Enumeration of Coliform Bacteria and *E. coli* Contaminating the Drinking Water of Al Gedarif City

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ABSTRACT

The present study enumerated the bacteriological contamination of the main sources of drinking water in Al Gedarif city. A total of 134 water samples (raw waters, treated waters, main reservoirs, main pipelines, and sabeel zeer waters) were tested for their total coliforms and *E. coli* counts, using the most probable number technique (MPN). The results indicated that the total coliform and *E. coli* counts were lower in the ground water sources (Al Azaza and Abu Al Naja boreholes) than that in the surface sources (Atbara River, Al Saraf and Dalassa dams). Moreover, both counts in most of the zeer water samples were higher than those of the other sources. It was also noticed that the zeers located in public areas (market) were more contaminated than the other sabeel zeers.

The seasonal variations study was performed for the surface sources, where it was found that the maximum densities of coliform bacteria and *E. coli* were occurred during the autumn season and the summer, while the periodical variations study was made for the ground sources, where the coliforms and *E. coli* densities were found almost higher during the second period of each year.

Key words: Coliforms, *E. coli*, Drinking water, Al Gedarif city.

INTRODUCTION

Bacterial contamination of a drinking-water source is a serious problem (Internet, 2008a). However, direct examination for various pathogenic bacteria that may be present in a drinking-water is difficult and time consuming (Madigan *et al*., 1997; Internet, 2008b). Worldwide the most valuable test for the routine bacteriological quality of water supplies is the total coliform and *E. coli* counts (Internet, 2009). According to the WHO (1997) safe water for drinking must 100 ml of these bacteria. The main principal techniques for counting /contain no single cell faecal coliforms, is the multiple tube test (Most Probable Number – MPN),

Enumeration of bacteria has been made in different areas in the world using this technique. In Uganda faecal coliform counts reached up to 8000/100 ml in river water, and even in borehole supplies the count reached 60/100 ml. Data from Nigeria showed that total coliforms in ponds can reach 4×10^6/100 ml. In canals in central Jakarta, Indonesia, faecal coliform organisms have shown counts as high as 3,100,000/100 ml (Slade, 1983). Tartera and Jofre (1987) found that the small rivers Besos and Liobregat which flow through densely populated areas north and south of Barcelona were highly polluted.

A study in the Nile and wells at Khartoum area, by El Hassan *et al.* (1984) indicated that there were 93 – 460/100 ml either coliforms or faecal coliforms in the Nile and 3–2400/100 ml of either coliforms or faecal coliforms in wells. But, tap water contained only 3 cells/100 ml either coliforms or faecal coliforms. According to Hammad and Dirar (1982), faecal contamination of sabeel zeers in Khartoum reached 69.88% of the samples examined. However in Khartoum, coliform bacteria were not found in the treated water entering the distribution system in both Mogran and Burri water works (Salih, 1998).

Ibrahim (2000) noted that all samples from water supply lines and cisterns, were free from *E. coli*, faecal streptococci, moulds and yeasts, although, coliforms were found in most of the collected water samples. Bagde and Varma (1982) found seasonal variation of coliform bacteria in water bodies; the bacterial number was lowest in winter, but highest in summer.

The objective of the present study is the enumeration of the coliform bacteria and *E. coli* in the main sources and their sites, supplying Al Gedarif city with drinking-water.

MATERIAL AND METHODS

The greater Al Gedarif city water supply is provided by two main sources; surface and ground water. The surface water includes treated water from Atbara River and seasonal drains and reservoirs water (Dalassa and Al Saraf Dams), which is untreated. The ground water is in the form of boreholes (150 – 250 m deep), drilled at Al Azaza and Abu Al Naja stations. The sites from which the samples were collected are as follows:

Cites of Atbara River (AR):
ARMS= Main steam, ARTW= Treated water, ARS38=Station 38, ARCI=City inlet, ARMV= Main reservoir, ARNL= Northern line, ARNZ= Zeer of Northern line, ARSL= Southern line, ARSZ= Zeer of southern line, ARCL= Circular line, ARCZ= Zeer of circular line.

