RESEARCH ARTICLE

IJVAR *International Journal of Veterinary and Animal Research*
E-ISSN: 2651-3609 5(3): 139-145, 2022
DOI: 10.5281/zenodo.7459048

Investigation of Physical Properties and Mineral Contents of Drinking Water in Some Villages of Van and Mardin Provinces

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Received: June 30, 2022
Accepted: August 21, 2022

Abstract

This study was carried out in order to examine a total of 40 drinking water samples taken from 20 locations selected from Mardin and Van provinces in terms of physical properties, heavy metal and mineral contents and to evaluate the quality of drinking water in accordance with the results obtained. Among the ion and mineral analyses of the samples, arsenic, copper, boron, cadmium, cobalt, manganese, nickel, lead, selenium and zinc analyses were made with Inductively Coupled Plasma and Mass Spectrometer, and magnesium analyses were made with Inductively Coupled Plasma-Optical Emission Spectrometer. Fluoride, chloride, nitrite, nitrate, bromide, sulfate and phosphate analyses were also performed by Dionex ion chromatography. Conductivity, pH, ORP, TDS and minimum salt analyses were performed with the Myron L device. As a result of the study, the difference between the fluoride, chloride, nitrite, nitrate, bromide, boron, cadmium, cobalt, zinc, conductivity, TDS, ORP and temperature values of the water samples of the two provinces was found to be significant. In addition, drinking water containing heavy metals was found to be above the limit values set by the Regulation on Water Intended for Human Consumption, nickel was detected in water samples taken from Van, and phosphate was not detected in samples taken from Mardin. The remarkable issues in water samples taken from 40 different locations in two provinces are presented in articles and it has been emphasized that it is important for the people living in this region to present the detected defects to local governments, environmental and public health units and to eliminate the defects.

Keywords: Heavy metal, drinking water, mineral matter, water quality.

INTRODUCTION

One of the most basic components of living cells is water. Water, an inorganic molecule, accounts for 50-60% of the total weight in adults. This ratio is about 75% in young people. About 60% of the total water in the body is outside the cell, while about 40% of the remaining water is inside the cell (Mert, 1996). In addition to being the main component and forming an important proportion of the body, water also has important biological tasks. Water is directly involved in the transport of macromolecules that are connected to water molecules by hydrogen bridges, their digestion, metabolic events in which the formed micromolecules enter, and the subsequent excretion of metabolites from the body. In addition, water participates in the structure of hydrolase and hydratase group enzymes as a co-substrate and takes part in metabolism. Moreover, it facilitates movement with its lubricating feature around and between moving organs. It is also involved in maintaining the body's heat balance. A high amount of heat spent on evaporation is reflected in the body as a heat loss, which ensures heat balance if necessary. This is how the cold sensation that sweating creates in the body is provided (Çalık et al. 2004).

Some of the criteria for compliance of drinking water with consumption are related to the physical properties of water. Healthy drinking water should be odourless, colourless, tasteless, clear and sediment-free. The clarity and colour characteristics can be understood by examining the water taken in a clean and transparent container. If there is a smell and taste, it is better to heat the water to a certain temperature for better understanding (Çalık et al., 2004). Drinking water should be odourless and tasteless. The source of different tastes and odours occurring in drinking water are organisms such as algae, as well as chemicals such as chlorine (Cl) and chlorine compounds (Dayıoğlu et al., 2004). Although the water is actually colourless, it is sky blue in very thick layers. The lack of discolouration of drinking water can be caused by algae, microorganisms, or iron salts. The waters in which mossy and microorganisms grow to acquire a greenish colour. Iron salts, on the other hand, give the water a yellowish colour. In waters containing iron salts in contact with air, iron salts precipitate, acquiring a red colour. The fact that the water has a blackened colour indicates that it came from granite sources. It is desirable that the drinking water is always clear. The sources of turbidity in water can be algae, iron bacteria, sand, clay, sulfur (S), manganese (Mn), iron (Fe) and degraded organic substances. The water that has lost its clarity suggests the possibility of contamination and human activity (Mahmood et al. 2020).

