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BACTERIOLOGICAL GROUND WATER QUALITY STUDIES IN THE TRIPOLI REGION-LIBYA

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Abstract

Libya is a country of desert and the arid climate makes it in extreme lack of surface water. Groundwater then becomes a very important resource to meet the economical and agricultural demand, which believed to be comparatively much cleaner and free from pollution than surface water. Water pollution is a state of deviation from pure condition, whereby its normal function and properties are affected. The present study is aimed at assesses the bacteriological pollution of ground water samples used for humans and animals at different 11 localities in Tripoli region, Libya. This study related to the bacteriological analysis revealed high values of total bacterial count in groundwater samples from both tanks (648.85 cfu /ml) and wells (349.34 cfu /ml) than standard count limit (100 cfu /ml) for drinking water by EPA. Nearly similar values of MPN of coliform (58.00 MPN/100 ml) and *E. coli* bacteria (0.20) from both tanks and wells, other than zero number per 100 ml set by WHO. Finally, we did not find pathogenic bacteria; as *Salmonella* and *Enterococci* bacteria, but there is very little number of pathogenic bacteria as *Staphylococcus aurous* (1.50) and *Pseudomonas aeruginosa* (0.07) isolated from both tanks and wells samples. Hence, it was concluded that, this research to analysis the bacteriological pollution of groundwater used for humans and animals at some different localities of Tripoli, Libya with review to the hygienic standards and suggest an approach for improving and prevent such contamination. microbiological tested ground waters samples are good and mostly suitable for domestic uses, the coliform and pathogenic bacterial contamination render this water unsatisfactory for drinking purposes unless bacteriologically perfectly treated, if necessary for consideration for utility.

Keywords: Groundwater, Characterization, Bacteriological Analysis.

INTRODUCTION

1. Background and Significance of Ground water

As a freshwater source, groundwater is of critical importance, particularly in arid areas,

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it constitutes over 97% of the planet's liquid freshwater resources. (Hoekstra, 2006). There is common perception for ages that it is a reliable and safe source of water that is available naturally. Water percolating through the soil mantle is purified by this natural filtration process. (WHO 2006). Communities, particularly in developing countries and low-income areas, rely primarily on groundwater for drinking, domestic purposes, and irrigation because of its perceived quality. (Pedley and Howard, 1997; WHO and UNICEF, 2000). The efficacy of this natural protection is geologically dependent. Fine-grained soils facilitate filtration, whereas porous formations like fractured bedrock and karst aquifers permit the rapid, widespread migration of contaminants. (Misund et al., 1999.).

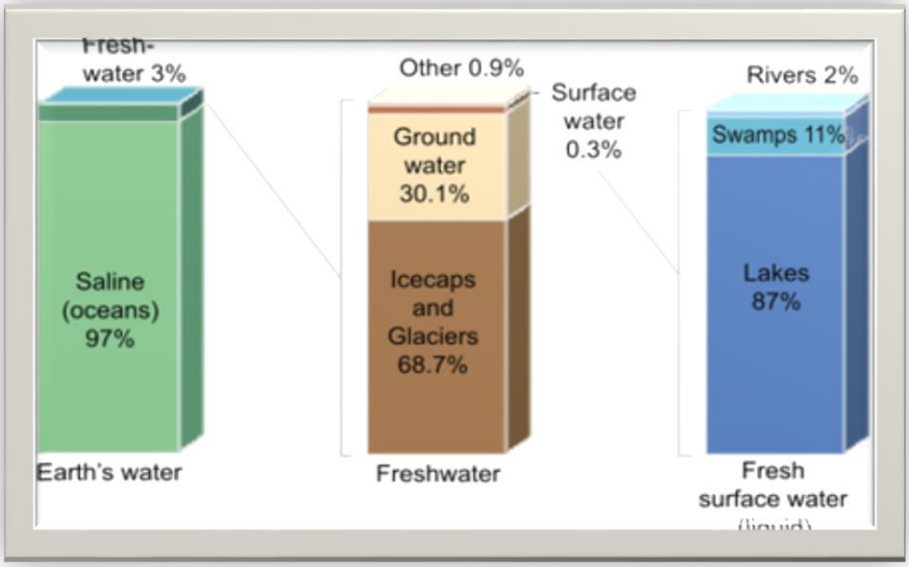

Figure 1: Distribution of water on the Earth (Hoekstra, 2006).