Cites of Al Saraf dam (SD):
SDLD= Lake of dam, SDET= Elevated tank, SDLD= Main line, SDZ= Zeer water.

Cites of Dalassa dam (DD):
DDLD= Lake of dam, DDET= Elevated tank, DDLD= Main line, DDZ= Zeer water.

Cites of Al Azaza boreholes (ZB):
ZBCT= Collection tank, ZBL= Main line, ZBZ= Zeer water.

Cites of Abu Al Naja boreholes (NB):
NBCT= Collection tank, NBL= Main line, NBZ= Zeer water.

Water samples for bacteriological enumeration were collected in clean and sterile screw-cap bottles, over the period 2005 – 2007, on a seasonal basis (summer, autumn and winter). The underground water samples, were collected on two different periods; (January – March) and (July – September) of each year of the study. The time of collection was between nine to eleven o'clock in the morning. All samples were examined in the laboratory of the Al Gedarif State Water Corporation (GSWC), one hour after collection using the most probable number techniques. The results were statistically analyzed.

RESULTS

The water samples were tested for their total coliforms and *E. coli* counts, using the most probable number (MPN) technique. The results (Table, 1), showed that the highest numbers of the coliform bacteria in Atbara River sources were recorded in zeer water of the circular line 10^4/100 ml, respectively), $\times 10^5$ and 7.7×during both, the summer and the autumn seasons (1.3

while the lowest numbers were recorded in the northern line water. Whereas, in the winter season, the counts were lower in all sources. However, there were no significant differences between the three seasons.

Table 1.The most probable number (MPN/100 ml) of the coliform bacteria in Atbara River sources during the three seasons.

Sample Site ♦	Seasons		
	Summer	Autumn	Winter
ARMS	1.0×10^{5}	4.2×10^{4}	3.3×10^{3}
ARTW	1.2×10^{3}	4.7×10^{3}	1.6×10^{3}
ARS38	9.4×10^{2}	2.0×10^{3}	8.0×10^{2}
ARCI	2.1×10^{3}	2.1×10^{3}	1.7×10^{2}
ARMV	4.8×10^{2}	4.0×10^{3}	2.6×10^{2}
ARNL	2.4×10^{2}	1.1×10^{3}	1.1×10^{3}
ARNZ	6.0×10^{4}	3.6×10^{4}	1.6×10^{3}
ARSL	2.0×10^{3}	1.9×10^{4}	1.2×10^{3}
ARSZ	3.9×10^{3}	5.1×10^{4}	3.0×10^{3}
ARCL	2.0×10^{3}	2.0×10^{4}	1.7×10^{3}
ARCZ	1.3×10^{5}	7.7×10^{4}	2.1×10^{3}
SD	4.6×10^{4}	2.5×10^{4}	9.5×10^{2}
SE	1.4×10^{4}	7.5×10^{3}	2.9×10^{2}

♦= As described in materials and methods.

The results in Table (2) illustrates the most probable number of the coliform counts in Al Saraf and Dalassa dams sources during the three seasons. The results showed that the highest 10^{6}/100 ml) and in zeer ×number was found in zeer water of Dalassa dam, during autumn (2.0 10^{5}/100 ml). The lowest counts during the three ×water of Al Saraf dam during summer (3.0 seasons were almost found in the elevated tanks. No significant differences were found between them.

The probable numbers of the coliforms in Al Azaza and Abu Al Naja sources as shown in Table (3). The results showed that during both periods, the highest values of the coliforms count 10^{2}/100 ml, respectively). The moderate ×10^{5}/100 ml and 4.5×were found in zeer waters (1.4 numbers were recorded for the line waters, while, the lowest numbers were found in the collection tank water samples.