The fact that it contains calcium (Ca) and magnesium (Mg) salts means that this water is hard. The sum of Ca and Mg ions determines the degree of hardness of the water. Calcium and magnesium bicarbonate salts are the ones that determine the temporary hardness of the water. Calcium and magnesium phosphate (P), sulfate, chlorine, nitrate and silicate salts in water are the ones that determine the permanent hardness. The inorganic salts in water, Ca, Mg, potassium (K), sodium (Na), bicarbonates, chlorides, sulfates, and a small amount of organic matter

Cite this article as: Baraj MG, Mert N, Mert H, Günbatar N. 2022. Investigation of physical properties and mineral contents of drinking water in some villages of Van and Mardin provinces. International Journal of Veterinary and Animal Research, 5(3): 139-145.

determine the TDS (total dissolved solids) value of water. TDS levels that are higher than 1200 ppm in drinking water may be unfavourable to consumers. Water with extremely low concentrations of TDS may also be unacceptable due to its plain and prosaic taste (WHO, 1990). Consuming acidic water leads to body fluids having acidic pH values and loss of minerals in the body. The desired pH value for body fluids is alkaline values. One of the criteria affecting the quality of water is the chemicals it contains. A number of analyses were carried out in the laboratory environment to determine whether the water is exposed to chemical contamination, as well as the proximity of its chemical properties to the desired level. In these analyses, the chemical content of water such as F, Mn, Cu, Zn, and Mg should be at the desired values. In addition, the most important chemicals that can be considered an indicator of contamination in analysis and are undesirable in water are ammonia and nitrite (Mert et al. 2015).

The fact that the chemical substances in the water content are outside the recommended range leads to a deficiency of certain minerals, toxicity or accumulation of certain heavy metals, which are taken with drinking water. In this aspect, the chemical content of drinking water can have positive or negative effects on health (Poyraz 2014). The main purpose of this study is to examine the chemical and physical properties of drinking water in villages of Van and Mardin provinces.

MATERIALS AND METHODS

Taking Water Samples: In the study, water samples were taken from a total of 40 locations, including 20 neighbourhoods in the Van region and 20 neighbourhoods in the Mardin region, in order to compare some physicochemical and chemical contents. 250 ml PP containers were used for water samples. While taking water samples, the sample containers were opened for the first time and the inside of the container was shaken 2 times with the sample to be taken and then poured from the source for 30 seconds. It was emphasized that the containers in which water samples were taken for analysis were labelled and studied fresh without freezing. The samples were delivered to Van Yüzüncü Yıl University Central Laboratory within a short time and the necessary analyses were performed here.

Analysis: The temperature values of the water samples were examined with TP 101 digital thermometer at the place where the sample was taken. Conductivity, pH, ORP, TDS and min. salt analyses of the samples were performed with the Myron L Company POOL PRO PS6FC device. Water samples with conductivity above 400 µS/cm were diluted in certain proportions with deionized pure water at rates that would reduce the conductivity value below 400 µS/cm.

The analyses of arsenic, copper, boron, cadmium, cobalt, manganese, nickel, lead, selenium and zinc of the samples were performed with Inductively Coupled Plasma and Mass Spectrometry (Thermo Scientific X II Series ICPMS) in Van Yüzüncü Yıl University Central Laboratory. Standards with values of 1, 3, 5, 10, 50 and 100 ppb were used for analysis, starting with Blank. Magnesium analyses of the samples were performed in Van Yüzüncü Yıl University Central Laboratory with an Inductively Coupled Plasma-Optical Emission Spectrometer (Thermo 27 Scientific Icap 6300 DOU ICP-OES).

