Indian J.Sci.Res. 11(1) : 133-138, 2015

ISSN : 0976-2876 (Print)
ISSN : 2250-0138 (Online)

ASSESSING VARIATIONS IN PHYSICO-CHEMICAL PARAMETERS OF TATAPANI SPRING OF DISTRICT RAJOURI - JAMMU

HARSH VARDHAN[a1], A. K. VERMA[b], SARTAJ AHMAD ALLAYIE[c] AND RAHEELA MUSHTAQ[d]

[acd]Department of Zoology, Govt. PG. College Rajouri, India
[b]Department of Science, Govt. College of Education Jammu, India

ABSTRACT

Groundwater is an important and renewable natural resource on the earth. Physicochemical characteristic of groundwater plays an important role on health of Human beings and other uses. The water samples for the present study were collected from small thermal spring situated at Kalakote in District Rajouri and were analyzed for physicochemical parameters like pH, calcium hardness, magnesium hardness, chloride and dissolved oxygen from June 2013 to April 2015. Statistical analyses were used to assess the level of significance of various parameters. The Physicochemical investigations showed that there were significant changes in the concentration of various parameters. However some of the parameters were found above the stipulated range affecting the quality of spring water. The water of this spring is used for multipurpose including washing, bathing and for various treatments like skin treatment, body ache, arthritis etc. As the practice is not hygienic the water may cause acute infectious diarrhea, repeat or chronic diarrhea episodes, and other non-diarrheal disease, which can arise from the chemical species in the water.

KEYWORDS : Groundwater, physicochemical, multipurpose use.

Hot springs are those places where the temperature of water lies significantly above the mean of annual air temperature of that region. Humans have had various kinds of relations with hydrothermal features throughout history, continuing even today. Aboriginal peoples were some of the first to use hot springs. Europeans later came in, and often considered the pools to be active in curing certain ailments. (Mountain Nature, 2003). Many people consider it as safe and economical. Ancient civilizations respected thermal springs because they were believed to have supernatural and healing powers (LaMoreaux and Tanner, 2001). Many thermal springs developed into flourishing centres of religion, culture and health such as those at Bath in England, Vichy in France, Baden-Baden in Germany and Saratoga Springs in the USA, but their socio-economic importance fluctuated over time (Booyens, `1981; Sanner, 2000; Edmunds, 2004).

Thermal spring waters are increasingly being used for industrial processing, agriculture, aquaculture, bottled water and the extraction of rare elements (Baradács et al., 2001; Atkinson and Davidson, 2002; Hellman and Ramsey, 2004; Petraccia et al., 2005). Moreover, with the increasing popularity of spas and the growing importance attached to the 'natural' health industry, thermal springs are again becoming centers of balneology (hydrotherapy) (Bojadgieva et al., 2002; Harvey, 2007). Thermal springs are thus natural resources that, if developed optimally, could make a considerable contribution to the local and regional economy.

In the rural and most urban settlements of Jammu and Kashmir, spring, surface, ground and rain waters are the main sources of drinking water. Jammu and Kashmir has various hot water springs. Tatapani is one of such hot springs which is located in the Kalakote region of Rajouri district. As all Jammu and Kashmir thermal springs are of meteoric, rather than volcanic origin, it follows that geology plays a vital role in the physical and chemical characteristics of the water. Tatapani spring lies between 350 14′36.770 N latitudes and 740. 04′54.900 E longitudes, and at an altitude of about 2469′ msl. The spring is situated in a village named after the spring Tatapani expanded in an area of about 3sq.kms. The spring water is considered to be of great importance for healing various bodily ailments, but the drinking ability of the water is still unknown.

The temperature of the water in this spring is about 42°C. So considering the extreme nature of this hot spring, physicochemical analysis was done with this aim that the data from this study will contribute to the knowledge of the physical and chemical properties of Tatapani spring that may be useful for general public health.

