QUALITATIVE STUDY OF DRINKING WATER OF VARIOUS SOURCES OF CHOUTAIR VILLAGES DISTRICT ZIARAT BALOCHISTAN, PAKISTAN.

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A B S T R A C T S

Water is one of the most vital and valuable natural resource in universe. The completion of lifecycle of human, animal, plants and microorganisms is impossible without the use of water. Worldwide, the contaminated surface and groundwater with heavy metals and microbes, severely affect the lifecycle of the said organisms. Therefore, the use of safe and pure water is necessary. People of Balochistan province mainly use spring and open well water for agriculture and drinking purposes. To know the microbial and heavy metals status of the water of district Ziarat Balochistan. Microbes, heavy metals, and physiochemical characteristics of drinking water of various sources of Choutair village District Ziarat (Balochistan) were. Total 27 samples were collected from spring, open and tube well. Each from Choutair, Ziarat, and Tandwani villages of District Ziarat (Baluchistan). Alarming results were regarding the colony of coliform in all tested water samples with the range between 2.32 to 19.33 MPN/100ml (more than acceptable range (0 CFU) of World Health Organization (WHO). While the E. coli range was 2.00 to 2.33 MPN/100 ml, found only in spring water more than the permissible range of WHO. Cadmium (Cd) and lead (Pb) were determined by using Atomic Absorption Spectrophotometer. Cadmium was slightly higher than the permissible range of WHO. While the lead was within the range set by WHO. Physicochemical parameters i.e. pH, Electrical conductivity (EC), Total dissolved solid (TDS) and Turbidity were ranged in the permissible standard set by WHO. These results concludes that the excessive amount of Coliform and Cadmium in drinking water of this area

is not safe for human consumption, restaurants, and food industries. Government should install treatment plants to make water free from microbiological and physiochemical contamination.

Keywords: Physiochemical parameters; heavy metal; microbes; Ziarat; spring water; well water.

1. INTRODUCTION

Water is one of the most vital and valuable natural resource in a universe. It is necessary for life process of living organism from the microorganism and the simplest plants to the most difficult living system known as human and animal body (Onifada *et al.* 2008). Without water, sustainable life is not possible on earth (Hussain. J *et al*. 2012).Water is a key natural resource recognized on the earth surface. The care of drinking water from any type of pollutant is crucial for human body. Pollution of water mostly caused by improper use of water for agriculture, domestic and industrial purpose. It is effected through several contaminations which, involved microbiological and chemical factors. These impurities caused the health issue (Adhena *et al.* 2015) worldwide because of its direct effect on marine and human life (Ezemonye *et al.* 2005). Water borne diseases is one of the critical health issues worldwide. Approximately, 4.3 billion diarrhea cases reported every year while 4.6% of the world water borne diseases problem occur in the year 2000 (WHO, 2002). The registered diarrheal cases in Pakistan are about one hundred million per annum (Daud M.K *et al.* 2017). Heavy metals (HM) are non-degradable and accumulate over food chain. Some metals such as Cu, Zn, and Fe are essential micronutrient. However, they can be harmful when take in excessive amount to the physiology of living organisms (Kar *et al.* 2008). Contaminated water causes different disease such as diarrhea, cardiovascular, neurological and tooth decay (Johnson & Hallberg., 2005). An excessive amount of HM may cause irreversible brain damage. Infant takes higher amount of metals from food than adults. They ingest more diets for their body weight, which cause several disease like learning difficulties, damage of nervous system and behavioral problems such as hyperactivity (Rajendran *et al.* 2003). According to the Environmental Protection Agency, the permissible limit of lead in drinking water is 0.006mg/l (Tareen A.K *et al.* 2014). Baluchistan is the largest province of Pakistan according to the area (Ahmed *et al*. 2014). Around 54% areas irrigated from surface water and the remaining 46% area irrigated from underground water (Ahmed S. 2007). Deforestation and industrialization has great effect of the ground and surface water pollution (Bhalme *et al.* 2012). People of Ziarat District (Baluchistan) mostly depend upon agriculture where the main sources of water are spring and open

wells. Water table is going down day by day in selected area therefore the chance of heavy metals may be higher. People of Balochistan province mostly live near the river and stream areas to get water for irrigation and drinking purpose (UNICEF, 2017). To avoid water of such factors it is necessary to classify degree and source of any contamination capacity (Ushie *et al.* 2008). To know the physicochemical, microbial, and heavy metals status of the drinking water of district Ziarat Balochistan, the current research was carried out.

