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RESEARCH ARTICLE

AN ASSESSMENT OF PHYSICO-CHEMICAL QUALITY AND BACTERIAL CONTAMINATION OF FAECAL ORIGIN IN GROUND WATER RESOURCES OF RURAL AREAS OF UJJAIN

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Abstract

Physico-chemical characteristics play a very important role in determining the potability of drinking water. Quality of drinking water used in rural areas of Ujjain was assessed by determining various physico-chemical characteristics of ground water. Bacterial contamination in ground water is assessed by using H₂S strip test. Temperature and pH were within the permissible limit but chloride value of 16 samples (out of 27 samples) crossed the maximum permissible limit (200-300mg/L). Total hardness values of 12 samples were reported beyond the permissible limit. Turbidity value of kamed hand pump water sample was 13.1NTU which is higher than the standard of drinking water quality. H₂S strip test were found to be positive in 13 samples in which maximum contamination were reported in well samples.

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Introduction:-

Water is one of the important natural resource that sustains all the kind of life on earth. According to National Environment Research Council Report (2007) 71% of earth surface is covered with water but fresh water is limited only 3%. Ground water constitute more than 90% of fresh water (Behaila,et.al.2017). Therefore it has been generally used for drinking, domestic and agriculture purposes.

Extensive survey was carried out by the author in study area, reported more than 90% population of rural resident of Ujjain were largely depends upon ground water resources for drinking and domestic purpose. As there is no regular water supply in these area. Therefore the quality of ground water used by rural resident of Ujjain is great concern to their health. Hence present study was carried to assess:-

The Physico-chemical characteristics of ground water like- Temperature, pH, Turbidity,TDS, Total hardness, chloride.

The bacterial contamination of faecal origin.

Material and Methods:-

Sample collection :

Total 27 ground water samples (9 wells, 9 bore wells and 9 hand pumps) were collected from three sub areas of Ujjain viz. mangalnath road, barnagar road and indore road of Ujjain in November 2016.

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Sampling was done in the early morning. For physico-chemical analysis samples were collected in good quality of plastic containers. To assess the bacterial contamination, ground water samples were collected in H₂S testing bottle (A readymade field testing kit). After collection, samples were immediately labelled and brought to the laboratory for further analysis.

Samples analysis:

Analysis of physico-chemical characteristics:

All samples were analyzed for various physico-chemical parameters by following standard methods of APHA(1992). Colour was noted by experience and other parameters like Temperature, pH, Turbidity, TDS, Total hardness, chloride were determined by methods given in table 1. The recorded data were compared with standard values (Table 2) recommended by ICMR(1975), BIS (2012) and WHO(2011).

Analysis for bacterial contamination:

For the analysis of presence of bacteria of faecal origin, ground water samples were filled in H₂S testing bottle up to the mark. Incubate the bottle for 24-48 hrs at 37°C. Change in the colour was recorded. +, ++, +++, +++++ indicate the degree of contamination ((-)No,(+)slight, (++) moderate,(+++ high, (++++ very high contamination).

Results and Discussion:-

Results of physico-chemical analysis of ground water samples of rural areas of Ujjain was showed in Table- 3, 4, 5.

Temperature:

Temperature is an important biologically significant factor which play an important role in the metabolic activities of the organism (Prasad,et.al,2014). WHO did not recommended definite value for the temperature, however BIS (1991) recommended 40°C is the permissible limit of drinking water. In study area slight variation in the temperature (23.8°C – 25.8°C) were recorded. It may be due to the difference in timing of sample collection.

pH:

pH is an important ground water quality parameter due to the sensitivity of organism to the pH of their environment. As per the standards (WHO,2011) pH of drinking water must ranged 6.5 – 8.5. Hence all ground water samples were found within the permissible limit. Mostafa,et.al (2013) also reported same result in ground water samples in Egypt.

Turbidity:

The value of turbidity varies from 0.1 – 13.1 NTU. As per standards of drinking water quality its value must below 1NTU and where resources are scared its value not crossed 5NTU. In kamed hand pump water sample turbidity was too high (13.1NTU). Sunita, R. Dandawate reported turbidity value higher in four out of five ground water samples in post monsoon season in Kopargaon area of Maharashtra.

Total dissolved solid (TDS):

The most important aspects of drinking water is its taste (Bruvold and pangborn,1966). Higher value of TDS reduces utility for drinking, irrigation and industrial purpose (Pandya,et.al.,2013). In present study TDS ranges from 436 – 1960mg/L. Water samples from two bore well viz. kamed and goyala chowki TDS recorded above the permissible limit while in well water sample of jawasiya its value was noted below the minimum acceptable limit. Sowrabha and Narayana (2014) assess the ground water quality used for drinking purpose in shivamogga town, Karnataka reported TDS value in all samples within the permissible limit .