[1]**Corresponding author**

Table 1 : Showing Range of Various Parameters Along With the ISSDW Recommended Values

S NO	PARAMETER S	HIGHEST VALUE	LOWEST VALUE	VALUE RECMONDED BY (ISSDW) IS: 10500
1	CALCIUM HARDNESS	58.0ppm	50.0ppm	75
2	TOTAL HARDNESS	470ppm	440ppm	300
3	pH	9.2	8.2	6.5 to 8.5
4	TEMPERATURE	45^0	35^0	--
5	CHLORIDE	70.0ppm	30.0ppm	250
6	FLUORIDE	2.0ppm	1.7ppm	0.6 to 1.2

Table 2 : Showing the Total Hardness of Tatapani Spring of District Rajouri from June, 2013 to May, 2015.

Year	JAN	FEB	MAR	APRL	MAY	JUNE
2013	-	-	-	-	-	445.0 ± 7.07^b
2014	440.0 ± 0.00^b	465.0 ± 21.2^c	470.0 ± 0.0^d	445.0 ± 7.07^b	450.0 ± 14.1^b	465.0 ± 21.2^b
2015	445.0 ± 7.07^b	455.0 ± 21.2^b	470.0 ± 14.1^a	455.0 ± 7.07^b	475.0 ± 7.07^b	-
Year	**JULY**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
2013	470.0 ± 14.1^b	450.0 ± 14.1^b	475.0 ± 7.07^c	460.0 ± 14.1^c	455.0 ± 7.07^b	460.0 ± 28.2^b
2014	465.0 ± 21.2^a	460.0 ± 0.00^b	475.0 ± 7.07^b	460.0 ± 14.1^c	450.0 ± 14.1^b	470.0 ± 14.1^c
2015	-	-	-	-	-	-

(Values are expressed as mean +SD [n=2].Value not sharing a common superscript differ significantly P<0.05 (Duncan's multiple range test)

Table 3 : Showing the pH of Tatapani Spring of District Rajouri from June, 2013 to May, 2015.

Year	JAN	FEB	MAR	APRL	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
2013	-	-	-	-	-	$8.5\pm.70^c$	$9.2\pm.35^d$	$9.2\pm.35^c$	$9.2\pm.35^d$	$8.2\pm.35^a$	$8.2\pm.35^c$	$9.2\pm.35^b$
2014	$8.2\pm.35^d$	$9.2\pm.35^e$	9.0 ± 0.0^e	8.7 ± 1.0^c	8.5 ± 0.0^b	$8.5\pm.70^b$	$9.2\pm.35^c$	$9.2\pm.35^d$	$9.2\pm.35^d$	$8.2\pm.35^a$	$8.2\pm.35^a$	$9.2\pm.35^b$
2015	9.0 ± 0.0^a	$8.2\pm.35^a$	$9.2\pm.35^d$	9.0 ± 0.0^c	8.7 ± 1.0^c	-	-	-	-	-	-	-

Values are expressed as mean +SD [n=2].Value not sharing a common superscript differ significantly P<0.05 (Duncan's multiple range test)

MATERIAL AND METHODS

Water samples were collected from Tatapani spring of district Rajouri from June, 2013 to May, 2015 in sterile bottles. Temperature was measured by using mercury bulb thermometer insitu. Following physico-chemical properties were studied by using the multi-parameter field water testing kit of Capacity Care and Development Unit (CCDU), Department of PHE Government of Jammu and Kashmir. The statistical analysis was done using SPSS 20 and the minimum, maximum, mean and standard deviations were calculated for each parameter. ANOVA were applied to test the significance of the differences between the groups.

