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A Study on the Microbial and Chemical Quality of Drinking Water in the Rural Areas of the Central District of Boyer-Ahmad, Iran

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Water is an initial necessity for living and one of the most useful substances in nature which is vital for human living and civilization. Therefore, it is important for everybody to be aware of the quality of water. The objective of the present study was to determine the microbial and chemical quality of drinking water in the rural areas of the central district of Boyer Ahmad. The present descriptive sectional study was performed in the rural areas of the central district of Boyer Ahmad. In this research 79 samples were tested for microbial quality study, and 21 for chemical quality study. The obtained results were analyzed using SPSS software. Based on the analysis of the tests, it was specified that in 100 percent of cases, the concentration average of measured chemical (Except remaining chlorine and floured) and microbial (fecal coliform) parameters in the standard limit, but 24% of measured microbial cases contained coliform. With respect to the fact that acceptable quality and quantity of drinking water is a very important matter that people are facing with, and on the other hand, it becomes a more serious problem over time, by increase of population and polluting sources such as industries and agriculture, a fundamental consideration to the matter is necessary with respect to the fact that the highest. Contradiction is in the chlorination rate of drinking water; therefore it could be evidence of incorrect management and in affection, the improvement of water resources and observance of standards of drinking water is necessary to prevent contamination of water to other coliforms.

Keywords: Drinking water, Chemical quality, Microbial quality, Boyer-Ahmad.

Water is not found pure in nature , but it always contains same salts , suspended mattes and dissolved gases , which cause different peculiarities of water in different regions. Existence of some salts in water is necessary for human health and this is while excessive quality endangers human health.[1, 2] Recently, the water crisis has bean introduced as a great global problem due to population growth , reduction of pen capita reserves of water resources , and physical, chemical and microbial contamination of water ,[3] so that some 45 million people are facing water – shortage in 29 countries of the world , and the mast water related concerns are in dry and semi- dry regions , and more than 80 percent of diseases originate from water across the world .[4]

According to WHO report (2006) 2.2 million in 4 milliard annual diarrhea cases are due to unavailable safe drinking water.[5,6,7] Also according to WHO water used for drinking must

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be without organisms, and chemicals dangerous for human health .Moreover the quality require mantes of water storage for drinking is a mast, situations, building, usage inspection, storage and distributing system. It should be protecting the water against any contamination.[8] Although, human activities in different sectors of industries agriculture and other services have resulted in generation of carious waste waters, some of which are inevitably evacuated to the ground and find their ways to underground water resources .[9,10]

Due to distinctive ecological peculiarities , the rural environment of Iran has a verity of spatial structures, factors such as climate lowness and highness, physical conditions of ground, water resources and other natural factors, have been quite effective in formation of rural spaces and establishment of villages. Scattered villages in view of unequal geographical distribution and distance of residences have made it difficult to provide distribute and protect the quality of water the villages . The water providing networks and antiseptic systems in villages are often tributary and old lack of correct supervision with respect to the rural texture nearness of live stocks and human scattered waste mattes in the environment and low level of public health diminished the quality of water . Shortage or lack of experienced and efficient manpower and fiscal shortage are among the obstacles of timely accomplish meat of development plans in the rural water providing sector.[11]

The remarkable matter in the management of providing drinking water is to control quality and prevent the outbreak of water transmitted diseases. With the same objective a study on microbial and chemical quality of drinking water in the rural areas of the central district of Boyer Ahmad will show the quality status of drinking water in those areas and the performance of authorities field because the rural areas are partly covered and partly not covered by the rural water and waste water company.

MATERIALS AND METHODS

The present descriptive cross-sectional study was performed in the rural areas of the central district of Boyer Ahmad.

Initially the basic data was collected from the rural water and the waste water company and relevant organizations on number of villages, water installations system and also population distribution. With respect to the fact that the highest probability of contamination is at the ending points of the network, judgmental sampling was used instead of random sampling.

Then microbial and chemical sampling was performed in the selected villages (50 villages), so that for testing two samples from each selected villages were collected, one from the distributing network (tap) and another from the water storage. Also for chemical tests one sample was collected from the water storage. With respect to the fact that is some cases drinking water of several villages come from the same source, so in total 79 microbial samples and 21 chemical samples for microbial tests were determined based on WHO standard and population of villages.

