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Investigation of tap water quality of Bingöl University

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Abstract: In this research, the chemical and microbiological quality of 20 tap water samples were randomly selected from Bingöl University in Bingöl. The Heterotrophic Plate Counts (HPC) numbers of samples were 1.09 ± 0.4 logs CFU/ml. The coliform and fecal coliform bacteria were not detected in all samples. The average pH value of samples was 6.79 ± 0.15 and all samples were nitrate negative, nitrate positive, qualitatively. The average hardness values of the water samples were determined as 6.16 ± 2.47 ºf. It can be said that all samples are classified as soft water. As a result, it is thought that tap water's simple chemical and microbiological quality in Bingöl University is sufficient for drinkability, However, this thesis should be supported by forwarding microbiological, chemical, and sensory analyses.
Keywords: Tap water, microbiological quality, chemical quality

Bingöl Üniversitesi musluk sularının kalitesinin araştırılması

Özet: Bu araştırmada Bingöl ilinde bulunan Bingöl Üniversitesindeki rastgele seçilmiş 20 musluk suyundan alınan örneklerin mikrobiyolojik ve kimyasal kalitesi araştırılmıştır. Örneklerdeki ortalama Heterotrophic Plate Counts (HPC) sayısı 1,09 ± 0,4 log CFU/ml olarak tespit edilmiştir. Örneklerin hiçbirinde koliform ve fekal koliform grubu bakteri tespit edilmemiştir. Kimyasal olarak örneklerdeki ortalama pH ve sertlik değerleri sırasıyla 6,79 ± 0,15 ve 6,16 ± 2,47 ºf olarak tespit edilmiştir. Ayrıca, örneklere kalitatif olarak nitrat ve nitrit testleri uygulanmış ve tümü nitrat pozitif, nitrit negatif bulunmuştur. Su numunelerinin ortalama sertlik değerleri ise 6,16 ± 2,47 ºf olarak belirlenmiştir. Tüm örneklerin yumuşak sular sınıfına girdiği söylenebilir. Sonuç olarak Bingöl Üniversitesi'ndeki musluk suyunun basit kimyasal ve mikrobiyolojik kalitesinin içilebilirlik için yeterli olduğu fakat bu tezin ileri mikrobiyolojik, kimyasal ve duyusal analizlere desteklenmesi gerektiği düşünülmektedir.
Anahtar Kelimeler: Musluk suyu, mikrobiyolojik kalite, kimyasal kalite

Introduction

Is known that drinking water may cause diseases or spread diseases. Continuously reaching for healthy and safe drinking water is a basic principle for protecting public health (Tuluk & Orhan, 2017). Reaching healthy water is a human's right. For this reason, drinking water services are supplied by the government in Turkey. Healthy and safe water is supplied by

local authorities and it is monitored by the Ministry of Health (Koksal & Samastı, 2007). In most cases, drinking water requirements for city folk are met by the network water obtained by treatment (precipitation, filtration, purification, disinfection) of surface waters (Tuluk & Orhan, 2017).

Perception of tap water is subject to a wide range of factors and interactions. Despite the access to drinkable tap water quality in developing countries supplied at cost-efficient, the consumption of bottled water has increased over the past years. One of the main reasons for this increase is the perception among citizens that tap water is unhealthier and tastes worse than bottled water. The water consumption profile is strongly linked with user satisfaction (taste, odor, color) (Delpla et al., 2020). On the other hand, researchers showed a positive correlation between tap water consumption and a water quality index assembly information on water quality parameters such as turbidity, color, free chlorine residual, and heterotrophic plate counts (Proulx et al., 2010). In general, users do not know about the daily use of tap water quality. In the light of this information, this study aims to investigate the chemical and microbiological quality of tap water in the university which, people daily use.

Materials and Methods

Microbiological Analyses: Turkish Standards Institute, TS-266 directives were followed while collecting tap water samples (Türk Standartları Enstitüsü, 2005). Five samples were collected on each analysis day and it took a month to collect 20 samples in total. Tap water samples were collected into sterile 200 ml glass bottles from the faculty buildings in the university for microbiological and chemical analysis. The samples were immediately transported microbiology laboratory. The standard plate count technique was used to enumerate heterotrophic culturable bacteria in water (Harrigan, 1998). Plates incubate at 37 ℃ for 24-48 h. The average number of colonies was calculated as log CFU/ ml.

For enumeration of Coliform and fecal coliform bacteria, the samples were subjected most probable number (MPN) test following procedures Food and Drug Administration's Bacteriological Analytical Manual (Çakır et al., 2002).