RESULTS AND DISCUSSION

As far as the physical characteristics of the water is considered the water appeared transparent with clear bottom and the substrata comprised of small stones. Algal mats floating on the surface were noticed. Moreover a striking physical feature observed was sulfur like odor of the

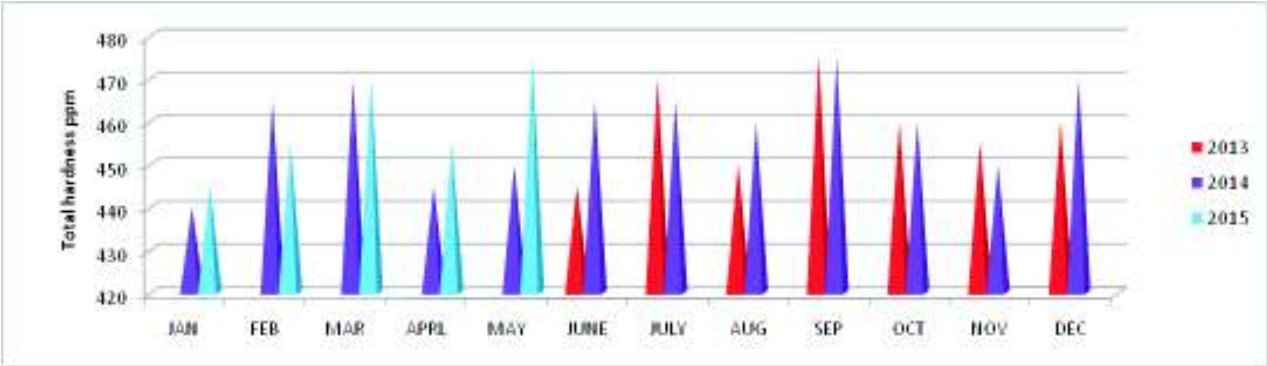

Figure1 : Showing the Total Hardness of Tatapani Spring of District Rajouri from June, 2013 to May, 2015

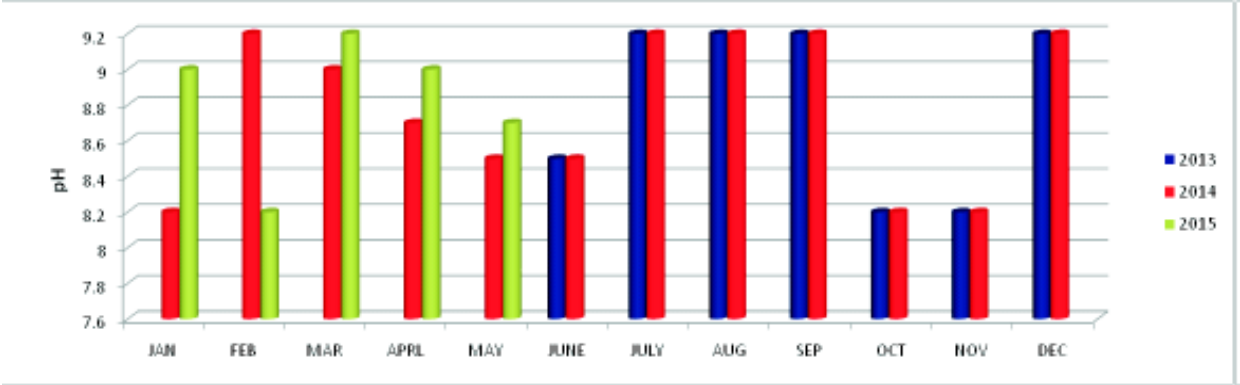

Figure 2 : Showing the pH of Tatapani Spring of District Rajouri from June, 2013 to May, 2015.

