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Research Article

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Microbial quality of drinking water in rural areas of Marivan city, Iran

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ABSTRACT

Microbial Safe drinking water supply has always been a main challenge for authorities in rural areas. The aim of this study was to investigate the microbial quality of drinking water distribution system in rural areas of Marivan city, Iran. The sampling was performed in a 12 months period from March 2010 to February 2011. Totally samples were collected during a 12 months period. At the site, 250 ml polypropylene bottle containing 0.4 ml of a 10% sodium thiosulfate solution was used for collecting water samples and transported to laboratory in 6 h and 4°C. In order to determine the quality of water, the turbidity, free residual chlorine, total and fecal coliform were analyzed. The result showed that the minimum and maximum of pH were 6.8 and 7.8 respectively. In 95% of samples residual chlorine was between 0 and 0.8 mg/L. The MPN of total coliforms was in the range of 0 to 1100/100 mL. The amount of fecal coliforms in 95% samples was lower than 23 MPN/100 mL. The maximum value of turbidity was 113 NTU. It is necessary to monitor carefully chlorination practice in drinking water distribution system of Marivan city and to ensure that the residual chlorine is available at consumer end.

Keywords: Turbidity, Residual Chlorine, Total coliform**,** Monitoring**,** Water quality, fecal coliform

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INTRODUCTION

One of the main principals of drinking water supply infrastructure is the provision of microbially safe drinking water (1). Thus, the drinking water monitoring from source to tap is a crucial step towards hygiene safety (1). Drinking water quality is affected by the specific composition and activity of microbial populations present during water treatment, storage and distribution(2). In developing countries, prevalence of waterborne disease due to microbiologically poor quality of water was reported by several studies (3). The provision of Safe drinking water for a community is related to many factors such as quality of the source water, mouth size and coverage of the vessel, design of the vessel, material of the vessel, transport distance from source and personal hygiene in handling of water(3). In developing countries particularly among young children, insecure drinking water is the most important cause for the waterborne disease (3). In spite of worldwide efforts and modern technology being utilized for the

production of safe drinking water, The transmission of waterborne diseases is still a matter of major concern(4). This problem is not specific to the developing world where water treatment may not exist or is inadequate (4). There may also be contamination during storage, a lack of regulations and limited understanding and awareness among the population (4). Water quality is often related to the degree of bacterial contamination (4). According to the World Health Organization (WHO) and European Council directives, a concentration of microorganisms, parasites or substances posing a possible risk to human health has to be prevented (1). Improper protection of water distribution system may lead to an increased incidence of waterborne diseases as a result of increased exposure to pathogenic microorganisms and, thus, pose risk to human health(5).The routine monitoring of drinking water can assure the populace that the quality of their drinking water is adequate(6). It can also be important to detect deterioration in the quality of drinking water and facilitate appropriate timely corrective actions with minimal negative impact on the health of the populace(6).The aim of this study was to investigate the microbial quality of drinking water distribution system in rural areas of Marivan city, Iran.

EXPERIMENTAL SECTION

The sampling was performed in a 12 months period from March 2010 to February 2011. Drinking water resources in Marivan city are deep and semi-deep wells and springs. Totally samples were collected during a 12 months period. The sampling sites of the study were selected based on general microbial quality, age and turbidity levels of water and construction and layout of distribution system. The water sampling program was performed according to the WHO guidelines for water sampling. At the site, 250 ml polypropylene bottle containing 0.4 ml of a 10% sodium thiosulfate solution was used for collecting water samples and transported to laboratory in 6 h and 4°C. Before the sampling, the sampling bottles were sterilized in autoclave apparatus. In order to determine the quality of water, the turbidity, free residual chlorine, total and fecal coliform were analyzed in the central water laboratory of Marivan city. All of the examination was performed according to standard methods for the water and wastewater examination (7).The obtained results were analyzed using SPSS and Excel software and for the comparison between average parameters ANOVA test was used.

RESULTS

The minimum, maximum, mean and standard deviation of measured parameters in villages of marivan city have shown in table 1. The minimum and maximum of pH were 6.8 and 7.8 respectively. The lowest mean pH was observed in April month. In 95% of samples pH was between 6.8 and 7.4(Fig. 1). The amount of residual chlorine of samples was in the range of 0 to 8 mg/L. in 95% of samples residual chlorine was between 0 and 0.8 mg/L. fig. 2 show the amount of residual chlorine of Marivan villages in different months.