2. Materials and Methods

2.1. Sampling area.

The current research was conducted evaluate the Microbes, heavy metals, and physiochemical characteristics of drinking water of various sources of Choutair village district Ziarat (Balochistan). Water samples collected from different sites of Ziarat district (Table 1). To avoid any risk of contamination the polythene bottle is use for the collection of water samples and labeled correctly.

Table. 1 Name of Sampling areas, sources with their samples.

Samples	Sources	Area
ZT	Tube well	Ziarat city
ZB	Bore	Ziarat city
ZS	Spring	Ziarat city
CT	Tube well	Choutair village
CB	Bore	Choutair village
CS	Spring	Choutair village
TT	Tube well	Tandwani village
TB	Bore	Tandwani village
TS	Spring	Tandwani village

2.2 Sampling.

Water samples collected from three different sites of district Ziarat (Table 1) in 250 ml polythene bottles. The collected samples tested in the laboratory of Pakistan Council of Research in Water Resources (PCRWR) research center Quetta.

2.3 Physiochemical parameters of selected water.

Analysis of physiochemical parameters of collected water samples carried out by method defined through (Joshi *et al*. 2009) these parameters are:

2.4. pH.

pH of collected samples of water was determined by means of pH meter (Jenway model. 3520) by following ordinary method of (AOAC, 2012).

2.5. Electric conductivity (EC).

Electrical conductivity of collected water samples examined through the using EC meter (LF-91) as standard by (AOAC, 2012).

2.6. Turbidity.

Turbidity was determine by using Nephelometer (Wag-WT-300) as per standard set by (AOAC, 2012).

2.7. Total dissolved solid (TDS).

Total Dissolved Solid was determined by means of using of TDS meter (HACH COISO USA).as per standard set through (AOAC, 2012).

2.8. Qualitative analysis of Microbes by MPN method.

Microbial status of total coliform and E. coli analyzed in collected water samples through the Most Probable Number (MPN-9221).

MacConkey broth used by means of the culture media for the calculation of Coliform bacteria. Media prepared by the weight of 4gm of MacConkey broth and dissolved in the100ml of distilled water. Durham tube placed upside down in each test tube. 10ml broth was distributed in the 15 test tubes and cotton plug used for every sample then sterilized on 121 C for 30 mints.

10ml, 1ml and 0.1ml of water samples were added to 15 test tube of each sample with 5 tubes then wrapped with cotton plugs and put in incubator for 24 hours and temperature was adjust at 37°C then observed. After some time incubation period positive tube was count up in every set of five test tubes and consult the proper number from MPN tables (Tandon p. 2005)

2.9. Sample preparation for heavy metals.

Collected water samples brought into the lab and the digestion process carried out. The digestion was performed via addition of (10ml) sample into the (5ml) of concentrated HCL solution and (5ml) of concentrated solution of HNO_3. The solution twisted gradually, and then covered with help of watch glass, allowed for 60 mint at room temperature. The solution was heated by the help of hot plate, fumes of yellow color was released and the samples were turn out to be clear. The acidic solution after cooling filtered by filter paper and then deionized water was added to make the volume 100 ml (fong SS *et al.* 2006).

2.10. Stock standard solution for lead.

Lead, 1000mg/l dissolved into 1.59g of lead nitrate in 1% (v/v) and dilute to one liter with 1% (v/v) HNO_3.

2.11. Stock standard solution for Cadmium.

Cadmium, 1000mg/l dissolved into 1.00g of cadmium in a minimum volume 0f (1+1) HCL. Dilute into one liter with 1% (v/v) HCL.

2.12. Analysis of Heavy metals.

Atomic Absorption spectrophotometer (Model Perkin Elmer 3280 USA) used for the analysis of cadmium (Cd) and lead (Pb) (Alzrog AM *et al.* 2013).