Table 4 : Showing the Calcium Hardness of Tatapani Spring of District Rajouri from June, 2013 to May, 2015

Year	JAN	FEB	MAR	APRL	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
2013	-	-	-	-	-	52.0±5.65^a	56.0±5.65^a	56.0±0.0^a	54.0±8.48^a	50.0±2.82^a	52.0±0.0^a	56.0±0.0^a
2014	52.0±5.6^a	58.0±2.8^a	50.0±2.8^a	50.0±2.8^a	54.0±2.8^a	54.0±8.4^a	58.0±2.8^a	52.0±5.6^a	54.0±8.4^a	52.0±0.0^a	54.0±2.8^a	54.0±2.8^a
2015	52.0±5.65^a	52.0±5.65^a	56.0±5.65^a	50.0±2.82^a	54.0±2.82^a	-	-	-	-	-	-	-

Values are expressed as mean +SD [n=2].Value not sharing a common superscript differ significantly P<0.05 (Duncan's multiple range test)

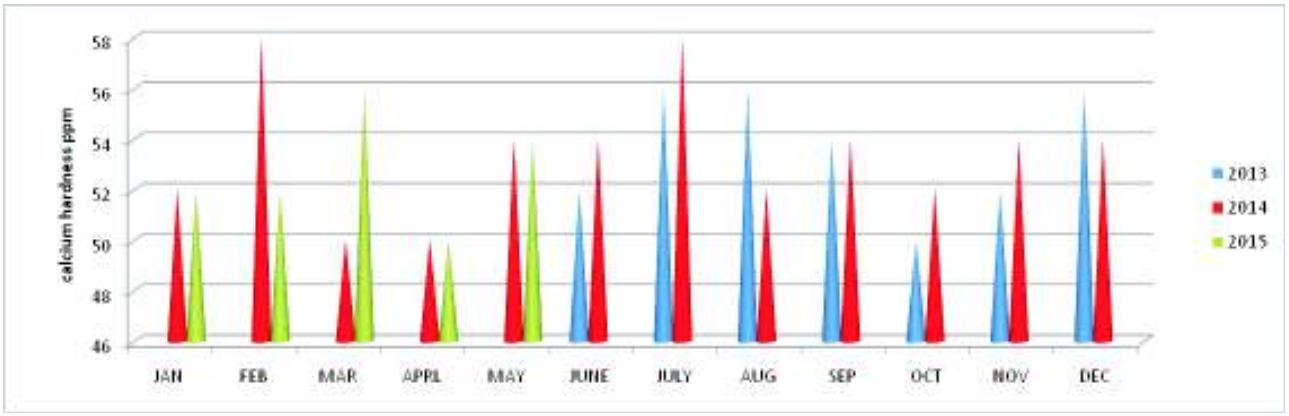

Figure 3 : Showing the Calcium Hardness of Tatapani Spring of District Rajouri from June, 2013 to May, 2015.

Table 5 : Showing the Chloride of Tatapani Spring of District Rajouri from June, 2013 to May, 2015

Year	JAN	FEB	MAR	APRL	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
2013	-	-	-	-	-	55.0±21.2^{a}	45.0±21.2^{a}	45.0±21.2^{a}	60.0±14.1^{a}	55.0±7.07^{a}	35.0±7.07^{a}	70.0±0.0^{c}
2014	45.0±21.2^{a}	50.0±0.0^{b}	50.0±14.1^{b}	30.0±0.0^{a}	65.0±7.07^{c}	40.0±0.0^{a}	65.0±7.07^{c}	40.0±14.1^{a}	60.0±14.1^{b}	45.0±7.07^{a}	55.0±21.2^{a}	50.0±28.2^{b}
2015	50.0±28.2^{b}	50.0±0.0^{c}	45.0±7.07^{b}	35.0±7.07^{a}	65.0±7.07^{d}	-	-	-	-	-	-	-

Values are expressed as mean +SD [n=2].Value not sharing a common superscript differ significantly P<0.05 (Duncan's multiple range test)

