Research Article

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Groundwater (GW) quality for drinking by gold–standard (GS) at high–altitude (HA) area, "VISION 2030 G", Taif, KSA

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Abstract

This paper was for confirm "Groundwater (GW) quality for drinking by gold–standard (GS) at high–altitude (HA) area, "VISION 2030 G", Taif, KSA", GW samples contained turbidity, were read high in (6 and 10); (0.03 and 0.018). pH were had falling within GS. EC were within the optimum value. TDS were had lowest value. TH of more than (300–500) mg L^{-1}, Cl$^-$ ranged (18–1759) mg L^{-1} with 30% and 70% samples. SO_4^{2-} ranged (33–2245) mg L^{-1} with 90% falling above GS, NO_3^- ranged (0–60) mg L−1 with 80% falling below GS. Bacterial types both Gram positive and negative were not in (1, 2, 6 and 7), both Gram positive and negative in (5, 8 and 9). The arrangement of colony count were in GW samples (9, 1, 8, 6, 7 and 5), that was ranged colony (550–15)/mL. The common bacteria were isolated (*Staph. spp., Micrococcus spp, E. coli* and *Klebsiella spp*). The results of bacteria were not agree with GS to community use. The most examined GW samples for drinking did not agree with GS, bacterial quality did not accepted from GS. The recommendation to "MOH", follow up GW for drinking through GS at HA area, so can using for human drinking without any harm.

Keywords: GW, GS, HA, pH, EC, TDS, TH

Introduction

GW resulted 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 (7,735.36ds/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, were *Coliform* bacteria 20%,[1] in Makkah, *E. col*,[2] *Acinetobacter* (1.5– 48%) and *Pseudomonas aeruginosa* (9.55×10⁻⁴).[5] The aim of this paper was for confirm "GW quality for drinking by GS at HA area, "VISION 2030 G", Taif, KSA", drinking water considered one of the priorities of research to GW at HA areas in order to ensure the difference than normal altitude (NA) area

Materials and methods

Location map

GW sources at Taif area (Figure 1).[6]

Collection samples

That were collected in sterile containers and were sent to Lab.[7]

Analysis methods

Physical: turbidity, EC and TDS were determined.[8–9]

Chemical: pH, TH, Calcium Ca^{2+} and Magnesium Mg^{2+}), Chlorides Cl$^-$ Nitrate (NO^{-1}) and sulfate (SO_4^{-2}) were determined.[10]

Bacterial: Isolation and identification methods were done.[11]

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

Figure 1 The location of GW samples collected from Taif area.

Results and Discussion

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

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 (550–15)/Ml.[1–3, 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 agree with GS to community.[8–10]

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	0.04	5.7	4	145
K7	0.015	6	3.5	137
K8	0.006	5.8	3.8	142
K9	0.011	5.7	3.7	139

*No.: Number, *pH: Potential of Hydrogen, *EC: Electric Conductivity, *TDS: Total Dissolved Salts

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	0%
*Cl-	18-1759	600	30%	400	30%	250	30%
*NO-3	0-60	<45	20%	<45	20%	50	20%
*SO-24	400	400	10%	250	10%	250	10%

*TH: Total hardness, *CL-: Chloride, *NO³: Nitrates, *SO_4^{-2}: Sulfate

Table 3 Prevalence of bacterial quality by bacterial growth

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

*GW: Groundwater, *No: Number

Table 4 Prevalence of bacterial quality by bacterial *CFU/mL

Item	Bacterial growth			
	Colony count		*CFU/mL	
Samples K *No.	Gram stain			
	Positive	Negative	Positive	Negative
K1	280	0	28000	0
K2	0	0	0	0
K5	13	10	1300	1000
K6	30	0	3000	0
K7	29	0	2900	0
K8	50	1	5000	100
K9	250	300	25000	30000

*No: Number, *CFU/mL: Colony Forming Unite/mL

Conclusion

The most examined GW samples for drinking did not agree with GS, bacterial quality did not accepted from GS. The recommendation to "MOH", follow up GW for drinking through GS at HA area, so can using for human drinking without any harm.

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Conflict of interest

Author declares that there is no conflict of interest.

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