Assessment of the Microbiological Characteristics of Groundwater in Alagilat Area, Libya

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Abstract

Water is a precious natural resource for all forms of life. Ground water is one key factor that play pivotal role in maintaining the economic worldwide. The scarcity and pollution of groundwater has become serious problem in the arid zones. The objective of the current study was to assess the biological characteristics of ground water in the rural and urban parts of Alagilat area, Libya. Sixty fife samples were collected from 26 villages in 2013.The microbiological quality such as fecal coliform(FC),and Escherichia coli(E.Coli) were enumerated using most probable number (MPN). Based on the outcomes of this study the fecal coliform presented in 63.1 % of the total samples, whereas E.coli was detected in 26.2% of the contaminated ones. The results revealed that the polluted water wells are due to intrusion of sewage and discharge of untreated sewage water into the ground. The study also revealed that the contaminated wells are not safe for drinking purposes.

Keywords: Alagilat, Coliform, Escherichia Coli, Groundwater, Sewage Water, Libya

I. INTRODUCTION

Water is a precious natural resource for all forms of life. Ground water is one key factor that play pivotal role in maintaining the economic worldwide. It is an important source of water supply for different phases of development, including agriculture, municipalities and industry. The scarcity of the precipitation, unsustainable human activities and environmental pollution, are some examples of the challenges faced in the dry regions of the globe. The ground water of the north western part of Libya is the main source for all daily application. Specifically, the ground water in the Jiffarah plain basin. In this part of Libya ground water quality has become a serious problem.

The quality of drinking water has been deteriorated because of the weakening of the infrastructure, mismanagement of the municipal wastewater and the direct discharge of wastewater into the ground. This deterioration has affected the quality of ground water, in terms of chemical, physical and biological aspects. The contaminated water may cause a number of diseases. Characterization the properties of ground water for specific purpose by its industrial or human consumption is considered fundamental for deciding the feasibility of the resources and its safeness for the public health and the ecosystem. For drinking water consumption, the biological characteristics of ground water should comply with the drinking water guidelines set by [1]**.** If these characteristics exceeded the recommended values, the water resource is considered unsafe. In many countries, different studies have been conducted to assess the microbiological characteristics of ground water and its suitability for the human consumption. For examples, the coliform organisms especially, Escherichia coli are considered good indicator of pollution by the remains of human and the animals, and used for the monitoring the water supply [2- 4].

Ground water quality in Lahore, Pakistan was assessed for its suitability for drinking [5]. A study was carried out to assess the microbiological quality of drinking water in Yaoundé neighborhoods [6]. Mismanagement of wastewater and leaking from septic tanks are considered the major sources of water borne diseases [7,8]. Infiltration from sewage dumpsites effects negatively the soils and ground water in the ecosystem [9]. The contamination of ground water by faecal coliforms has been considered critical issue worldwide [10]. [11] studied the presence of faecal coliforms in ground water samples of Gorakhpur City, India. Faecal pollution indicators including, total coliform bacteria, faecal coliform bacteria and Escherichia coli were assessed in the ground water of south India [12]. [13] carried out study to investigate the microbiological safety of ground water wells in Bugeserg and Muhanga, Rwanda. According to [14] the major source of the fecal pollution by Escherichia coli are the animals and the human.

Ground water samples were assessed for total and fecal coliforms between Tamilnadu and Pondicherry states, India [15]. Groundwater was investigated for the presence of Escherichia coli in three areas of the Valencia community, Spain [16]. Whereas, [17] reported the occurrence of the microbial indicator organisms in the groundwater wells and boreholes in Ekiti State, Southwestern Nigeria. A study was carried out in Kumasi, Ghana to assess the microbiological quality of groundwater and its suitability for the human consumption [18]. Presence of total coliforms and Escherichia coli in drinking water is due poor sanitation of water supply [19]. Growth of the colonies of bacteria in drinking water is a major critical issue that should be addressed [20]. Biological quality of groundwater was assessed in Makkah, Saudi Arabia, the assessment indicated occurrence of the indicator

organisms such as coliforms and Escherichia coli [21]. Bacteria was detected in groundwater wells in Makurdi town, Benue State, Nigeria, [22]. In the tropical countries high counts of bacteria in drinking water were detected. [23-26] carried out studies and reported high counts of faecal coliforms in groundwater wells. Ground water samples were investigated in Rohri City, Sindh, Pakistan and were found polluted in terms of total coliform and Escherichia coli [27]. According to [28,29] standards for the microbiological assessment for drinking water recommended that fecal coliforms, total coliform and Escherichia coli should be nil / 100ml sample.