Fluoride, chloride, nitrite, nitrate, bromide, sulfate and phosphate analyses of the water samples were carried out by Dionex ion chromatography (Dionex ICS 3000). The samples were analysed at a column temperature of 30 °C, a flow of 1 ml per minute, an injection volume of 1500 microliters and a pressure of 1599.9 PSI. During the analysis, a 4 mm Thermo Scientific Dionex brand suppressor was used as a suppressor.

Statistical Analysis: Statistical analysis of the data obtained in the study was performed using the SPSS 20.0 package program (IBM Electronics, USA). In the statistical analysis of the numerical data obtained as a result of chemical analyses, independent samples (t-test) were performed.

RESULTS

Some statistical values determined by the results of chemical analysis of water samples belonging to the provinces of Mardin and Van are shown in Table 1.

Table 1. Chemical analysis results of 20 water samples belonging to the provinces of Mardin and Van.

Parameters	Mardin				Van				P value
	Max.	Min.	Mean	SE	Max.	Min.	Mean	SE	
F^- (ppb)	0.488	0.068	0.225	0.088	1.922	0.282	0.644	0.475	0.001
Cl^- (ppm)	48.861	3.1376	8.028	10.016	110.172	5.6204	26.251	32.307	0.021
NO_2^-(ppm)	0.0494	0.0158	0.023	0.012	0.26025	0.0206	0.053	0.055	0.020
NO_3^- (ppm)	97.317	8.026	25.061	25.930	31.91	2.1726	9.247	10.329	0.031
Br^- (ppm)	0.084	0.0056	0.028	0.017	0.366	0.0088	0.081	0.103	0.031
2-SO4 (ppm)	48.768	4.8088	15.055	10.132	93.7525	10.634	26.284	23.903	0.061
3-PO4 (ppm)	-	-	-	-	0.0725	0.0058	0.009	0.0166	-
As (ppb)	9.336	0.41	2.026	2.575	801.6	1.72	64.0196	204.49	0.127
B (ppm)	0.4298	0.13112	0.227	0.066	2.4335	0.1957	0.637	0.645	0.008
Cd (ppb)	0.1	0.002	0.016	0.034	9.994	5.494	7.744	3.181	0.000
Cu (ppm)	0.00432	0.00135	0.00268	0.0015	0.0097	0.000274	0.00297	0.00285	0.18
Mn (ppb)	2.356	0.026	0.992	0.717	23.84	0.5175	4.191	6.734	0.090
Ni (ppb)	1.6525	0.534	0.847	0.262	-	-	-	-	-
Pb (ppb)	6.806	2.316	4.706	1.647	15.565	0.926	5.535	3.309	0.441
Co (ppb)	0.085	0.01	0.039	0.0245	1.935	0.286	0.837	0.512	0.003
Se (ppb)	5.15	0.58	1.629	1.268	4.82	0.246	2.129	2.001	0.439
Zn (ppb)	57.32	0.42	13.256	21.077	157.46	0.85	23.334	37.531	0.0339
Mg (ppm)	61.325	9.404	29.133	10.483	54.75	21.12	34.707	10.144	0.096

The conductivity, mineral, Salt, TDS, ORP, pH and temperature values of the water samples in Mardin and Van, the maximum and minimum values determined for each parameter, and the calculated average and standard deviation values are shown in Table 2.

Table 2. Physical analysis of 20 water samples belonging to the provinces of Mardin and Van

Parameters	Mardin				Van				P value
	Max	Min	Mean	SE.	Max	Min	Mean	SE.	
İletkenlik (µS-cm)	956.4	195.4	523.5	145.294	1786	500	809.07	335.113	0.001
Min. Salt (ppm)	470	93.58	242.109	72.534	889.2	214.5	388.4	173.625	0.001
TDS (ppm)	668.2	128.5	355.505	103.691	1271	336.2	554.44	244.862	0.002
ORP (mV)	258	145	207.4	36.466	286	235	261.1	13.886	0.000
pH	8.62	6.13	7.781	0.521	7.92	7.32	7.654	0.163	0.307
Sıcaklık (°C)	25.2	21.5	23.41	1.039	23.1	16.6	19.92	1.918	0.000

While there was no conformity with the Turkish Standard on Water Intended for Human Consumption in the examinations of colour in Arısu, Kocakent, Dikyamaç, Evciler, Aşağı Azıklı and Göllü villages, odour in Arısu village, and turbidity in Yetkinler village of Mardin province; no conformity was found in terms of colour in Yassıtepe, Kocabasan, Yukarı Kuyucak villages of Van province, and turbidity in Yassıtepe, Aşağı Yanıktaş, Topaktaş, Serpmetaş and İstasyon villages.

