Journal of Young Scientist, Volume X, 2023
ISSN 2344 - 1283; ISSN CD-ROM 2344 - 1291; ISSN Online 2344 - 1305; ISSN-L 2344 – 1283

WATER QUALITY MONITORING FROM THE PRIVATE WELL

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Abstract

Mismanagement of drinking water supplies can pose serious public health risks. There are many concerns about water source management among private well owners, as they are often solely responsible for maintaining their wells, and monitoring and testing of their own water quality. Lack of worry about contamination and a strong sense of control over risks in relation to drinking water quality have been identified as important factors that influence peoples' perceptions and behaviour.

The most effective way to check water supplies for faecal contamination is microbiological analysis, and a range of test methods designed for that purpose has been developed for the water analysis. Instead of carrying out separate tests for each of the potential pathogens, viruses, or parasites that might be in the water, microbiologists test for indicator organisms that are always present when enteric pathogens and viruses are.

Defined substrate technology (DST) developed by IDEXX can produce results in 24 hours. The IDEXX Colilert uses a colourimetric ONPG assay to detect coliforms and a fluorescence MUG assay for E. coli. Colilert can simultaneously detect these bacteria within 18-24 hours. It can also suppress 2 million heterotrophic bacteria per 100 mL present. As of 2014, this technology from IDEXX has been published as a European Standard Method, and many countries now use this technology as their gold standard for water testing like Finland and Ireland. The Enterolert Test from IDEXX uses a proprietary Defined Substrate Technology (DST) nutrient indicator to detect enterococci. This nutrient indicator fluoresces when metabolized by enterococci. DST improves accuracy and avoids the need for hazardous sodium azide suppressants used in traditional media.

In order to achieve the proposed goal, the groundwater sample taken from a family from Tamasi, Corbeanca commune, Ilfov county was analyzed in the laboratory of Ecology and Environmental Microbiology, F.I.F.I.M., U.S.A.M.V. Bucharest from an organoleptic, physicochemical and microbiological point of view.

The groundwater sample from a private well was taken from the kitchen cold tap water of a family in a sterile glass container for organoleptic, physicochemical and microbiological analyses. The underground water from the private well comes from a depth of 120 m and the drilling is located in Tamasi, Corbeanca commune, Ilfov county. The groundwater sample was transported in a refrigerated box to the laboratory of Ecology and Environmental Microbiology within the Faculty of Land Reclamation and Environmental Engineering within the U.S.A.M.V. Bucharest. The experiments performed and presented in this paper represent a part of the studies performed for the bachelor's thesis.

All analyzes for water quality (colour, taste, smell, pH, turbidity, ammonia, nitrites and nitrates) from the private well fall within the maximum limits allowed by the standards in our country, except for the concentration of water hardness that exceeded the limits allowed. Microbiological analyzes for the detection of faecal contamination of the water sample using classic methods and IDEXX defined substrate technology confirmed the absence of coliform indicator bacteria. The recommendation for bringing the water hardness to optimal parameters and falling within the water quality standards was to install a water softening station.

Key words: *organoleptic, physicochemical and microbiological analyses, private well, water quality monitoring*

INTRODUCTION

Mismanagement of drinking water supplies can pose serious public health risks.

There are many concerns about water source management among private well owners, as they are often solely responsible for maintaining their wells, and monitoring and testing of their own water quality.

Lack of worry about contamination and a strong sense of control over risks in relation to drinking water quality have been identified as important factors that influence peoples' perceptions and behaviour.
The most effective way to check water supplies for faecal contamination is microbiological analysis, and a range of test methods designed for that purpose has been developed for the water analysis.
Instead of carrying out separate tests for each of the potential pathogens, viruses, or parasites that might be in the water, microbiologists test for indicator organisms that are always present when enteric pathogens and viruses are.

