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# Assessment of Drinking Water Quality in *El-Obeid City, North Kordofan State, Sudan,* (Jan to Dec 2017).

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**Abstract:**

Objective: to assess the quality of drinking water in El-Obeid City, North Kordofan State, Sudan. Methodology: A total of (142) samples were selected from all clusters (n=142). According to (WHO) guidelines for water sampling measurement, the size of water samples is (54), which recommends taking one sample per 10,000 population, plus 10 additional samples, (WHO, 1997). But samples were taken by the researcher is (142). Results: it was shown that more than half of the samples taken from all sources were containing faecal- E.coli. The water sample was taken from the main source of water such as; Bara basin "groundwater" and Khazan "surface water" were free contamination after treatment. More than half of the samples without residual chlorine. Most of the water samples had hardness. Conclusion: Selection of proper designs for the distribution system and regular check to network system to remedy any leakage that may happen and Appropriate storage of drinking water at houses in El-Obeid City to avoid any contamination and encourage all populations to make regular cleaning of storage facilities.

**Keywords**: Treatment, Contamination, Quality, Hardness, Membrane Filtration, Palintest

## 1. Introduction:

A provision of water is critical to the existence of life as we know it. Human, faunas and floras need water to drink. The basic purposes of society require water: cleaning for public health, consumption for manufacturing processes, and cooling for electrical generation [(1)]. Water covers 75% of our earth, however, only a tiny fraction of this copious water is available to us as

potable water. The majority of water (97%) is found in the oceans and is too salty for drinking, irrigation or industrial purposes except as a coolant [16].

In Africa, the number of people with access to an improved water supply in 2000 was (62%), while that for improved sanitation was (60%). Thus the total of population without access to safe water and sanitation was 300 million and 313 million respectively. Access to clean water and proper sanitation in rural Africa was only (47%) and (45%) respectively. Thus the number of people without access to safe water and sanitation is 300 million and 313 million respectively. Access to safe water in rural Africa is only 47%. As of 2008, the latest year for which data are available from the UNICEF/WHO‟s Joint Monitoring Program (JMP), Sub-Saharan Africa accounted for over a third of the 822 million people without access to improved water supply [2].

Water-related diseases caused by inadequate safe water supplies tied with poor sanitation and hygiene cause 3.4 million deaths a year, mostly among children. Despite continuing efforts by governments, civil society and the international community, over a billion people still do not have access to improved water sources [3]. The provision of sufficient supply of safe water is one of the eight components of primary health care identified by the International Conference on Primary Health Care in Alma-Ata in 1978 [4].

Much of the ill-health which affects humanity, especially in the developing countries can be traced to lack of safe and wholesome water supply. There can be no state of positive health and well-being without safe water. Water is not only a vital environmental factor to all forms of life, but it has also a great role to play in socio-economic development of human population [5].

Having safe drinking water is a human need and right for everybody. Populations need safe water to maintain their health and dignity. Having better water and sanitation is necessary in cutting the cycle of poverty since it improves people’s health, strength to work, and ability go to school [6].

In Sudan , the rural population constitutes about 80% of the country’s total population. Most of the year these people use untreated water directly from sources such as traditional surface, deep bores, rivers, intermittent rainy season streams "Khours", natural rain ponds and artificial rain water catchments "Hafirs" [7].

## 2. **Methodology:**

**2.1 Study Dasign:**

Descriptive cross sectional study was carried out for assessment of drinking water quality in El-Obeid City.

**2.2 Samples:**

Sample size was selected according to WHO (1997) guidelines for water sampling measurement, which recommend taking one sample per 10,000 population, plus 10 additional samples as follow:

Number of the population: 440483

Sample size: 44 sample + 10

According to WHO guidelines, the size of the water samples is (54), but samples were taken is (142).

**2.3 Ethical Principles:**

To obtain permission to conduct the study is very important for collecting data. to obtain permission to conduct the study is very important for collection of data. The researcher will contact and receive approval from the appropriate management authority and will take.