3. Results and discussion

3.1. Physicochemical parameters.

3.1.1. pH

Data in (Table 1) represented that the pH of water collected from different sites of District Ziarat (Balochistan). pH is the indicator of acidity and alkalinity condition of water status. Water pH

is important to keep our health in balance and to regulate metabolic processes. In current research the highest values of pH was recorded (7.76 ± 0.05) in bore water of Tandiwani village while the lowest value was reported (7.42 ± 0.13) in tube well water of Ziarat city. Mean values of pH concentration for different sources were (7.51, 7.57, and 7.62NS), while the mean values of pH concentration for different areas were (7.49, 7.54, and 7.67NS). The data indicated that the pH level of collected water samples were in the range of World Health Organization (WHO) as standard level (6.5 to 8.5) (WHO, 1993).

Acidic water being found near mining sites, chemical dumps, power plants, animal feeding operations, and landfills. Acidic water can be easily leach out the metal ions such as, manganese, lead, iron, zinc, and copper from pipes. Acidic water is due to industrial pollution. It may cause various chronic and acute diseases like vomiting and stomach irritation. The basic nature of water may be due to the limestone basin or alkalinity minerals are present in underground water. It does not causes the health issue, but it attribute unpleasant or soda-like taste to the water (Shakirullah *et al.* 2006).

3.1.2. Electrical conductivity (EC).

The data in (Table 1) pointed out the electrical conductivity (EC) of water collected from different sites of District Ziarat (Balochistan). Electrical Conductivity is the ability of any medium to conduct the electric current. Salt and dissolved solid in water can break down into positively and negatively charged ions. These free ions in the water conduct electricity, so the water electrical conductivity depends on the concentration of ions (Sivaraju H.P. 2012). The results show that the highest (EC) value (959.44 ± 1.24 µS/cm) was reported in bore water of Tandwani village while the lowest value (389.25 ± 2.88 µS/cm) was reported in tube well water of Choutair village. Mean values of EC concentration for different sources were (498.89, 540.05 and 859.74 µS/cm) while the mean value of EC concentration for different area were (516.09, 628.96 and 753.63 µS/cm). The permissible range of conductivity is 1000 µS/cm. Thus results showed that the (EC) status of collected water samples were in the acceptable range of WHO.

The conductivity of drinking water also effected by the presence of inorganic dissolved solid i: e nitrate, sulfate, phosphate, chloride, calcium, and magnesium ions. Electrical conductivity does not affect directly on human health. Conductivity is determine for numerous purpose such as determination of mineralization rate and estimate the quantity of chemical substance used to treat of water (Kavcar. P *et al.* 2009). Reverse Osmosis (RO) and microfiltration is use to remove the dissolved solid and colloidal maters for reducing of EC load from drinking water (Azrine *et al.* 2011).

3.1.3. Total Dissolved Solid (TDS).

The data in (Table 1) denoted that the Total Dissolved Solid (TDS) of water collected from different sites of District Ziarat (Balochistan). TDS is the indicator for general water quality since it direct effect on the aesthetic value of drinking water by increasing the turbidity level. TDS value show that water is highly mineralized (Vaidya S.R; Labh S.N. 2017). In the current study the highest TDS value (616.33 ± 0.88 mg/L) was reported in open well water of Tandiwani village while the lowest value (247.33 ± 0.88 mg/L) was reported in tube well of Choutair village. Mean values of TDS concentration for different sources was in the range of (318.44 to 551.22mg/L) while mean values of TDS concentration for different areas was in the range of (329.89 to 481.22mg/L). High value of TDS in drinking water are usually not harmful for consumer but in some causes. It effect that person who are suffering from kidney and hearth diseases (Vaidya S.R; Labh S.N. 2017). The acceptable range of TDS is 1000 mg/L. So overall results were within the standard range of WHO. Therefore, the selected water is safe for consumption in term of TDS.