2. Diseases and deaths attributable to poor drinking-water quality

Groundwater which was considered most pure has been gradually becoming polluted around the globe. Pollution is caused by human activities, such as intensive agriculture, sewage disposal, industrialization, and urbanization (Nash and McCall, 1995; Longe and Balogun, 2010). Similarly, geological origin and natural conditions can release toxic elements (Frengstad et al., 2000). Waterborne disease outbreaks can occur due to microbial contamination of fecal origin. It is one of the significant risks. (Prüss et al., 2002) Waterborne diseases, including cholera, typhoid, dysentery and hepatitis are caused by water containing pathogens such as Salmonella, Shigella and Vibrio cholerae (WHO, 2001; Eubank et al., 1995). According to the World Health Organization (WHO), the unsafe water kills 1.7 million people every year, mainly in developing countries.

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Figure 2: Groundwater basin Libya (Source: General Water Authority, Libya) (Salem, 2007).

The issue is further worsened in dry areas dealing with a severe lack of water resources. Libya is a notable example of this situation: despite being located above substantial reserves of ancient groundwater like the Kufra, Sirt, and Murzuk basins (salem, 2007), it is categorized as one of the most water-deficient countries worldwide (FAO,2009). With more than 90% of its territory being desert and no permanent rivers, the nation heavily relies on groundwater for its water supply (Iglesias,2007). The challenge is intensified by the fact that the majority of the population and farming activities are situated in the northern coastal region, particularly around Tripoli, leading to excessive exploitation of local groundwater sources. Consequently, this has caused declining water levels, intrusion of seawater, and deterioration of water quality (rajab, 1995). Given the absence of comprehensive monitoring programs in many areas, regular assessment of the microbial quality of groundwater is not just a theoretical exercise but a crucial public health necessity in such circumstances.

3. Research Aim and Objectives

The main goal of this study is to fill a significant gap by conducting a thorough analysis of the bacterial content in groundwater in the Tripoli region of Libya. The principal objective is to assess its cleanliness according to well-recognized global benchmarks, particularly those outlined by the WHO in 2006. The specific aims include: Identifying the extent and kinds of microbial pollution, with a focus on viable heterotrophic bacteria, total and fecal coliforms (such as E. coli), fecal streptococci, and specific harmful microorganisms. Developing a logical and fact-based strategy to enhance groundwater quality and prevent potential contamination, thus guiding local water management and public health policies.

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LITERATURE REVIEW

1. Groundwater Resources and Management Challenges in Libya

Libya's water security relies on ancient, non-renewable groundwater reserves known as "fossil" aquifers, containing water trapped since prehistoric times. (Salem, 2007). The Great Manmade River Project (GMRP) is a major engineering project initiated to transfer this water from the southern aquifers to the densely populated coastal regions. (FAO, 2009). While designed to address water scarcity, the project underscores a management paradigm that prioritizes large-scale transfer infrastructure over the conservation and protection of local water resources. Research indicates that unsustainable groundwater withdrawal in coastal areas has led to significant environmental degradation, most notably through the creation of depression cones and the consequent intrusion of saltwater. (Rajab, 1995; Mckenzie and Elsaleh, 1994). This may result in the risk of pollution.

