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Microbiological and Physicochemical Characteristics of Karaçomak Dam Lake in Kastamonu

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Abstract: This study deals with the chemical and microbiological analysis of some samples which have been taken from Karaçomak Lake in Kastamonu. This lake is a staple source of potable water in the city of Kastamonu. In this study drinking water samples, from the four stations sources of Karaçomak Dam Lake in Kastamonu, were analyzed physicochemical and microbiological, to find out their suitability for drinking purposes. All the result of chemical, physical, and bacteriological analysis of water had been compared with World Health Organisation and Turkish Republic Water Regulations Intended for Human Consumption and World Health Organisation Guidelines of the quality of drinking water. Temperature, pH, dissolved oxygen, total alkalinity, total hardness, turbidity, total nitrate, nitrite, phosphate and ammonium were measured, average 4.45±0.75 ºC, 8.84±0.12, 9.90±1.30 mg L^{-1}, 37.50±11.09 mg L^{-1}, 25.63±6.04 mg L^{-1}, 4.69±5.96 FTU, 0.50±0.28 mg L^{-1}, 0.03±0.04 mg L^{-1}, 0.18±0.095 mg L^{-1} and 0.08±0.06 mg L^{-1}, respectively. Total germ count was found to average 115±124 cfu mL^{-1}. Also *Pseudomonas aeruginosa* was isolated from water samples of Karaçomak Dam Lake.

Key words: Drinking water, Karaçomak Dam Lake in Kastamonu, water quality

1. Introduction

Water is an important, essential and useful substance for life and also it is valuable source of all living things. It is necessary to development of both urban and rural regions, which is one of the most important natural resources, in world (Nevondo & Cloete, 1991). Safety and cleaning of the drinkable water are not important parameters for human; it has very effective on the all stages of all life (Dara, 1997; Ahmad, 2005).

Quality of drinkable water has an important discussion on the all world (Thurman et al., 1998; Khan et al.,

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2013). Owing to the poor water quality, approximately five billion children are death every year. World Health Organization (WHO) reported that, diseases caused by waterborne is comprises 80% of all human diseases in developing countries (Tebbutt, 1983).

Generally incorrect discharge of domestic and industrial effluent wastes is done, with improperly seepage. According to Huttly (1990) and Jain et al. (2005), major sources of water pollution and the spread of water borne diseases are contamined water reservoir, agricultural wastes, and bad management of farm wastes. Amount of the all water is 1.4 billion km^3 in the world, amount of this only 2.5% fresh water. Turkey has a lot of fresh water sources, which are 120 natural lakes, 706 dam lakes and approximately 10.000 km rivers.

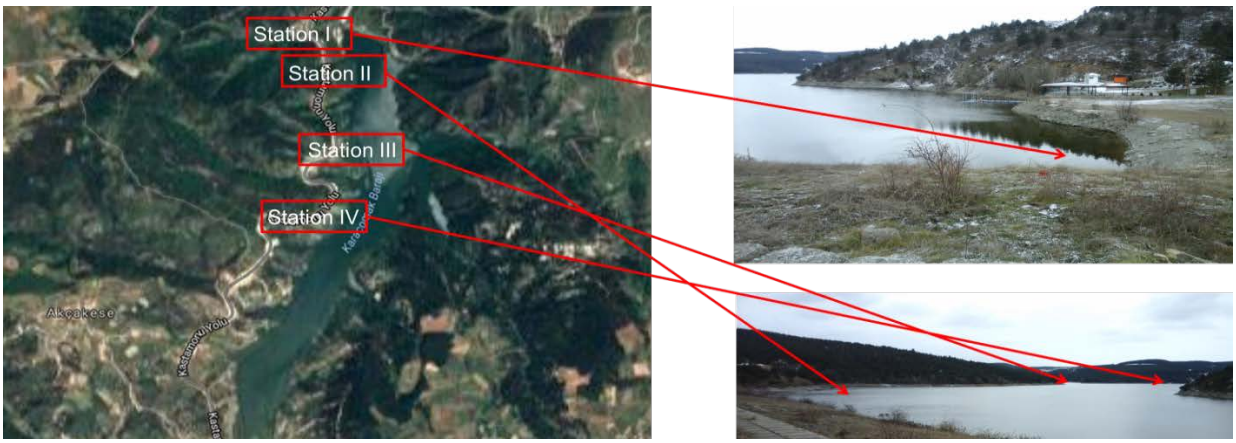
Currently various human activities is abundantly (>70%) required usage of groundwater and natural water sources. A lot of researchers are working for indicator microorganisms in the digestive system of human and animal to safety of water at microbiological quality and fecal pollution (Vilanova et al., 2004; Anderson et al., 2005; Khan et al., 2012). As results of these studies shown that, *Enterobacteriaceae* and especially coliform bacteria isolated from water sources, water can be contaminated with fecal pollution (Allen et al., 2000). *Escherichia coli* are a famous and well known species of the *Enterobacteriaceae*. Human and animal faeces have plenty of *Escherichia coli* bacterium. *E. coli* can be isolated high concentration of 10^9 per gram on faeces. Also *Escherichia coli* can be finding in natural water, soil, waterway, and all environments, which is contaminated with human, animal or agricultural activity. Generally all researcers are using *E. coli* for qualification of drinking water sources to biological pollution (Fujioka et al., 1998).

