Journal of Applied Biological Sciences 7 (1): 61-65, 2013
ISSN: 1307-1130, E-ISSN: 2146-0108, www.nobel.gen.tr

Chemical and Bacteriological Properties of Fresh Water Fountains of Karaman Province

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Received: 28 September 2012
Accepted: 05 November 2012

Abstract

In this study, the potableness level of the 18 fresh water fountains in Karaman were tested for chemical and bacteriological properties. The research was carried out between January-June 2012 by taking sample four times. *Escherichia coli* and coliform bacteria were analysed by membrane filtration method. 31,94% samples showed the presence of coliform bacteria. 18% samples were tested *Escherichia coli* positive and 12,5% samples contained both *E.coli* and coliform. pH, total hardness, conductance, turbidity, nitrite, ammonium, free chlorine, calcium, flouride, and chloride of water were also investigated and can be classified as mild alkali and soft. Traces of flouride and free chlorine was also found in the samples. The other chemical properties were deemed suitable for the national and international potable water standard. Fresh water fountains of Karaman province is chemically fit for usage but 28 fountains contain bacteriologic contamination which can be control easily by taking necessary actions.

Keywords: Potable Water, Coliform, *Escherichia coli*, Water Quality, Karaman

INTRODUCTION

Water, the basic elements of life is also an indispensable factor in the development of civilization. In all multi-dwelling units, a significant amount of water is needed for cleaning, health, agricultural production and leading a humane life. Water resources used for drinking and household usage should be adequate amount with appropriate chemical and bacteriological characteristics. The access of human beings to safe and healthy drinking water for their vital needs simply involves the processes of finding, storing and distributing water of drinkable quality.

Rapid increase in the world's population also lead to increased demand of drinking and household water. On the other hand, water resources are polluted with each passing day, finding and bringing appropriate quality water resources into use gets to be limited in practice. Drinking water quality is negatively affected by factors such as problems in refinement and distribution and not being able to properly protect the water resources [1].

Chemically and biologically healthy water is the best water to be used. . However, such type of water supplies is limited and it is necessary to use water in a planned manner [2].

Three quarters of the surface of the earth is covered with water. Every year, nearly 2.10^{22} liters of water fall to the earth as rain. Ninety-seven percent of this water is sea water and is inappropriate to be used for many industrial purposes. Approximately 2% of the water is condensed as ice in the polar regions and about 1% is left as drinking water [3]. Eighty countries that harbor the 40% of the world population already facing water shortages. The need for water has been increasing each passing day due to the rapid increase in population in contrast with the existence of fixed water supplies. For this reason, it is highly important not only to reduce all kinds of pollutants but also to determine the microbiological pollution potentials and eliminate such conditions to protect limited drinking water resources [4]. It is highly important for public health to obtain healthy and reliable drinking water and to deliver it to the consumers. According to the data provided by the World Health Organization (WHO), 80 % of the illnesses that occur in developing countries are water borne [5].

Table 1. Mean values of the chemical analysis of fresh water fountains of Karaman.

Fountain No	CA mg/L	Turbidity (NTU)	pH	Total Hardness (°dH)	Amonyum (mg/L)	Nitrite mg/L	Chlorine (mg/L)	Fluoride (mg/L)	Free chlorine (mg/L)	Conductance (µS/cm)
1	23,3	0,301	7,75	3,94	0,018	0,0025	38,5	0	0,01	540
2	22,2	0,279	7,74	3,6	0,024	0,0022	40	0	0,04	532
3	11,4	0,274	7,68	2,05	0,024	0,0015	38,7	0,10	0,04	524
4	16,1	0,267	7,74	2,33	0,021	0,0022	37,9	0	0,03	528
5	20,4	0,302	7,7	2,71	0,015	0	37,6	0,07	0,03	526
6	26	0,215	7,75	3,4	0,018	0,0017	40,6	0,12	0,08	530
7	20,8	0,331	7,83	3,31	0,014	0,0017	42	0,02	0,05	530
8	16,9	0,294	7,74	2,85	0,016	0,0012	47,4	0,04	0,04	527
9	26,8	0,557	7,5	4,55	0,015	0,0042	38	0,09	0,03	704
10	18,8	0,312	7,68	2,79	0,015	0,0027	42,1	0,11	0,07	524
11	18,2	0,346	7,76	3,08	0,016	0,003	40	0,10	0,03	527
12	17,3	0,247	7,79	3,16	0,007	0,0027	46,2	0,09	0,02	526
13	14,2	0,289	7,73	1,89	0,015	0,005	41,4	0,11	0,04	525
14	14,0	0,273	7,73	2,76	0,011	0,002	36,5	0,06	0,03	494
15	16,5	0,297	7,72	2,7	0,012	0,0032	33,8	0,09	0,03	572
16	23,7	0,284	7,75	4,66	0,020	0,0037	33,8	0,07	0,03	495
17	26,3	0,345	7,76	3,79	0,015	0,0045	43,3	0,10	0,05	506
18	25,1	0,376	7,75	4,38	0,02	0,0022	38,4	0,07	0,07	495
Min.	11,4	0,132	7,5	1,89	0,009	0	33,8	0	0,007	493
Max.	26,8	0,690	7,83	4,66	0,02	0,0135	47,4	0,27	0,14	556