MATERIAL AND METHODS

In order to achieve the proposed goal, the groundwater sample taken from a family from Tamasi (Sârbu family), Corbeanca commune, Ilfov county was analyzed in the laboratory of Ecology and Environmental Microbiology, F.I.F.I.M., U.S.A.M.V. Bucharest from an organoleptic, physicochemical and microbiological point of view.
The groundwater sample from a private well was taken from the kitchen cold tap water of a family in a sterile glass container for organoleptic, physicochemical and microbiological analyses.
The underground water from the private well comes from a depth of 120 m and the drilling is located in Tamasi, Corbeanca commune, Ilfov county.
The groundwater sample was transported in a refrigerated box to the laboratory of Ecology and Environmental Microbiology within the Faculty of Land Reclamation and Environmental Engineering within the U.S.A.M.V. Bucharest.
The experiments performed and presented in this paper represent a part of the studies performed for the bachelor's thesis.

HI-3824 AMMONIA TEST KIT FOR FRESH WATER

The Hanna HI 3824 chemical test kit is designed to measure concentrations of ammonia in rivers and drinking water reservoirs which indicates the presence of agriculture or urban pollution.
When the concentration of ammonia is high enough, it can alter the smell and taste of water. In industrial applications, high concentrations of ammonia can cause corrosion in pipes.

HI-3874 NITRATE TEST KIT

Nitrate ions are present in trace amounts in surface water and in higher levels in some groundwater. Nitrate is found only in small quantities in domestic wastewater but can reach higher concentration (up to 30 mg/L as nitrogen) in the outflow of nitrifying biological treatment plants.

HI-93708-01 NITRITE HIGH RANGE REAGENT, FERROUS SULPHATE METHOD

The HI-93708-01 are high quality reagents that are pre-measured, allowing for users to achieve fast and accurate colorimetric measurements. These reagents follow an adaptation of the Ferrous Sulphate method in which the reaction between nitrite and the reagent causes a colour change in the sample.
The concentration will be displayed in mg/L (ppm) of nitrite. These reagents are designed to be used with samples that have an expected range of 0 to 150 mg/L nitrite.

HI-38033-100 HARDNESS, TOTAL, EDTA METHOD

Titration is used to find the concentration of an identified chemical in a solution (e.g., water).
Significance and use
Water hardness has traditionally been defined as the capacity of water to precipitate soap.
The ionic species in water causing the precipitation were later found to be primarily calcium and magnesium.
At the present time, water hardness is a quantitative measure of these ions in the water sample.
Now it is also known that certain other ion species, such as iron, zinc and manganese, contribute to the overall hardness of water.
The measure and subsequent control of water hardness is essential to prevent scaling and clogging in water pipes.
1 gpg (grains per gallon) $CaCO_3$ is equivalent to 17 ppm $CaCO_3$ (where ppm - parts per million - is equivalent to mg/L).
Chemical Reaction

The hardness level as gpg calcium carbonate (CaCO3) is determined by an EDTA (ethylene-diamine-tetraacetic acid) titration. The solution is first adjusted to a pH of 10 using a buffer solution. The indicator chelates with metal ions such as magnesium or calcium to form a red colored complex. As EDTA is added, metal ions complex with it. After all the free metal ions have been complexed, an excess EDTA removes the metal ions complexed with the indicator to form a blue colored solution. This color change from red to blue is the endpoint of the titration.

IDEXX Colilert-18®

Colilert simultaneously detects total coliforms and E. coli in water. It is based on IDEXX's proprietary Defined Substrate Technology.

When total coliforms metabolize Colilert's DST nutrient-indicator, ONPG, the sample turns yellow.

When E. coli metabolize Colilert's DST nutrient-indicator, MUG, the sample also fluoresces.

Colilert can simultaneously detect these bacteria at 1 cfu/100 mL within 24 hours even with as many as 2 million heterotrophic bacteria per 100 mL present.

E. coli possesses the enzyme β-glucuronidase, which metabolizes MUG, releasing the 4-methyl-umbelliferyl dye.

This dye has the ability to fluoresce under long wave ultra-violet light (365 nm).

After incubating for 18 hours at 35°C, the samples were examined for fluorescence.

IDEXX Enterolert – E

Enterolert-E detects enterococci, such as E. faecium and E. faecalis, in ground water, fresh and marine water.

It is based on IDEXX's proprietary Defined Substrate Technology (DST).

When enterococci utilize their ß-glucosidase enzyme to metabolize Enterolert-E's nutrient-indicator, 4-methyl-umbelliferyl ß-D-glucoside, the sample fluoresces.

Enterolert-E detects enterococci at 1cfu per 100 mL sample within 24 hours.