2. Sources and Pathways of Groundwater Contamination

Groundwater pollution is a complex and multi-dimensional issue. Groundwater is threatened by pathogens that are introduced to aquifers mainly via leaching of fecal material from sources such as septic tanks, cesspools, animal husbandry operations and defective sewage systems (Bitton, 1994; Miller, 1997). Extreme risks come from shallow, unprotected wells in peri-urban and rural areas of rapid, unplanned development and poor provision for sanitation (Howard et al., 2003). The leaching of contaminants from solid waste and chemical pollutants from fertilizers, industrial effluents represent a simultaneous and critical threat to groundwater quality. (Raja et al., 2002). A significant concern is that pollutant concentrations in groundwater frequently exceed those found in surface water sources, and are often colorless or tasteless, which requires using periodic STD Method call type detection.

3. Bacteriological Assessment of Water Quality

The microbiological safety of drinking water is typically assessed using indicator organisms since testing for all potential pathogens in a water supply is troublesome. In particular, the detection of total coliform and fecal coliform (E. coli) and fecal streptococcus (Enterococcus spp.) (anionic detergent), serves as a reliable indicator of fecal contamination and signals the potential presence of enteric pathogens. (Rompré et.al, 2002; EDWD, 1998). Common methods for their detection are Most Probable Number (MPN) and selective media culture (Schlegel, 2002).

The Heterotrophic Plate Count (HPC) offers a broad assessment of the total bacterial concentration in water. Although the levels of HPC are not direct sanitary indicator, their data can reflect whether the efficacy of the water treatment process is sufficient, and whether there is potential regrowth in the distribution system (Barrell et al. 2000; WHO 2008). Scientists use selective media and confirming biochemical tests in order to detect specific pathogens, for example, Salmonella and Vibrio Colerae (Prescott et al.,

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2002). Studies on Libya's groundwater have shown the physicochemical challenges and over-abstraction (e.g., Rajab, 1995; Salem, 2007).

It seems that there is no any systematic study in the recent time in relation to groundwater micro-biological quality in population centres like Tripoli. Moreover, this resource has crucial importance for many communities even though, they lack the knowledge regarding its sanitary condition and management responses are often anecdotal rather than being supported scientifically (Brown and Halweil, 1998).

The purpose of this study is to provide a detailed, empirical assessment of microbial contamination of Tripoli's groundwater. The results will produce critical baseline data for raising public health awareness, promoting science-based policymaking, and shaping the design of targeted protection and remediation strategies for this vital resource.

MATERIALS AND METHODS

This investigation had been done at the northwestern region of Libya in a community at some different localities of Tripoli to assess the bacteriological pollution of ground water used for humans and animals. At these localities with review to the hygienic standards adopted by WHO and other international standards also suggest the rational approach for improving and prevent contamination of groundwater. Study area was involved 11 localities, in Tripoli- Libya.

1. Collection and handling of water samples:

I-Source and topographic examination of the tested wells

One hundred and twenty-two samples' examinants bacteriologically collected from each 61 well and 61 reservoir tanks, as shown on Table (1). The topographic examination of the tested wells in different localities in Tripoli was carrying out as questioner sheet investigation of ground water.

Table 1: Sampling Number and Localities

1- **Locality Number**	**Localities**	**Number of wells tested**
1	**Al Daribe**	5
2	**Al Hay Senae**	**5**
3	**Trek Matar**	**4**
4	**Mashroa Al hadba**	6
5	**Al karemeya**	14
6	**Al Fernag**	3
7	**Tajora**	2
8	**Ain Zara**	10
9	**Janzur**	4
10	**Al Serag**	3
11	**Ghot elshaal**	2
Total	**11 Localities**	**61 Wells**

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II-Collection of samples

The driven pumps are thoroughly washing with a stiff brush to remove any visible dirt. Representative water samples from tube wells were collect after allowing them to flow for at least 10 minutes. and Depth of groundwater level and location of the tube well was properly marked on the topographic survey sheet.

Two samples of water are obtained from each well; one of them were collected in a sterile standard glass bottles (200 ml) from the tank and other(200ml) from the well for bacteriological examination.

III-Handling

1- The bottles are securely corked and labeled with sample information needed including, location, collection date, construction and well.

2- Information on equipment to be use for bacteriological examination, types of media to use, and their methods of preparation and storage can be found in (APHA 1998 and WHO 2008).