However, in Libya, including the Northwestern area, there are no intensive studies were done on a major scale. Therefore, the aim of the current study is to investigate the microbiological characteristics of ground water for human consumption in the Northwestern region, particularly, Alagilat area.

II. MATERIALS AND METHODS

The study area is located in the area coordination of latitude 32° 45` 25`` and longitude 12 22 34 in Alagilat area, Northwestern of Libya. It is 85 km from Tripoli and about 4 meters above the sea level Fig 1. The maximum temperature is around 45 °C and minimum 20 °C with an average annual rainfall of 120 mm. It has a dry climate with hot summer and cold winter. Groundwater is considered the main source of water supply in the study area. The dominant soils are sandy and sandy loam. The agriculture is one of the most important activities in the area where barley, wheat, luttice, sparsely, carrots and fodder crops are grown.

In the current study a total of 65 ground water samples were collected in 2013 from 26 villages of Alagilat area, Libya using Global Positing system (GPS). The samples were collected from public wells, private wells, water sources in the health centers, and schools. First, the water was left to run for 15 minutes from the wells to pump out the standing water before taking the final samples. The samples were collected in glass bottles sterile of 300 ml capacity then put in coolers with ice in a temperature below 4°C. The samples were transported in less than 6 hours to Tripoli, Libya where the analysis were performed in standard microbiological testing laboratories of the Biotechnology Research Center, Tripoli, Libya. They were assessed for microbial indicator organisms such as fecal coliform and Escherichia coli by the standard most probable number method The results were expressed as the most probable number (MPN / 100ml). The Libyan National standard (LNS) for drinking water [29], and World Health Organization [28]standards were used for the microbial evaluation.