The importance of providing pure and safe drinking water is essential to humans and, considering that Karaçomak Lake is the staple is the only source which supplies the city of Kastamonu which supplies drinking water. The aim of this study to know the characteristics of drinking water in Karaçomak Lake in Kastamonu and suitability for drinking by identifying components and their specifications microbiological and chemical and compare them to Turkey& WHO Guidelines of the quality of drinking water.

2. Methodology

Water samples were collected in sterile bottles from four different stations direct in Karaçomak Lake in January 2016. Some parameters of the samples were measured while collecting stage, water samples were taken in duplicate for all stations.

Figure 1. Karaçomak Dam Lake and the sampling stations



pH and electrical conductivity, temperature, dissolved oxygen, turbidity of the samples were measured while collecting the samples of each water sample was taken in duplicate at two different sampling periods approximately at the same time that the sample taken (Gültepe et al., 2000a,b).

Bacteria were isolated from samples with dilution-plate methods (Gültepe & Aydın, 2009). All of the bacteriological media used in this research was from Merck (Merck, Germany). Individual colonies were then identified (Plumb & Bowser 1983; Austin & Austin 1999). Gram staining, catalase, oxidase and motility were using for presumptive identification of the bacterial strains. Biochemical characteristics of bacteria were determined with API 20 E test (BioMerieux S.S., France) at 25±0.5 ºC for 48 h (Aydın et al., 2005; Gültepe & Tanrıkul, 2006; Tanrıkul & Gültepe, 2011).

3. Conclusion

Temperature of fresh water varies normally from 0 to 40ºC depending on the different factors, as a source, and season. Some important physical properties and characteristics of water affected with the temperature such as density, viscosity, conductance, salinity, solubility of dissolved gases etc. Also, chemical and biological reaction rates increases with temperature. In this study, temperature of the Karaçomak Dam Lake at stations measured between 3.8-5.2 ºC. The pH determines a lot of features to water, for example the solubility (amount that can be dissolved in the water) and biological condition (amount that can be utilized by aquatic life) of chemical ingredients such as nutrients (phosphorus, nitrogen, and carbon) and heavy metals (lead, copper, cadmium, etc.). pH is also an important factor in water treatment. Proper chemical treatment of water including disinfection requires pH control. The pH values in all the samples tested during Jan range it is observed that the pH of the water was slightly acidic from 3.8-5.2. According to declaration of World health organization

(Huttly, 1990) standards, pH value must be in range of 6.5-8.5 shows that pH in selected water samples varied in the range of 8.68-8.98. Oxygen is dissolved in water in varying concentrations. It is a very important water quality parameter and is also an index of physical and biological processes going on in water the reason for the low dissolved oxygen (DO) content was due to decomposition of organic matter, which indicates a pollution load in the water. The deficiency of the oxygen in the water is shelter for bacteria and other pathogens. Analysis of DO is very important in water pollution control. The guideline value for DO is >5 mg L^{-1} according to WHO. The oxygen is dissolved in the diagram above between 8.62-11.05 mg L^{-1}. The obtained values are in the range 8.62-11.05 mg L^{-1} in the stations, which satisfy WHO standards in the all stations. Total alkalinity values of the studied drinking water samples ranged between 29-53 mg L^{-1}. Among the bottled water total alkalinity values varied from 30 to 38 mg L^{-1}. On comparison of it was found that all the drinking water samples were having total alkalinity values within the WHO / Turkish standard value for total alkalinity in drinking water (500 mg L^{-1}). These results of the total alkalinity shown that, Karaçomak Dam Lake water source are safe and can be used for drinking and other usual domestic purposes. Total hardness changed from 19.30 to 31.76 mg L^{-1} at measured stations. WHO standard value for total hardness in drinking water is 500 mg L^{-1}. Results were clear that, have total hardness value less than the prescribed limits of WHO. Thus, the results indicate that all water samples have been little hardness; hardness analysis revealed that all of these water samples were have on values prescribed limits of WHO and thereby suitable for drinking. Formazin Turbidity Unit (FTU) was using for the turbidity measurement. Researchers are using several practical applications for measuring water quality, the most direct being some measure of absorbance (that is, reduction in light power) of light as it passes through a target layer of water. Turbidity values of the studied drinking water samples changed between 1.34- 13.6 .All measurements were according to the WHO (10 FTU) except for one sample was 13.6. It can be performed from turbulence of water and/or water inlet from river. Total nitrate values of the studied drinking water samples ranged between 0.3-0.9 mg L^{-1}, but regarding nitrite was 0.006-0.090 mg L^{-1}, as for phosphate was 0.11-0.32 mg L^{-1}. All results were normal rates compared the WHO. Measured water sample was suitable for drinking and domestic usage. Ammonia and ammonium is generally an indication of pollution in drinking water. According to the guideline value given by WHO, the concentration of ammonia should be 0 mg L^{-1}. The maximum concentration of ammonium was found to be 0.023-0.138 mg L^{-1} and in most of the test was between this ranged. Results of physicochemical parameters of Karaçomak Dam Lake Water were given Table 1.