DISCUSSION AND CONCLUSION

Atıcı et al., (2016) took drinking water samples from 18 different points in the study they carried out in Erciş district of Van province and its affiliated settlements. When the fluoride levels of the samples were examined, it was determined that the lowest was 0.29 ppm in the tap water of the State Hydraulic Works, while the highest was 1.29 ppm in the Yukarı TOKİ storage water. The mean fluoride level of 18 water samples was calculated as 0.58±0.07ppm

Average fluoride levels taken from Bitlis province and Adilcevaz, Ahlat, Güroymak, Hizan and Tatvan districts in November 2006 and May 2007 were determined as 0.35±0.03 ppm in 164 drinking water samples, 0.35±0.03 ppm in 51 tank water samples, and 0.35±0.03 ppm in 115 tap waters. It has been observed that the highest fluoride level in the region is in Ahlat and the lowest level is in Bitlis (Kahraman et al., 2011). In a study conducted in Van, fluoride levels were found in the range of 0.22-0.61 ppm in water samples taken from surrounding villages (Mert et al., 2017).

Ağaoğlu et al., (2007) investigated the fluoride content of a total of 366 water samples from wells, streams, springs/fountains, taps and storage waters in the city centre of Van and the districts of Erciş, Özalp, Saray, Muradiye, Çaldıran, Gürpınar, Gevaş, Edremit and they found the highest fluoride average in tap water (0.950±0.091ppm) in Çaldıran samples. The highest fluoride averages in well water and tank water samples were found to be 0.766±0.304 ppm and 0.366±0.088 ppm, respectively, in samples taken from Erciş district. The highest fluoride level was detected in the creek waters in samples taken from the Gevaş district (0.875±0.206 ppm).

Fluoride detected in the range of 0.092-0.42 ppm in all water samples taken from 50 wells in the city centre of Konya was found to comply with TS 266 (Dursun et al., 2005). In the Cappadocia region, fluoride levels of water samples taken from 62 separate points were found in the range of 0.11–0.96 ppm (Dodurka and Kayar, 2002). In this study presented, the fluoride level in the samples taken in Mardin province was 0.068-0.488 ppb, while it was found between 0.282-1.922 ppb in the samples taken from Van. The highest fluoride levels were measured in Tabanlı, Serpmetaş and Bezirhane villages of Van, and the water fluoride levels of the Bezirhane and Tabanlı villages were determined above the standards according to TSE values. There was no controversial value in terms of fluoride in the samples of Mardin province (Table 1). Differences of the mean F levels of two city were significantly important ($p \leq 0.001$). These values are consistent with those previously measured in Van and its region. Because the soil structure and physical properties of Van support a volcanic structure, there are extinct volcanoes such as Ağrı, Tendurek, Süphan and Nemrut around which may be active for some.

In their study investigating the physicochemical properties of samples taken from storage and tap water in Bitlis city centre and its districts, Alemdar et al., (2009) found the lowest and highest chloride values of a total of 164 samples taken in two separate periods as 0.11 ppm and 30.52 ppm in the tank and tap water taken from the centre, respectively. In a study conducted in Aksaray province to determine the organic matter content of drinking water before the treatment process, the chloride amounts in the samples taken in two different periods of the year from 11 selected points in the region were found to be 20.11-119.11 ppm in the April-May period, and 13.71-91.108 ppm in the July-August period (Hınıs, 2007). In a study investigating the physicochemical properties of the surface waters of Lake Gaga within the borders of Ordu province, 1.0 ppm of chloride was detected in the water samples taken for a year only in the summer season, and no Chloride was detected in the samples taken in the other seasons (Taş, 2011). In this study; chloride values were found in the range of 48.861-3.1376 ppm in the samples taken from Mardin province, and in the range of 110.172-5.6204 ppm in Van province (Table 2). The waters of the villages of Mardin Ömürlü and Van Serpmetaş have the highest values on the basis of chloride. Differences of the mean chloride levels of two city were significantly important ($p \leq 0.021$)