Table 2. The most probable number (MPN/100 ml) of the coliform bacteria in Al Saraf and Dalassa dams sources during the three seasons.

Sample Site ♦	Seasons		
	Summer	Autumn	Winter
SDLD	- *	5.8×10^{5}	8.0×10^{2}
SDET	7.3×10^{2}	1.1×10^{3}	3.0×10^{2}
SDL	8.1×10^{2}	1.3×10^{3}	3.4×10^{2}
SDZ	3.0×10^{5}	2.4×10^{5}	5.8×10^{2}
DDLD	-*	4.0×10^{5}	8.5×10^{4}
DDET	8.4×10^{4}	1.3×10^{5}	2.7×10^{2}
DDL	8.3×10^{2}	1.4×10^{3}	3.3×10^{2}
DDZ	1.6×10^{5}	2.0×10^{6}	8.2×10^{4}
SD	7.9×10^{4}	9.4×10^{5}	4.8×10^{4}
SE	4.6×10^{4}	4.7×10^{5}	2.4×10^{4}

er.

♦= As described in materials and methods.

Table 3. The most probable number (MPN/100 ml) of the coliform bacteria in Al Azaza and Abu Al Naja sources during the two periods.

Sample Site ♦	Periods	
	Period (1)	Period (2)
ZBCT	4.3×10^{2}	4.5×10^{2}
ZBL	5.3×10^{2}	5.7×10^{2}
ZBZ	1.4×10^{5}	1.4×10^{5}
NBCT	1.6×10^{2}	1.8×10^{2}
NBL	2.4×10^{2}	2.6×10^{2}
NBZ	4.5×10^{2}	4.3×10^{2}
SD	1.5×10^{2}	1.3×10^{2}
SE	9.0×10^{1}	7.3×10^{1}

♦= As described in materials and methods

The most probable number of *E. coli* in Atbara River sources during the three seasons is shown in Table (4). The results indicated that the highest count of *E. coli*, during the summer, 10^{4}/100 ml), while the lowest count was shown ×were in the zeer water of the circular line (2.3 10^{2}/100 ml). The same pattern was also reported for the autumn season. ×in the northern line (1.6 Generally, the lowest counts were found in the winter compared to the other two seasons (Table, 4).

Results of the MPN of the total *E. coli* count in Al Saraf and Dalassa dams sources are shown in Table (5). The results showed that the maximum counts of *E. coli* during the three seasons, were found in the zeer water samples, while the lowest counts were almost recorded in the water samples of the elevated tank. However, there were no significant differences between the seasons.

Data in Table (6) illustrated the most probable number of E. *coli* in Al Azaza and Abu Al Naja sources during the two periods. It could be noticed that the most probable number of *E. coli* in Al Azaza and Abu Al Naja sources, was almost similar for both periods. During both periods, the highest numbers were found in zeer water samples followed by the line waters, while the lowest numbers were recorded in the collection tank water samples. However, no significant differences were found.

Table 4. The most probable number

	SD	7.1×10^{3}	1.1×10^{4}	6.2×10^{2}
	SE	2.1×10^{3}	3.4×10^{3}	1.9×10^{2}

(MPN/100 ml) of *E. coli* in Atbara River sources during the three seasons.

Sample Site ♦	Season		
	Summer	Autumn	Winter

ARMS	1.1×10^{4}	7.6×10^{3}	1.2×10^{3}
ARTW	2.1×10^{3}	1.7×10^{3}	1.1×10^{3}
ARS38	4.5×10^{2}	1.6×10^{3}	2.0×10^{2}
ARCI	5.4×10^{2}	3.6×10^{2}	6.5×10^{1}
ARMV	2.6×10^{2}	7.1×10^{2}	1.5×10^{2}
ARNL	1.6×10^{2}	2.6×10^{2}	8.1×10^{2}
ARNZ	2.3×10^{3}	3.4×10^{3}	6.0×10^{2}
ARSL	6.4×10^{2}	1.2×10^{4}	5.1×10^{2}
ARSZ	1.5×10^{3}	4.0×10^{3}	2.2×10^{3}
ARCL	7.8×10^{2}	7.8×10^{3}	5.4×10^{2}
ARCZ	2.3×10^{4}	4.0×10^{4}	5.3×10^{2}

Table 5. The most probable number (MPN/100 ml) of *E. coli* in Al Saraf and Dalassa dams sources during the three seasons.