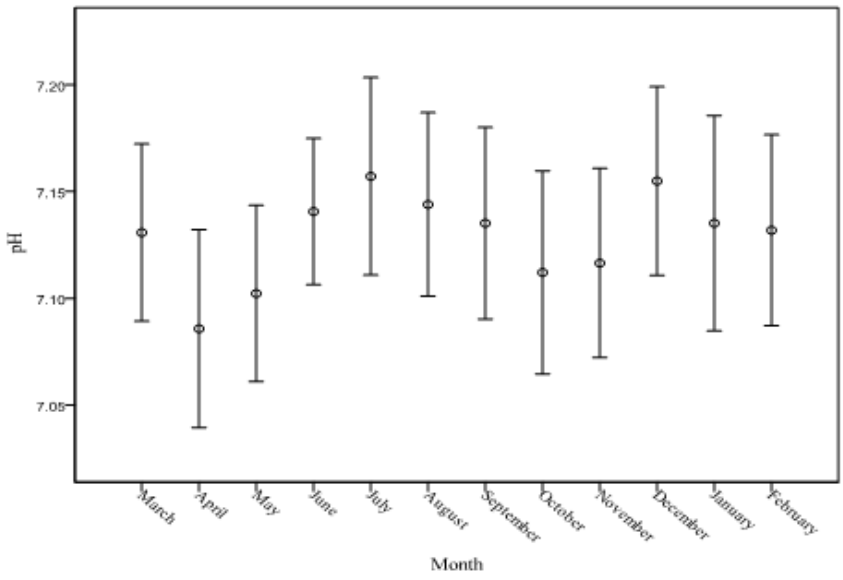

Fig. 1: Variations of pH of Marivan's villages in different months

Table 1: minimum, maximum, mean and standard deviation of measured parameters in villages of Marivan city

Months	pH				Residual Chlorine (mg/L)				Total Coliforms(MPN/100 ml)				Fecal Coliforms(MPN/100 ml)				Turbidity (NTU)			
	Min.	Max.	Mean	S.D.	Min.	Max.	Mean	S.D.	Min.	Max.	Mean	S.D.	Min.	Max.	Mean	S.D.	Min.	Max.	Mean	S.D.
March	6.8	7.8	7.13	0.19	0	1	0.205	0.27	0	1100	28.98	123.6	0	240	9.66	39.5	0.35	59	1.799	6.08
April	6.8	7.8	7.08	0.22	0	0.8	0.207	0.26	0	460	19.49	72.4	0	150	7.1	27.6	0.23	93	2.181	9.63
May	6.8	7.6	7.10	0.19	0	1.5	0.249	0.34	0	460	19.62	65.6	0	150	4.26	22.3	0.41	2.46	1.051	0.42
June	6.8	7.6	7.14	0.16	0	1.5	0.22	0.31	0	1100	23.58	120.7	0	150	5.47	26.9	0.58	91	4.079	14.6
July	6.8	7.8	7.15	0.22	0	1.5	0.302	0.36	0	460	9.97	48.9	0	38596	463	4045.6	0.1	113	4.28	16.4
August	6.8	7.8	7.14	0.20	0	1.5	0.22	0.28	0	460	25.2	73.4	0	240	7.54	33.7	0.26	14	1.32	1.55
September	6.8	7.8	7.13	0.21	0	1.5	0.21	0.29	0	1100	27.37	123.7	0	240	11.27	44.8	0.16	2.75	1.14	0.53
October	6.8	7.8	7.11	0.22	0	8	0.86	2.03	0	1100	41.65	145.4	0	150	3.44	17.2	0.23	3.57	1.13	0.57
November	6.8	7.8	7.11	0.21	0	1.5	0.24	0.3	0	240	18.61	52.4	0	150	2.56	16.4	0.26	3.23	1.12	0.6
December	6.8	7.8	7.15	0.21	0	1.5	0.21	0.3	0	460	23.11	69	0	150	2.4	16	.26	6.34	1.2	0.96
January	6.8	7.8	7.13	0.24	0	5	0.295	0.58	0	460	16.68	61.6	0	240	3.11	25.2	0.07	8.03	1.35	1.13
February	6.8	7.8	7.13	0.21	0	0.8	.021	0.26	0	93	4.04	13.2	0	43	.077	4.64	0.28	3.91	1.15	0.64