**2.4 Instrumentation:**

Water samples for biological, chemical and physical testing were collected in the sterilized bottle. The outside of the tap to be sterilized by flame, and then water is allowed to run for two minutes to wash out any organism in the pipe. The bottle is then filled with water and closed immediately. A total of water samples of each in tightly sealed sterile bottles packed in the cool box then to be submitted to the ministry of health laboratory in El-Obeid on the same day for analysis.

**2.4.1 Biological parameters**: include: *E. coli*. Traditionally, membrane filtration using international standardized methods was recommended to measure indicator bacteria in drinking water [(6)]. Required; (Sterile filtration unit, sterile grid membrane filters, sterile 47 mm diameter cellulose pads, and sterile Petri dishes 50–60 mm diameter [(8)]. For hardness and nitrate test using POTATEST WE10005 instruction and Wagtech WTD Incubator.

**2.4.2 Chemical parameters:** (PH, Chlorine, Hardness, Fluoride, and Nitrate); the physical parameters of a water sample was used the following equipment: For measured PH using the Palintest phenol red clear tablets, Palintest automatic wavelength selection photometer and

round test tubes, 10 ml glass. For chlorine and fluoride test using Wagtech DPD No.1/ No.2 tablets, Wagtech comparator, Wagtech colour disc and square test tubes (13.5 mm) 10 ml [(6)]. For hardness and nitrate test using the Palintest hardicol NO.1/NO.2 tablets/nitricol tablets, Palintest automatic wavelength selection photometer and round test tubes, 10 ml glass.

**2.4.3 Physical parameters**: include; (Turbidity and Colour):

The physical parameters of a water sample were used the following equipment: For turbidity and colour test using Palintest colour/turbidity set and Palintest automatic wavelength selection photometer.

**1.2 Procedures:**

El-obied City was divided into four equal quarters (clusters). The different types of blocks are considered as cluster where (35) samples is selected from each cluster of El-obeid city by using a process of simple random sample, and (2) samples are selected from water distribution network, so the total number of samples selected is (142) samples from all blocks. The following table shows sample distribution:

| **Quarters** | **Numbers of sample** |
|---|---|
| Quarter 1 | 35 |
| Quarter 2 | 35 |
| Quarter 3 | 35 |
| Quarter 4 | 35 |
| Water Networks | 2 |
| Total | 142 |

After determination of sample size required from each quarter samples for each quarter is distributed over blocks following a process of stratified sampling and within the blocks, a simple random sample is used, so the total number of samples selected from each quarter as shown below:

| **Source of samples** | **Number of samples** |
|---|---|
| Houses | 27 |
| Animals carts | 25 |
| Tankers | 11 |

| | |
|---|---|
| Gerba | 69 |
| Wells/Pumps | 10 |
| Total | 142 |

### 2.4 Statistical Analysis:

The data were analyzed by the computer. After taking samples, data were analyzed using Statistical Package for Social Sciences (SPSS), Microsoft Excel and Master Sheet. Data analyzed has been displayed by tables and figures.

## 5. Result:

The study showed that about (51.4%) of samples of drinking water from all sources were containing *faecal- E.coli*, Figure [(I)]. While this study showed that there were (59.3%), (27.3%), (72%), (44.9%) and (50%) of samples from houses, tankers, animals cart, gerba, and Wells/Pump, respectively, contain *E.coli*, Figure (II). The study showed that the water sample taken from the main source of water coming from the Bara basin (groundwater) and Khazan (surface water) were free contamination after treatment. This study showed that (4.2%) only of samples contained pH above SSMO and WHO Standard, that means (4.2%) of samples tend to alkaline, and (57.3%) samples without residual chlorine, Table (1). Most of the water samples had hardness while only (1.4%) is soft water, Table (2). The study illustrated that the value of turbidity and colour of water distributed about (12.7%) and (26.1%) of samples above the WHO and SSMO standard, respectively, Table (3).