Table 1. Results of physicochemical parameters of Karaçomak Dam Lake at all stations

Stations	I	II	III	IV
Temperature (ºC)	3.8	3.8	5	5.2
pH	8.86	8.83	8.98	8.68
Dissoved Oxygen (mg L^{-1})	11.05	10.99	8.94	8.62
Total Alkalinity (mg L^{-1})	53	38	30	29
Total Hardness (mg L^{-1})	31.76	29.70	21.75	19.30
Turbidity (FTU)	1.34	13.6	2.45	1.36
NO_2 (mg L^{-1})	0.010	0.090	0.006	0.006

According to microbiological analyses results, bacterial count of Karaçomak Dam Lake Water was changed from $3x10^1$ to $3x10^2$ cfu mL^{-1}. Results of bacterial count of Karaçomak Dam Lake Water were given Table 2. These results are acceptable for drinkable and usage water Regulations of Turkish Republic and WHO. *Escherichia coli*, coliform bacteria and *Enterococcus* sp. bacterium are undesirable bacterium for drinkable-usage water (0/100 mL). Also, acceptable values for the *Escherichia coli*, coliform bacteria, *Enterococcus* sp. and *Pseudomonas aeruginosa* are 0/250mL; sporative anaerob sulphite reduced bacterium are 0/50 mL; pathogen *Staphylococcos* sp. are 0/100 mL and parasites are 0/5 L. In this study results showed that, bacterial count is in the acceptable level.

Table 2. Results of bacterial count of Karaçomak Dam Lake Water at all stations

Stations	Number of Bacterium (cfu mL^{-1})
I	$6x10^1$
II	$3x10^2$
III	$3x10^1$
IV	$7x10^1$

First identification of the all isolated bacterium was performed by Gram staining, motility, oxidase and catalase, according to Tanrıkul and Gültepe (2011). API 20 E test (BioMerieux S.S., France) was used to determine biochemical characteristics of bacteria at 25±0.5 ºC for 48 h. API 20 E test results and biochemical characteristics of bacteria were given Table 3, which is isolated bacteria from Karaçomak Dam Lake. According to these results, isolated bacteria from Karaçomak Dam Lake for all stations are determined as *Pseudomonas aeruginosa*.

Pseudomonas aeruginosa has been characterized as a “ubiquitous” microorganism, because it can live in all environments. It is an opportunistic pathogen both human and some animal. It can be generally cause intestinal

infections and also scarring and burning (Botzenhardt & Doring, 1993; Holt et al., 1994; Austin & Austin, 1999; Onuk et al., 2015).

Table 3. Results of bacterial count of Karaçomak Dam Lake Water at all stations

Samples from All Stations / **Specify**	**Isolated Bacteria**
	Pseudomonas aeruginosa
Gram stain	-
Motility	+
Oksidase	+
Catalase	+
ONPG	-
ADH	+
LDC	-
ODC	-
CIT	+
H_2S	-
URE	+
TDA	-
IND	-
VP	-
GEL	+
GLU	-
MAN	-
INO	-
SOR	-
RHA	-
SAC	-
MEL	-
AMY	-
ARA	-
OX	+

In conclusion; temperature, pH, dissolved oxygen, total alkalinity, total hardness, turbidity, total nitrate, nitrite, phosphate and ammonium values of water of the Karaçomak Dam Lake were measured, average 4.45±0.75 ºC, 8.84±0.12, 9.90±1.30 mg L^{-1}, 37.50±11.09 mg L^{-1}, 25.63±6.04 mg L^{-1}, 4.69±5.96 FTU, 0.50±0.28 mg L^{-1}, 0.03±0.04 mg L^{-1}, 0.18±0.095 mg L^{-1} and 0.08±0.06 mg L^{-1}, respectively. Total germ count was found to average 115±124 cfu mL^{-1}. Also *Pseudomonas aeruginosa* was isolated from water samples. According to this study, levels of measured physicochemical parameters and count of *Pseudomonas aeruginosa* bacterium are not harmful for human health. As a results, Karaçomak Dam Lake water has acceptable levels both physicochemical and microbiological qualification, according to Turkish Republic Water Regulations Intended for Human Consumption and World Health Organization Standards.

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