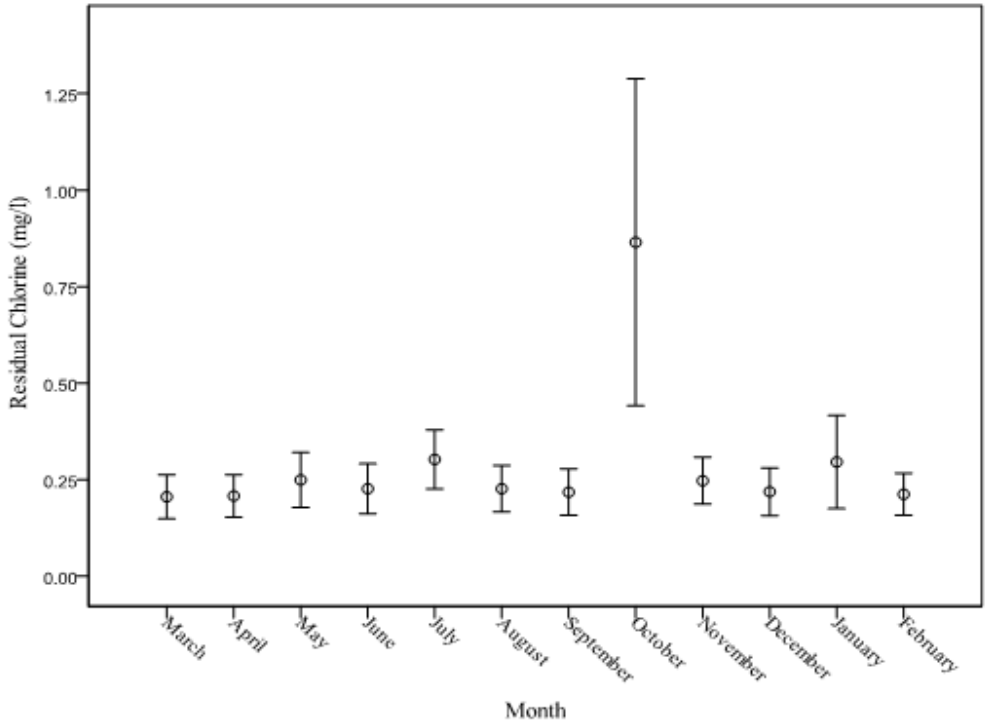

Fig. 2: variations of residual chlorine of Marivan's villages in different months

The MPN of total coliforms was in the range of 0 to 1100/100 mL. In 95% of samples TC was lower than 150 MPN/100 mL(Fig. 3). The amount of fecal coliforms in 95% samples was lower than 23 MPN/100 mL. The mean and standard deviation was 40.64 and 1168.2 MPN/100 mL respectively. The maximum value of turbidity was 113 NTU. In 95% of samples turbidity was lower than 2.43 NTU (Fig.4).