**n= 142**

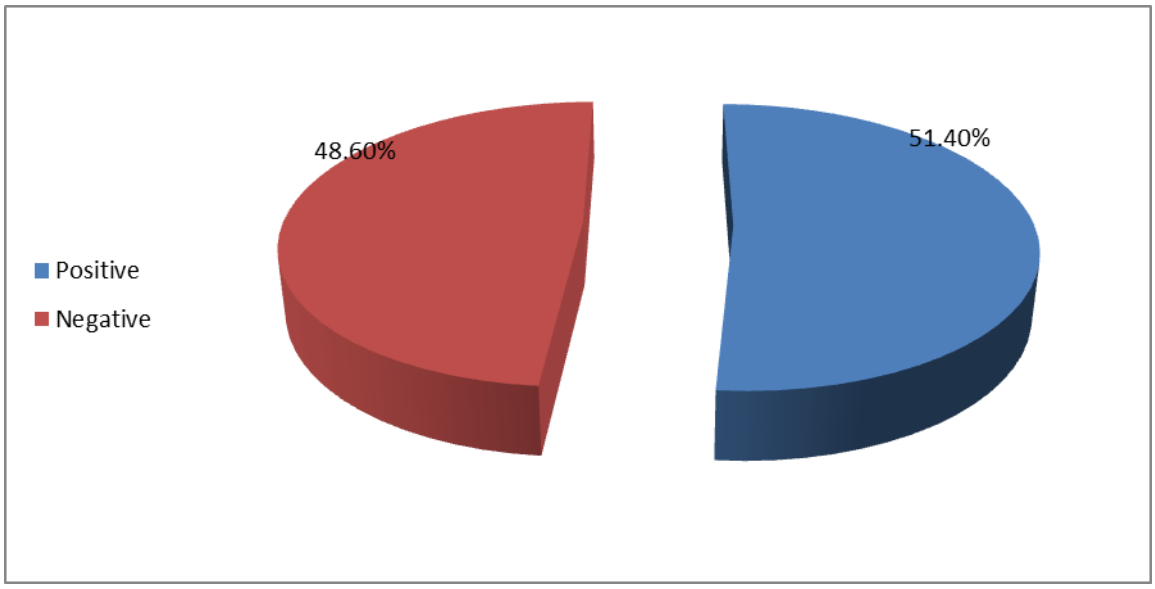


**Figure (I): The distribution of *faecal - E.coli* among samples in El-Obeid City, Jan to Dec 2017**

**n= 142**

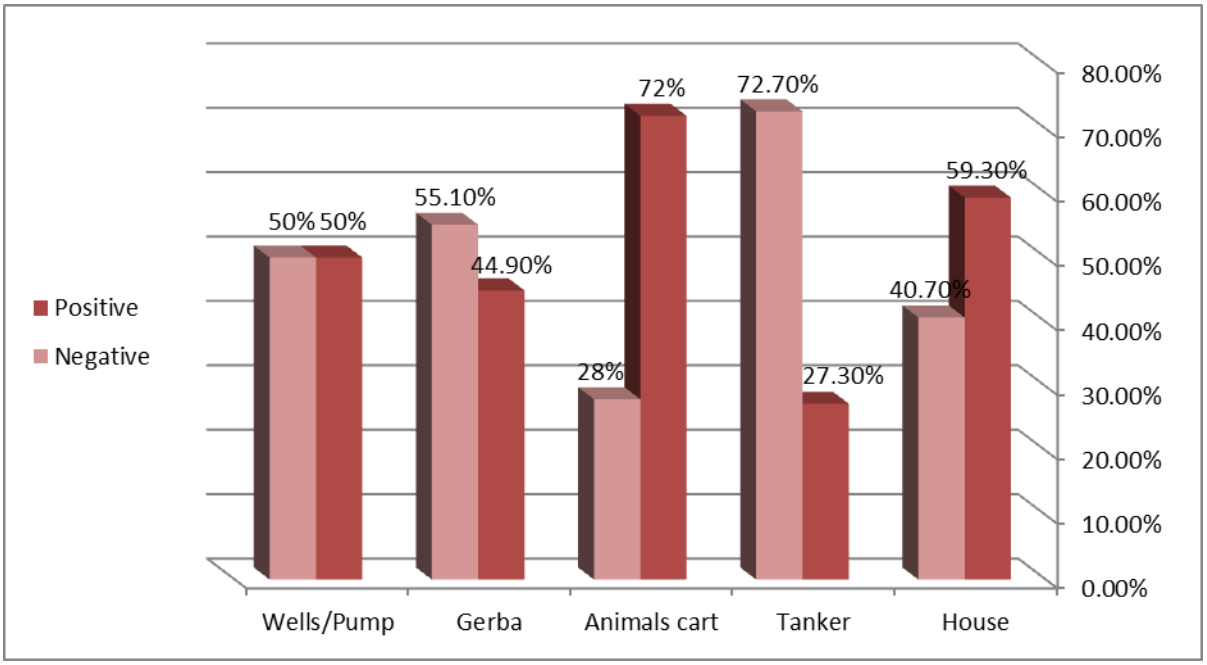


**Figure (II): The distribution of *faecal E.coli* among samples by sources samples, El-obeid City, Jan to Dec 2017**

**Table (1): The chemical parameters of water and comparative with SSMO and WHO standard – in El-obeid City, Jan to Dec 2017**

| Parameter | Mean | Standard deviation | SSMO* | | | WHO | | |
|---|---|---|---|---|---|---|---|---|
| | | | Standard | Less than standard | Above standard | Standard | Less than standard | Above standard |
| **PH** | 7.381338 | 1.525666 | 85.9% | 9.9% | 4.2% | 86.6% | 9.2% | 4.2% |
| **Hardness** | 208.6831 | 115.2272 | NS** | | | 3.5% | 0 | 96.5% |
| **Fluoride** | 0.682028 | 0.578701 | 0 | 80.3% | 19.7% | 0 | 80.3% | 19.7% |
| **Residual chlorine** | 0.275655 | 0.598535 | 8.5% | 57.3% | 35.2% | 8.5% | 57.3% | 35.2% |
| **Nitrite** | 0.035655 | 0.047908 | 0 | 97.9% | 2.1% | 2.8% | 93.7% | 3.5% |

**n=142**

SSMO*= Sudanese Standard Measurements Organization

NS**=No Standard

**Table (2): The degree of hardness for water, in El-obeid City, Jan to Dec 2017**

| Parameter | Less than 50 (soft) | | 50-150 (moderately hard) | | 150-300 (hard) | | Above 300 (very hard) | |
|---|---|---|---|---|---|---|---|---|
| Hardness | 2 | 1.4% | 41 | 28.9% | 78 | 54.9% | 21 | 14.8% |