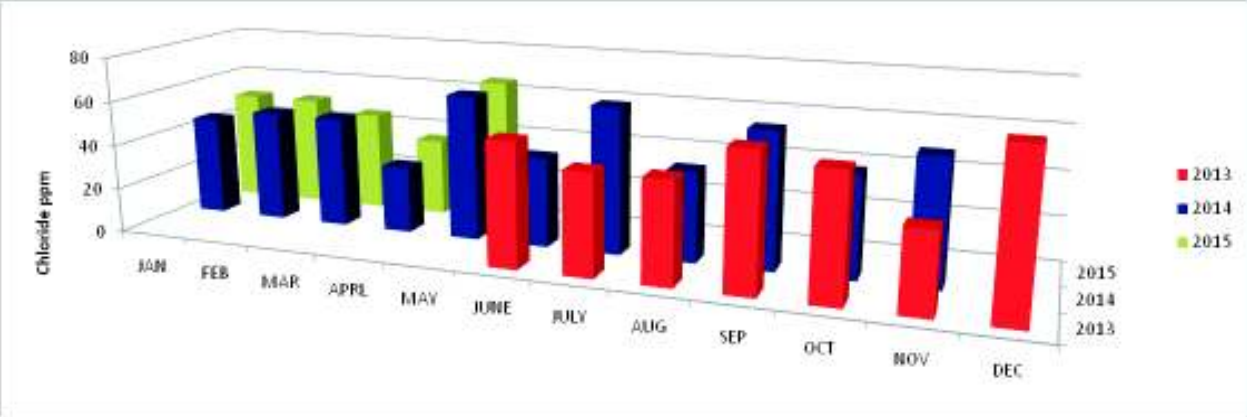

Figure 4 : Showing the Chloride of Tatapani Spring of District Rajouri from June, 2013 to May, 2015.

Table 6 : Showing the Flouride of Tatapani Spring of District Rajouri from June, 2013 to May, 2015

Year	JAN	FEB	MAR	APRL	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
2013						1.75±.35^{a}	2.0±0.0^{b}	1.7±.35^{a}	1.7±.35^{a}	1.7±.35^{a}	1.7±.35^{a}	1.7±.35^{a}
2014	1.7±.35^{a}	2.0±0.0^{b}	1.7±.35^{a}	1.7±.35^{a}	1.7±.35^{a}	1.7±0.0^{a}	1.7±.35^{a}	1.7±.35^{a}	2.0±0.0^{c}	1.7±.35^{a}	1.7±.35^{a}	1.7±.35^{a}
2015	2.0±2.0^{b}	1.7±1.7^{a}	1.7±1.7^{a}	1.7±1.7^{a}	1.7±1.7^{a}							

Values are expressed as mean +SD [n=2].Value not sharing a common superscript differ significantly P<0.05 (Duncan's multiple range test)

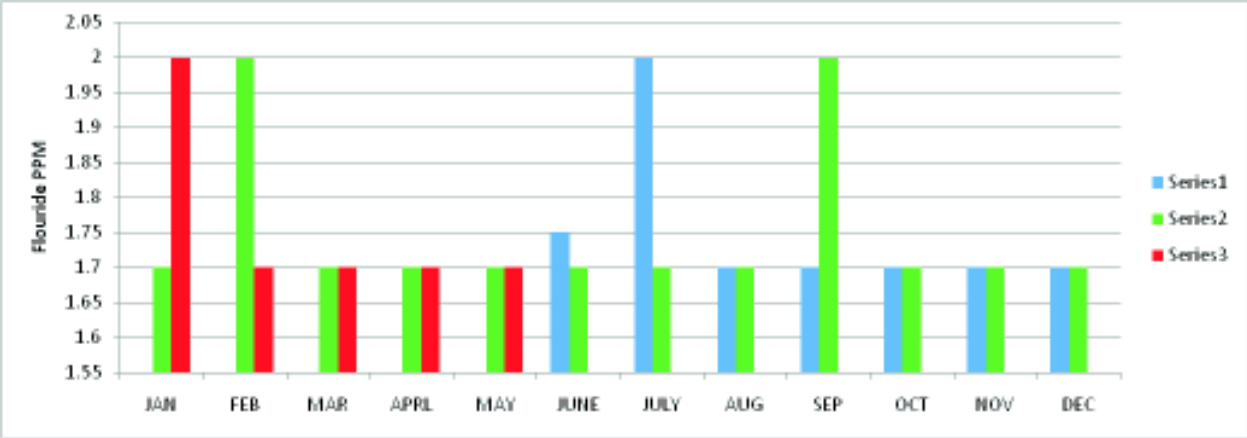

Figure 5 : Showing the fluoride of Tatapani spring of district Rajouri from June, 2013 to May, 2015