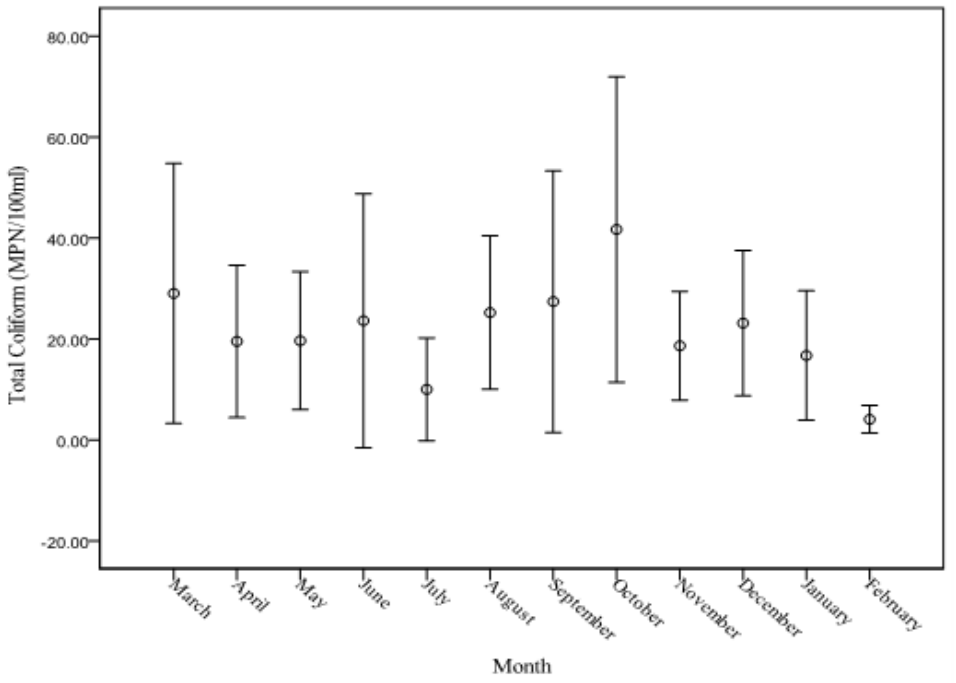

Fig. 3: variation of Total coliforms Marivan's villages in different months

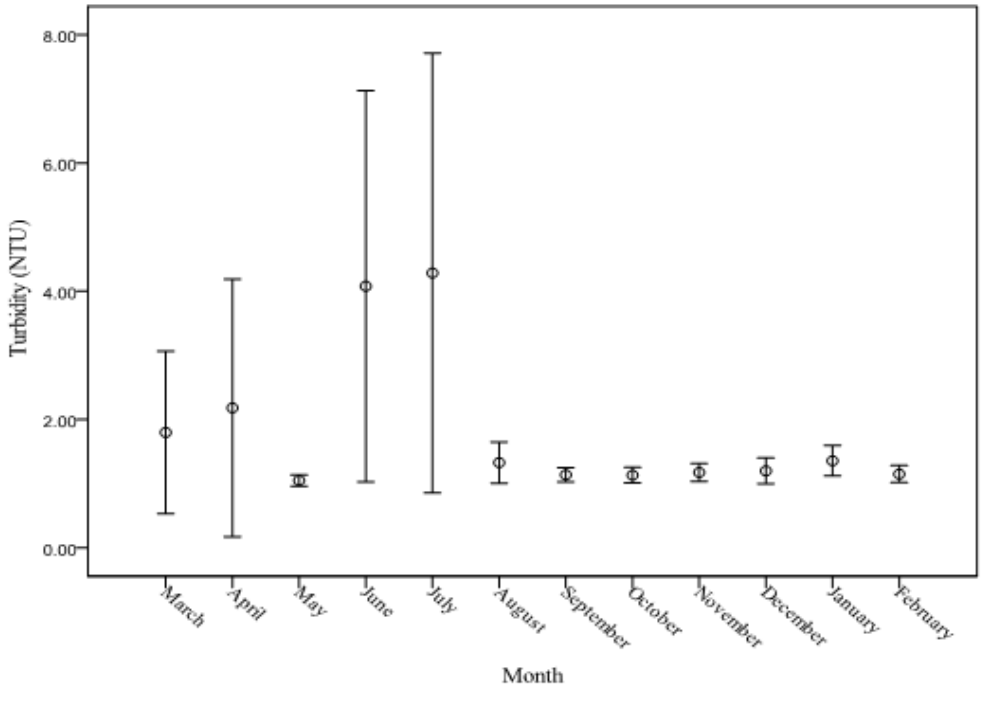

Fig. 4: variation of Turbidity of Marivan's villages in different months

DISCUSSION

The amount of pH in any point of water distribution system in Marivan city was between 6.8 and 7.8. According to WHO and Iranian drinking water standards, the optimum limit of pH is between 6.5 and 8.5(8, 9). All of the pH values are in the range of the WHO permissible limit and Iranian drinking water standards. These results are in