**n=142**

**Table (3): The physical parameters of water and comparative with SSMO and WHO standard – in El-obeid City, Jan to Dec 2017**

| Parameter | Mean | Standard deviation | SSMO | | | WHO | | |
|---|---|---|---|---|---|---|---|---|
| | | | Standard | Less than standard | Above standard | Standard | Less than standard | Above standard |
| **Turbidity** | 3.717817 | 12.47433 | 2.1% | 85.2% | 12.7% | 2.1% | 85.2% | 12.7% |
| **Colour** | 21.28662 | 99.33859 | 0.7% | 73.2% | 26.1% | 0.7% | 73.2% | 26.1% |

**n=142**

## 4. Discussion:

The present study showed that about (51.4%) of samples of drinking water from all sources were containing *faecal-E.coli*, this finding is in contrast with WHO guidelines which indicate that *E.coli* must not be detectable in any 100-ml sample of water for drinking [(9)]. Thus those samples were considered as unsafe water because it contains bacteria indicating faecal pollution; because of the risk that enteric pathogens may be present [(10)], this finding considered similar to result of study conducted in El-obeid City (2017), showed that about (57%) of samples of drinking water all sources were containing *faecal E.coli* [(11)], this finding is higher with our study. in a study conducted in Palestinian Authority, (2011), showed that (100%) were found to contain coliforms and to be heavily contaminated with heterotrophic bacteria. About (67%) of all samples were contaminated with fecal coliforms [(12)]. Also in a study conducted in Western Maharashtra, India (2005) illustrated that overall (49.8%) of samples were polluted [(15)].

