STATUS OF CERTAIN METAL IONS IN THE GROUNDWATER OF FAISALABAD AND SURROUNDING AREAS

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Water samples from 218 different sources such as hand pumps, donkey type pumps, tubewells and open wells were collected at random in and around Faisalabad city to determine the concentration of calcium, sodium and potassium to evaluate their suitability as drinking water. Calcium content was 53 ± 25.4, magnesium 71 ± 37.9, sodium 660 ± 430 and potassium 23 ± 21.9 mg l^{-1}. Noorpur, Behari Colony, Gukhuwal, Kaleem Shaheed Colony, outer areas of Ghulam Muhammad Abad, Maqbool Road, Samanabad and D-type Colony were found to have higher amounts of these cations whereas a small belt along Rukh Branch Canal from RD 250,000 to RD 263,000 and Civil Line areas were found to have lower concentration of these metal ions. Sodium was the major cation making the Faisalabad groundwater undesirable for drinking whereas calcium content was the least.

INTRODUCTION

Groundwater is an important source of water supply throughout the world. According to Murray and Reeves (1977) 96% of rural homes in U S A are supplied by groundwater. In Faisalabad only 49,000 m^3 day^{-1} is provided by the surface water (Rukh Branch Canal and Dijkot Distributory) whereas the total estimated requirement is 400,000 m^3 day^{-1} which means more than 87% is supplied through groundwater (WASA, 1983). The groundwater is obtained by hand pumps, motor pumps, tubewells and very rarely by open wells. Only one open well was sampled in the study area.

Faisalabad lies in a saline zone. The groundwater in most of the areas is unfit for drinking due to the presence of excessive amount of different salts (Tariq, 1962). Faisalabad is the third largest city of Pakistan and has emerged as a major manufacturing and industrial center of the country. The city lies in the Punjab plains between Ravi and Chenab rivers at an elevation of 182.87 m above sea level. Due to haphazard construction of different industries which kept on pouring their untreated, heavily polluted waste industrial effluent on the fields around them, this huge amount of polluted water was bound to affect the groundwater. The present study was thus undertaken to evaluate the status of certain metal ions like Na, K, Ca and Mg in the groundwater of Faisalabad and surrounding areas.

MATERIAL AND METHODS

Water samples from 218 different sources such as hand pumps, motor pumps, tubewells and open wells, subject to the availability of the sample source, were collected in clean one litre capacity PVC bottles. The samples were collected at random from different areas of Faisalabad and its surroundings. These samples were analyzed for sodium, potassium, calcium and magnesium as recommended by Franson (1985).

Table 1. Metal ion concentration in groundwater of Faisalabad and surrounding areas

Metal ion	Mean (mg l^{-1})	Standard deviation	Range (mg l^{-1})	WHO guide-line value, 1985 (mg l^{-1})	Sample per-centage below the guide-line value
Sodium	660	430	6-1851	200	14.5
Potassium	23	21.9	2-181	-	-
Calcium	53	25.4	6-180	200*	100.0
Magnesium	71	37.9	4-200	150*	95.6

*WHO permissible level of international standard of drinking water (1971)

RESULTS AND DISCUSSION

Overall results are presented in Table 1. There is a marked variation within each analyzed cation status. Sodium is in abundance in Faisalabad groundwater. It was estimated to be 660 ± 430 mg l^{-1}. Only 14.52% samples were below the sodium guideline value of WHO i.e. 200 mg l^{-1}. Excessive intake of sodium in the form of sodium chloride may lead to vomiting and elimination of much of the salt. Acute effects may include convulsion, muscular twitching, rigidity, cerebral and pulmonary oedema (MSS, 1980). It has been suggested that high sodium intake may lead to hypertension. It has been reported from USA and Netherlands that school children (especially girls) living in areas with moderate levels of sodium in drinking water had slightly higher blood pressure than those living in areas with low level of sodium (Tuthill, 1976). The areas along Millat Road, Sargodha Road around Bawewala, Ghulam Muhammad Abad's boundary areas, Maqbool Road and North Western side of General Bus Stand showed higher amounts of sodium whereas areas along R.B. Canal (from RD 250,000 RD 263500) and Civil Lines showed lower concentration of sodium (Table 2).

