RESULTS OF MICROBIOLOGICAL ANALYSIS OF SOME SURFACE AND UNDERGROUND WATER SAMPLES ALONG KHERLEN RIVER

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Abstract

The aim of this study is to assess the current level of pollution and to identify the main sources of pollution by analyzing the surface and deep well waters according to microbiological parameters used as drinking purposes surrounding the Kherlen basin. The analyzing points were selected from the location where the pollution level is high. Surface and underground water samples will be analyzed to the microbiological parameters according to the water regulations in Mongolia.

According to the results of 61 groundwater points along the Kherlen River, the maximum number of total number of coliforms were 80, the minimum was 0, and the average was 10.8 CFU. But for the total number of bacteria, the maximum was 91, the minimum is 0, and the average was 41.5 CFU. Salmonella spp was detected in 2 samples or 3.2%, while E.coli was not detected in all samples. The percentage of water that not meets the water demand were 31.1%. Microbiological test results show that surface water were not suitable for drinking purpose. If it is necessary to use filtering and boiling methods is recommended.

Keywords: *total bacteria, thermotolerant bacteria, Salmonella spp, E.coli*

Aims and objectives of the research work:

This study aims to assess the current level of surface and groundwater microbiological pollution by their microbiological safety parameters of the Kherlen river watershed and groundwater for drinking purposes, and to determine the main sources of pollution as well as how the central settlements affect the river. Within the framework of the above objectives, the following objectives have been set.

It includes:

- Establish sampling points for microbiological analysis of river and groundwater.
- Microbiological analysis and evaluation of river and groundwater samples taken from selected points will be conducted according to the standards in Mongolia.

Introduction

The Kherlen River originates from the Khan Khentii mountain range and flows through Khentii and Dornod provinces to the Khulun Lake in PRChina. The total length of the river is 1254 km, the river flow is 54 m^3/s, and the catchment area is 116,400 km^2. The river passes through several large central settlements: Baganuur, Pulganmort soum-Kherlenbayan-Ulaan soum, Bayanmunkh soum, Chinggis city, Bayan-Ovoo soum, Khulunbuir soum, Bayantumen soum, and Choibalsan city. In addition to the above, there are 20 settlements located near the river.

Cities and towns are often located along rivers, which is the main reason for river pollution (6). Not only cities, industrial waste water is a source of water pollution. Organic and inorganic pollutants contained in industrial waste water have a high probability of causing negative effects on the surface and groundwater environment, as well as risks to the environment, human and animal health (7). In addition to stream and groundwater samples, river sediments also contain a similar diversity of microorganisms (5). When the waste water is thrown into the river water in larger or smaller quantities, it enters the water environment and is constantly mixed and diluted, changing the water environment, while the sediment environment is relatively stable. In addition,

microorganisms in fresh water sediments are very susceptible to physical and chemical changes. The biological diversity of microorganisms and the physicochemical properties of water affect the normality of the water ecosystem. Microorganisms usually exist in aggregates on small particles in water and are the main driving force behind the self-purification process of rivers (3). Regarding the research materials on the Kherlen River, there are enough chemical research materials such as the annual reports of the Watershed Environmental Analysis Center and the results of research conducted by the researchers of the Institute of Geography and Geoecology, but there is a lack of information on detailed microbiological research.

For other countries, detailed studies related to microbial pollution of large rivers and streams, biological and chemical pollution, effects of industrial waste water on bacterial communities, relationship between rainfall and microbiological pollution of river water, and human health and quality safety have been carried out for a long time. (4, 5).

Total number of microorganisms (bacteria): Most of the microorganisms living in the environment are mesophilic (living at average temperature) and aerobic bacteria. It is a key indicator of the presence of microbial contamination in the sample. Because oxygen is necessary for the life process of bacteria to grow and multiply in the air, the oxygen content in water contaminated with microorganisms is low (Davaadorj, 2010).

