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SM Journal of Public Health and Epidemiology

Research Article

Prevalence of *Escherichia Coli* in Drinking Water Collected From the Local and Municipal Water Supply in Zenica-Doboj Canton, Bosnia and Herzegovina

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Article Information

Received date: Sep 09, 2015
Accepted date: Oct 25, 2015
Published date: Nov 19, 2015

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Keywords *E. coli*; Coliforms; Drinking water

Abstract

Aim: To investigate prevalence of Escherichia coli in drinking water samples collected from municipal and local water supply in the period January 2013 to December 2013 in Zenica-Doboj Canton, Bosnia and Herzegovina.

Methods: A total of 1080 and 2206 water samples from municipal and local water supply were taken over one year from the Protocols of the Laboratory for Sanitary and Clinical Microbiology (Cantonal Public Health Institute of Zenica-Doboj Canton). Membrane filtration method was used for the analysis the samples of drinking water, according to International standards.

Results: Among total of 1080 water samples from municipal water supply, 59 (5.5%) were positive for Escherichia coli, while from local water supply, 560 (25.4%; out of 2206) were positive on E. coli. Fourty-five samples from municipal water supply (4.2%; out of 1080) were positive on coliforms, and 724 from local water supply (32.8%; out of 2206) were positive on other organisms.

The highest number of positive samples on E. coli from municipal and local water supply were from the municipality of Olovo, 30 (27.8%; out of 108), and the lowest was from the municipalities of Doboj-Jug and Usora, in each 12%, respectively.

Conclusion: Monitoring the microbiological quality of drinking water relies largely on examination of indicator bacteria such as coliforms, Escherichia coli, and Pseudomonas aeruginosa. Preventive activities and more frequent water sampling are necessary measures.

Introduction

The quality of drinking water has an important role in human infection and disease [1]. Water is the most vital and important matter for survival for many organisms [2].

Three of five people in developing countries have no access to safe drinking water [3], and only one of four people have some sort of water sanitation [3]. Only 15-20% of the world's population have access to drinking water (treated, chlorinated or uncontaminated water) [3]. Daily consumption is about 300 liters of water per person in cities with modern drinking water supply systems, while only 25 liters in developing countries [3]. Around 1.1 billion world population depend on unsafe sources of drinking water [3].

Escherichia coli is a member of the faecal coliform group and is a more specific indicator of faecal pollution than other faecal organisms [4]. Many countries were documented waterborne disease causing with the *E. coli* and other microorganisms [4].

Waterborne disease might account for one-third of the infections world-wide [5], while it is estimated that water, sanitation and hygiene were responsible for 40% of all deaths and 5.7% of the total disease burden occurring worldwide [5].

Several studies have documented the prevalence of *E. coli* in drinking water such as 10.0% in Iran [1], 7.4% in Netherlands [6] and 75.0% in South Africa [7], respectively.

The purpose of this study was to determine the prevalence of *E. coli* in drinking water from local water supply and municipal water supply in Zenica-Doboj Canton, Bosnia and Herzegovina.

Materials and Methods

Sample collection

Zenica-Doboj Canton is one of the ten cantons in Bosnia and Herzegovina with population of

Table 1. Distribution and prevalence of *E. coli* in drinking water from municipal water supply.

Municipalities in Zenica-Doboj Canton	Water samples from municipal water supply				
	Total number of samples tested	Number (%) of negative samples	Number (%) of positive samples	Number (%) of *E. coli* in samples	Number (%) others positive samples
Zenica	192	174 (90.6)	18 (9.3)	1 (5.6)	17 (94.4)
Kakanj	91	69 (75.8)	22 (24.1)	9 (40.9)	13 (59.1)
Visoko	76	70 (7.89)	6 (7.89)	2 (33.3)	4 (66.7)
Vareš	11	9 (81.8)	2 (18.1)	1 (50.0)	1 (50.0)
Breza	102	92 (90.1)	10 (9.8)	2 (20.0)	8 (80.0)
Doboj-jug	34	28 (82.3)	6 (17.6)	2 (33.3)	4 (66.7)
Tešanj	159	157 (98.7)	2 (1.25)	1 (50.0)	1 (50.0)
Zavidovići	286	207 (72.3)	79 (27.6)	34 (43.0)	45 (57.0)
Maglaj	42	41 (97.6)	1 (2.38)	0	1 (100.0)
Žepče	25	24 (96.0)	1 (4.0)	0	1 (100.0)
Usora	29	28 (96.5)	1 (3.44)	0	1 (100.0)
Olovo	33	15 (45.4)	18 (54.5)	7 (38.9)	11 (61.1)
UKUPNO	1080	914 (84.6)	166 (15.3)	59 (35.5)	107 (64.5)

477.868 and an area of 3904 square kilometers. Zenica-Doboj Canton consists of twelve municipalities, respectively.

The drinking water in towns is supplied from municipal water supply, while rural areas from local water supply.

In this study, total of 1080 drinking water from municipal water supply and 2206 drinking water from local water supply were examined over a period of one year from Jaunary 2013 to December 2013 in Laboratory for Sanitary and Clinical Microbiology (Cantonal Public Health Institute of Zenica-Doboj Canton). All samples were collected in 500 ml glass bottles containing 0.5 g of sodium-thiosulphate for dechlorination of the water.