3- Collected samples were kept in cooler box contains ice and dispatched to the laboratory with the minimum delay for bacteriological examination. All the water samples were analyzed within 12 to 24 h after collection for bacteriological examination.

4- Collection and analysis of water samples for bacteriological examination were started from 15 /11/2019 and finished at 22/4/2020.

2. Laboratory site

bacteriological examination carried out in Bio-Technology Research Center, Bio-microbiological Laboratory (BTRC).

I- Bacteriological examination

The bacteriological examination of a water sample consists of: -

- Determination of the total number of viable organisms (total bacterial count),
- extent of fecal pollution and
- Detection of pathogenic microorganisms.

The precaution taken for examination of water samples bacterioloically as follows:

- ❖ The samples should be examined as quickly as possible after collection.
- ❖ Shake the sample thoroughly before examination.
- ❖ All steps must be done under aseptic conditions.
- ❖ All equipment used must be sterile.

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II- Determination of the total number of viable organisms (Total bacterial count).

The number of viable bacteria in water samples is counted by using the standard plate count method (total plate count was conducted by pour plate technique on plate count agar (PCA)and counting the colonies developing after the incubation at 37^{o}C for 24h as described by (APHA, 1998. 2001). It is considered as an index of the extent to which organic matter of vegetable or animal origin is present in water. The organisms associated with the organic matter of vegetable origin, an optimum temperature for growth and multiplication of about 20^{o}C. On the other hand, organisms associated with organic matter of fecal origin have an optimum temperature of 37C^{o}. Therefore, it is advisable to determine the number of organisms, which will grow on a standard medium at both of these temperatures.

III- Procedure for total bacterial count

Tenfold serial dilution from water sample was made up to 10^{-6} using sterile normal saline solution. After thorough mixing, one ml of each dilution was carefully mixed with about 10ml of melted standard nutrient agar cooled at 45^{o}C (in two Petri dishes) so that the organisms were uniformly distributed through the medium. After solidification, one plate of each dilution incubated at 37^{o}C for 48 hours, while the other plate incubated at 22^{o}C for 72 hours (must be in inverted position). Developing colonies were count using bacterial colony counter and the total colony count per ml of water sample was calculating at 37^{o}C and at 22^{o}C (Count only the plates having between 30 and 300 colonies).

To calculate the probable number of bacteria per ml in the original sample, it is necessary only to multiply the bacterial colony count by the reciprocals of the dilution and the volume used number of bacteria in terms of Colony-Forming Units (CFU)

Calculation: CFU/ mL= CFU/plate multiply by dilution factor multiply by 1/aliquot

Expected Result: A marked increase in the count at 22^{o}C indicates probable contamination with soil organisms or organisms of non-fecal origin and may be of little significance. On the other hand, a marked increase in the count at 37^{o}C is more serious and often indicates contamination with organisms of fecal origin.

Very low counts are generally obtained from deep wells while unclean surface water may give high count. All procedures for total bacterial count were done as described by (APHA, 2001).

IV- Detection of extent of fecal pollution

Drinking water supplies are liable to contamination with sewage or other excreted matter. Although the isolation of pathogens e.g., *typhoid bacilli* constitute the most direct proof of a dangerous impurity, but it is impracticable for the ordinary purposes because the organism if present is usually so scanty. Instead, it relies on tests, which reveal the presence of some bacteria as indication of fecal pollution such as:

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Coliform bacilli (particularly *E. coli*) are the most reliable indicator for fecal pollution.

Streptococci faecalis is strong evidence of faecal pollution but its absence does not exclude such impurity.

Clostridium welchii (sporeforming anaerobe): being highly resistance; therefore, in absence of other intestinal organisms, it indicates pollution of old period rather than recent occurrence (old pollution).