The present study showed that there were (59.3%), (27.3%), (72%), (44.9%) and (50%) of samples from houses, tankers, Animals cart, gerba and Wells/Pump, respectively, contain *E. coli*, this percentage refer to a high pollution of water in this sources, which is corresponding with WHO guideline which indicate that is all water intended for drinking *E. coli* or *thermotolerant coliform* bacteria must not be detectable in any 100-ml sample, in treated water entering the distribution system *E. coli* or *thermotolerant coliform bacteria* and Total coliform bacteria must not be detectable in any 100-ml sample, and treated water in the distribution

system [9]. in a study conducted in El-obeid City (2017), showed that there were (60%) samples from houses contain *E .coli*, (50%) from tanker and gerba contain *E.coli* and (81%) from animal cart samples contain *E. coli* [11]. in a study conducted in Western Maharashtra, India (2005) illustrated that (45.9%) of the samples from piped water supply were polluted [15]. The study showed that the water sample taken from the main source of water coming from Bara basin (groundwater), Khazan and Hafir Eljallbyia (surface water) were free contamination and this indicates that the contamination that occurs in samples tested may be due to leakages in the distribution system or bad handling and storage methods. WHO guideline which indicates that there are several of health concerns associated with water supplied to consumers by water vendors. These include access to adequate volumes and concern regarding inadequate treatment or transport in inappropriate containers, which can result in contamination. Where the source of water is uncertain or the quality of the water is unknown [13]. Our study is corresponding with a study conducted in El-obeid City (2017),which showed that all samples were taken from the main source of water coming from Bara basin, Khazan and were free contamination [11].

In our study, only (4.2%) of samples contained pH above SSMO and WHO Standard, that means (4.2%) of samples tend to alkaline, at pH levels above 8, there is a progressive decrease in the efficiency of the chlorine disinfection process [5]. The present result is corresponding partly with a study conducted in El-obeid City (2017), showed that only (3.7%) of samples contained pH above SSMO and WHO Standard [11].

The present study showed that (57.3%) samples without residual chlorine, that residual chlorine means is less than recommended value of WHO guideline and SSMO Standards, which is equal 0.5 mg /l in both, that make water more vulnerable to contamination because free residual chlorine provides a margin of safety against subsequent microbial contamination such as may occur during storage and distribution of water [5]. The present result considered high with a study conducted in El-obeid City (2017), which showed that (50%) samples without residual chlorine [11]. The majority of water samples (96.5%) had hardness (hard water) and only (3.5%) were soft, WHO guidelines have shown hardness above 200 mg/liter, can result in scale deposition, particularly on heating. Soft waters with a hardness of less than about 100 mg/liter have a low buffering capacity and may be more corrosive to water pipes. No health-based guideline value is proposed for hardness. However, the degree of hardness in water may affect its acceptability to the consumer in terms of taste and scale deposition [13]. The present

result considered corresponding partly with a study conducted in El-obeid City (2017), showed that most of the samples hard and only (1.9%) are soft water [11].

In our study, regarding the value of turbidity of water, about (12.7%) sample above WHO and SSMO standard. That means this turbidity value exceeds the maximum of WHO and SSMO standards, which equals 5 NTU for both this value is not preferable because high turbidity interferes with disinfection and microbiological determination, [5]. The present result is in contrast with a study conducted in El-obeid City (2017), the value of turbidity of water distributed about (18.5%) above the WHO and SSMO standard [11]. In a study conducted in Zambia (2003), showed that high Turbidity (35NTU; 22NTU) in Musonda and Chipata as peri-urban dwellings while least values (<5NTU) were obtained in water samples from urban dwellings [14].

## 5. Conclusion:

The study found that most samples taken from houses, animal carts (karo), tankers, and gerba were polluted with *feacal E.coli*, and samples taken from main sources were free from contamination, as shown in the result of water analysis, which indicate the safety of water from main sources, and pollution of it after handling and storage. Also the study illustrated that the concentrations of residual chlorine in most samples were zero, the other problem may be related to the road vendor of water who uses unclean tankers and unsafe water sources. Thus selection of proper designs for distribution system and regular check to network system to remedy any leakage that may happen and encourage all venders who transfer water by tankers, gerbas and animal carts to take water from safe sources of drinking water and clean and paint storage water equipment regularly to avoid any contamination.

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