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GROUNDWATER QUALITY FOR DRINKING BY GOLD-STANDARD AT HIGH-ALTITUDE AREA, TAIF, KSA "VISION 2030 G"

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ABSTRACT

This paper was for Groundwater (GW) quality for drinking by gold-standard (GS) at high-altitude (HA) area, Taif, KSA "VISION 2030 G", GW samples contained turbidity, resulted high in samples (6 and 10); (0.03 and 0.018). Public health (PH) were had declined within GS. Electric conductivity (EC) were within the optimum value, total dissolved salts (TDS) were had lowest value. Total hardness (TH) were of more than (300–500) mg L^{-1}, Chloride (Cl^{-}) ranged from (18-1759) mg L^{-1} with 30% and 70% samples. Sulfate (SO_4^{2-}) ranged from (33-2245) mg L^{-1} with 90% falling above GS, Nitrates (NO_3^{-}) ranged from (0–60) mg L−1 with 80% falling below GS. Bacterial types revealed both Gram-positive and negative were not in samples (1, 2, 6 and 7), both Gram-positive and negative were present in samples (5, 8 and 9). The arrangement of colony count were in samples (9, 1, 8, 6, 7 and 5), that was ranged the colony from (550-15) / mL. The common bacteria were isolated included *Staphylococcus Species* (*Staph. Spp.*), *Micrococcus Spp*, *Escherichia coli* (*E. coli*) and *Klebsiella Spp*. The conclusion were discharged from the results, that did not agree with GS to the community use. The most examined GW samples for drinking water (DW) did not agree with GS, bacterial quality did not accepted from GS, will affect PH. The recommendation were directed to "MOH", to follow up GW for DW through GS at HA area, so could using for human as DW without any harm and did'not affect PH.

INTRODUCTION

GW resulted in wide variation TDS, had pH falling within GS [1], taste and odour had (2-3) as TON (0.11-0.79 NTU), turbidity recorded in E-Makkah, was High pH 8.44, EC (7,735.36 ds/m) in N-Makkah, low pH 6.62 in NW-Makkah and low EC 115.61ds/m in E-Makkah [2]. Turbidity was 0.6 NTU within 5 NTU, Na value for total alkalinity [3]. The total nitrogen and organic carbon ranged (15.21-61.33) mg/l and (10.63-70.60) mg/l, which exceeded GS [3]. At Al-khamis, *Coliform* count was 100%, faecal *Coliforms* 87.9% and *Strept. Spp* 57.6% [4]. In Hail, *Coliform* bacteria were 20% [1], in Makkah, *E. coli* [2], *Acinetobacter* (1.5- 48%) and *Pseudomonas aeruginosa* (9.55×10^{-4}) [5].

The aim of this paper was for GW quality for drinking by GS at HA area, Taif, KSA "VISION 2030 G", the DW considered as one of the human priorities and so this paper was made for clearfy GW using at HA area "Taif" as perfect DW for human by compared its physical, chemical and bcacterial quality with GS for ideal DW at HA area to protect PH.

MATERIALS AND METHODS

-Location map: GW sources at HA area "Taif" (map 1) [6].

-Collection samples: That were collected in sterile containers and were sent to Lab. [7].

Map 1: The location of GW samples collected from HA area "Taif"

-Analysis methods:

Physical and Chemical: The turbidity, pH and electrical conductivity (EC) of GW samples were measured using portable pH meter and electrical conductivity meter. TH, Calcium Ca2+ and

Magnesium (Mg2+), Chlorides Cl− Nitrate (NO-1) and sulfate (SO-2 4) were analyzed [8-9]. Magnesium were estimated by EDTA volumetric titrations. Chloride ion concentration was determined by volumetric titrations using AgNO3. Sulfate was measured using turbidity meter. EC was used to obtain the total dissolved solids (TDS) concentration in water by dividing EC values expressed in µS/cm by 1.56. The total hardness (TH, mg/L CaCO3) of water samples was determined by using the following equation: TH = 2.5Ca2+ + 4.1Mg2+ [8-10].

Bacterial: GW sample was diluted with 1:10 by distaled water, 100 ml was filtered by (LabTech, Korea) with fresh cellulose nitrate filter (Sartorius, Germany, with pore size 0.45 µm). The partitions were poured through filter trap, then two cellulose nitrate filter was taken out carefully by sterile forceps and placed on the Chromo-agar for isolation and identification, that were incubated for 48 hrs at 37ºC, then confirmed by Micro-scan [11].