The samples were transferred to laboratory in proper condition, and tests were performed in accordance with the latest edition of the book "Standard Methods[12]". The studied microbial parameters included total coliforms and fecal coliforms (in a 9 tube fermentation method). Also for chemical tests one sample was collected from each drinking water supply. The following parameters were assessed (based in the book standard methods): alkaline level, hardness, calcium chloride, magnesium (titration method), fluoride, phosphate and sulfate, nitrate (by spectrophotometer model DR-5000), sodium, potassium (by flame photometer, model JENWAY PFP7), turbidness, bicarbonate, remains of chlorine and PH. Before using all the tools and machines, assurance was made of the calibrations. Moreover to study the correctness of analysis ionic equilibrium was studied for each sample. Ionic equilibrium means the time when the total of conational cations and anions of water (expressed in terms of milliequivalent per liter), must be in the equilibrium status . The difference percentage is calculated using formula 1 i.e. Difference percent = (Total of cations – Total of anions) ÷ (Total of cations + Total of anions) × 100.

Ultimately the data were compared using Excel and SPSS software with the items mentioned by lraninan institute of standard and industrial

research, guidelines of US Environment Preservation Administration (USEPA), World Health Organization (WHO) and European Economic Community (EEC).[13]

RESULTS

The objective of present study was to determine the microbial and chemical quality of drinking water in the rural areas of the central district of Boyer Ahmad and determine the rate of rural population having healthy drinking water in view of microbial and chemical contamination and also the function of authorities in this field .

Table 1. Percentage of acceptable difference between total of cations and anions of water

Total of anions (Milliequivalent per liter)	Acceptable difference[1] (Percent)
0-3	± 0/02
3-10	± 2
10-80	± 5(Endnotes)

[1] Peavy H, Rove DR, Chebanoglas J. Environmental engineering. Trans. Ebrahimi S, Keynejad MA. Tabriz, Iran: Sahand University Press; 1996. p. 35-42. [In Persian].

The microbial and chemical quality of drinking water is separately provided in this section. The studied sources of drinking water in the covered villages included to springs, and 17 walls, and also in the uncovered villages included 6 springs and 17 wells, the status of which in microbial and chemical view is pointed in Tables 1-6.

The ratio of collected samples in the covered villages with healthy drinking water were significantly less than the uncovered villages. It is a necessary to be mentioned that of 13 samples with coliform in the covered villages, 7 samples were from springs and 6 from wells. Also of 7 samples with coliform in the uncovered villages 5 samples were from springs and 2 from wells.

DISCUSSION

In the research the microbial and Chomical quality of drinking water studied in the villages of the central district of Boyer Ahmad based on three factors: total coliform, fecal coliform, and chemical quality. Furthermore, with respect fact that the supervision of Boyer Ahmad rural water and sewerage company covers only a number of villages, we also studied the different of

Table 2. Microbial quality of drinking water sources in the covered and uncovered villages and all studied villages

Status		Covered rural water sources		Uncovered rural water sources		
	Unit	Spring	well	spring	well	Total
Users of water with coliform contamination	Per person	2285	10250	753	69	13358
	(%)	(17.1)	(76.7)	(5.7)	(5)	(100)
Users of water without coliform contamination	Per person	20953	21236	2612	4213	49614
	(%)	(42.2)	(42.8)	(5.3)	(9.7)	(100)
Total	Per person	23238	31487	3365	4882	62972
	(%)	(36.6)	(50)	(5.3)	(7.8)	(100)

Table 3. Contamination status of water in separation of covered and uncovered villages

Type of village	No coliform in the water sample	Coliform positive in the water sample	Number of sample
Covered	34	13	47
Uncovered	25	7	32
Total	59	20	79

microbial and chemical quality of drinking water in the covered and uncovered villages.

According to the results in hundred percent of cases (in the covered and uncovered villages by rural water and sewerage company) the results were negative for fecal coliforms. In accordance with Irainan standard for drinking water, the number of fecal coliform bacterium in drinking water should be zero while in 2006 the indicator of microbial quality of rural drinking water in Iran was estimated to be 93.07% in view of absence of fecal coliform bacterium.[14]

Table 4. Population with access to healthy water in separation of covered and uncovered villages

Village	Population of contaminated water		Population of healthy water		
	Number	percent	Number	Percent	Total
Covered	12536	22.9	42189	77.1	54725
Uncovered	822	10	7425	90	8247
Total	13358	21.2	49614	78.8	62972

Fisher P= 0/28

Table 5. Analysis results of different measured parameters of water in the villages of the control district of Boyer Ahmad, Iran