Sample Site ♦	Season		
	Summer	Autumn	Winter
SDLD	- *	1.1×10^{5}	2.7×10^{2}
SDET	2.0×10^{2}	3.2×10^{2}	1.5×10^{2}
SDL	2.7×10^{2}	4.0×10^{2}	1.7×10^{2}
SDZ	5.0×10^{4}	1.3×10^{5}	3.2×10^{2}
DDLD	- *	1.6×10^{3}	1.8×10^{2}
DDET	1.2×10^{3}	1.2×10^{3}	6.0×10^{1}
DDL	2.6×10^{2}	6.0×10^{2}	1.3×10^{2}
DDZ	9.4×10^{4}	2.3×10^{4}	2.7×10^{3}
SD	4.1×10^{4}	3.9×10^{4}	4.8×10^{2}
SE	2.5×10^{4}	4.5×10^{4}	3.2×10^{2}

* The lake of the dam was completely dry in the summer.

♦ = As described in materials and methods.

For the enumeration of the sanitary bacteria (coliforms and *E. coli*) in the five sources that supply Al Gedarif city with drinking-water, the most probable number (MPN) technique was selected. This technique was recommended for its accuracy, specificity and recovery (Tubin *et al*., 1980; and Rice *et al*., 1987). Moreover, it was stated that the MPN test is worldwide, clearly applicable to the isolation of coliform bacteria from all waters, whether from water within the distribution system or raw or natural sources (Jacobs *et al*., 1986 and Camper *et al*., 1986). The results showed the presence of a large number of bacteria.

Table 6. The most probable number (MPN/100 ml) of *E. coli* in Al Azaza and Abu Naja sources during the two periods.

Sample Site ♦	Periods	
	Period (1)	Period (2)
ZBCT	8.5×10^{1}	1.1×10^{2}
ZBL	1.4×10^{2}	1.4×10^{2}
ZBZ	2.7×10^{4}	2.7×10^{4}
NBCT	8.6×10^{1}	1.0×10^{2}
NBL	1.4×10^{2}	1.4×10^{2}
NBZ	2.0×10^{2}	2.0×10^{2}
SD	5.6×10^{1}	5.0×10^{1}
SE	3.2×10^{1}	3.0×10^{1}

♦= As described in materials and methods.

In general, the highest MPN counts in the raw water samples collected from the three surface sources (Atbara River, Al Saraf dam and Dalassa dam) were 1.0×10^5 /100 ml, 5.8×10^5 and 4.0×10^5/100 ml, respectively. These counts, in fact, were higher compared to those reported by Dirar (1986) for the surface water system at Khartoum. However, the counts were still higher than that reported by Mahgoub (1984) and Hussein (2002) who investigating quality of drinking-water samples collected from different parts in the Sudan. Microbiological contamination of drinking-waters, were also recorded in different parts in the world (Garbow and Preez, 1979; Carter *et al.*, 1987 and Pathak *et al.*, 1994). The raw water of the ground water sources (Al Azaza and Abu Al Naja), showed lower counts than the surface water sources. However, Abdel Magid *et al*. (1984) found more counts of coliforms and faecal coliforms for wells around Khartoum. The results of the present study were in contrast to Smith (1981) who found that deep-well water usually contains very few microorganisms, and with Osman (1994) who reported negative results in the boreholes water in the eastern bank of the White Nile. The results could be explained by the fact that samples were taken from the collection tanks and not directly from wells.