3.1.4. Turbidity.

The data in (Table 1) denoted that the Turbidity of water collected from different areas of District Ziarat (Balochistan). Turbidity is the cloudiness of water caused by the variety of suspended particles and it is the chief parameter in drinking water analysis. (Hammer. 1986). Turbidity may be because of very fine partial of silt, clay, organic and inorganic matter or caused by algae growing. High turbidity interfere with disinfection of water treatment process and provide a medium for microbial growth, which lead to water borne diseases. Excess turbidity can cause heavy metals to add to the water. Soluble particles of organic matters, soil, and other materials hinder to the passage of light to water by absorbing and scattering the rays. In the current study the highest turbidity range (4.40 ± 0.33 NTU) was reported in spring water of Choutair village while the lowest value (2.97 ± 0.44 NTU) was reported in open well of Choutair village. Mean values turbidity concentration for different sources was in the range of (3.55 to 4.28 NTU) while mean values of turbidity concentration for different sites was in the range of (3.84 to 4.16 NTU).The standard recommended range of turbidity set by WHO for drinking water for drinking water is 5 NTU (WHO. 2011). The results indicate that the turbidity of all collected water samples was below the WHO standard limit (5 NTU). Thus, the selected water is pure and safe for consumption in term of turbidity. Reverse Osmosis (RO), ultrafiltration, Settling, and decanting method used to reduce the turbidity level in drinking water.

Parameters	Source	Area			Mean	WHO Standard
		Ziarat	Choutair	Tandwani		
pH	Tube well	7.42 ± 0.13 NS	7.57 ± 0.14 NS	7.56 ± 0.23 NS	7.51 NS	6.5-8.5
	Bore	7.56 ± 0.17 NS	7.53 ± 0.22 NS	7.76 ± 0.05 NS	7.62 NS	
	Spring	7.49 ± 0.15 NS	7.51 ± 0.26 NS	7.71 ± 0.07NS	7.57 NS	
	Mean	7.49 NS	7.54 NS	7.67 NS		
Electrical conductivity (EC)	Tube well	766.78 ± 2.65 C	389.25 ± 2.88 H	464.11 ± 1.46 F	540.05 B	1200 (µS/cm^3)
	Bore	872.44 ± 1.24 B	747.33 ± 2.60 D	959.44 ± 1.24 A	859.74 A	
	Spring	621.67 ± 5.36 E	411.67 ±1.95 G	463.33 ± 3.29 F	498.89 C	
	Mean	753.63 A	516.09 C	628.96 B		
Total Dissolves Solid (TDS)	Tube well	489.67 ± 2.03 C	247.33 ± 0.88 H	298.67 ± 1.76 F	345.22 B	1000 mg/l
	Bore	558.67 ± 2.19 B	478.67 ± 0.66 D	616.33 ± 0.88 A	551.22 A	
	Spring	395.33 ± 1.76 E	263.67 ± 0.66 G	296.33 ± 1.20 F	318.44 C	
	Mean	481.22 A	329.89 C	403.78 B		
Turbidity	Tube well	4.13 ± 0.08 A	4.13 ± 0.26 A	4.30 ± 0.26 A	4.28 A	5 (NTU)
	Bore	4.00 ± 0.05 A	2.97 ± 0.44 B	3.67 ± 0.06 AB	3.55 B	
	Spring	4.33 ± 0.24 A	4.40 ± 0.33 A	4.30 ± 0.26 A	4.26 A	
	Mean	4.16 A	3.84 A	4.09 A		

Table. 1 Physicochemical parameters of drinking water of selected areas and sources of district Ziarat (Baluchistan).

Sources of heavy metals in drinking water.

Water polluted from different perilous metals and rock crystal can arises from natural as well as anthropogenic sources. Heavy metals are seepage from sedimentary rock into the water, forest fires, and volcanic activity. Rapid industrialization is one of major sources of heavy metals entrance in drinking water. These poisonous metals enter the body generally by water and food or lesser extent through breathing of polluted air. Usage of cosmetic, paints, lead acid batteries, coal based thermal power plants, mining, fuel combustion are the key factor of heavy metals in drinking water.

