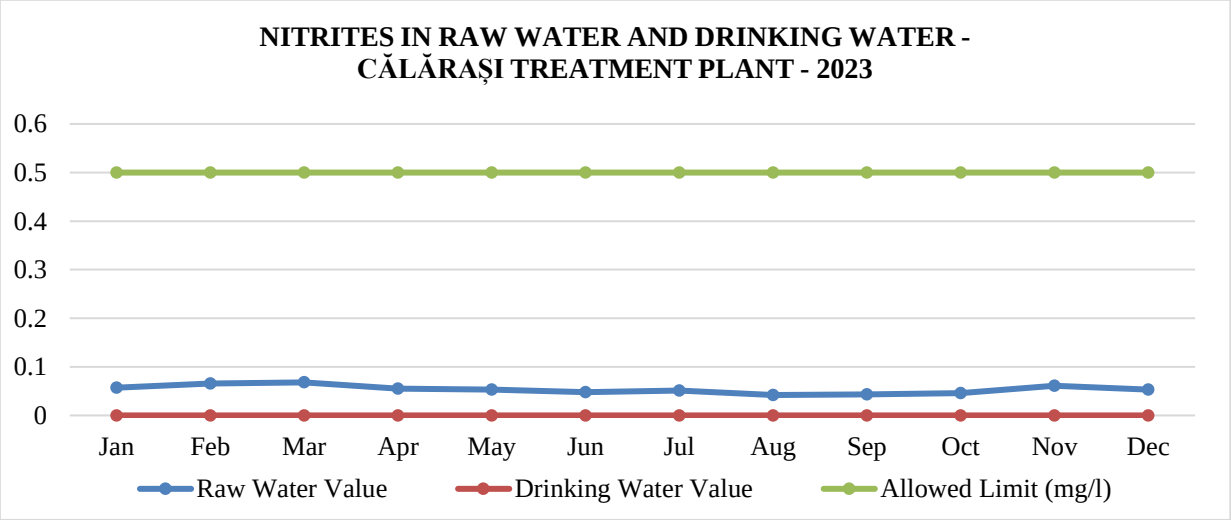

Fig. 4. Variation of Nitrites in raw water and drinking water in 2023 - Călărași Treatment Plant
Source: Elaborated by authors in accordance with the analysis bulletins.

In Figure 4., the raw water has a nitrite level between 0.042 mg/l and 0.068 mg/l. The highest amount of nitrites is 0.068 mg/l in March, and the lowest value is 0.042 mg/l in August. The biggest difference in raw water nitrites is observed between October and November, where the difference is 0.015 mg/l. The water leaving the treatment plant has a constant nitrite level of 0 mg/l.

Total water hardness is a physical-chemical property that determines the total amount of calcium and magnesium salts dissolved in

drinking water. Total hardness includes both permanent hardness, represented by soluble calcium and magnesium salts, and temporary hardness, represented by calcium and magnesium bicarbonates [15]. These salts, mainly carbonates and bicarbonates, give water a specific property of forming solid deposits or causing precipitation of salts when the water is heated or chemically treated [20]. Because of this, limescale deposits form in pipes, boilers and other household appliances. The greater the amount of salts, the greater its hardness.

On the other hand, water hardness can also have health benefits by providing additional calcium and magnesium in the diet.

However, they can affect the skin and in exceptional cases can lead to heart disease or stroke [21].

In accordance with the provisions of Government Ordinance 7/2023 and Government Decision 971/2023, no maximum limit is provided, but it is provided as the minimum permitted limit of drinking water hardness which must be 5 German degrees [7] [8].

The tests were conducted based on the national standard SR ISO 6059/2008 [4].

Table 5. Value of Total Hardness of raw water and drinking water in 2023 - Călărași treatment Plant

Month	Value of raw water (°G)	Value of drinking water (°G)	Minimum admitted limit (°G)
JAN.	10.294	10.143	5
FEB.	10.279	10.108	5
MAR.	10.2	10.142	5
APR.	10.25	10.017	5
MAY.	10.372	10.117	5
JUNE.	9.881	10.093	5
JULY.	10.044	9.876	5
AUG.	9.376	9.416	5
SEP.	9.372	10.041	5
OCT.	10.639	10.128	5
NOV.	11.058	10.926	5
DEC.	10.368	10.144	5

Source: According to analysis bulletin provided by the company [4].