RESULTS AND DISCUSSIONS

Organoleptic, physico-chemical indicators for ground water

Figure 1. pH &Turbidity

Table 1. Organoleptic, physico-chemical indicators of the ground water samples
(laboratory environmental conditions - T oC = 28 oC, humidity = 54%)

Indicator name	Test method	Maximum allowable values (see L 458/2002 republished in 2011)	Quantification limit	The determined values
Color	SR ISO 7887/2012	Acceptable to consumers and no abnormal change	-	White - yellowish
Smell	SR EN 1622/ 2007	Acceptable to consumers and no abnormal change	-	Acceptable to consumers and no abnormal change
Taste	SR EN 1622/ 2007	Acceptable to consumers and no abnormal change	-	Acceptable to consumers and no abnormal change
pH / Temperature	SR EN ISO 10523/ 2012	6,5 – 9,5 unit pH/oC	-	sample – 7,2 unit pH/ 28 oC
Turbidity	SR EN ISO 7027/2001	< 5 NTU	-	sample - 0,01 NTU

Classification in German degrees
This divides hard water into 4 categories:
slightly hard water - it is between 1 and 3.5 degrees;
moderate hard water - between 3.5 and 7 degrees;
water with increased hardness - between 7 and 15 degrees;
very hard water - over 15 degrees.

Classification in parts per million
This is done according to the amount of limestone (CaCO3, calcium carbonate) present in the water, depending on which there are 5 types of water:
softened water - the concentration of CaCO3 is below 17.5 parts per million;
low hardness water - CaCO3 between 17.5 and 60 ppm;
medium hardness water - CaCO3 between 60 and 120 ppm;
hard water - CaCO3 between 120 and 180 ppm;
very hard water - the concentration of CaCO3 is greater than 180 ppm.
One German degree is equivalent to 17.5 ppm.

AMMONIA TEST, NITRITE TEST and NITRATE TEST

Figure 2. Ammonia test, nitrite test and nitrate test

HARDNESS TEST

Figure 3. Hardness test

Defined substrate technology (DST) developed by IDEXX can produce results in 24 hours.
The IDEXX Colilert uses a colourimetric ONPG assay to detect coliforms and a fluorescence MUG assay for E. coli.
Colilert can simultaneously detect these bacteria within 18-24 hours.
It can also suppress 2 million heterotrophic bacteria per 100 mL present.
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This nutrient indicator fluoresces when metabolized by enterococci. DST improves accuracy and avoids the need for hazardous sodium azide suppressants used in traditional media.
As of 2014, this technology from IDEXX has been published as a European Standard Method, and many countries now use this technology as their gold standard for water testing like Finland and Ireland.

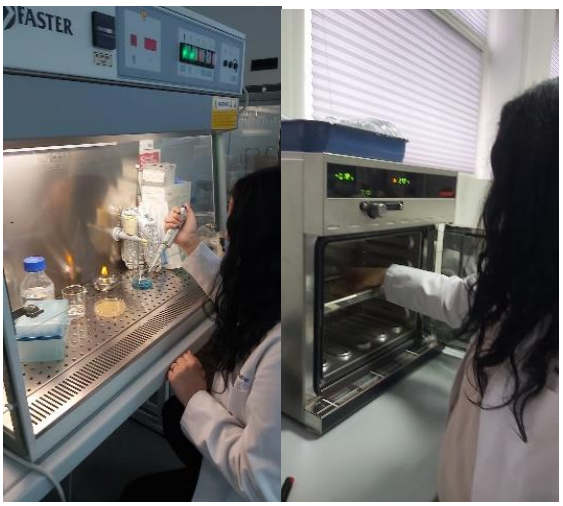

Figure 4. Microbiological indicators of the ground water

CONCLUSIONS

- All analyzes for water quality (colour, taste, smell, pH, turbidity, ammonia, nitrites and nitrates) from the private well fall within the maximum limits allowed by the standards in our country, except for the concentration of water hardness that exceeded the limits allowed.
- Microbiological analyzes for the detection of faecal contamination of the water sample using classic methods and IDEXX defined substrate technology confirmed the absence of coliform indicator bacteria.
- The recommendation for bringing the water hardness to optimal parameters and falling within the water quality standards was to install a water softening station.

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