Bacterial isolation

For detection and isolation of *E. coli*, 100 ml of water were filtered through 0.22 μm membranes (Sanatorius, Geottingen, Germany). Membranes were subsequently incubated on Chapman TTC Agar – Tergitol 7 agar (Scharlab, Spain) for 24 h at 37^{0}C. Five suspective colonies (yellow color) were transferred to Tryptic Soy Agar –TSA (Scharlab, Spain), incubated for 24 h at 37^{0}C, and tryptophan broth (Scharlab, Spain), incubated for 24 h at 44^{0}C. Oxydase negative test, citrate negative test, and indol positive test were indicating of *E. coli* [7].

Results

During the period January 2013 – Decembar 2013, a total of 1080 and 2206 water samples from municipal and local water supply were included in the study.

The culture technique showed that 166 (15.3%) out of 1080 water samples from municipal water supply, and 1284 (58.2%) out of 2206 water samples from local water supply were positive.

Among positive samples from municipal water supply, 59 (35.5%) were positive for presence of *E. coli*, respectively (Table 1).

The high prevalence of *E. coli* isolated from municipal water supply (34 out of 59; 57.6%) were detect in Zavidovic's town with the 38027 population.

Among other positive samples, 45 out of 107 (42.1%) were positive on *Enterococcus faecalis*, coliforms or other saprophytes in municipality Zavidovici (Table 1).

Generally, among total samples, 59 out of 1080 (5.5%) were positive on *E. coli*, and 9.9% on other organisms, respectively (Table 1).

Among positive samples from local water supply, 560 (43.6%) were positive for presence of *E. coli*, respectively (Table 2).

The prevalence of E .coli was in range 0.7% in municipality Doboj-Jug with the 4523 population to 20.0% in the municipality Tesanj with the 48427 population, respectively (Table 2).

Among total samples from local water supply, 560 out of 2206 (25.4%) were positive on *E. coli*, and 32.8% on other microorganisms (Table 2).

Discussion

In the present study a prevalence of *Escherichia coli* isolated from municipal and local water supply in Zenica-Doboj Canton, Bosnia and Herzegovina, for the first time, has been reported.

Escherichia coli is a member of the faecal coliform group and is a

Table 2: Distribution and prevalence of *E. coli* in drinking water from local water supply.

Municipalities in Zenica-Doboj Canton	Water samples from local water supply				
	Total number of samples tested	Number (%) of negative samples	Number (%) of positive samples	Number (%) of *E. coli* in samples	Number (%) others positive samples
Zenica	346	125 (36.1)	221 (63.8)	91 (41.2)	130 (58.8)
Kakanj	236	63 (26.6)	173 (73.3)	71 (41.0)	102 (59.0)
Visoko	361	172 (47.6)	189 (52.3)	72 (38.1)	117 (61.9)
Vareš	117	64 (54.7)	53 (45.2)	24 (45.3)	29 (54.7)
Breza	72	22 (30.5)	50 (69.4)	22 (44.0)	28 (56.0)
Doboj-jug	16	8 (50.0)	8 (50.0)	4 (50.0)	4 (50.0)
Tešanj	459	264 (57.6)	195 (42.4)	112 (57.4)	83 (42.6)
Zavidovići	190	49 (25.7)	141 (74.2)	60 (42.6)	81 (57.4)
Maglaj	211	90 (42.6)	121 (57.3)	52 (43.0)	69 (57.0)
Žepče	85	30 (35.2)	55 (64.7)	21 (38.2)	34 (61.8)
Usora	38	18 (47.3)	20 (52.6)	8 (40.0)	12 (60.0)
Olovo	75	17 (22.6)	58 (77.3)	23 (39.7)	35 (60.3)
UKUPNO	2206	922 (41.7)	1284 (58.2)	560 (43.6)	724 (56.4)

more specific indicator of faecal pollution than other faecal coliforms [9]. In developing countries with deteriorating environments, the demand for clean drinking water supply is growing rapidly in recent times [10]. Only, 40% of the total urban population has direct access to pipe water. Only about 10.3 million people are reported to have improved water supplies [11]. The potential of drinking water to transport microbial pathogens to great number of people causing subsequent illness is well documented in countries at all levels of economic development [12], which is the reason for monitoring of prevalence of *E. coli* in drinking water.

Our results showed that 5.5% and 25.4% samples from municipal and local water supply were positive on *E. coli*, which is similar with the report from the Netherlands, 7.4% [6], but lower than report from Pakistan, 35.6% [13]. Momba, et al. reported that 75% of water samples were positive for *E. coli*, respectively [7]. The results of the present study are in contradictory with our investigation.

In addition, it is very important to monitor the prevalence of other organisms. Our results showed that 9.9% and 32.8% of samples from municipal and local water supply were positive on other organisms, such as *Enterococcus faecalis*, *Pseudomonas aeruginosa* and coliforms. Nino, et al. from BiH, reported the continued decline of prevalence of *E. coli* and coliforms in drinking water in Zenica-Doboj Canton in the period from 2007 to 2012 [14]. Ahmad, et al. Reported a higher prevalence of coliforms in Pakistan, 64.4% [13].

In our investigation there is a little higher prevalence of organisms in samples from local water supply, than from municipal water supply. Probably reason of these is that, which the water from local water supply is under the influenced by many factors which pollute drinking water, such as: sewage waters [13], rodent droppings [15], and heavy rains and floods [16].

Good manufacturing practices, food safety and quality standards and the hazard analysis and critical control point system need to be continuously applied and performed in all regions [1].

Acknowledgement

Performed the experiments, acquisition and analysis of the data: AI, NB, EI. Conception and design, drafting the manuscript: AI, NB, EI. Final approval of the version to be published: AI. All authors have read and approved the final manuscript.

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