-Data analysis: Simple Excel Methods were analyzed the results [12].

RESULTS AND DISCUSSION

Table 1: Prevalence of physical characters

*Samples *K *No.*	*Turbidity*	**pH*	**EC*	**TDS*
K1	*0.007*	*6.5*	*2.7*	*144*
K2	*0.001*	*6.8*	*2.8*	*122*
K5	*0.008*	*5.7*	*3.6*	*144*
K6	*0.040*	*5.7*	*4.0*	*145*
K7	*0.015*	*6.0*	*3.5*	*137*
K8	*0.006*	*5.8*	*3.8*	*142*
K9	*0.011*	*5.7*	*3.7*	*139*
****K *No.: Key Number, *pH: Potential of Hydrogen, *EC: Electric Conductivity, *TDS: Total Dissolved Salts***				

Table 1 showed prevalence of physical characters, turbidity, GW samples contained turbidity, were read high in (6 and 10); (0.03 and 0.018) [1-3]. The pH were had falling within GS [1-3]. EC all GW samples were within the optimum value [1-3, 8-10]. TDS were had lowest value [1-3].

Table 2: Prevalence of chemical quality

Parameters	*Range*	*SASO standards*	*Percent %*	*G.C.C.S. standards*	*Percent %*	*WHO Standards*	*Percent %*
****TH***	*55-2793*	*500*	*30%*	*500*	*30%*	**NS*	*00%*
****Cl⁻***	*18-1759*	*600*	*30%*	*400*	*30%*	*250*	*30%*
****NO^-_3***	*0-60*	*<45*	*20%*	*<45*	*20%*	*50*	*20%*
****SO^{-2}_4***	*400*	*400*	*10%*	*250*	*10%*	*250*	*10%*
****TH: Total hardness, *CL-: Chloride, *NO^{3-}: Nitrates, *SO^{-2}_4: Sulfate***							

Table 2 showed prevalence of chemical quality, TH of more than (300–500) mg L^{-1} objectionable scale in heating vessels and pipes [8-10]. Cl^- ranged (18-1759) mg L^{-1} with 30% [8-10] and 70% samples [1-3, 8-10]. SO_4^{2-} ranged (33-2245) mg L^{-1} with 90% falling above GS [8-10] NO_3^- ranged (0–60) mg L−1 with 80% falling below GS [1-3, 8-10].

Table 3: Prevalence of bacterial quality

Item	*Bacterial growth*			
Samples *K *No.*	*Growth rate*	*Colony type*	*Gram stain*	
			Positive	*Negative*
*K1	+	2	+	-
*K2	-	0	-	-
*K5	+	2	+	+
*K6	+	2	+	-
*K7	+	2	+	-
*K8	+	2	+	+
*K9	+	2	+	+
*K *No.: Key Number				

Table 3 showed prevalence of bacterial quality by bacterial growth, both Gram-positive and negative were not in samples (1, 2, 6 and 7), presence of both Gram-positive and negative in samples (5, 8 and 9) [1-2, 4-5].

Table 4 : Prevalence of bacterial quality by colony count and *CFU/mL

Item	*Bacterial growth*			
Samples * K *No.*	*Colony count*		*CFU/mL	
	Gram stain			
	Positive	*Negative*	*Positive*	*Negative*
*K1	280	00	28000	00
*K2	00	00	00	00
*K5	13	10	1300	1000
*K6	30	00	3000	00
*K7	29	00	2900	00
*K8	50	1	5000	100
*K9	250	300	25000	30000
*CFU/mL: Colony Forming Unite/mL, *K *No.: Key Number				

Table 4 showed prevalence of bacterial quality by bacterial CFU / mL, the arrangement of colony count were in GW samples (9, 1, 8, 6, 7 and 5), that was ranged colony from (550-15) / mL [1-2, 4-5]. The common bacteria were isolated (*Staph. Spp., Micrococcus Spp*, *E. coli* and *Klebsiella Spp*) [1-2, 4-5]. The result of bacteria were not agreed with GS to community [8-10].

CONCLUSIONS

The most examined GW samples for use as DW revealed the chemical quality did not agree with GS, also bacterial quality did not agreed with GS and did not accepted from GS to help PH.

RECOMMENDATION

"MOH" must follow up GW for use as DW through GS at HA area, so could using for human drinking without any harm and protect PH.

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