3.2. Heavy metals analysis.

3.2.1. Lead (Pb).

The data in (Table 2) showed that the lead (Pb) concentration in drinking water collected from different areas of District Ziarat (Balochistan). High concentration of lead in drinking water may be due to seepage of rocks, corrosion of pipes, lead acid batteries, paints, ceramics; coal based thermal power plants and industrial waste (Uzma, I; Chandio T.A. 2017). In current research, the highest lead range (0.00800 ± 0.0057 mg/L) reported in tube well water of Tandwani Village while the lowest range (0.0010 ±0.00057 mg/L) recorded in spring water of Tandwani village. Mean values lead concentration for different sources was in the range of (0.0024- 0.0422 mg/L) while mean values lead concentration for different sites was in the range of (0.0048- 0.0381 mg/L). The standard recommended range of lead set by WHO for drinking water is 0.05 mg/L (WHO. 2011). The results indicate that the lead status of all collected water samples was below the WHO standard range (0.05 mg/L). Thus, the selected water is pure and safe for human consumption. Higher concentration of lead can attacks the brain and certain nervous system, and has serious effects on fetus cause the baby to be born too early or too small. Lead exposure has been associated with increased risk of lung, stomach, and urinary-bladder cancer in human being (WHO. 2011).

3.2.2. Cadmium (Cd).

The data in (Table 2) showed that the Cadmium (Cd) concentration in drinking water collected from different areas of District Ziarat (Balochistan). Cadmium (Cd) come in water as the result of waste dumping, Industrial discharge, plastic, coal, automobile, motor oils, and tires. Cadmium is the carcinogenic for human body and classified as the first group through International Agency for Research on Cancer (IARC) (Godt J *et al.* 2006). Due to its great toxicity, cadmium can cause a wide

range of food toxins. Less cadmium can also have harmful effects on the blood vessels in the human kidney. Since cadmium can biochemically replace zinc, it can harm the kidneys and raise blood pressure (Rajappa B *et al.* 2010). In present studies the highest cadmium (Cd) range (0.056 ± 0.0015 mg/L) reported in tube well water of Choutair Village while the lowest range (0.010 ± 0.00082 mg/L) was reported in bore water of Tandwani village. Mean values Cd concentration for different sources was in the range of (0.017 to 0.033 mg/L) while mean values Cd concentration for different sites was in the range of (0.017 to 0.039 mg/L). The standard recommended limit of Cadmium by WHO for drinking water is 0.05 mg/L (WHO. 2011). The results indicate that the Cd status of all water samples was above the WHO standard range (0.003 mg/L). It may cause severe health issue. Therefore, the selected water is not safe for consumption. Government should start purification plants and public awareness programs so that people adopt proper measure to protect one of the most valuable fresh water resource.

Table .2 Heavy metals concentration (mg/l) of drinking water of selected areas and sources of district Ziarat (Balochistan).

Heavy metals	Source	Area			Mean	WHO Standard
		Ziarat	Choutair	Tandwani		
Lead (Pb)	Tube well	0.0067 ± 0.00088 C	0.0400 ±0.030 B	0.00800 ± 0.0057 A	0.0422 A	0.05 mg/L
	Bore	0.0060 ± 0.0011 C	0.0097 ± 0.00088 BC	0.0333 ± 0.0088 BC	0.0163 B	
	Spring	0.0017 ± 0.00066 C	0.0047 ± 0.0057 C	0.0010 ±0.00057 C	0.0024 C	
	Mean	0.0048 C	0.00181 B	0.0381 A		
Cadmium (Cd)	Tube well	0.020 ± 0.0012 DEF	0.056 ± 0.0015 A	0.019 ± 0.00088 EF	0.032 A	0.003 mg/L
	Bore	0.022 ± 0.0012 D	0.018 ± 0.00088 F	0.010 ± 0.00082 G	0.017 B	
	Spring	0.035 ± 0.00088 C	0.042 ± 0.00082 B	0.021 ± 0.0013 DE	0.033 A	
	Mean	0.026 B	0.039 A	0.017 C		