Total hardness:

According to some classification water with hardness 0 – 75mg/L is classified as soft, 76 – 150mg/L is moderate, 151 – 300mg/L is hard and more than 300mg/L is very hard (Saravanakumar and Ranjith kumar,2011). In study area hardness value ranged between 260 – 1630mg/L. 5 wells, 4 bore wells and 3 hand pumps water samples hardness value exceed the WHO standards. The high concentration of total hardness may cause heart disease and kidney problem (jain,et.al.,1997). Satyavani,et.al.(2013) reported hardness value 500-1300mg/L in pre monsoon and 800-1600mg/L in post monsoon season, exceeded the permissible limit.

Chloride:

Chloride is the most common inorganic anion present in water (Sudha and sangeetha,2017) but higher values in drinking water serve as indicator of sewage pollution and unacceptable for human for human consumption

(Ananthkrishnan,rt.al,2012). In water samples chloride concentration varies from 190 -1201mg/L. Therefore only 1 well, 3 bore wells and 4 hand pumps samples were reported as per WHO standards (200 –300mg/L). Satyavani,et.al.(2013) studied the physicochemical and microbial analysis of ground water samples recorded higher values of chloride in 3 ground water samples in pre monsoon and 2 in post monsoon season.

Bacterial contamination:

Presence of bacterial contamination of faecal origin in the ground water samples of different rural areas of Ujjain was tested by H₂S strip test. Total 27 samples were tested in which 13 (7 wells (54%), 3 bore wells (23%) and 3 hand pumps(23%)) samples were reported contaminated as H₂S strip test (fig 2.) were found to be positive there. Singh,et.al.(2017) recorded bacterial contamination in 58 samples (out of 67 samples) from urban areas of Patna, Bihar.

Conclusion:-

Physico-chemical analysis of ground water samples concluded that turbidity, TDS, total hardness and chloride values has been crossed the maximum permissible limit of drinking water quality as per WHO (2011) standards. Higher the value of TDS decreases the solubility of oxygen enhance eutrophication. Total hardness values of 13 samples were reported beyond the permissible limit. It might be due to dissolve carbon dioxide release by bacteria present in water. In 5 wells, 6 bore wells and 5 hand pumps sample chloride value higher than permissible limit (fig.1.) indicated that resources might be contaminated by sewage. Results showed that in most cases were Physico-chemical characteristics of the ground water samples were not as per the standards H₂S strip test were found to be positive.

Table 1:- Methods Used for the Analysis of Various Quality Parameters of Ground Water Samples of Ujjain.

S. No	Parameter	Units	Method used
1	Colour	-	By experience
2	Turbidity	NTU*	By nephelometer
3	Temperature	^o C	Thermometer
4	pH	-	Digital pH-meter
5	Total dissolved solid (TDS).	Mg/l	By TDS meter
6	Total hardness	Mg/l	By EDTA titrimetric method.
7	Chloride	Mg/l	By Argentometric method

*-Nephelometric turbidity units

Table 2:- Various Standards of Ground Water Quality parameters.

S.No	PARAMETERS	STANDARDS OF GROUND WATER		
		WHO (2011)	BIS (2012)	ICMR (1975)
1	pH	6.6-8.5	6.6-8.5	6.0-8.5
2	Colour	-	-	-
3	Turbidity(NTU)	1-5	5-10	2.5-10
4	TDS(mg/100ml)	500-1500	500-2000	500-3000
5	Total Hardness (mg/100ml)	200-600	200-600	200-600
6	Total Chloride (mg/100ml)	200-300	250-1000	200-1000
7	Coliform (cfu/100ml)	0	0	0

Table 3:- Impact of PhysicoChemical Characteristics on Faecal Contamination of Ground Water Resources of Rural Area (Mangalnath Road) of Ujjain.

S.No.	Sub area	Resources	Temp.(^o C)	pH	Colour	Turbidity (NTU)	TDS (mg/l)	TH (mg/l)	Chloride (mg/l)	H ₂ S
1	Ankpat	Well	24	7.04	Clear	0.3	1244	1320	1201	+
		BW	24	7.3	Clear	0.3	1131	560	595	-
		HP	24	6.92	Clear	1.8	1251	592	1151	-
2	Mangalnath	Well	24.3	6.94	Clear	0.4	830	670	360	+
		BW	24	7.04	Clear	0.4	882	560	365	+

		HP	24	7.2	Clear	2.6	913	470	260	+
3	Kamed	Well	24	7.2	Clear	0.4	720	520	190	+
		BW	23.9	6.86	Clear	0.1	1960	1628	1061	-
		HP	24	6.95	Turbid	13.1	1256	1470	961	-

Note -: Temp.= Temperature ,TDS= Total dissolve solid, TH=Total hardness, BW=Bore well, HP= Hand pump

Table 4:- Impact of PhysicoChemical Characteristics on Faecal Contamination of Ground Water Resources of Rural Area (Barnagar Road) of Ujjain.