Chemical Analyses: When microbiological analyses were completed, pH analysis was performed using a pH meter (PH Selecta, pH 2001) (AOAC, 1984). For qualitative nitrite and nitrate analyses, the method described by Tolgay & Tetik (1964) was used. For the determination of French hardness, the method previously described by Tolgay & Tetik (1964) was used. The results were explicated according to Table 1.

Results

All microbiological and chemical data are shown in Table 1. The HPC, pH, and Hardness results were expressed as average ± standard deviation (X ± SD). Other qualitative results were expressed as negative or positive.

Table 1: Microbiological and chemical data of collected water samples in the University region.

Microbiological	HPC (log_{10} CFU/ml)	Total coliform	Fecal coliform	
	1.09 ± 0.4	Negative	Negative	
Chemical	pH	Total Hardness	Nitrite	Nitrate
	6.79 ± 0.15	6.16 ± 2.47 ºf	Negative	Positive

Discussion

The microbial quality of tap water samples in this study was not of concern. HPC was not detected in 60% (12) of the samples. An average of 1.09 ± 0.4 log CFU/ml microorganisms were detected in the remaining 40% (8) samples (Table 1). Microorganisms will usually grow in water, and on surfaces in contact with water as biofilms. Growth following drinking water treatment is normally referred to as 'regrowth'. The principal determinants of regrowth are temperature, availability of nutrients (organic matter), and lack of residual disinfectant (etc. Chlorine) (Robertson & Brooks 2003). Koçak & Güner (2009) reported an average of 3.88 ± 3.68 log CFU/ml HPC numbers in 45 tap water samples in Erzurum. This value is considerably higher than our results. Control of fecal contamination in drinking water systems and sources where it occurs is of primary concern. Fecal-specific indicator bacteria such as *Escherichia coli* (*E. coli*) are the parameters of primary importance in monitoring fecal pollution (Robertson & Brooks, 2003). Coliform and fecal coliform were not detected in any of the tap water samples in this study (Table 1). These results are consistent with most of the studies on tap water quality (Can, 2000; Alim, 1995). Although Kocak & Güner (2009) isolated coliform group microorganisms from well water and reservoir water samples, this microorganism group was not found in any tap water samples. The microbiological data in this study showed that the treatment and monitoring of the university mains waters are well.

pH is clearly an important water quality parameter. If pH values are higher than 8, water is unsuitable for effective disinfection and, this situation can cause a slippery feeling. Also, the value of less than 6.5 of water can have a corrosive and metallic taste (Tuluk & Orhan, 2017).

In this study, the average pH value of samples is 6.79 ± 0.15 and all samples have acceptable pH values.

As expected, nitrate was detected in all of the samples, while nitrite could not be detected qualitatively in any of the samples. It is known that nitrate in drinking water is an important risk factor for methemoglobinemia in bottle-fed infants (WHO, 2011). Nitrate levels in this study are uncertain. Further analysis is required in terms of question marks. In the drinking water regulation of the Ministry of Health, it is stated that nitrate in drinking water should not exceed 50 mg/l (Resmi Gazete, 2005).

Table 2: Water hardness (total hardness) scale

Water Hardness	Soft	Average	Hard	Very Hard
French Hardness (ºf)*	0-10	11-20	21-30	> 30

*1 ºf = 10 mg/L as $CaCO_3$

The average hardness values of the water samples were determined as 6.16 ± 2.47 ºf (Table 1). When the samples are evaluated according to Table 2, it can be said that all samples are classified as soft water. Similarly, Can (2000) reported that the total hardness value of tap water used as drinking water in the Balıkesir region is between 8.21-10.53 °f. Bigin (2003) determined the hardness value between 12.3 and 16.8 °f in water samples taken from different points of the drinking water network of Niğde Province. These results show that the tap waters in the Niğde are of average hardness class (Table 2). In a study conducted in Erzurum, the hardness rate was 7.96 (Kocak & Güner, 2009). Our results are consistent as the Bingöl and Erzurum regions are geographically close to each other.

Conclusions

As a result, it is thought that the simple chemical and microbiological quality of tap water in Bingöl University is sufficient for drinkability, However, this thesis should be supported by forwarding microbiological, chemical, and sensory analyses. Generally, drinking water quality parameter values of the cities are regularly published on the Water and Sewerage Administration website of that city. Although the competent authority in Bingöl does not have an official website, it is recommended that it be in the future.

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Ethical Statement

This study does not present any ethical concerns.

Conflict of Interest

The authors declared that there is no conflict of interest.

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