Analysis of Fitness of Groundwater for Drinking of Dera Ghazi Khan

Ayaz Ahmad[1]* and Sahrish Khan[2]

[1]Biology Government Degree College, Pakistan

[2]University of Veterinary & Animal Sciences Lahore, Pakistan

*Corresponding author: Ayaz Ahmad, Biology Government Degree College, Pakistan

Abstract

There were 32 samples of groundwater collected randomly from different sites of Dera Ghazi Khan and were analyzed on physical and chemical basis which shows that quality of groundwater is not good for humans as well as for cattle's, because it has high values of arsenic, microorganisms, metal ion leaching from the mine wastes and reduction of hydrous ferric oxide. Physical parameters like pH, EC, turbidity and chemical parameters like alkalinity, CO_3, HCO_3, Cl, F, NO_3, and microbial contamination of potential concern for drinking water were estimated by using analytical techniques. During the study it was observed that Electrical conductance (EC) values of groundwater were extremely high from WHO guideline. Likewise, the chemical quality of groundwater samples also goes beyond the WHO guideline values for parameters such as chlorides, sodium, calcium, magnesium and this behaviour of ground water is due to geographical distribution of this area.

Keywords: Groundwater; Physical Parameters; Chemical Parameters; Alkalinity; Dera Ghazi Khan

Introduction

The nature and concentration of salts present in ground water depends upon the source of ground water. This addition of salts is due to weathering of rocks present in area of study [1]. Groundwater, passing through igneous rocks, dissolves very small quantities of mineral matter because of the relative insolubility of the rock composition. Sources of groundwater contamination include saltwater intrusion, landfills, leakage of underground storage and severe agricultural practice [2]. Geographically, Dera Ghazi Khan Pakistan is important in sense due to its central location in the country. The two factors, mountainous area and river are likely to be responsible for changing the chemical behavior of groundwater and making it unfit for drinking with slightly bitter taste. In the study area, groundwater is not only used for drinking, cooking and washing but also people are dependent on groundwater for their agriculture and industry.

Methodology

The methodology reported by [3] was of paramount importance. To find the turbidity of the samples, Nephelometric method by using turbidity meter (Lamotte, model 2008 USA) was adopted and formazin polymer was used as the reference turbidity standard suspension. The sampling bottle was filled up to the mark given on the bottles. After shaking and keeping it at 35 °C for 24–48 h, evaluation was made on the basis of color change in the bottles. Highly bacteriologic contaminated bottles completely turned into black (100% black coloration). Slightly contaminated bottles gave 1/4th or 25% black coloration while bottles with no black color were marked with absolutely free bacteriologic contamination [4].

Sampling

In order to carry out qualitative, quantitative, and semi-qualitative microbial analysis, groundwater samples were collected from 32-locations while keeping in view the population and area of Dera Ghazi Khan. Groundwater samples were collected separately in clean, sterilized testing bottles available in the microbiological testing kit for semi-qualitative bacteriological contamination.

Results

(Tables 1-3)

Table1: Statistics of Physical and chemical parameters of groundwater in the area of Dera Ghazi Khan.

Parameter	Units	Min	Max	Median	Average	10th	90th	SD	Cᵛa
EC	µS cm^{-1}	1.43	8.35	5.59	4.88	2.15	7.85	2.44	50.1
pH		7.2	8.17	7.49	7.58	7.3	7.93	0.27	3.54
Turbidity	NTU	0	9.4	6.54	0.99	0	2.52	2.24	225.76
Alkalinity	mg L^{-1}	0.8	9.1	4.95	5.27	2.52	8.5	2.27	43.1
CO_3^{-2}	mg L^{-1}	0	20	0	1.09	0	0	4.35	397.76
$H CO3^{-1}$	mg L^{-1}	104	540	375	380.91	281	498	92.21	24.21
Cl^{-1}	mg L^{-1}	42.5	554	206	221.11	86.49	446.9	133.3	60.28
F^{-1}	mg L^{-1}	0.25	1.5	1.08	0.96	0.27	1.4	0.42	43.44
NO_3^{-1}	mg L^{-1}	1.4	130	23	32.32	9.41	67.83	27.8	86.04
As	µg L^{-1}	0.37	29.3	1.24	4.7	0.58	16.06	7.28	154.79

Table 2: Physical and chemical groundwater quality parameters in the area of Dera Ghazi Khan.