Parameter	Maximum (mg/liter)	Average (mg/liter)	Minimum (mg/liter)
Chloride	15.7	12.23	7
Sulphate	236	88.24	6
Fluoride	0/7	0/27	0/14
Bicarbonate	363.6	256.71	139.1
Nitrate	2.6	9.22	1.7
Calcium	156	73.02	37
Magnesium	32	15.90	7.4
Sodium	8	4.19	1
Potassium	1.2	0/57	0/1
General hardness	523.2	248.85	140.2
Calcium hardness	39.	182.54	92.4
Magnesium hardness	133.2	66.30	31
Level of Alkaline	298	210.41	114
Solid dissolute substance	661.9	282.81	149.7
PH	7.9	7048	7.1
Remained chlorine	0/17	0/01	0

Table 6. The average number of total coliform and fecal coliform in the studied samples

Number of samples	Number of Total coliform (MPN/100ml)	Number of fecal coliform (MPN/100ml)
60	0	0
11	1-10	0
4	11-30	0
4	>31	0

A study by lamka et al on private wells and spring water belong to 78 families in a modern village, showed that 35% of house water sources had coliform , and fecal coliform contamination.[1] Furthermore, Sardar Khan et al reported the coliform bacterial contamination (2–5 MPN 100 mL^{-1}) in some sources of water in Charsadda district, Khyber Pakhtunkhwa, Pakistan, which confirming the bacterial contamination of drinking water.[2]

The results of tests showed coliform contamination in 24 percent of samples. In other words 77.1% of population in covered villages and 90% of population in the uncovered villages, and in total 78.8% of population in all villages had coliform - free healthy drinking water.

A study by Souri et al on microbial quality of water supply system of 35 villages under company showed that 78.3% of water sources in the water supply system (net work) were without contamination and in other cases the problem of water contamination was also removed through continuous chlorination and drinkable water obtained.[3]

The results of a study (2010) of chemical quality of drinking water in the rural areas of the central district of Boyer Ahmad also show the claim that in hundred percent of cases, the average concentration of chemical parameters (Except fluoride and chlorine) is in the limits of national and international standards, so that the minimum concentration of fluorine was 0.14 mg/l, and maximum 0.7 mg/l, which are much lower than the minimum provided standard. It is substantiated that for dental health, the desirable concentration of fluoridation in water sources is about 1mg/l and in case of reduction of this concentration dental decay will become an intensive problem on the contrary in case of increase fluoridation, dental fluorosis will cause problem.[4]

The results of this research showed the at chlorination status of water sources are quite undesirable, so that the average residue of chlorine in water was reported to be 0.01 mg/l, while, the results of a study by Hashemi and Hajizasdeh (2005) on water of 432 village in the province of Ilam showed that the residue of chlorine was desirable in 74.78% of rural areas.[5] Therefore, desirable rate of antiseptic (0.2-0.8) is necessary because desirable rate of residue chlorine prevents the secondary contamination of drinking water.

With respect to the fact that a remarkable amount of budget is spent to provide water in rural areas, it seems that because of lack or shortage of specialist manpower, the supervision over existing water sources is not efficient. Therefore, some arrangements must be taken in to consideration, such as establishing specialist committees of rural water hygiene, consisting of provincial and local members, planning for develop out of chlorination stations, enabling reliant personnel (preferably native people), preserving drinking water sources and distributing networks, translating technical and managerial documents needed, simplifications, standardization documents needed, simplifications and standardization of applied technologies. Because at present the rural water and sewerage company has not a proper role in providing healthy drinking water in view of microbial quality.

Generally speaking, the microbial and chemical quality of drinking water in the rural areas of the central district of Boyer Ahmad is at the national standard level. There is a remarkable difference in the microbial and chemical quality of water in the villages covered and uncovered by the rural water and sewerage company, so that the status of uncovered villages were better in coliform contamination than covered villages. While in a study by Heidari et al.[17] the status of covered villages of Kashan city was reported to be better in coliform contamination showing that the supervision of rural water and sewerage company has been the cause.

The most (highest) contradictions are in chlorination rate of drinking water which could be an evidence of improper management of water distributors and their inattention to the matter. Meanwhile improvement of water sources is necessary to prevent contamination to other coliforms and observing standards of drinking water for users of water sources.

With respect to the results of this study, it is recommended that relevant authorities and researchers put the following items in the priority of their plans.

Special attention to improvement of water sources with the purpose of preserving health of users.

Giving proper education to water

distributors for chlorination and preserving water reservoirs.

Continuous supervision and control aver P.T.O chlorination system of water sources.

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