Strept. faecalis and *E. coli* are common in fresh feces and their presence in water indicates very recent contamination, while *Clostridium welchii* indicates old pollution.

a) Coliform bacteria

- Presumptive test
- Confirmatory test

b) Identification of typical coliform (E. coli) forms

c) *Enterococci* count

- Presumptive test
- Confirmatory test

The standard tests used for all bacterial of fecal pollution were enumerate by most probable number (MPN) technique described by (APHA, 1998, APHA, 2001, Leo.M.LN, 2007).

(A) Presumptive coliform test (E. coli count)

Coliform group bacteria present in the gut and feces of warm-blooded animals generally include organisms capable of producing gas from lactose in a suitable culture medium at 44 ^{o}C. In as much as coliform organisms from other sources often cannot produce gas under these conditions, this criterion is use to define the fecal component of coliform group. **I**n the routine examination of water, it is generally sufficient to carry out a presumptive coliform test as an index of fecal pollution of water. It is significant to differentiate between atypical coliform bacteria (which can grow only at 20 ^{o}C and normally found in the soil) and the pathogenic typical coliform bacteria that can grow at 44 ^{o}C and which are mostly be found in man or animal excreta (APHA, 2001). Arrange fermentation tubes (MacConkey`s lactose bile salt broth) containing inverted Durham's in rows of five tubes in a test rack. For non-potable water use five tubes per dilution (of 10, 1, 0.1ml).

Procedure

For each water sample, apply the following:

1. Prepare five containing 10 ml of MacConkey`s lactose bile salt broth and 10 tubes containing 5ml MacConkey`s lactose bile salt broth. All of these tubes containing inverted Durham's tubes.

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2. To each tube, transfer the water sample as recorded, so that the amount of water in 15 tubes is 55.5ml.
3. Shake the tubes well and incubate them at 37 ^{o}C for 48 hours.

Result: Production of an acidic reaction (pink color) or gas in the tubes within 48 hours constitutes a positive presumptive reaction. The positive tubes will be submitted to confirmatory test. The absence of acidic reaction or as gas formation at the end of 48 hours incubation constitutes a negative test.

(B) Confirmatory test

This test is applied to ascertain whether coliforms detected by the previous test are pathogenic (of fecal origin) or not. This test depends on the ability of E. coli to produce gas (typical forms) when incubated with MacConkey`s lactose bile salt broth at 44 ^{o}C, while atypical coliforms cannot produce gas.

Procedure

1- Submit all presumptive fermentation tubes showing acid or gas production within 48 hours of incubation to the confirmatory test (fecal coliform test).
2- Gently shake the (+ve) presumptive fermentation tubes. Transfer loopful from the positive tubes into fresh tubes containing 5ml MacConkey`s lactose bile salt broth containing inverted Durham's tubes.

Result: Gas production with growth in the broth culture tubes within 24 hours is considering a positive fecal coliform reaction. Failure to produce gas (with little or no growth) constitutes a negative reaction. If multiple tubes are used, calculate most probable number of coliform (MPN) from the number of positive broth tubes.

The sanitary classification of water for coliform count, according to the American standard, was cleared as shown in **Table (2).**

Table 2: Sanitary classification of water for coliform count (APHA, 2001)

Class	Presumptive (No / 100ml of water sample)	Confirmatory (No /100ml of water sample)	Quality
I	Zero	Zero	Excellent
II	1-3	Zero	Satisfactory
III	4 -10	Zero	Suspicious
IV	More than 10	1 or more	unsatisfactory

3. Isolation and identification of pathogenic and potentially pathogenic bacteria

1-Detection of *Salmonella* and *Shigella* species

Were done by the enrichment of water samples on selenite F broth, followed by isolation of the typical organism on selective medium, Xylose lysine deoxycholate Agar (XLD) as described by (HOKO, 2005), as well as methods in food and dairy microbiology (Leo R Diliello 1982).

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2-Detection of Staphylococcus aureus

Were done by primary isolation on selective and / or differential media. Mannitol salt Agar (MSA) was use and incubated at 35 to 37^{o}C for 48hr. as reported on methods in food and dairy microbiology (Leo R Diliello, 1982).