In the present study water samples collected from the storage tanks were highly contaminated, 100 ml in Abu /100 ml in the elevated tank of Dalassa dam to 1.6×10^2/ranging between $1.3\text{x } 10^5$ Al Naja boreholes. Contamination of tanks could be due to lack of cleaning, absence of chlorination and they may be exposed to dust storm that can certainly contribute to their contamination. According to El Tom (1997) and Ahmed Alhag (2005), the presence of a thick sediment layer at the bottom of a tank, may be a potential source of contamination. However, Lim and Flint (1989) and Brettar and Hofle (1992) added that sediments could protect enteric bacteria from certain stresses, and are known to act as nutrients that support bacterial growth.

It was clearly seen that water samples collected from the distributing lines of the drinking-water of Al Gedarif city, were all contaminated. Microorganisms can be introduced into the water distributing system of a city via air valves and chronic pipeline breaks (Dirar, 1986; Internet, 2009).

Water samples collected from zeers distributed in different areas in Al Gedarif city, were all highly contaminated with coliform bacteria. Elrofaei (2000) noted that water samples collected from sabeel zeers in Jebel Awlia area (Sudan), were more contaminated than the water inside other containers. Hammad and Dirar (1982) examined sabeel waters (zeers) and recorded large numbers of the faecal coliforms and more faecal streptococci. They attributed the effect to be in part due to dusty winds (haboub) and the contaminated hands of passing by people drinking

from the zeers. Similar results were also reported by Elattar *et al.* (1982) and Abdel Monem and Monem (1988), in Egypt, It was noted that most of the zeers tested in the present study, were without covers and not well protected.

In all the surface water sources, the highest counts were recorded during the autumn and summer seasons, while the lowest were recorded during winter. These results were in agreement with those reported by El Tom (1997), who stated that the recovering rates of the indicator bacteria was tended to be greater in the flood season and to decline gradually with winter season. Geldreich *et al.* (1968) stated that the frequent rain falling to the earth during autumn season is contaminated with traces of organic matter and occasionally with bacteria acquired via water-borne particulates. However, Habiballa (1981) mentioned that the presence of the coliform group in higher numbers was during the hot rainy season than in the dry winter season. Ahmed (1994), in Sudan, also found that the total and faecal coliform counts in the Blue and White Niles waters, were higher during the summer months (May-July). Moreover, the toilet system-pit latrines are common in Al Gedarif city. The pits are usually shallow and most of them become full and flooded during the autumn, leaking sewage and therefore constituting a major source of contamination.

REFERENCES

Abdel Magid, H. M.; Ibrahim, I. S. and Dirar, H. A. (1984). Chemical and microbiological examination of well and Nile water, Environment International, 10: 259 – 263.

Abdel Monem, MHAA and Monem, MHAAA (1988). Studies on water bacteria in Egypt.111 Bacteriological examination of zeer and sabeel water. Annals of Agricultural science – Cairo, 33 (2): 787 – 798.

Ahmed Alhag, I. F. (2005). Microbiological Quality of Water in Some Food Factories Storage Cisterns in Khartoum North Industrial Area. Ph. D. Thesis, Department of Botany, Faculty of Science, University of Khartoum, Sudan.

Ahmed, E. M. (1994). A comparative study of the water quality of the Blue and White Niles at Khartoum State. M. Sc. Thesis, Institute of Environmental Studies, University of Khartoum, Sudan.

Bagde, U. S. and Varma, A. K. (1982). Distribution and Periodicity of Total Faecal Coliform in Aquatic Ecosystem. International Journal of Environment, 19: 215 – 220.

Brettar, I. and Hofle, M. (1992). Influence of ecosystematic factors on survival of Escherichia coli after large-scale release into lake water mesocosms. Applied and Environmental Microbiology, 58: 2201 –2210.