While Mert et al., (2017) determined the amount of Nitrate in the range of 0.6087-20.2304 ppm in the samples taken from 20 water sources in Van, Nitrate was not detected at two points in the study area. Nitrite levels of 20 points in the region were found in the range of 0.0002-0.006 ppm. In another study, while the nitrate level of 83 well waters taken from the centre and districts of Şanlıurfa was in the range of 0.63-46.61 ppm and contamination with nitrite could not be detected in a total of 24 samples,

the highest Nitrite concentration of 69 water samples 0.14 ppm was detected in well water in the town of Viranşehir (Durmaz et al., 2007).

Nitrite levels are between 0.0494 and 0.0158 ppm, while nitrate levels are between 97.317 and 8.026 ppm in the villages of Mardin province. Nitrite was found between 0.26025-0.0206 ppm and Nitrate between 31.91-2.1726 ppm in the villages of Van province. Nitrate levels in the Bahçecik, Kocakent and Ömürlü villages of Mardin are above the TSE standards of 50 ppm, while the nitrite level is within normal values. However, in the villages of Van province, all values in terms of both nitrate and nitrite were found within normal limits. Differences of the mean nitrate and nitrite levels of two city were significantly important ($p \leq 0.020$- $p \leq 0.031$), respectively.

Sulphate values of water samples taken from 11 drinking water sources in Aksaray in 2 different periods of the year are in the range of 15.529-30.893 ppm in the April-May period, and in the range of 19.804-64.187 ppm in the July-August period (Hınıs, 2007). Atıcı et al., (2016) detected an average of 5.94 ± 1.56 ppm sulfate in 15 of the drinking water taken from 18 points in Erciş district of Van province. The sulfate levels of water samples taken from 20 selected points in the streams on the Çaldıran plain of Van were found to be in the range of 1.87-22.92 ppm (Aydın, 2017). In this study, sulfate levels were found to be within normal levels according to TS 266 in villages belonging to both district. But differences of the mean sulphate levels of two city were significantly important ($p \leq 0.061$).

Bromide levels of 20 water samples taken from Mardin were found to be between 0.0056 and 0.084 ppm, with an average of 0.028±0.017 ppm (Table 1). Likewise, the bromide values of the samples in Van were found to be in the range of 0.0088–0.366 ppm, with an average of 0.081±0.103 ppm. The difference between the bromide amounts of a total of 40 water samples taken from Mardin and Van provinces was reported as significant ($p<0.031$).

Phosphate was not detected in water samples taken from 20 points on the Çaldır Plain of Van province (Aydın, 2017). Phosphate levels in the drilling water sample taken from the Düzce University campus were outside the detection limit (Yılmaz and Ekici, 2004). Phosphate values of drinking water in 18 points in Erciş district of Van province were found in the range of 0.29-1.13 ppm (Atıcı et al., 2016). While phosphate was not detected at 4 points in the April-May period in the water samples taken from 11 different points before the treatment process from drinking water sources within the borders of Aksaray province and in two separate periods of the year, the Phosphate values of the remaining samples were found to be in the range of 0.2221-4.613 ppm. (Hınıs, 2007). In this study, phosphate could not be detected in the drinking waters of the villages of Mardin province, while phosphate was found between 0.0725-0.0058 ppm in 13 villages of the province of Van.