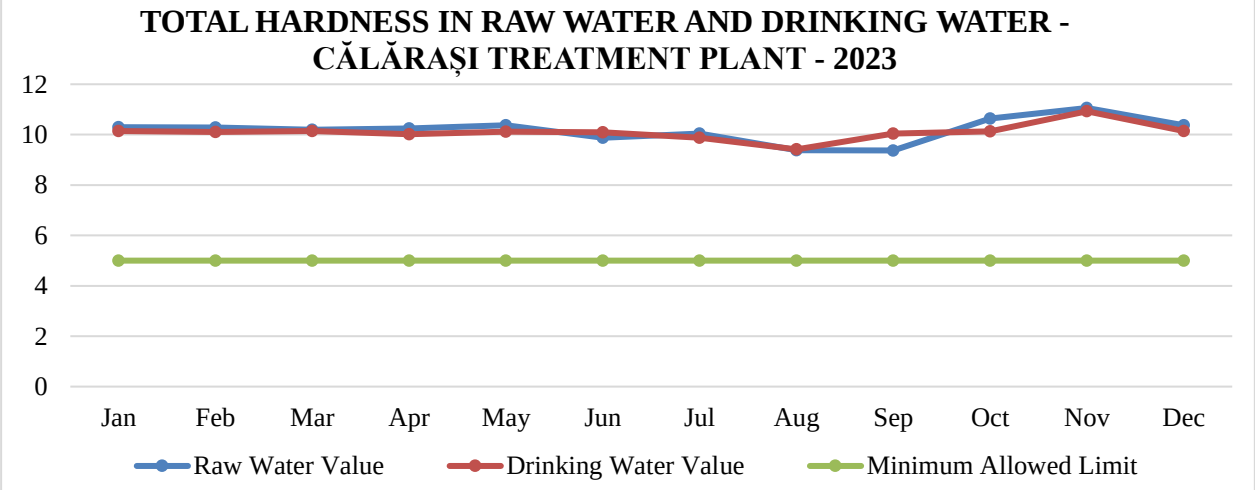

Fig. 5. Variation of Total Hardness in raw water and drinking water in 2023 - Călărași Treatment Plant
Source: Elaborated by authors in accordance with the analysis bulletins.

In Figure 5, we can see that raw water has a total hardness between 11.058°G in November and 9.372°G in September. The largest difference in hardness is found between September and October, which is 1.267°G.

The highest value of drinking water hardness is recorded in November, with 10.926°G, and the lowest value is observed in August, with a value of 9.416°G. Analyzing the data, we notice that the treated water has double values compared to the minimum allowed value, which shows a high content of salts, indicating a semi-hard water.

The semi-hard drinking water observed from analysis brings us essential minerals in the body (calcium, magnesium) but for those prone to kidney stones, it can bring possible deposits of limescale in the body (the risk is not as high as for hard water). The semi-hard drinking water observed from analysis brings us essential minerals in the body (calcium,

magnesium) but for those prone to kidney stones, it can lead to possible limescale deposits in the body (the risk is not as high as for hard water). Despite these small risks, it is within legal limits.

Aluminum is an essential nutrient for the human body. It is found in drinking water as suspended particles or dissolved form. Aluminum can end up in water following drinking water treatment. In small amounts, aluminum is necessary for the body, for example, aluminum is a necessary cofactor for the activity of some enzymes involved in energy metabolism and the formation of neurotransmitters. However, in large quantities, aluminum has negative effects on human health, for example: neurological toxicity, kidney disease and involvement in the development of serious diseases such as Parkinson's and Alzheimer's [23].

The World Health Organization recommends a maximum aluminum level of 200 µg/l in drinking water [3]. In accordance with the provisions of Government Ordinance 7/2023 and Government Decision 971/2023 [7] [8], the maximum allowed limit for aluminum in drinking water must not exceed 200µg/l.

The tests were conducted based on the national standard SR EN ISO 12020:2008 [4].

As we can see in Figure 6, the highest value of aluminum in raw water is 67.93 µg/l in January, and the lowest value being 36.66 µg/l in December. The biggest difference in the aluminum level is found between the months of November and December, which is 9.59 µg/l.

Table 6. Value of Aluminum in raw water and drinking water in 2023 - Călărași Treatment Plant

Month	Value of raw water (µg/l)	Value of drinking water (µg/l)	Admitted limit (µg/l)
JAN.	67.93	170.05	200
FEB.	69	85.662	200
MAR.	56.65	84.936	200
APR.	50.37	119.818	200
MAY.	49.18	136.32	200
JUNE.	48	148.1	200
JULY.	39.8	194.98	200
AUG.	56.93	184.5	200
SEP.	50	189.8	200
OCT.	48.75	185.5	200
NOV.	46.25	164.025	200
DEC.	36.66	140.4	200

Source: According to analysis bulletin provided by the company [4].