Camper, A. K.; Le Chevallier, M. W.; Broadway, S. C. and Mc Feters, G. A. (1986). Bacteria Associated with Granular Activated Carbon Particles in Drinking Wate Applied and Environmental Microbiology, 52 (3): 434 .

Carter. A. M; pacha. R. clark. G. W. and William. E. A. (1987). Seasonal Occurrence of *Campylobacter sp*.in surface water and their correlation with Indicator Bacteria. Applied and Environmental Microbiology, 53 (3) – 523 – 526

Dirar, H. A. (1986). Coliform bacterial count in the Nile water at Khartoum. Environment International, 12: 571 – 576.

Elattar, L.; Abdel Gawad, A.; Khairy, E. M. and Elsebaie, O. (1982). The Sanitary condition of rural drinking water in a Nile Delta village. Journal of Hygiene, 88 (63).

El Hassan, B.; Awad El Karim, M. A.; Abdel Magid, H.; Ibrahim, I. S. and Dirar, H. A. (1984). Water quantity and quality and their impact on health in Khartoum Province, Sudan. Water Quality Quarterly, 9 (4): 225 – 230.
Elrofaei, N. A. (2000). Microbiological examination of drinking water for the displaced people living around Khartoum State. Ph. D. Thesis, Faculty of Agriculture, University of Khartoum, Sudan.
El Tom, A. M. (1997). Microbiology of Port-Sudan Water Supply. Ph. D. Thesis, Faculty of Agriculture, University of Khartoum, Sudan.
Garbow, W. and Preez, M. (1979). Comparison of M - Endo LES, MacConkey and Teepol media for membrane filtration counting of total coliform bacteria in water. Applied and Environmental Microbiology, 38: 351 – 358.
Geldreich, E. E.; Best, L. C.; Kenner, B. and Van Donsel, D. (1968). The bacteriological aspects of storm water pollution. Journal of Water Pollution. Control Fed, 40: 1868 – 1877.
Habiballa, H. I. (1981). A comparative Study, of the Sources of Domestic Water Supply in Khartoum. M. Sc. Thesis, Institute of Environmental Studies, University of Khartoum, Sudan.
Hammad, Z. H. and Dirar, H. A. (1982). Microbiological Examination of Sabeel Water.Applied and Environmental Microbiology, 43 (6): 1238 – 1243.
Hussein, O. S. (2002). Assessment of physical, chemical and microbiological features of drinking water from different areas in the Sudan. M. Sc. Thesis, Department of Botanyand Agricultural Biotechnology. Faculty of Agriculture, University of Khartoum, Sudan.
Ibrahim, O. A. (2000). Assessment of water quality in institutes storage cisterns in Khartoum metropolitan. M. Sc. Thesis, Faculty of Public and Environmental Health, University of Khartoum, Sudan.
Internet (2008a). International and Knowledge for Optimal Health. Population eport. www. Infoforhealth. Org/pr/m14/m14/chap5 1.shtml.//http:
Internet (2008b). Center for Disease Control and Prevention. Epidemiology Program Office. mmwr. tml. mmwr epo/www.cdc. ov//orbidityand ortality eeklyreport.
Internet (2009). Water Quality. Water. Quality Association. Glossary of E. *coli*. *E.coli*.html./Glossary/WQA/www.Wqa.org//http:
Jacobs, N. J; Zeigler, W. L.; Reed, F. C.; Stukel, T. A. and Rice, E. W. (1986). Comparison of Membrane Filter, Multiple-Fermentation-Tube and Presence-Absence Techniques for Detecting Total Coliforms in Small Community Water Systems. Applied and Environmental Microbiology, 51 (5): 1007 – 1012.
Lim, C. and Flint, K. (1989). The effects of nutrients on the survival of Escherichia coli in lake water. Journal of Applied Bacteriology, 66: 50 – 62.
Madigan, M.; Martinko, J. and Parker, J. (1997). Brock Biology of Microorganisms. 8th Ed. Prentice-Hall International, London. pp. 902 – 984.
Mahgoub, D. M. (1984). Coliform Bacteria in the Nile at Khartoum. M.Sc. Thesis, Faculty of Agriculture, University of Khartoum, Sudan.
Osman, H. N. (1994). A study on ground water quality in the eastern bank of the White Nile at Khartoum state, Sudan. M. Sc. Thesis, Institute of Environmental Studies, University of Khartoum, Sudan.
Pathak, SP; Kumer, S.; Ramteke, PW; Murthy, RC; Bhattacherjee, JW and Gopal, K.