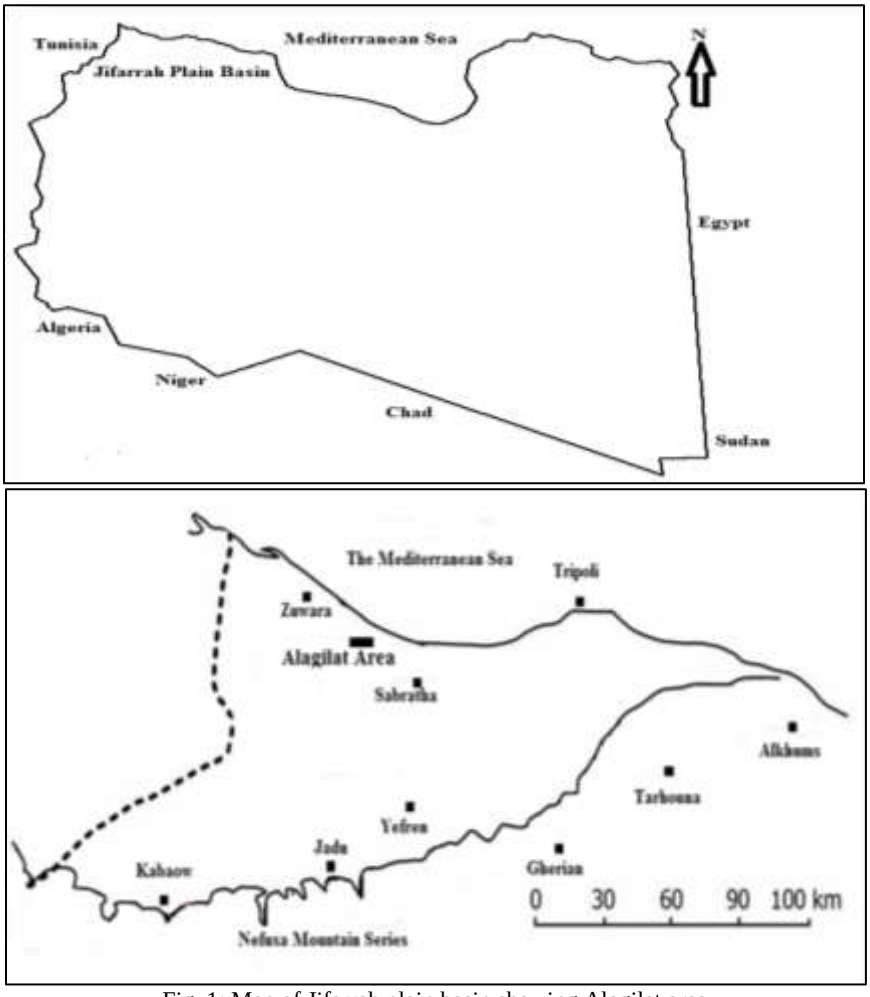

Fig. 1: Map of Jifarrah plain basin showing Alagilat area

III. RESULTS AND DISCUSSION

The results of the bacteriological analysis in the study area presented in Table 1. The counts of bacteria in the samples were expressed as the most probable number (MPN/100ml). From Table 1 can be concluded that 63.1% (41) of the total samples gave positive results for the occurrence of faecal coliforms whereas, the remaining samples (24) were found to be negative. The faecal coliform ranging between 2 and 2400. It also can be concluded that out of 65 samples 26.2% (17 samples) gave positive outcomes for the presence of Escherichia coli whereas 48 samples were found to be free of bacterial counts. The outcomes obtained exceeded the permissible limits recommended by world health organization and the Libyan standards maximum limits for drinking water nil colonies / 100 ml [28,29].

The current study showed that the ground water in the study area is polluted and that is due to discharge of untreated wastewater into the ground. The results of the current research agreed with the studies which carried out by [30,31,32]. Furthermore, the septic tanks and sewers become overloaded during the rainfall season. In the study area the texture of the soil is sandy and sandy loam which make the wastewater moves quickly down to the groundwater.

Table - 1
Results of the Microbiological analysis of the water samples

Well code	*Faecal Coliform*	*E.Coli*	*MPN**
W1	+	+	*150*
W2	-	-	*2*
W3	+	+	*1100*
W4	-	-	*2*
W5	+	+	*1100*
W6	+	+	*1100*
W7	-	-	*2*
W8	+	-	*23*
W9	+	-	*43*
W10	+	-	*43*
W11	-	-	*2*
W12	-	-	*2*
W13	-	-	*2*
W14	+	+	*23*
W15	+	+	*43*
W16	+	-	*9.2*
W17	+	+	*1100*
W18	+	-	*460*
W19	+	-	*93*
W20	+	-	*15*
W21	+	+	*93*
W22	+	+	*1100*
W23	-	-	*2*
W24	+	+	*460*
W25	+	+	*43*
W26	+	+	*460*
W27	+	-	*23*
W28	+	+	*43*
W29	+	+	*240*
W30	-	-	*2*
W31	+	-	*38*
W32	+	-	*1100*
W33	+	-	*460*
W34	+	-	*460*
W35	-	-	*2*
W36	+	-	*43*
W37	-	-	*2*
W38	-	-	*2*
W39	+	-	*43*
W40	+	-	*23*
W41	+	-	*75*
W42	-	-	*2*
W43	+	-	*3.6*
W44	+	+	*3.6*
W45	-	-	*2*
W46	-	-	*2*
W47	+	+	*1100*

W48	-	-	*2*
W49	-	-	*2*
W50	-	-	*2*
W51	+	-	*21*
W52	+	-	*3.6*
W53	+	-	*23*
W54	+	+	*9.2*
W55	+	-	*3.6*
W56	+	-	*23*
W57	-	-	*2*
W58	-	-	*2*
W59	-	-	*2*
W60	+	-	*9.2*
W61	-	-	*2*
W62	-	-	*2*
W63	-	-	*2*
W64	+	-	*9.2*
W65	-	-	*2*

*Most Probable Number

IV. CONCLUSION AND RECOMMENDATIONS

The outcomes of the current study indicated that such ground water samples in Alagilat area were found polluted. The results obtained crossed the recommended limits of World Health organization and Libyan guidelines for drinking water consumption. The study reveals that the contaminated wells are attributed to the point sources such as discharge of untreated wastewater into the ground and the overloaded of the sewers in winter season. The current study also reveals that the polluted wells in the study area is not safe for drinking purposes and utilization of such water may cause diseases to the residents. From the obtained outcomes the following recommendations can be made.

1) Installation of water treatment plants where groundwater should be treated for the human consumption.
2) Sewage water should be managed efficiently and treated to avoid the contamination of water resources.
3) regular bacteriological analysis should be carried out on ground water to ensure that it meets the recommended limits of water consumption
4) Implementation of the media to educate the residents of the area on the causes and how to prevent the water bodies from pollution.
5) Groundwater wells should be constructed according to the recommended technical specifications to prevent the contamination and to keep the water source clean and potable
6) The damaged pipes in the water supply system should be replaced regularly.
7) The recommended limits stipulated by world health organization and Libyan center for standardization and metrology should be applied to keep the water resources clean and the ecosystem healthy.

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