accordance with those found in other studies (10,11). The results showed that the value of residual chlorine in Marivan varies from 0 to 8 mg/l. According to Iranian drinking water standard, the minimum concentration of residual chlorine in any point of distribution system is in the range of 0.5 to 0.8 mg/l. but in epidemic conditions and disasters it must be 1 mg/l(9). Therefore, in Marivan city, the mean concentration of residual chlorine was lower than Iranian standards except in October month. Similar results have also been reported by Farooq et al. they found residual chlorine in the range of 0.8 to 1.7 mg/l in drinking water distribution system of Rawalpindi, Pakistan (12). According to WHO guidelines, amount of free residual chlorine has no any harmful effect on human health up to 5 mg/l (8). The turbidity can be significantly influenced on microbiological quality of drinking water (12). The turbidity was highest value of 113 NTU in July and lowest value of 0.07 NTU in January. Turbidity can protect opportunistic microorganisms and pathogens against chlorination. Optimum and maximum permissible level for turbidity in drinking water are 1 and 5 NTU based on Iranian drinking water standards (9). The mean turbidity of drinking water in obtained samples was in the range of permissible level. The study conducted by Zacheus et al showed that turbidity and soft deposits are the key site for microbial growth in drinking water distribution networks (13). Waters with high turbidity from organic sources also give rise to a substantial chlorine demand and for disinfection purposes. This could cause reductions in the free chlorine residual in distribution systems as protection against possible recontamination. Increased prechlorination dosage requirements are strongly correlated with increases in turbidity (10). The biological contamination of drinking water can be duo to the presence of coliform organisms (10). Iranian drinking water and WHO standards recommend 0/100 ml for total and fecal coliforms(8,11). High rate of total and fecal coliforms is probably duo to a failure in the transport water system, lack of sanitation in water resources such as the springs and well, lack or failure in chlorination system. The coefficient of spearman was used to evaluate the correlation among different parameters. The results showed that the effect of changes for residual chlorine was significant on total and fecal coliforms (p-value < 0.001). Evaluation of data obtained showed that samples collected in July were more contaminated with fecal coliforms than those other months. It is important to note that turbidity indicates the presence of organic suspended material which promotes the growth of micro-organisms (11). In addition as the chlorine residual decreased, there was a statistically significant increase in total and thermo tolerant coliforms(10).

CONCLUSION

The drinking water quality monitoring in the distribution network is one of the most important parts of quality control. This study showed that following conclusions can be drawn on microbial quality of drinking water in Rural Areas of Marivan city.

- All of the mean pH and turbidity values in this study were found within the permissible limits of the WHO and Iranian water quality standards.
- The amount of residual chlorine in 90.3% of water samples was lower than standard level.
- 26.3 And 11.2% of total and fecal coliforms of samples were higher than standard level respectively.
- The results of this study will help government to monitor carefully chlorination practice in drinking water distribution system of Marivan city.
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REFERENCES

[1] Sebastian Volker, Christiane Schreiber, Thomas Kistemann. *International Journal of Hygiene and Environmental Health*, **2010**, 213, 204–209.
[2] Anca Farkas, Mihail Dragan-Bularda, Vasile Muntean, Dorin Ciataras, Stefan Tigan. *Cent. Eur. J. Biol*, **2013 ,**8(2) 201-214.
[3] Vaithiyanathan Lavanya & Seetharaman Ravichandran. *India. J Public Health*, **2013,** 21:481–488.
[4] Marie Eliza Zamberlan da Silva, Rosangela Getirana Santana, Marcio Guilhermetti, Ivens Camargo Filho, Eliana Harue Endo, Taˆ nia Ueda-Nakamura, Celso Vataru Nakamura, Benedito Prado Dias Filho. *Int. J. Hyg. Environ. Health*, **2008,** 211 504–509.
[5] Shakhawat Chowdhury. *Environ Monit Assess*, **2012**, 184:6087–6137.

[6] Abua Ikem, Seyi Odueyungbo, Nosa O. Egiebor, Kafui Nyavor. *The Science of the Total Environment*, Ž**2002**, 285, 165_175.
[7] APHA. Standard methods for the examination of water and wastewater, 20th edn. American Public Health Association. American Water Works Association, **1998.** Water Environment Federation Publication, Washington, DC.
[8] WHO. Guidelines for Drinking-water Quality. fourth edition. **2011**. Switzerland.
[9] Iranian institution for standard and economic research. Physical and chemical properties of drinking water. **1997**: Standard No: 1053.
[10] Imran Hashmi, Shaukat Farooq, Sara Qaiser. *Environ Monit Assess*, **2009,** 158:393–403.
[11] Iranian institution for standard and economic research. Microbial properties of drinking water. **1997**: Standard No: 1101.
[12] Shaukat Farooq, Imran Hashmi, Ishtiaq A. Qazi, Sara Qaiser, Sajida Rasheed. *Environ Monit Assess*, **2008,** 140:339.
[13] Zacheus, O. M., Lehtola, M. J., Korhonen, L. K., & Martikainen, P. J. *Water Research*, **2001**, 35(7), 1757–1765.