The highest value of aluminum in drinking water is recorded in July, with 194.98 µg/l, and the lowest value is observed in March, with a value of 84.936 µg/l. Analyzing the data, we notice that the water leaving the station has a higher aluminum level than the raw one, and these increased values can be explained by the fact that aluminum polyhydroxychloride is used in the treatment station. However, it is observed that the treated water has an average value of 75% of the legal limit allowed.

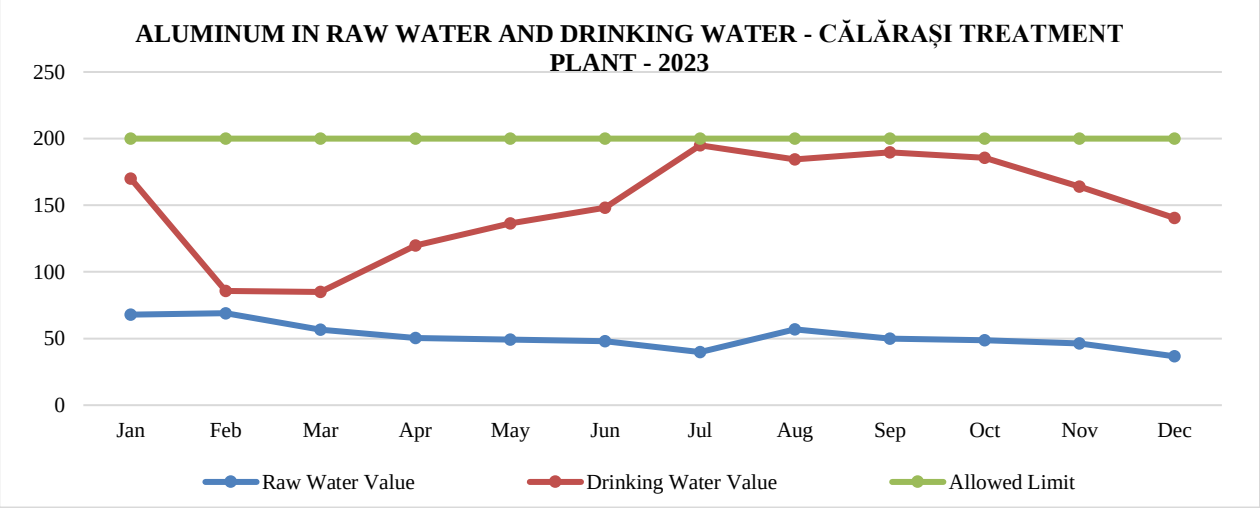

Fig. 6. Variation of Aluminum in raw water and drinking water in 2023 - Călărași Treatment Plant
Source: Elaborated by authors in accordance with the analysis bulletins.

CONCLUSIONS

The purpose of the case study carried out in this work was to evaluate the quality of water from the water network of the Călăraşi municipality in the year 2023, by comparing the main physico-chemical parameters of the raw water and the water at the exit from the Călăraşi Treatment Plant. The water treatment process is an efficient one, this can also be seen from the graphic representation of the monthly variation of the 6 analyzed parameters.

The physico-chemical parameters monitored were: pH, turbidity, free residual chlorine, nitrites, total hardness and aluminum. The analysis bulletins were provided by the company EcoAqua SA, and the analyzes carried out in accordance with the national standards imposed by law.

Following the analysis of the evolution of the physico-chemical parameters presented previously, we can draw the following conclusions:

• In 2023, the pH level of the water leaving the station was below the maximum limit allowed by law, and after the treatment, the pH is quite close to the neutral value of 7.

• Water turbidity after treatment reaches values between 13-19% of the maximum allowed value.

• Free residual chlorine, even if in some months it exceeds the legal limit, does not affect too much the health of consumers in the respective doses.

• Nitrites found in raw water are completely removed following the water treatment process.

• When we talk about hardness there is no maximum value, but a minimum one (50^0G). The treated water is between 9-11^0G, classifying it as a semi-hard water.

• Aluminum is the only one that increases a lot after treatment, increasing even 4 times, reaching several times close to the legal limit allowed.

In conclusion, all parameters are below the legal limits, which makes the water safe for human consumption. The only exception is free residual chlorine, which in January, February, March and November slightly exceeds legal limits. However, this does not affect the health of consumers. Even though free residual chlorine can be carcinogenic and toxic in large amounts, the use of chlorine is essential in the disinfection process. It plays an important role in reducing microorganisms present in water, which can transmit disease. The taste of water can be slightly altered by the level of chlorine in the water, making it taste slightly medicinal.