4- Statistical Analysis

All data obtained were subjected to statistical analysis by using SPSS version 17. Descriptive analysis used for each element classified by region and depth.

RESULTS

1- Bacteriological analysis of the ground water

To ascertain the microbiological characteristics of ground water under study, both presumptive and differential tests were conducted. Ground water samples from either tanks or wells were subjected to the following bacteriological tests; total bacterial count, enumeration of viable microorganisms, detection of extent of fecal pollution and identification of pathogenic and potentially pathogenic bacteria. **T**he number of viable bacteria in water samples is counted by using the standard plate count method (total plate count was conducted by pour plate technique on plate count agar (PCA) and counting the colonies developing after the incubation at 37^{0}C for 24h (**Figure 3).**

Figure 3: Plate count method for viable total bacterial colony count (cfu/ml)

The extent of fecal pollution in tested water samples detected by presence of coliform bacteria such as Coliform bacilli (particularly *E. coli*), *Streptococci Faecalis* and *Clostridium welchii* (spore forming anaerobe) by using the presumptive test (**Figure 5**) and confirmed by the standard tests used for all bacterial of fecal pollution using most probable number (MPN) technique (**Figure 4**).

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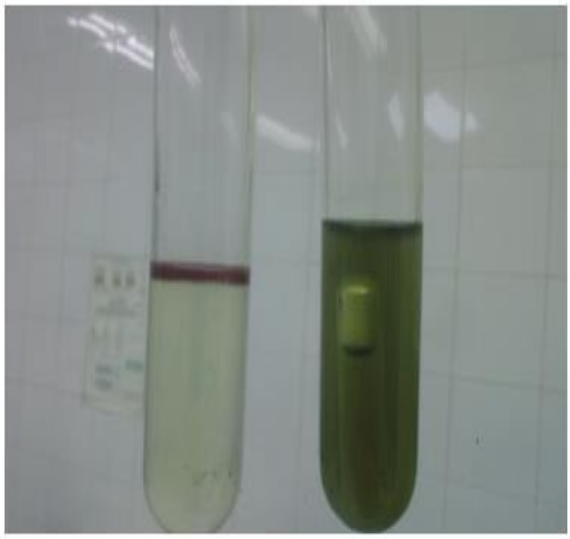

Figure 4: The Most Probable Number (MPN)

Figure 5: The presumptive test the extent of fecal pollution

2- Bacteriological characteristics of ground water samples from tanks

The bacteriological analysis of ground water samples obtained from tanks in the different 11 localities revealed mean bacterial level of 1.58, 0.15, 648.85, 58.21 and 0.07 for *Staphylococcus*, *E. coli*, Total bacterial count of colony forming units (cfu/ ml), Mean Probable number of coliform (MPN/100 ml) and *Pseudomonas* bacteria, respectively. On other hand, the bacteriological analysis of all tank ground water samples cannot be detecting any of *Enterococci* and *Salmonella* bacteria (**Table 3**).

Table 3: Mean Levels of bacteriological examine in ground water samples from tanks in all localities

Bacteriological analysis	Source	Mean	St. d	Minimum	Maximum
Staphylococcus	**Tank**	**1.58**	8.052	0.00	40
E Coli	**Tank**	**0.15**	0.358	0.00	1
Enterococci	**Tank**	0.00	0.00	0.00	0.00
Salmonella	**Tank**	0.00	0.00	0.00	0.00
TBC cuf/ ml	**Tank**	**648.85**	1155.018	10	6300
MPN of coliform per 100 ml	**Tank**	**58.21**	199.54	0.00	1100.0
Pseudomonas	**Tank**	**0.07**	0.250	0.00	1

3- Bacteriological characteristics of ground water samples from wells

The bacteriological analysis of ground water samples obtained from wells in the different 11 localities revealed mean bacterial level of **1.54**, **0.20**, **349.34**, **57.80** and **0.07** for *Staphylococcus*, *E. coli*, Total bacterial count (cfu/ml), Mean Probable number of coliform (MPN/100 ml) and *Pseudomonas* bacteria, respectively. In addition, the