water. A hot spring or a hydrothermal spring is a place where warm or hot groundwater issues from the earth on a regular basis for at least a predictable part of the year, and is significantly above the ambient ground temperature. During the present investigation the temperature of the hot spring water was observed to vary from 35 to 45°C. The physico-chemical parameters are shown in table (2-6) and figures (1-5).

The concentrations of Calcium hardness, ranged from 50.ppm - 58.0 ppm. The minimum value of calcium hardness is 50.0 ppm and the maximum value of calcium hardness is 58.0 respectively which is less than the requirement desirable limits as prescribed by the Indian Standard Specifications for Drinking Water (table 1). The permissible limit of calcium hardness as per Indian Standard Specifications for drinking water in the absence of alternate source is 200mg/l. The main sources of calcium in natural water are various types of rocks, industrial waste and sewage. (Choudhary et al., 2011) There is evidence that hard water plays a role in heart diseases (Sastry et al 1998).

The value of total hardness ranged from 440 ppm to 475 ppm respectively. The minimum value of total hardness was found 440 ppm and the maximum value is 470 ppm which falls within the permissible limit of Indian Standard Specifications for Drinking Water and WHO. But it is much higher than the permissible limit as prescribed by BIS. The hardness of water is not pollution parameter but indicates water quality mainly in terms of Ca^{2+} and Mg^{2+} expressed as $CaCO_3$ (De, A.K, 2006). The water containing excess hardness is not desirable for potable water. It consumes more soap during washing of clothes. As per Moyle et al. (1956) all value above 64 mg/l comes under the category of hard water.

pH indicates the intensity of acidic or basic character at a given temperature. Measurement of pH is one of the most important and most frequently used tests in determining water quality. During the present study, pH was observed from 8.2-9.2 which is greater than the requirement desirable Limit (6.5-8.5) recommended by Indian standard specifications for drinking water (IS) due to greater photosynthetic activity and greater utilization of the CO_2(Nwachukwu et al., 2010). Every phase of water treatment and water supply like acid-base neutralization, water softening, precipitation, coagulation, disinfection, corrosion control etc is pH dependent. (Choudhary et al., 2011). Thus it can be incidental from the above reference that pH and water palatability are directly related. A measure of the hydrogen ion concentration; pH of 7.0 indicates a neutral solution, pH values smaller than 7.0 indicate acidity, pH values larger than 7.0 indicate alkalinity. Water generally becomes more corrosive with decreasing pH; however, excessively alkaline water also may be corrosive (U.S. Environmental Protection Agency (1994).

Chloride is an anion found in variable amount in groundwater. Chloride may present naturally in groundwater and may also originate from diverse sources such as weathering, leaching of sedimentary rocks and infiltration of seawater etc. (Rout and Sharma, 2011) The spring was characterized by low chloride concentration ranging from 30.0 ppm and 70.0 ppm, which is lesser than the requirement desirable Limit recommended by Indian Standard Specifications for Drinking Water (IS) and WHO (250ppm). Large concentrations increase the corrosiveness of water and, in combination with sodium, give water a salty taste (U.S. Environmental Protection Agency (1994). Chlorides occur naturally in all types of waters. The chloride concentration serves as an indicator of pollution (Hasalam, 1991).