Intestinal coliform bacteria: Short, 1-3 μm long, 0.6-0.8 μm wide, gram-negative, non-spore-forming, oxidase-inactive, bacilli. It does not reproduce in natural water, but it is preserved for a certain period of time. A high number of these bacteria indicates contamination with feces and recent contamination. Detect pink colonies growing on MacConkey medium. oxidase test by Gram method (Battsetseg, 2011, Davaadorj, 2010). It includes oxidase-negative, gram-negative, bacilli, and non-spore-forming bacteria that can be cultured in an incubator and thermostat at a temperature of 35-370C, in an aerobic and non-polar anaerobic, differential environment, which decomposes lactose into acid and gas.

E.coli: E.coli is a bacteria that regularly resides in the large intestine of humans and animals. Grows on endo agar medium forming shiny metallic colored colonies. These microorganisms are capable of growing and multiplying at high temperatures (Battsetseg, 2011, Davaadorj, 2010). Cultivate at 44-45^0 C, lactose intolerant, indole from tryptophan, methyl red positive, citrate only from carbon source.

Research materials and methods:

In the field research, water samples were collected from 21 points on the surface of Kherlen River and 38 points of deep water and analyzed according to microbiological indicators. The areas where the level of pollution is likely to be the highest, i.e. points located near cities and towns, were selected as risk points. For microbiological analysis, samples from each point were taken in a sterile 250 ml glass bottle, labeled and sealed after drying in a cabinet at 180°C for 2 hours. At fixed points, some microbiological parameters were measured in water samples using a portable instrument, and total bacteria count/airborne bacteria count, heat-resistant (Thermo-tolerant) enteric group bacteria, *E.coli*, enteric group pathogen *Salmonella* were enriched for 24-48 hours at 35°C in the laboratory, in respective selective media. 24-48 cultured at 35 degrees in the medium, and the results were based on morphological and biochemical analysis.

Used media for cultivation: NA (Nutrient agar), SS (Salmonella Shigella agar), MacConkey agar, Endo agar, E.coli broth, Peptone buffered water.

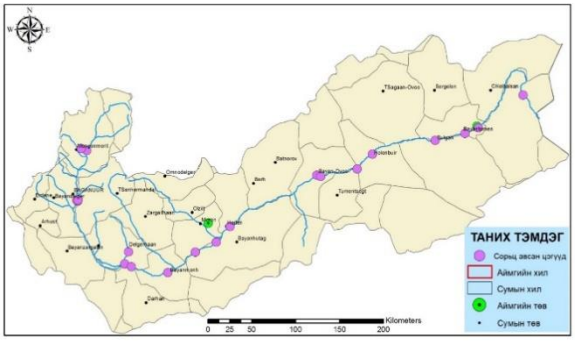

Figure 1. Location of surface water sampling points

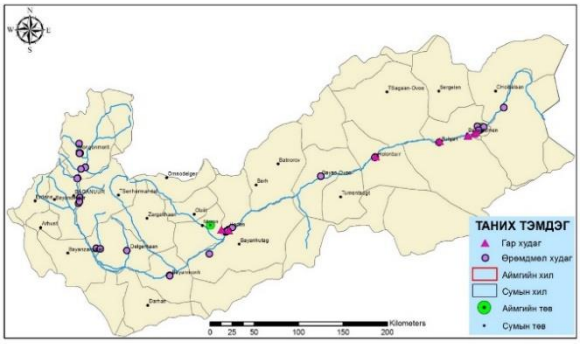

Figure 2. Location of groundwater sampling points /hand wells and drilled wells

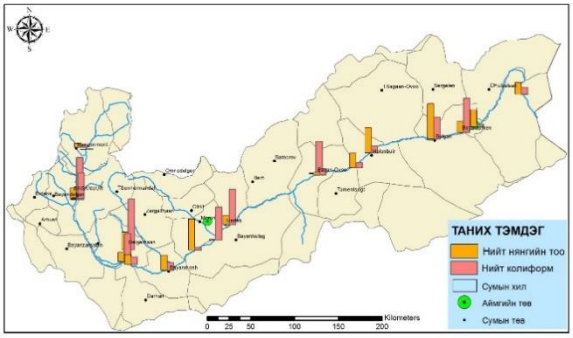

Figure 3. Results of total bacterial counts and total coliforms in surface water samples