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bacteriological analysis of all well ground water samples cannot be detecting any of *Enterococci* and *Salmonella* bacteria (**Table 4).**

Table 4: Mean Levels of bacteriological examine in ground water samples from wells in all localities

Bacteriological analysis	Source	Mean	St. d	Min	Max
Staphylococcus	**Well**	**1.54**	4.75	0.00	21
E Coli	**Well**	**0.20**	0.401	0.00	1
Enterococci	**Well**	0.00	0.00	0.00	0.00
Salmonella	**Well**	0.00	0.00	0.00	0.00
TBC cuf/ ml	**Well**	**349.34**	563.539	10	3100
MPN of coliform per ml	**Well**	**57.80**	200.977	0.00	1100.0
Pseudomonas	**Well**	**0.07**	0.250	0.00	1

DISCUSSION

Groundwater is a key water resource in much of the world. Many major cities and small towns in the world depend on groundwater for their water supplies, mainly because of its abundance, stable quality and because it is inexpensive to exploit (Morris *et al.,* 2003). Groundwater serves as a reliable source of water for a variety of purposes in an arid country like Libya, including industrial and domestic uses and irrigation. The use of generally high-quality groundwater for irrigation dwarfs all other uses (Burke, 2002). In developing countries, use of shallow groundwater sources for drinking and other domestic purposes is a common feature of many low-income communities (Schmoll *et al.,* 2006). The communities relying on such sources tend to be poor and live-in polluted environments with associated high health risks (WHO and UNICEF, 2000). Such communities occur in most cities in developing countries, for example in Asia, Africa, Latin America and the Caribbean. Their occurrence is attributing to rapid urbanization where urban growth is associated with rapid expansion of small, unplanned urban centers and Peri-urban settlements (Bachman SB, 1997). The use of groundwater as a source for drinking water has expanded much in modern times and today makes up 25 to 30% of the total water extraction of the world. Anthropogenic activities and over-exploitation of groundwater resources has led to degradation of the groundwater quality in many places. There are also several natural contamination sources of groundwater (Younger, 2007). However, microbial contamination easily can be occurring in ground water. Generally, ground water believes to be the purest known. Because of the purification of the soil, as pathogenic microorganisms and dissolved organic matter are removes from the water during subsurface passage through adsorption and trapping by fine sandy materials, clays and organic matter, hence resulting in water with a lower microbial population (Gordon and John, 1996; Prescott *et al,* 2002). Standard plate count and coliform count have been used extensively as a basis for regulating the bacteriological quality of tested ground water.

In this study, results of the bacteriological analysis of the ground water samples in the different 11 localities from tanks and wells are presents in Tables (3 and 4). Concerning

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Total bacterial count of colony forming units' bacteria (cfu/ml), all the ground water samples from both tanks and wells were generally high exceeding the limit of 100 cfu/ml which is the standard limit of heterotrophic count for drinking water (EPA, 2002). However, ground water samples obtained from tanks revealed presence of more total bacterial count (648.85 cfu/ml) than that in samples obtained from wells (349.34 cfu/ml). The high total heterotrophic bacterial count obtained in this study is indicative of the presence of high organic and dissolved salts in the water. The primary sources of these total bacterial cunt in water are animal and human wastes and also include surface runoff, pasture, and other land areas where animal wastes are deposited (Potgieter *et al.,* 2006).

Concerning the results Mean Probable number of coliform bacteria (MPN/100 ml). The presents study results in the different 11 localities were founds to be contaminated with total coliforms. Whereas, they showed nearly similar values of MPN of coliform bacteria in the tested ground water samples obtained from tanks (58.21 MPN/100 ml) and wells (57.80 MPN/100 ml), Also, somewhat similar values of important coliform bacteria, Escherichia *coli (E. coli)* were detected in both tanks (0.15) and wells (0.20) water samples. Accordingly, the presence of fecal coliform (MPN/100 ml) and *E. coli* bacteria from tested ground water sample in this study which exceedingly high the EPA maximum contamination level (MCL) for coliform bacteria in drinking water of zero total coliform or *E. coli* per 100 ml of water (EPA, 2003). The high coliform obtain in the samples may be an indication that the water sources are fecal contaminated through human or animal waste (Osuinde and Enuezie, 1999).