In order to improve the quality of drinking water offered by EcoAqua S.A., we can suggest the following recommendations:

- Adjusting the chlorine dose: it is very important to find a balance between disinfection efficiency and residual chlorine concentration.

-Applying chlorine at another stage of the treatment process, usually after clarification and filtration, reduces the amount of chlorine needed, thus reducing the contact of chlorine with organic matter, which reduces the formation of disinfection by-products.

-Advanced techniques such as coagulation, flocculation and filtration can significantly reduce the amount of organic matter, thus decreasing chlorination requirements.

-Activated carbon filters can be used at the treatment stage to reduce the concentration of free chlorine and chloramines prior to water distribution.

-Chemical neutralization in the distribution network: agents such as sodium thiosulphate or vitamin C can be used to neutralize excess chlorine in treated water prior to distribution to consumers.

-Introduction of alternative disinfection methods: ozonation or the use of UV radiation.

-Reduced retention time in the distribution system (e.g. optimizing water circulation in tanks and pipes).

REFERENCES

[1]Berca, M., 1998a, Strategies for environment protection and resources management, Grand Publishing House, p. 23.

[2]Berca, M., 1998b, Theory of environment management and natural resources, Grand Publishing House, p. 45.

[3]Cirtina, D., Capatina, C., 2017, Assessment of Drinking Water Quality of Targu Jiu City by Analyzing Physical and Chemical Quality Parameters, Rev. Chim (Bucharest), 68(3), 439-446.
https://doi.org/10.37358/RC.17.3.5473
[4]EcoAqua S.A. Călărași. Internal documents of the company.
[5]EU Parliament and Council Directive 2184/16 Dec. 2020 on the quality of water intended for human consumption
[6]Environment Protection Agency, Calarasi. Report on the state of the environment factors in Călăraşi in 2023. www.apmcl.ro, Accessed on Sept. 1, 2024.
[7] Government Ordinance 7/2023
[8]Government Decision 971/2023
[9]Hill, J.W., Mccreary, T.W., Kolb, K. D., 2015, Chemistry for Changing Times, Pearson Publishing House, p. 499.
[10]Howe, J. K., Hand, W. D., Crittenden, C. J., Trussell, R. R., 2012, Tchobanglous George, Principles of Water Treatment, John Wiley & Sons Publishing House, p. 30.
[11]Ianculescu, O., Ionescu, G., 2002, Water supply, Matrix Rom Publishing House, Bucharest, p. 214.
[12]Iova, R. A., Neagu, C., Crețu, D., 2021, Case Study Regarding the Variation of the Qualitative Parameters of Wastewater, Chemistry magazine, Vol. 72(2), 1-8, https://doi.org/10.37358/RC.21.2.8414.
[13]Lacoste, Y., 2003, Water - flight for life, RAO Publishing House.
[14]Munteanu, C., Dumitrescu, M., Iliuta, A., 2011, Ecology and environment quality protection, Balneară Publishing House, p. 37.
[15]Negulescu, M., Antoniu, R., Rusu, G., Cușa, E., 1982, Protection of water quality, Technical Publishing House, Bucharest, p. 200.
[16]Obilonu, A. N., Chijioke, C., Igwegbe, W.E., Ibearugbulem, O.I., Abubakar, Y.F., 2013, Water quality challenges and impact. International Letters of Natural Sciences Vol. 4, pp. 46-47.
[17]Pișota, I., Zaharia, L., Diaconu, D., 2005, Hydrology, University Publishing House, Bucharest.
[18]Qadir, M., Oster, J.D., 2004, Crop and Irrigation Management Strategies for Salinesodic Soils and Waters Aimed at Environmentally Sustainable Agriculture. Science of the Total Environment, Vol. 323, pp. 1-19.
http://dx.doi.org/10.1016/j.scitotenv.2003.10.012
[19]Rojanschi, V., Bran, F., Diaconu, G., 2002, Environment protection and engineering, Second edition, Economic Publishing House.
[20]Stelian, M., Țăgorean, P., 2009, Environment protection in the European Union, Detective Publishing House, p.25.
[21]Stingaciu, E., Simonescu, C.M., 2009, Surveilance and control of natural water quality, Matrix Rom Publishing House, p. 57.
[22]Teodosiul, C., 2001, Technology of drinking and industrial water, Matrix Rom Publishing House, p. 143.
[23]Vișan, S., Angelescu, A., Alpopi, C., 2000, Environment Polution and protection, Economic Publishing House, p. 32.