Research result

According to the results of 20 points of the surface water of the Kherlen River, the total number of bacteria was 420 /100 ml/ at maximum and 1 for minimum, the average was 119.5, the total number of coliforms was 600 at max, and 5 at minimum, the average was 207. as well as *Salmonella* spp. and *E.coli*, which are pathogenic bacteria of the intestinal group, were not detected. According to the norms of sanitary classification of surface water, the total number of bacteria does not exceed 5*10^5, intestinal pathogenic bacteria should not be detected, but in the case of MNS 0900: 2018 drinking water requirements, it cannot be used for drinking water because it exceeds the parameters specified in the standard.

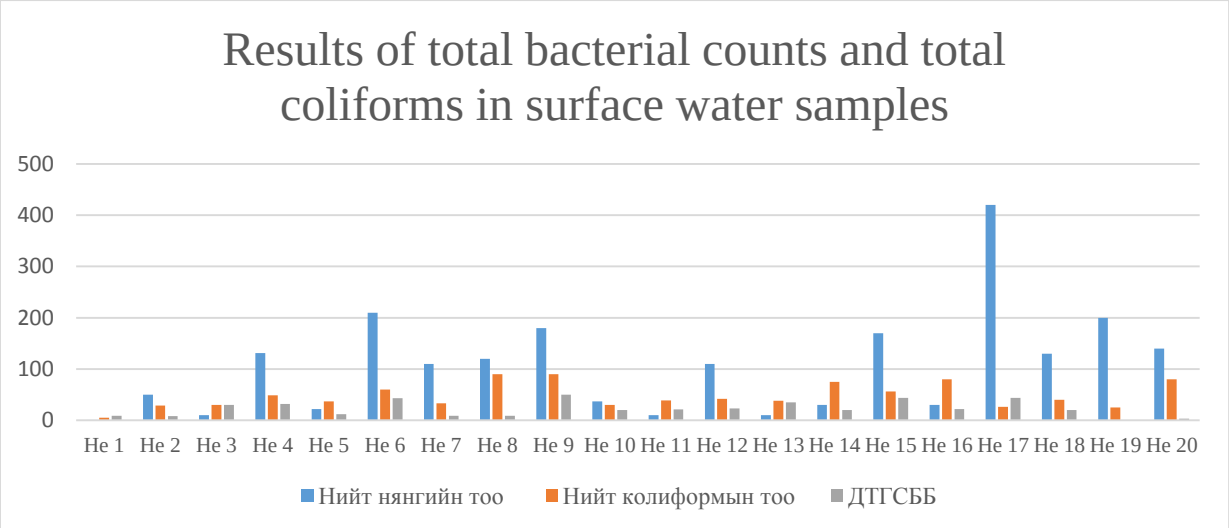

Figure 4. Levels of microbiological contamination of total surface water pointS

Explanation: From the 20 samples, 8 samples with up to 100 CFU or 40%, 9 samples with up to 200 or 45%, 2 samples or 10% with up to 300, and 1 or 0.5% with up to 500 CFU were found in 100 ml of water.