Table 2. Bacteriological analysis of water taken from fresh water fountains. (CFU/ 100ml).

	JANUARY		**MARCH**		**MAY**		**JUNE**	
Fountain No	Coliform cfu/100 ml	*E.coli* cfu/100 ml	Coliform cfu/100 ml	*E.coli* cfu/100 ml	Coliform cfu/100 ml	*E.coli* cfu/100 ml	Coliform cfu/100 ml	*E.coli* cfu/100 ml
1	7	2	0	0	0	0	0	0
2	6	1	0	0	1	0	0	1
3	0	0	0	0	0	1	1	2
4	6	1	0	0	58	0	0	0
5	2	0	0	0	0	0	1	1
6	0	0	3	0	0	0	0	0
7	8	2	0	0	0	0	0	0
8	21	0	0	0	0	0	2	0
9	6	3	1	1	2	0	0	0
10	0	0	0	1	0	0	0	0
11	25	0	0	0	0	0	0	0
12	3	0	0	0	0	0	0	0
13	0	0	0	0	1	2	0	0
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0
16	0	0	1	0	0	0	0	1
17	2	0	2	0	39	0	0	0
18	0	0	1	0	0	0	0	0

Drinking and household water of Aydın Province was analyzed and 16.6% of the bacteriologic inspections and 18.7% of the chemical and physical inspections were found to be harmful to health. 25.8% samples were found extremely hard, 5.8% had high nitrite content, 2.6% had high ammonia content, 28.6% had high turbidity and 14% had high chlorine content [6]. The study conducted to assess the quality (pH, conductivity, ammonium parameters and coliform and *E.coli* bacteria) of the drinking water in the rural areas of Karaman Province revealed 7.3-7.7 pH, 490-535 µS/cm conductivity and no ammonium was not detected. The analysis of drinking water in urban areas showed that 23.5% contained coli form bacteria, 62.2% contained *E. coli* and 9.8% had both coliform and *E.coli* content [7].

In our country, the drinking water delivered to the public in cities generally consists of tap water supply or commercial spring water. Besides, another drinking water resource is the fresh water fountains which the municipalities provide to different places in the city center. In the present study, chemical and bacteriological characteristics of the water from these fresh water fountains used as drinking water in Karaman city center were examined and the conformity of the findings with national and international standards was investigated.

MATERIAL AND METHOD

Water samples from fresh water fountains were taken from 18 different fountains selected from the center of Karaman Province at four different times in January, March, May and June. The fountain from which the samples were taken were selected by taking into consideration the intensity of use by the public and from different routes. It was also endeavored to regard the difference among the stations. There are 2 water softening plants managed by the municipality. One of these plants is located under the municipal building and the other is located in the locality of Naldöken in Beyazkent District. The water given to these fountains is taken from the water supply network of the city and respectively softened by being treated through a sand filter, resin and activated carbon filter. After this process, a small amount of chlorine is added to the water. Softened water is transferred to storage tanks and disinfected again using ultraviolet at the exit. Samples were collected from a total of 18 taps fed by these two water softening plants. Both water softening plants were taken into consideration in determining the fountain from which samples were taken.

Sample Collection

Collection and transfer of the samples were carried out according to the procedures of the Ministry of Health [8]. Glass bottles of 500 cc were used for chemical analyses. Sterile single use PP (polypropylene) with sodium thiosulphate locked lids of 250-500 cc and amber sample vials were used for microbiological analyses. During sample collection, the fountain was turned to the maximum and the water was discharged for 3-4 minutes. After the tap was turned off, the beak of the tap was singed for 2 minutes. The flame of burnt cotton saturated with ethyl alcohol and held with pliers was used for this procedure. Following the flame treatment, the tap was turned on and the flow of water at a proper dimension to fit the mouth of the bottle was maintained to collect the sample and the water was kept flowing for 1-2 minutes. During this waiting period, the lid of the ready-to-use sample collecting bottle was opened (the bottle was by no means touched with hands while opening the lid) and the sample was collected. The sample was taken to the laboratory on the same day in 6-8 hours without being exposed to the sun or any other heat and under conditions that were in conformity with cold chain rules (at +4, +8 ^{o}C) [9].