S.No.	Sub area	Resources	Temp.(⁰ C)	pH	Colour	Turbidity (NTU)	TDS (mg/l)	TH (mg/l)	Chloride (mg/l)	H ₂ S
1	Jawasiya	Well	24	7.4	Clear	0.3	436	428	110	+
		BW	24	7.3	Clear	0.1	714	420	294	-
		HP	24	7.3	Clear	4.5	842	260	294	+
2	Mullapura	Well	24.2	6.95	Clear	0.4	882	680	390	+
		BW	24.1	7.47	Clear	0.3	862	380	430	-
		HP	24.1	7.27	Clear	0.2	910	360	475	-
3	Gonsa	Well	23.9	7.52	Clear	1.4	1212	1390	1151	+
		BW	23.8	7.3	Clear	0.2	1130	730	916	-
		HP	23.8	7.24	Clear	0.9	1170	1080	976	-
4	Sadawal	Well	24.3	7.29	Clear	0.3	994	610	435	-
		BW	24	7.14	Clear	0.2	812	650	280	+
		HP	24	7.12	Turbid	4.1	762	540	285	+
5	Ajampura	Well	24	7.58	Clear	0.4	546	450	145	-
		BW	24	6.85	Clear	0.3	1207	1630	791	-
		HP	24	7.3	Clear	0.4	978	780	385	-

Note -: Temp.= Temperature ,TDS= Total dissolve solid, TH=Total hardness, BW=Bore well, HP= Hand pump

Table 5:- Impact of PhysicoChemical Characteristics on Faecal Contamination of Ground Water Resources of Rural Area (Indore Road) of Ujjain.

S.No.	Sub area	Resources	Temp.(⁰ C)	pH	Colour	Turbidity (NTU)	TDS (mg/l)	TH (mg/l)	Chloride (mg/l)	H ₂ S
1	Goyala Chauki	Well	25	6.85	Clear	0.2	816	520	282	+++
		BW	24.9	6.98	Clear	0.2	1670	512	290	+
		HP	24.8	7.03	Clear	0.2	1140	380	276	-

Note -: Temp.= Temperature ,TDS= Total dissolve solid, TH=Total hardness, BW=Bore well, HP= Hand pump

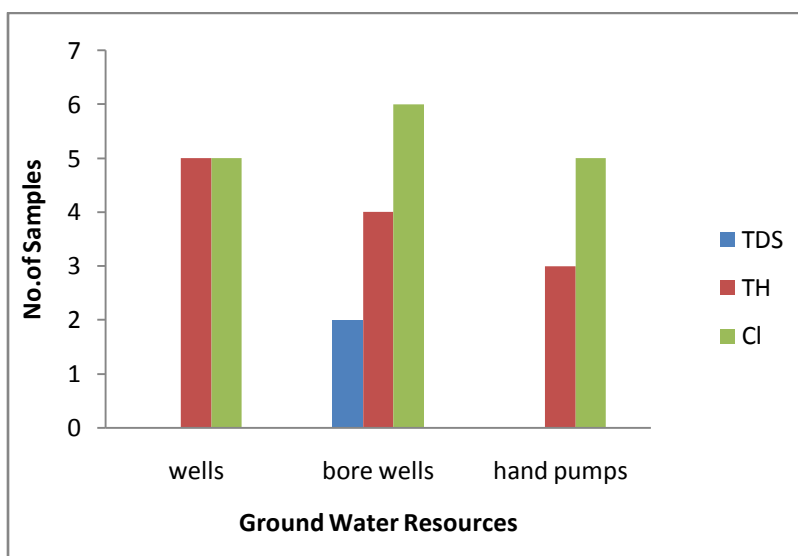


Fig.1:- No. of ground water samples showing TDS, TH, Cl values above permissible limits.

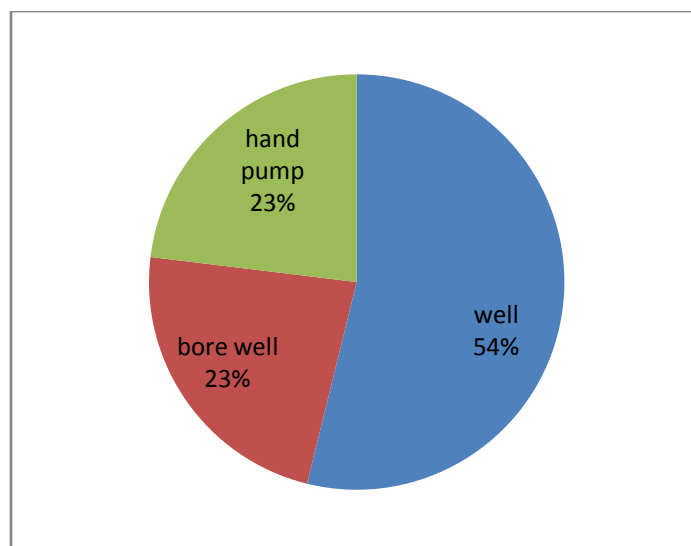


Fig. 2:- Ground water resources showing bacterial contamination.

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