Although arsenic can be useful in fields such as agriculture and industry, it has a toxic effect on many living things in nature and is carcinogenic (Duker et al., 2005). Arsenic exposure affects many different organs in the body, including the skin, heart, blood vessels and lungs, as well as the immune, genital and urinary, gastrointestinal and nervous systems (Abernathy, 2001). In a study conducted in the Van region (Yılmaz and Ekici, 2004), a total of 77 water samples were taken from İpekyolu, Tuşba, Başkale, Çaldıran, Çatak, Edremit, Erciş, Gevaş, Gürpınar, Muradiye, Özalp and Saray districts and their connected villages, and the Arsenic level of drinking water was investigated. The amount of arsenic in Çaldıran district and its affiliated villages was reported in the range of 9.440-12.040 ppb. In another study, As value was reported as 345.2 µg/L in Tabanlı village of Van province (Mahmood et al. 2020). In the present study, while the As level in the water samples from the villages of Mardin province was between 0.41-9.336 ppb; these values were found to be much higher in the villages of Van province. But differences of the mean arsenic levels of two city were not significantly important ($p>0.127$). The minimum As level of 1.72 ppb reached a maximum of 801.8 ppb. Since the acceptable values of the TSE are 10 ppb, the villages of Yassıtepe, Serpmetaş, Yukarı Kuyucak, Hanköy, examined in the province of Van exceed this value. The value at the level of 801.6 ppb in the old water supply used in the village of Tabanlı is noteworthy. Local authorities do not currently use this water supply. The new resource has been activated.

In a study conducted to investigate the pollution level in the Karaçay branch of the Gediz River, the B of the water samples taken from four stations was found to be in the range of 0.134–3.937 ppm. Although there are no boron mines and geothermal water resources in the region, the boron value is low at the first station, which is far away from the residential areas and the industrial area, and above the limit values at the three stations after the industrial area (Minareci et al., 2009). While B was found between normal values in the water samples of Mardin province, B 1.186-2.433 ppm and above the specified normal values were measured in Topaktaş, Serpmetaş and Bezirhane villages in Van, while normal B levels were measured in the remaining 17 villages. But differences of the mean B levels of two city were significantly important ($p \leq 0.008$).

In a study conducted to evaluate the heavy metal content of drinking water in Konya, Cadmium (Cd) concentration in water samples taken from 50 points was determined as the lowest at 0.25 ppm and the highest at 1.42 ppm in a sample taken from Çumra district (Yalçın, 2005). Cd values were determined in the range of 0.0001-0.006 ppm in 20 water samples taken from different sources in the villages of Van province (Mert et al., 2017). In water samples taken from 15 selected points in the Marmara Region and its immediate vicinity, the Cd value remained below the detection limit of 0.006 µg/L (Poyraz, 2014). In this study, while Cd in the waters was at a very low level in the villages of Mardin province, it was found to be higher than the accepted Cd values, such as 5.494 ppb in Yassıtepe and 9.994 ppb in Tabanlı village as 2 villages of Van province. But differences of the mean Cd levels of two city were significantly important ($p \leq 0.001$).

Copper (Cu) concentrations were found to be 0.0047-0.01323 ppm in drinking water samples taken from 11 different points during two periods of the year in Aksaray province (Hınıs, 2007). Cu was not detected in 16 of 18 points from which drinking water samples were taken from the Erciş district of Van province, 1-6 ppm Cu was detected in 2 samples (Atıcı et al. 2016). In another study conducted in Van, the Cu amounts of water samples taken from 20 points were determined in the range of 0.0033-0.031 ppm (Mert et al., 2017). In this study, Cu concentration was determined at normal levels in the drinking water of the villages of Mardin and Van provinces ($p>0.18$).