Concerning Pathogenic and potentially pathogenic bacteria, the analsysis revealed an absence of *Salmonella* (0.00) and *Enterococci* (0.00) in all tested ground water samples from both tanks and wells. However, low and broadly comparable of bacterial contaminations were detected for *Staphylococcus aurous* (1.50) and *Pseudomonas aeruginosa* (0.07) in samples from both sources. The presence of few bacterial contaminations with *Staphylococcus aurous* and *Pseudomonas aeruginosa* in this study is not in agreement with EPA water standard which states that these pathogenic organisms must not be present (0.00) in water. Because they are of public health significance, having been associated with gastrointestinal infections: diarrhea, dysentery, fever and other form of infection through gain entry into damage skin and production of enterotoxin (Bennett and Lancette, 1998). The variation of ground water bacterial contamination results varies depend on the depth of the well and as well as the contamination may due to industrialization and urbanization which leads to environmental consequences (Longe and Balogun, 2010). Several studies have demonstrated the contamination of groundwater with pathogens, Nola *et al*, (1998) reported the isolation of *Pseudomonas aeruginosa, Aeromonas hydrophila* and indicators of fecal contamination in spring and well water. Idakwo and Abu (2004) reported that a wide variety of microorganisms pathogenic to human beings is transmitting through contaminated water. Potgieter, *et al.*, (2006) reported an average

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count for total coliforms, fecal coliforms, fecal enterococci and *Clostridium perfringens* exceeding recommended guideline limits in ground water source.

CONCLUSIONS

The bacteriological analysis of the ground water samples in the different 11 localities from tanks and wells showed that: High values of **total bacterial count** in ground water samples obtained from both **tanks** (**648.85** cfu /ml) and **well**s (**349.34** cfu /ml) than **standard** count limit (**100** cfu /ml**)** for drinking water by EPA. These high bacteria counts are indicative of the presence of more organic and dissolved salts in the tested water samples due to infiltration of animal and human wastes**.** Nearly similar values of **mean probable number of coliform** bacteria (**58.00** MPN/100 ml) and ***E. coli*** bacteria (**0.20**) obtained from both tanks and wells. However, WHO set that drinking water must of zero total coliform or *E. coli* per 100 ml of water. The presence of these coliform bacteria may be an indication that these water sources are fecal contaminated through human or animal waste.Although, there is no **pathogenic bacteria** such as ***Salmonella*** (**0.00**) and ***Enterococci*** (**0.00**) bacteria in ground water samples. There is very little nearly similar number of **pathogenic bacteria** as ***Staphylococcus aurous*** (**1.50**) and ***Pseudomonas aeruginosa*** (**0.07**) isolated from both tanks and wells samples. This is not in agreement with **EPA,** which states that **pathogenic organism must not be present** (**0.00**) in water, because they are of public health significance.

finally, to protect against the transmission of waterborne disease, levels of all pathogen in drinking water should be monitored and bacteriological examination of water is used and control the quality and safety of water. From the microbiological point of view, the coliform and pathogenic bacterial contamination render this water was unsatisfactory for drinking purpose unless bacteriologically treated. water borne diseases are due to improper disposal of refuse, contamination of water by sewage, surface runoff, therefore, proper well location and construction, control of human activities to prevent sewage from entering water body is the keys to the avoiding bacterial contamination of drinking water. General populace must apply proper disposal of refuse, treatment of sewage and the need to purify our ground water to make it fit for drinking and to avoid public health significance organisms. Educative programs must be organized by researchers and government agencies to enlighten the villagers on the proper use of ground water. The drill of Wells should be outraised by the government.

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