Chemical Analysis

pH and conductivity were measured using Hach Lange HQ40d electrometric device, Hach Lange 2100AN Turbidimeter was used for turbidity; ammonium, nitrite, chlorine, fluoride, free chlorine, total hardness and calcium were measured through Hach Lange DR 2800 (UV 340-900 nm) spectrophotometer device using ready kits (Hach Lange is produced by the spectrometer for) in the laboratory environment.

Bacteriological Analysis Methods

The membrane filtration method is used as a legal obligation in the microbiological analysis of waters (Natural spring waters, drinking waters, etc.) [8]. Sartorius brand membrane filtration device was used in the study.

Statistical Analysis

Statistical calculations were performed by using SPSS 15 Statistical Package Software. The *α* significance level was taken as 0.05 in the study. Firstly, the test for conformity to normal distribution (kolmogorov-smirnov test) was used in evaluating the results of our study. After determining the conformity of the data to normal distribution, variance homogeneity was tested. ANOVA test was applied to examine the differences among the months in which samples were taken

RESULTS AND DISCUSSIONS

Minimum, maximum and mean values of chemical parameters obtained from the samples collected in January, March, May and June are presented in Table 1. Results regarding Coliform and *E. coli* results of the bacteriological studies according to months are presented in Table 2 and the accepted limit values in Turkey regarding the parameters examined in our study are given in Table 3.

Table 3. Parameters and limit values measured in waters in Turkey [8]

Parameter	**Parametric value**	**Unit**
pH	≥6,5 ve ≤ 9,5	
Conductance	2500	µS/cm
Turbidity	0-1	NTU
Total Hardness	30>	°dH
Calcium	100	mg/L
Nitrite	0,1	mg/L
Ammonium	0,5	mg/L
Chloride	250	mg/L
Flouride	1,5	mg/L
Free Chlorine	0,5	mg/L
Coliform	0	CFU/100 ml
E.coli	0	CFU/100 ml

The statistical evaluation of the results of the chemical analysis in this study showed that there was not a difference among months with respect to conductivity, chlorine, nitrite, fluoride, and ammonium levels. Total hardness values were classified as very soft water in January, March, May and June. There was a significant difference in turbidity and calcium levels obtained in May compared to other months. The values obtained in January show that pH and free chlorine values were at the highest level in this month.

The amount of free chlorine was found to be low in the samples taken four times in monthly periods between January 2012 and June 2012 from 18 of the soft water taps managed by Karaman Municipality. The measured level of fluoride was found to be lower than the desired level in all the taps. For this reason, it can be suggested to add fluoride to drinking water storages.

Bacteriological analysis of the 72 samples conducted through membrane filtration showed the presence of coliform bacteria 23 samples. *E. coli* was found in 13 samples and 28 of these samples were not found to conform to the Regulation concerning Water Intended for Human Consumption of the Ministry of Health. Bacteriological pollution was observed in all the samples that did not conform to the regulation. The examination of the coliform results of taps number 4 and 17 in May showed the excessive amount of coliform bacteria. It is believed that the reason for these excessive levels was the excavation work in that region or the conformity of the water transmission pipes needed to be investigated. There could probably have been a leakage in the transmission line.

In conclusion, the physicochemical characteristics of water from fresh water fountains that are consumed as drinking water by the general public in the center of Karaman Province were found to conform to WHO standards and to the Regulation concerning Water Intended for Human Consumption of the Ministry of Health. If necessary, fluoride addition through appropriate methods is possible to adjust the fluoride levels that were found to be below desired values. However, microbiological pollution was detected in contrast to chemical results. The results of the bacteriological analysis show that the observed pollution was temporary. Coliform or *E.coli* bacteria observed in bacteriological analysis can be prevented by paying more attention to the chlorination process, which was seen to be inadequate. This is up from the source to the tap with the chlorination process, repair, maintenance and cleaning troubleshooting this with sanitation. Furthermore, water should be let to flow from the tap for a long time to prevent the contamination that occurs in the pipes before using the soft water taps that are underutilized due to being not preferred by the public or located at the end points of the network.

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