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Physico - Chemical & Bacteriological Assessment of ground water springs of Nalanda District, Bihar, India

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ABSTRACT

This paper aims to study physical, chemical and biological properties in the ecological system of Rajgir hot spring site located in Nalanda district of Bihar state. The physical – chemical and biological parameters were analyzed as per WHO & APHA. The physical parameter include temperature, total solid, total suspended solid, electrical conductivity. The chemical parameter included total hardness, Ca- hardness, Mg- hardness, total alkalinity and bacteriological parameters included SPC (standard plate count), MPN (most probable number).

The water sample have collected from there selected hot spring site during period from October 2014 to june 2016 (within an interval of 4 month). All results were compared with WHO and found that water is potable.

Key words – springs, WHO, SPC, MPN, APHA.

1. Introduction

Hot springs are the sites that discharge hot ground water, the temperature at which is notably higher than the ground water. The high temperature of hot spring because of exothermic reaction and radioactive disintegration element and long cracks in sedimentary rock[1], the water can be present within cracks and crevasses of rock, sand, clay, gravel or other material and in spaces between adjust particles of material[2].

The Rajgir hot spring is famous for numerous hot water spring attracting not only outsider people comes from different part of India and abroad but also sick people suffer from various skin diseases. The hot water supposed to come from saptaparni cave, situated on top of the hills. Although there are many hot springs sites in Rajgir namely Vishwamitra kund, Gautam kund, Laxman kund, Sita kund, Kapil muni kund, Brahm kund, Makhdum kund. Rajgir hot spring sites is also known to have the mineral like Ca, Mg, Sulphate, Flouride and Chloride (Das et. al 2013)[3]. It is believed that water from these hot spring can cure several skin related diseases (das, S : Sherpa, M.T. Thakur, S. Thakur, U., Thakur 2012)[4].

So, the physico – chemical and bacteriological parameters of these selected hot spring of Rajgir namely- 1) Vishwamitra kund 2) Brahm kund 3) Makhdum kund were studied and analyzed during period from October-14 to June-16 and discuss its suitability for drinking.

2. Sampling Method

For the present investigation the water samples collected from Rajgir hot water spring and taken in pre-cleaned polythene bottle without any air bubble. Each sample bottle was accurately labelled and information were recorded. The sample were kept in refrigerator at 4^0 c and analyzed within 12 to 48 hrs., 1 – 7 days respectively.

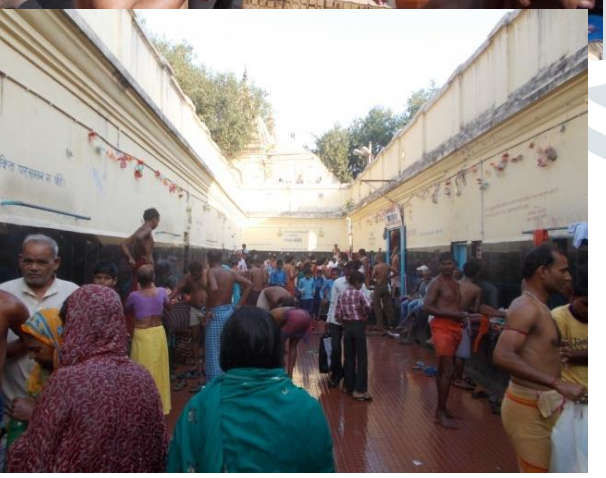
The all water quality parameter estimated by standard method given by APHA[5].

Table – 1 : Analytical methodology for various parameters analyzed.

S.L. No.	Parameters	Analytical method
1	Temperature	Mercury thermometer
2	Total Solid	Evaporation method
3	Total Suspended Solid	Evaporation method
4	Electrical Conductivity	Digital conductivity meter
5	Total Hardness	EDTA titrimetric method
6	Ca – Hardness	EDTA titrimetric method
7	Mg – Hardness	EDTA titrimetric method

8	Total Alkalinity	Acid Titration
9	SPC Count	Plate dilution method
10	MPN Count	Tube dilution method.

Photograph of selected sites



3. Results and Discussion

1. Temperature :- The observed temperature three selective sites of Rajgir thermal spring during selective period (Oct. – 14 to June - 16) varies from 31^0c to 41^0c, 33^0c to 42^0c and 29^0c to 38^0c respectively.

2. **Total Solid (T.S)** :- Total solid cancelation observed during three selected sites of Rajgir hot water spring during selective period varies from 42 mg/l to 70 mg/l, 94 mg/l to 154 mg/l and 40 mg/l to 54 mg/l respectively.

3. **Total Suspended Solid (T.S.S.)** :- The total suspended solid observed of site, Vishwamitra kund, Brahm kund and Makhdum kund varies from 16 mg/l to 32 mg/l, 36 mg/l to 38 mg/l and 18 mg/l and 26 mg/l respectively which are well within permissible limit as per WHO[6], APHA[7] etc. standard.

4. **Electrical conductivity** :- The observed electrical conductivity observed in three selected hot spring site of Rajgir during selective period varies from 60.6 µs/cm to 97.75 µs/cm , 98 µs/cm to 200.25 µs/cm and 60 µs/cm to 82.5 µs/cm respectively, which are well within permissible limit as per WHO[8] standard (250 µs/cm)

5. **Total Hardness** :- The observed total hardness concentration of three selected hot spring sited of Rajgir during selective period varies from 16 mg/l to 32 mg/l, 36 mg/l to 52 mg/l and 10 mg/l to 28 mg/l, which are well within permissible limit as per WHO (300 mg/l).