Average potassium content was determined to be 23 ± 21.9 l^{-1} in drinking water. WHO has not set a guideline value for potassium in drinking water. However, excessive intake of potassium may lead to renal failures, convulsions, mental confusion, weakness, numbness, weakness of respiratory muscles and paralysis of extremities. Areas around Crescent Sugar Mills contain higher amounts of potassium whereas areas around Muslim Town and along Rukh Branch Canal have low potassium content (Table 2).

Calcium and magnesium ions in water are the major contributors to hardness. Calcium was estimated to be 53 ± 25.4 mg l^{-1} and magnesium 71 ± 37.9 mg l^{-1}. Calcium ion concentration of all the samples was within the WHO permissible level for drinking water quality which is 200 mg l^{-1}. Of the total samples 95.5% were within the permissible level of magnesium i.e., 150 l^{-1} (WHO, 1971). Shadab Colony and surrounding areas along Jhang road showed higher concentration of Ca^{++} and Mg^{++} ions, whereas areas along R.B. canal from RD 250,000 to RD 263,500 and Yousaf Chowk areas along Sargodha Road showed less calcium + magnesium concentration (Table 2). Water hardness contributes to

Table 2. Faisalabad groundwater areas of relatively high and low concentration in selected metal ions

Metal ion	Area	Mean (mg l^{-1})	Standard deviation	Range (mg l^{-1})
Sodium	Overall	660	430	6-1851
	Noorpur, Gukhuwal, Behari Colony	1331	333	802-1676
	G.M. Abad, Kaleem Shaheed Colony & Kuriwala*	1027	186.6	713-1435
	North West boundary of General Bus Stand	1051	176.3	7.94-1185
	Maqbool Road Area*	1065	340	657-1487
	Along Rakh Branch Canal**	92.3	65	14-244
	Civil Lines Area**	175.3	130.2	49.7-396
Potassium	Overall	23	21.9	2-181
	Nishatabad, Crescent Sugar Mills Area**	107	28.2	88-181
	Green Town, Muslim Town along Sargodha Road upto Small Industrial Estate**	12.9	3.99	5-18
	Along R.B. Canal from RD 250,000 to Pepsi Cola Factory**	12.42	4.56	6-20
$Ca^{++} + Mg^{++}$ (as $CaCO_3$)	Overall	416	194.7	70-1080
	Muzaffar Colony, D-Type and Samanabad*	915	160.4	595-1080
	Maqbool Road Area*	728	72.2	650-790
	Jhang Road (Shadab and Sheikh Colonies*)	667.5	77.5	605-770
	Green Town, Muslim Town, Nawaz Town along Sargodha Road upto Small Industrial Estate**	133.9	59.1	70-300

scale formation and incrustation. It has been reported that drinking hard water may lead to increased incidence of urolithiasis.

From the present study, it may be suggested that the Faisalabad groundwater generally is unfit for drinking purposes due to excessive metal ions especially sodium. Therefore, alternate water sources having low salts need to be explored, particularly in view of fast increasing population.

REFERENCES

Franson, M.A.H. (Ed.). 1985. Standard Methods for the Examination of Water and Wastewater. Amer. Public Health Assoc., Washington, USA.

Murray, C.R. and E.B. Reeves. 1977. Estimated use of water in the United States in 1975. U.S. Geological Survey Cir. 765.

MSS (Ministry of Supply and Services). 1980. Guidelines for Canadian drinking water quality. Quebec, Canada.

Tariq, M.J., S. Akbar and A. Majid. 1992. Predicting the life of tubewells in the well field area of Faisalabad based on corrosion/incrustation character of groundwater. Paper presented at the 4th Nat. Cong. Soil Sci. Soc. Pak., Islamabad. 23-25 May.

Tuthill, R.W. and E.J. Calabrese. 1976. Elevated sodium levels in the public drinking water as a contributor to elevated blood pressure in the community. Arch. Environ. Health, 37: 197.

WASA (Water and Sanitation Agency). 1983. Greater Faisalabad Water Supply, Sewerage and Drainage Project. Rev. Report.

WHO. 1971. International Standards for Drinking Water. World Health Org., Geneva, Switzerland.