The value of fluoride was found in the range of 1.7 mg/l to 2.0 mg/l found to be above the permissible limit as prescribed by Indian Standard Specifications for Drinking Water. A fluoride concentration of approximately 1.0 mg/l in drinking water effectively reduces dental caries without harmful effects on the health. Fluoride may occur naturally in water or it may be added in controlled amounts. Flourosis may occur when the fluoride level exceeds the recommended limits. (Choudhary et al., 2011).

Analysis of variance has shown that the physiochemical parameters of Tatapani collected during the period of investigation differ significantly (Table 2-6). The data from the present study shows that, some of the parameters measured are not within the acceptable range for drinking or domestic water like fluoride whose

concentration lies above the permissible limit while that of calcium hardness which lies below the permissible limit. It is therefore recommended that strict monitoring of the concentration of potentially harmful elements should be mandatory whenever the thermal spring water is used for bottling, domestic or full-contact recreational purposes.

ACKNOWLEDGEMENT

We are very much thankful to Capacity Care and Development Unit (CCDU), Department of PHE Government of Jammu and Kashmir for providing the multi-parameter field water testing kit for analyzing the various physiochemical parameters of water samples.

REFERENCES

All standards are from U.S. Environmental Protection Agency. 1994

Aneja K.R., 2003. Experiments in Microbiology, Plant pathology and Biotechnology. New age International publisher, Fourth edition.

APHA, AWWA, WEF, Standard methods for the examination of water and waste water (20th edn.) Washington, DC: American Public Health Association (1998).

Atkinson TC and Davidson. 2002. Is the water still hot? Sustainability and the thermal springs at Bath, England. Geol. Soc., London, Special Publications 193:15-40.

B.I.S. 1991. Bureau of Indian Standards Drinking water specification, Ist revision, ISS 10500.

Baradács E, Hunyadi I, Dezs Z, Csige I and Szerbin P.2001. in geothermal and bottled mineral waters of hungry. Radiat. Meas. 34 (1-6): 385-390.

Bojadgieva K, Dipchikova S, Benderev A and Koseva J. 2002. Thermal Waters and Balneolody in Bulgaria. GHC Bulletin, March, 18-25.

Booyens B 1981. Bronwaters van Genesing Die Tradisionele Warmbronwaterkultuur in ons Volksgeneeskunde. Tafelberg, Kaapstad.

De, A. K. 2006. Environmental chemistry (6th edn.). New Delhi, India: New Age International Publishers (232)

Edmunds WM. 2004. Bath thermal waters: 400 years in the history of geochemistry and hydrogeology. Geol. Soc., London, Special Publication 225:193-199.

Harvey K. 2007. Healing Touch. Sawubona, January 2007:75-76.

Hasalam, S.M., 1991. River Pollution-an Ecological Perspective. Belhaven Press, Great Britain.

Hellman MI and Ramsey MS. 2004. Analysis of hot mineral springs and associated deposits in Yellowstone National Park using Aster and Aviris Remote Sensing. J. Volcanol. Geotherm. Res. 134 (1-2):195-219.

Joshi, P.C and Singh. 2001. Analysis of certain physico-chemical parameters and planktons of fresh water hill stream at Nanda Devi biosphere reserve. Uttar Pradesh J. Zoo., 21: 177-179.

LaMoreau x PE and Tanner JT (eds.). 2001. Springs and Bottled Waters of the World. Ancient History, Source, Occurrence, Quality and Use. Springer Verlag, Berlin.

Mountain Nature. 2003. Hot Springs. MountainNature.com, the Field Guide for the next Millenium. 9 Jun.

Moyle, J., Relationship between the chemistry and Minnesota surface waters and wild life management. J. Wild L. Marg, 20:

Petraccia L, Liberati G and Masciullo SG. 2005. Water, mineral waters and health. Clin. Nutrit. 25 (3): 377-385.

Sanner B. 2000. Baden-Baden, a famous thermal spa with a long history. GHC Bulletin, September, 16-22.

WHO. 1984. Guidelines for Drinking Water, Water Quality, 1, 2, 3, Health criteria and other supporting information, Geneva.