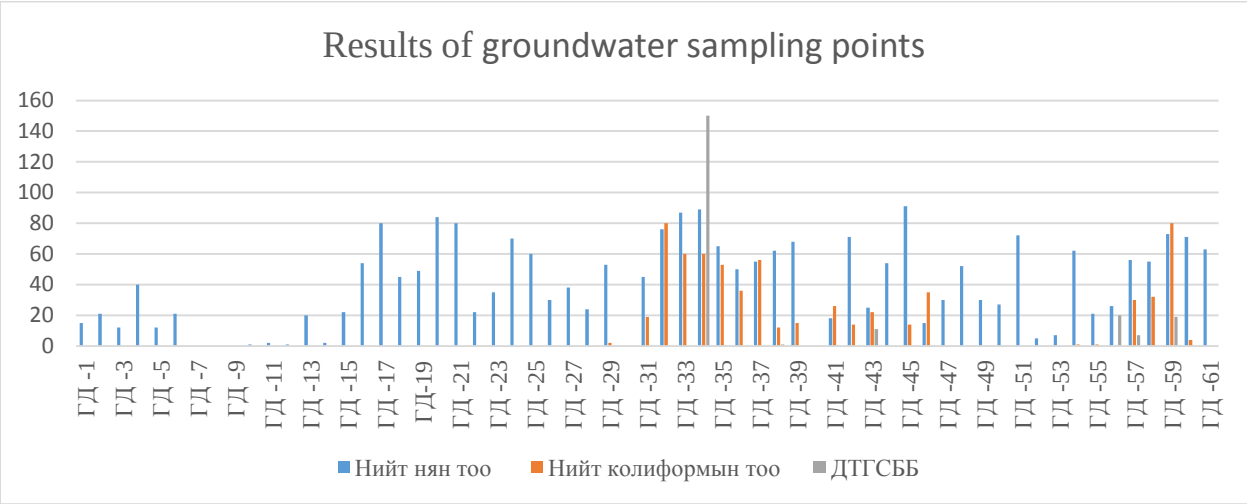

Figure 4. Quantification of total bacteria in groundwater

Explanation: Among the 61 samples, 14 samples or 22% of 0-20 CFU in 1 ml of water, 16 samples or 26% from 21-40, 11 samples or 18% of 41-60 CFU, 16 or 26%, From 61 to 80, 4 samples or 6.5% were found with 81 to 100 CFU.

According to the results of a total of 61 groundwater points along the Kherlen River, the maximum number of coliforms was 80, the minimum was 0, and the average was 10.8 CFU, while the number of total bacteria was at maximum 91, the minimum was 0, and the average was 41.5 CFU. 150, minimum 0, average 3.4 CFU, but *Salmonella* spp, a pathogenic bacterium of the intestinal group, was detected in 2 samples or 3.2% of all samples, and maximum 6 samples were detected, while *E.coli* bacteria was not detected in all samples. According to the requirements of the drinking water standard, 31.1% of the total water samples were found to be non-compliant. Therefore, it is necessary to prohibit the use of food from the point that does not meet the requirements, and it is necessary to carry out further monitoring and repeat the analysis of the samples.

Conclusion

According to the results of our research, the water of the Kherlen River is in agreement with the results of Ch.Javzan et al. (2016), which compared to surface water sanitation classification norms, it was evaluated as clean-to-moderately polluted, but compared to the results of the researchers of Dayana et al. in the rivers of Ecuador, the coliform count and *E.coli* /*E.coli* 2.5*10^4, total coliform 3.25*10^4 CFU/ was low.

• Although it is rated as low-moderately polluted, in the future, attention should be paid to the quality of the river water, effective and low-cost methods of protection and prevention of pollution / not to use strong poisons for fertilizers and insecticides in farming and agricultural areas near the river, It is necessary to introduce the reuse of mine and industrial waste water and the supply of water that meets the standards to the environment. In addition, it is possible to reduce the use of expensive chemical fertilizers by using surface water such as rivers appropriately for agricultural purposes.

• The detection of *Salmonella* bacteria in the sample indicates that the water is contaminated by human or warm-blooded animal feces, and environmental studies will be important in detecting the spread of *Salmonellosis*. Therefore, if *Salmonella* is detected in a repeated test at that point, the source of the contamination should be determined.

• According to the results of microbiological analysis, it is not suitable to use surface water or river water for drinking. If drinking is necessary, it is advisable to use the methods of settling, filtering and boiling.

• Since the microflora of river water tends to change constantly, it can be seen from the research conducted in foreign countries that it is more important to carry out regular surveillance research for a certain period of time. According to some articles, Salmonella is more common during the flood season and winter, while Enterococci is more common in autumn.

• In terms of ground water, 31.1% of non-compliant samples are used for drinking purpose, so it is considered appropriate to pay attention to this point and make recommendations to the local communities to monitor these points regularly (on average 2 times per season).

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