Sample	Temperature (°C)	E.C (µS cm^{-1}) × 1000	pH	Turbidity (NTU)
S-1	31	7.62	8.42	0
S-2	29	7.5	8.12	0.8
S-3	30	6.21	8.21	0
S-4	31	6.72	7.6	0
S-5	28	7.91	8.00	0
S-6	31	6.93	7.71	1.5
S-7	30	7.56	7.9	0
S-8	29	5.73	7.8	9.6
S-9	30	6.51	7.3	0.4
S-10	28	7.51	7.6	0
S-11	26	8.52	7.9	0
S-12	28	5.51	7.4	0.3
S-13	31	6.51	7.8	0
S-14	30	7.95	7.4	0
S-15	28	5.94	8.4	0.24
S-16	30	4.86	7.9	0
S-17	31	2.34	7.7	0
S-18	29	6.83	7.52	0.36
S-19	30	8.26	7.73	0
S-20	31	2.45	7.64	0
S-21	28	3.74	7.96	0
S-22	26	2.21	7.52	1.63
S-23	28	1.47	7.53	1.56
S-24	30	2.7	7.65	0.4
S-25	31	2.5	7.48	0
S-26	30	2.51	7.74	7.15
S-27	29	2.46	7.64	6.0
S-28	28	2.5	7.54	0
S-29	31	2.85	7.83	0.84
S-30	27	2.00	7.56	0
S-31	30	2.61	7.41	0
S-32	31	1.51	7.52	2.64

Sample	Alkalinity (mg L^{-1})	CO$_3^{-2}$(mg L^{-1})	H CO$_3^{-1}$(mg L^{-1})	Cl^{-1}(mg L^{-1})	F1-(mg L^{-1})	NO$_3^{-1}$(mg L^{-1})
S-1	3.2	15	270	312	1.4	41.3
S-2	9.1	0	210	383	1.5	33.2
S-3	3.8	20	280	241	0.86	35
S-4	9.1	0	440	312	1.24	17
S-5	6.2	0	410	255	1.36	11
S-6	9.1	0	340	454	1.45	78.4
S-7	6.8	0	450	465	1.18	130
S-8	1.9	0	500	156	1.11	42
S-9	4.8	0	480	255	1.08	28
S-10	3.6	0	430	554	1.36	60
S-11	5.4	0	380	227	1.43	23.5
S-12	5.1	0	350	184	1.26	22.5
S-13	2.5	0	400	199	1.39	30
S-14	8.5	0	370	213	1.26	20.5
S-15	5.4	0	510	241	1.12	30
S-16	3.5	0	350	227	1.07	7.6
S-17	4.8	0	460	99	0.96	1.4
S-18	5.4	0	360	227	1.08	68.7
S-19	0.8	0	320	525	1.4	53.5
S-20	4.5	0	540	128	0.41	73.5
S-21	8.5	0	300	241	1	53.5
S-22	8.5	0	104	128	0.27	9.5
S-23	6.4	0	390	85	0.27	11.9
S-24	1.5	0	400	156	0.86	15
S-25	5.6	0	360	99	0.66	9.6
S-26	4.5	0	290	113	0.72	5.2
S-27	6.2	0	360	128	0.35	17.5
S-28	4.8	0	500	42.5	0.29	55
S-29	4.5	0	365	142	1.14	10.6
S-30	2.7	0	360	85.1	0.25	9.4
S-31	4.6	0	480	149	0.7	16.8
S-32	7.2	0	430	50	0.26	13

Table 3: Analysis of bacteriological contamination in groundwater of study area.

Sample	Source	Level of bacterial contamination	(%) Age of black	Result/remarks
S-1	Tube Well	High contamination	100	Unfit for drinking
S-2	Hand pump	No contamination	Nil	Fit for drinking
S-3	Tube well	High contamination	100	Unfit for drinking
S-4	Hand pump	No contamination	Nil	Fit for drinking
S-5	Hand pump	No contamination	Nil	Fit for drinking
S-6	Hand pump	Moderate contamination	50	Unfit for drinking
S-7	Turbine	No contamination	Nil	Fit for drinking
S-8	Hand pump	No contamination	Nil	Fit for drinking
S-9	Tube well	Moderate contamination	50	Unfit for drinking