In the drinking water samples taken from 50 selected points in the city center and districts in Konya region, the

highest manganese (Mn) value was found at the level of 23.81 µg/L in Karapınar district and the lowest Mn value was found at the level of 0.82 µg/L in the sample in Çumra district (Yalçın, 2005). In 4 of the 15 drinking water points in and around the Marmara Region, the Mn level remained below the detection limit of 0.012 µg/L. Manganese concentrations in the remaining 11 points ranged from 0.02 to 6.32 µg/L (Poyraz, 2014). Manganese level in the villages of Mardin province was determined between 2.356µg/L, while the values of 23.84 µg/L in the villages of Van province are below the critical amounts specified in TS 266. But differences of the mean Mn levels of two city were significantly important ($p \leq 0.090$).

Nickel (Ni) was detected in 22 of 50 sampling points in the drinking waters of Konya region, the highest (15.2 µg/L) Ni in Beyşehir district and it was also found in the other 21 points as 0.01-3.46 µg/L (Yalçın, 2005). In another study conducted in Konya again, Ni (22.76 µg/L) was detected only in the waters of Kadınhanı district in the July-August period in water samples taken from 11 different points in 3 different periods in a year (Tofan, 2008). In this study presented, Ni was found to be within acceptable limits only in samples in Mardin province (0.534-1.6525 µg/L), while it was not detected in the waters of Van province villages.

When the seasonal lead (Pb) levels of the samples taken for 12 months in Horohon stream water, which provides the water needs of some settlements within the borders of Sivas province, are evaluated, the Pb value is at the highest level in winter and September (Mutlu et al., 2013). Lead was not found within the detectable limit in all of the analyses in the water samples taken from the centre and its districts of Konya (Tofan, 2008). In this study, Pb amounts within acceptable limits were determined in the villages of Mardin province (2.316-6.806 µg/L). However, in Serpmetaş village of Van province, the Pb value of 15.565 µg/L is above the accepted limits according to TSE and its use is harmful. Again, values approaching 10 µg/L are noted in the villages of Tabanlı and Süphan. When the human health and nervous system effects of Pb are evaluated, the quality of the waters in some villages of Van province is disputable.

Cobalt (Co) concentrations in the water samples taken every month for a year from 3 selected stations in Aksu Stream, which is an important drinking water source in Giresun, were found as 0-2.6 ppb at the 1st Station; 0-2.4 ppb in 2nd Station and 0-1.6 ppb in 3rd Station. (Tunç Dede and Sezer, 2017). Cobalt values were found in the range of 0.0001-0.011 ppm in 13 of 20 water sources used for livestock in the villages of Van (Mert et al., 2017). In the study, presented, Co levels ranged between 0.085-0.01 ppb in samples taken from Mardin province, while it was found to be slightly higher between 1.935- 0.286 ppb in the waters of Van province's villages. In terms of Co, the waters of Mardin province seem to be better (Table 1). But differences of the mean Co levels of two city were significantly important ($p \leq 0.003$).

Selenium (Se) was detected in the range of 0.0006-0.013 ppm in 13 of 20 separate water sources in rural areas in Van (Mert et al., 2017). While Se in the water samples of Mardin province was in the range of 5.15-0.58 ppb, the highest was determined as 5.15 ppb in the waters of Aşağı Azıklı village and below the reference values. In samples taken from Van province, the lower and upper limits (4.82-0.246 ppb) are lower than the values in Mardin (Table 1).

Zinc (Zn) levels of drinking water samples taken from 18 points in Erciş district of Van province were determined in the range of 0- 0.04 ppm (Atıcı et al., 2016). In the present stud, Zn levels in the waters of 20 villages of Mardin province vary between 0.42-52.32 ppb, and in Van water samples between 0.85-157.46 ppb. But differences of the mean Zn levels of two cities were significantly important ($p \leq 0.033$).

Magnesium (Mg) values of 20 different water sources in villages connected to Van were determined in the range of 30.07-5.645ppm (Mert et al., 2017). The Mg detected in water samples taken from 18 points known to be used as drinking water in Erciş district of Van province was calculated within the limits of 3.2-45.4 ppm (Atıcı et al., 2016). The mean Mg level of 164 water samples from storages and tap waters in the central and districts of Bitlis province was determined as 3.81-8.06 ppm (Alemdar et al., 2009). Magnesium amounts were found to be in the range of 61.325-9.404 ppb in water samples taken in Mardin province and 54.75-21.12 ppb in Van villages and very close to each other. Differences of the mean Mg levels of two cities were not important ($p > 0.096$).