6. **Ca – Hardness**:- The Ca-Hardness concentration of three selected hot spring sites of Rajgir during selective period varies from 4 mg/l to 12 mg/l, 10 mg/l to 20 mg/l, 4 mg/l to 12 mg/l respectively. Which is well within desirable limit as per WHO standard.

7. **Mg – Hardness**:- The observed Mg-Hardness of Vishwamitra, Brahmkund & Makhdum Kund of Rajgir hot spring site during selective period varies from 10 mg/l to 20 mg/l, 24 mg/l to 32 mg/l and 6 mg/l to 16 mg/l respectively.

8. **Total Alkalinity** :- Total alkalinity of Vishwamitra kund, Brahm kund & Makhdum kund of Rajgir during selected period varies from 6 mg/l to 16 mg/l, 16 mg/l to 28 mg/l and 8 mg/l to 18 mg/l, which are well within permissible limit as per WHO standard (200 mg/l).

9. **SPC** :- Ther observed SPC concentration in all selected site of Rajgir hot water spring during selective period varies from 30 cfu/ml to 40 cfu/ml, 60 cfu/ml to 130 cfu/ml, 30 cfu/ml to 40 cfu/ml respectively.

10. **MPN** :- Ther observed MPN in all selected site of Rajgir hot water spring varies from <_2 MPN/ 100 ml to 4 MPN/100ml, <_2 MPN/ 100ml to 7 MPN/100 ml, <_2 MPN/100 ml to 2 MPN/ 100 ml respectively.

Table – 2 : Variation of Physico – chemical parameters of water samples at Vishwamitra kund site of Rajgir hot spring.

Season	Temp	T.S	T.S.S.	E.C	TH	Ca-H	Mg-H	TA
Oct-14	41^0c	70	30	97.75	16	4	12	8
Feb-15	31^0c	54	18	62.60	20	10	10	16
Jun-15	41^0c	58	28	94.00	24	8	16	12
Oct-15	36^0c	42	16	70.00	16	6	10	6
Feb-16	32^0c	58	22	60.60	32	12	20	16
Jun-16	37^0c	66	32	88.00	26	12	14	16

Table – 3 : Bacteriological data of Vishwamitra hot spring site at Rajgir.

Season	SPC count	Bacteria/Growth	MPN count	Bacterial / Growth
Oct-14	Nil	No growth	≤ 2 MPN/100 ml	No growth
Feb-15	40 cfu/ml	Growth	2 MPN/100 ml	Growth
Jun-15	Nil	No growth	≤ 2 MPN/100 ml	No growth
Oct-15	30 cfu/ml	Growth	4 MPN/100 ml	Growth
Feb-16	Nil	No growth	≤ 2 MPN/100 ml	No growth
Jun-16	Nil	No growth	≤ 2 MPN/100 ml	No growth

Table – 4 : Variation of Physico – chemical parameter of water sample at Brahm kund at Rajgir hot spring site.

Season	Temp	T.S	T.S.S.	E.C	TH	Ca-H	Mg-H	TA
Oct-14	40^0c	104	38	200.25	40	10	10	16
Feb-15	33^0c	96	38	138.60	44	16	16	24
Jun-15	42^0c	94	40	128	36	12	12	16

Oct-15	38^0c	154	88	186	52	32	28	28
Feb-16	33^0c	104	36	148	48	30	32	20
Jun-16	40^0c	102	42	98	36	24	24	22

Table – 5 : Bacteriological data of sample at Brahm Kund at Rajgir hot spring.

Season	SPC count	Bacteria/Growth	MPN count	Bacterial / Growth
Oct-14	60 cfu/ml	Growth	4 MPN/100 ml	Growth
Feb-15	130 cfu/ml	Growth	7 MPN/100 ml	Growth
Jun-15	Nil	No growth	≤ 2 MPN/100 ml	No growth
Oct-15	90 cfu/ml	Growth	6 MPN/100 ml	Growth
Feb-16	110 cfu/ml	Growth	7 MPN/100 ml	Growth
Jun-16	110 cfu/ml	Growth	6 MPN/100 ml	Growth

Table – 6 : Variation of Physico – chemical parameter of water sample of Makhdum kund hot spring site at Rajgir.

Season	Temp	T.S	T.S.S.	E.C	TH	Ca-H	Mg-H	TA
Oct-14	38^0c	46	22	81.5	10	4	6	8
Feb-15	29^0c	46	20	60	20	8	12	12
Jun-15	37^0c	54	22	68	28	12	16	18
Oct-15	38^0c	52	26	82.5	20	8	12	12
Feb-16	31^0c	40	18	64.8	20	8	12	12
Jun-16	38^0c	44	22	64	18	8	10	8

Table – 7: Bacteriological data of sample at Makhdum Kund at Rajgir hot spring.

Season	SPC count	Bacteria/Growth	MPN count	Bacterial / Growth
Oct-14	40 cfu/ml	Growth	2 MPN/100 ml	Growth
Feb-15	Nil	No Growth	≤ 2 MPN/100 ml	No Growth
Jun-15	30 cfu/ml	Growth	2 MPN/100 ml	Growth
Oct-15	Nil	No Growth	≤ 2 MPN/100 ml	No Growth
Feb-16	Nil	No Growth	≤ 2 MPN/100 ml	No Growth
Jun-16	Nil	No Growth	≤ 2 MPN/100 ml	No Growth

4. Conclusion :-

From the result of physico – chemical & bacteriological analysis, it is concluded that all parameter that all parameter lies within portability range as per WHO and APHA water standard parameters.

However, concentration of Brahm Kund is more than both Vishwamitra and Makhdum Kund, but all three selected sites of Rajgir is well suited for drinking purposes.

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