S-10	Hand pump	No contamination	Nil	Fit for drinking
S-11	Hand pump	No contamination	Nil	Fit for drinking
S-12	Hand pump	Slight contamination	25	Unfit for drinking
S-13	Turbine	No contamination	Nil	Fit for drinking
S-14	Hand pump	No contamination	Nil	Fit for drinking
S-15	Hand pump	No contamination	Nil	Fit for drinking
S-16	Tube Well	Slight contamination	25	Unfit for drinking
S-17	Hand pump	No contamination	Nil	Fit for drinking
S-18	Hand pump	Slight contamination	25	Unfit for drinking
S-19	Motor pump	No contamination	Nil	Fit for drinking
S-20	Hand pump	Slight contamination	25	Unfit for drinking
S-21	Pump motor	No contamination	Nil	Fit for drinking
S-22	Hand pump	No contamination	Nil	Fit for drinking
S-23	Hand pump	No contamination	Nil	Fit for drinking
S-24	Motor pump	No contamination	Nil	Fit for drinking
S-25	Hand pump	High contamination	Nil	Fit for drinking
S-26	Hand pump	No contamination	Nil	Fit for drinking
S-27	Hand pump	Moderate contamination	50	Unfit for drinking
S-28	Tube Well	No contamination	Nil	Fit for drinking
S-29	Hand pump	No contamination	Nil	Fit for drinking
S-30	Hand pump	No contamination	Nil	Fit for drinking
S-31	Turbine	No contamination	Nil	Fit for drinking
S-32	Hand pump	No contamination	Nil	Fit for drinking

Discussion

The quality characteristics of physical parameters in the groundwater of DG Khan-Pakistan are summarized in Table 2, which indicates that electrical conductivity (EC) is extensively high for almost all 32-samples examined. High values of EC are related to enhanced concentration of soluble inorganic salts in groundwater of Dera Ghazi Khan-Pakistan. Apparently, the reason for such high concentration of salts in groundwater is geographical location of study area across the rocky/mountainous region namely Fort Minro in the west. Thus, excessive soluble salts in groundwater of the area may be on the account of dissolution of minerals from local soil and bed rock [4,5]. Nevertheless, few samples with comparatively less EC values are of those sites which are close to Indus River in the east and farther from mountainous area in the west. Of all thirty-two samples, pH is predominantly alkaline and thus is in the satisfactory range i.e. 7.00–8.20 which is in accordance with the prescribed limit of WHO guideline value for pH i.e. 6.5–8.5 (World Health Organization (WHO), 1984). Table 1 shows that turbidity of many samples comes under the WHO recommended guideline i.e. 5-NTU. Bacteria (coli forms) even if in slight contamination make water unfit for drinking purpose and pose permanent threat for several diseases such as diarrhea, typhoid, cholera, dysentery, hepatitis, stomach problem and intestinal disturbances. Out of 32-samples analyzed for microbial contamination, 11 samples gave indication for bacteriological contamination, from highest to slight level, which is mainly result of an open, leaky, unhygienic and unsafe drainage or sewerage system of liquefied solid waste in Dera Ghazi Khan (City)-Pakistan. The results as shown in the Table 3, give an idea about the level or intensity of the microbial contamination in the study area.

Conclusion

Most of the groundwater samples taken from random sites of Dera Ghazi Khan were found unfit for drinking, cooking, washing, bathing and for agricultural aspects. High values of EC, sulfates, chlorides, sodium, magnesium, bicarbonates and bacterial contamination in many water samples were found and thus do not comply with WHO guideline values for these parameters. Nevertheless, parameters like fluoride, potassium, carbonate, alkalinity and arsenic are within the safe limit in many samples of study area.

References

1. Abu Rukah, Alsokhny, Abu Rukah Y, Alsokhny K (2003) Geochemistry APHA Standard methods for the examination of water and wastewater (18th edn), American Public Health Association, New York, USA, pp. 171-181

2. Braman RS (1975) Arsenical Pesticides American Chemical Society, Washington DC, USA.

3. Cassidy DP, DD Werkema, WA Sauck, EA Atekwana, S Rossbach (2001) The Effects of LNAPL Biodegradation Products on Electrical Conductivity Measurements. Journal of Environmental and Engineering Geophysics 6(1): 47-52.
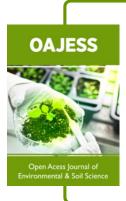
4. Chae GT, Yun ST, Kim K, Mayer B (2006) Hydro geochemistry of sodium-bicarbonate type bedrock groundwater in the Pocheon spa area, South Korea. Journal of Hydrology 321(1-4): 326-343.

5. E Peters (1984) Evaluation of environmental factors affecting yields of major dissolved ions of streams in the United States. USGS Water-Supply Paper 2228.

To Submit Your Article Click Here: **Submit Article**

OAJESS

Open Acess Journal of Environmental & Soil Science

Open Access Journal of Environmental and Soil Sciences

Assets of Publishing with us

- Global archiving of articles
- Immediate, unrestricted online access
- Rigorous Peer Review Process
- Authors Retain Copyrights
- Unique DOI for all articles