3.3. Bacteriological analysis of selected water.

3.3.1. Fecal coliform.

Table 3 showed that the fecal coliform concentration in drinking water collected from different areas of District Ziarat (Balochistan). Improper management of waste disposal is the key source of microbial contamination of water. Coliform pollution of drinking water introduces a variety of intestinal pathogens. The unprotected areas from where children and woman collecting water can be source of microbial contamination. (Shewaye M *et al.* 1999). Coliform is the rod shape and largely occurs in gram negative in nature. Mostly these bacteria are aerobic and facultative in nature. In this study the highest coliform range (19.33 ± 1.67 MPN/100ml) reported in spring water of Ziarat city while the lowest range (2.33 ± 1.20 MPN/100ml) recorded in bore water of Choutair village. Mean values coliform for different sources was in the range of (7.222 to 15.22 MPN/100ml) while mean values coliform for different sites was in the range of (6.89 to 12.89 MPN/100ml). Recommended range of coliform set by WHO for drinking water is zero CFU/100ml (WHO. 2011). The data point out that the fecal coliform status of all water samples was above the WHO standard range (0 CFU/100ml). It may cause severe health issue. Therefore, the selected water is not safe for human consumption. People should trained to use boiling or filtration techniques to remove microbiological contamination before consuming specially spring water for drinking. Government should start proper sanitary survey, maintenances, and supervisions of water sources and regular bacteriological assessment of drinking water sources to avoid any kind contamination.

3.3.2. Escherichia coli.

Table 3 pointed out the E. coli range in drinking water collected from different location of District Ziarat (Balochistan). Improper management of waste disposal is one of the main source of E. coli in drinking water sources. E. coli is a water borne pathogen that appeared as a main cause of hemorrhagic colitis and transmitted to human being by water or foodstuff (Bide P *et al.* 2005). E. coli was the indication of water pollution by human and animal manure. This threshold effect recommends that in developing countries where the quality of drinking water is good or moderate other transmission routes of diarrheal, hepatitis and typhoid diseases (Kosek M *et al.* 2003). In current study the E. coli range was (2.00 to 2.33 MPN/100ml) that is found only in spring water. The data point out that the E. coli status in spring water from all sites was above the WHO standard range (0 CFU/100ml). It may cause severe health issue. Therefore, the selected spring water is not safe for human consumption.

Government should be channelized the spring water of surrounding areas through pipelines to avoid any kind bacterial contamination.

Table .3 Microbe's analysis (MPN/100ml) of drinking water of selected areas and sources of district Ziarat (Balochistan).

Microbes	Source	Area			Mean	WHO Standard
		Ziarat	Choutair	Tandwani		
Total coliform	Tube well	5.67 ± 0.88 DE	4.667 ± 0.33 EF	11.33 ± 0.88 C	7.222C	0 CFU/100ml
	Bore	7.67 ± 0.88 D	2.33 ± 1.20 F	14.67 ± 0.88 B	8.22 B	
	Spring	19.33 ± 1.67 A	13.67 ± 0.88 BC	12.67 ± 0.33 BC	15.22 A	
	Mean	10.89 B	6.89 C	12.89 A		
E. coli	Tube well	Nil	Nil	Nil	Nil	0 CFU/100ml
	Bore	Nil	Nil	Nil	Nil	
	Spring	2.33 ± 0.33 A	2.00 ± 0.00 A	2.33 ± 0.33 A	2.23 A	
	Mean	0.78 A	0.67 A	0.78 A		

4. CONCLUSION.

The current research was conducted in district Ziarat (Balochistan) on drinking water quality status and contamination. The source of contamination is chemical pollution from the toxic substance due to the mining, combustion emissions, fertilizers, pesticides and other organic substances. By the said issue, the heavy metals especially (cadmium) status are above the WHO standards range. Bacteriological contamination of drinking water is due to agriculture runoff, animal feces, industrial and domestic waste. In current study the fecal coliform status in all water; samples were higher than recommended standard. While E. coli found only in spring water from all sites was above WHO standard range. It may cause severe health issue. Therefore, the selected water is not safe for human consumption. Government should start purification plants and public awareness programs so that people adopt proper measure to defend one of the most valuable fresh water resource. Government

should be channelized the spring water of surrounding areas through pipelines to avoid any kind bacterial contamination.

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