The pH values of the water samples taken from 18 points commonly used as drinking water in the Erciş district of Van province were determined in the range of 6.03-7.98 and the pH average of the waters was calculated as 6.95±0.12 (Atıcı et al., 2016). Again, the pH levels of different water sources used in livestock farming in Van were found to be in the range of 7.73-8.09 (Mert et al., 2017). The pH values of the Mardin and Van water samples were found in the range of 6.13-8.62 and 7.32-7.92, respectively (Table 2). Based on these results, it is seen that the waters of Van province are more homogeneous in respect of pH. Differences of the mean pH levels of two cities were significantly important ($p \leq 0.001$)

The conductivity levels of drinking water of 55 neighborhoods in Denizli, measured at different periods, were determined at the lowest values of 300 µS/cm and the highest values of 1068 µS/cm. The average conductivity levels of the neighbourhoods in different periods were found to be between 400-800 µS/cm (Fakir, 2012). The electrical conductivity levels of drinking water taken from 11 different sources in Aksaray were determined in the range of 216-742 µS/cm in the April-May period, and in the range of 183-946 µS/cm in the July-August period (Hınıs. 2007). In this study presented, the difference in the conductivity values of the drinking water of the two provinces was found to be significant, while the highest value was measured as 1786 µS/cm in a sample taken from Bezirhane Village in Van. When the average values were examined, the conductivity levels of drinking water in Van were found to be higher than those found in Mardin ($p \leq 0.001$).

The TDS values of water samples taken from 51 boreholes in Ergene basin were determined in the range of 125-620 ppm (Kaykıoğlu and Ekmekyapar, 2005). TDS values were measured in the range of 21- 319 ppm in surface water samples taken during the rainy period in Trabzon (Gultekin et al, 2012). TDS values were determined as the smallest at 14.20 ppm, the largest at 42.10 ppm, and the average 28.28±0.43 ppm in water samples taken from the Fırtına Stream within the borders of Rize province, from 7 stations determined monthly on the stream for a year (Gedik et al., 2010). In terms of TDS values, 668.2-128.5 ppm values were determined in the villages of Mardin province and 1271-336.2 ppm values

were determined in the water samples of the villages of Van province. These values seem to be quite high from the studies mentioned above. I differences of the mean Zn levels of two cities were significantly important ($p \leq 0.002$). It has been determined that the waters of Mardin province are of better quality in terms of colour, odour and turbidity, and the water samples of Van province are not in good condition in terms of these 3 parameters. As a matter of fact, colour was detected in 3 villages and turbidity was detected in the waters in 5 villages (Table 2).

As a result, water samples taken from different settlements of these two provinces in the east of Turkey in terms of fluoride and phosphate resources were compared. A detailed study was carried out examining 7 parameters by ion chromatography, 11 parameters by AAS, 6 parameters by Ultrameter II device, 3 parameters by sensory, a total of 27 parameters. It was emphasized that remarkable issues and detected defects in water samples taken from 40 different points in Van and Mardin provinces should be reported to local governments, environment and public health units and that the elimination of these defects is important for the residents of this region to have the same citizenship rights as those residing in other places, with the conditions of nutrition, living and welfare.

Conflict of Interest

The authors declare that they have no competing interests.

Authorship contributions

Concept: N.M., N.G., Design: MG.B., N.G., Data Collection or Processing: H.M., MG.B., N.M., Analysis or Interpretation: N.M., N.G., MG.B., Literature Search: H.M., N.M., Writing: MG.B., N.M.

Financial Support

This research was supported by the Directorate of Scientific Research Projects of Van Yüzüncü Yıl University as a project numbered TYL-2018- 6906.

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