(1994). Potability of water sources in relation to metal and bacterial contamination in Some northern and north-eastern districts. Environmental-Monitoring and Assessment, 33 (2): 151 – 160.

Rice, E. W.; Fox, K. R.; Nash, H. D.; Read, E. J. and Smith, A. P. (1987). Comparison of media for recovery of total coliform bacteria from chemically treated water. Applied and Environmental Microbiology, 53 (7): 1571 – 1573.

Salih, M. (1998). Study on Domestic water supply in Khartoum province. M.Sc. Thesis, Institute of Environmental Studies, University of Khartoum, Sudan.

Slade, J. S. (1983). Discharge to the environment of viruses in waste water, sludge and aerosols. In Berg, G. (Ed.) Viral Pollution of the Environment- C.R.C. Press Inc., Boca Raton, FL.

Smith, A. L. (1981). Principles of microbiology. 9th Ed. Mosby Company St. Louis. Toronto. London.

Tartera, C. and Jofre, J. (1987). Bacteriophages Active against Bacteriooides Fragilis in Sewage–Polluted Waters. Applied and Environmental Microbiology, 53 (7): 1632 1637.

Tubin, R. S.; Lomax, P. and Kushner, D. S. (1980). Comparison of nine Brands of Membrane Filter and the Most Probable Number Methods for Total Coliform Enumeration in Sewage Contaminated Drinking Water. Applied and Environmental Microbiology, 40 (2): 186 – 191.

WHO (1997). Guidelines for Drinking-Water Quality. Vol. 3, World Health Organization, Geneva.

التعداد البكتيري للقولونيات والبكتيريا ***E. coli*** الملوثة لمصادر مياه شرب مدينة القضارف

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الملخص

بحثت الدراسة الحالية التعداد البكتيري الملوث لمصادر مياه الشرب الرئيسية بمدينة القضارف. لقد تم فحص 134عينة ماء (مياه خام، مياه معالجة، خزانات رئيسية، خطوط رئيسية و مياه أزيار سبيل) لحساب التعداد الكلي للقولونيات و البكتيريا *Escherichia coli* ، وذلك بإستخدام تقنية العدد الأكثر إحتمالاً (Most Probable Number–MPN). لقد أشارت النتائج إلى أن التعداد الكلي لكل منهما كان منخفضاً في مصادر المياه الجوفية (آبار العزازة و أبو النجا) عما هو في المصادر السطحية (نهر عطبرة و سدي السرف و دلسة). علاوة على ذلك، فإن التعداد البكتيري في أغلب عينات مياه الأزيار كان أعلي من تلك المصادر الأخرى. و لوحظ كذلك أن الأزيار الموجودة في المناطق الشعبية (السوق) كانت أكثر تلوثاً من أزيار السبيل الأخرى.

لقد تمت الدراسة على قاعدة فصلية للمصادر السطحية ، حيث لوحظ أن الكثافة العالية للقولونيات وللبكتيريا *E. Coli* *كانت* خلال فصلي الخريف والصيف، بينما دراسة الإختلافات الدورية أجريت للمصادر الجوفية. حيث وجد أن كثافة القولونيات والبكتيريا *E. Coli* أعلى تقريباً خلال الفترة الثانية من كل عام.