International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2015): 78.96 | Impact Factor (2015): 6.391

Characterization of Metal ions in Rural Water Supply Drinking Waters by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) Technique for Assessing the Metal Toxicity

P. Lakshmi Ganapati[1], P. V. S. Machiraju[2], V. Ranga Rao[3]

[1]Department of Chemistry, Government College, Rajahmundry, A.P, India

[2]Department of Chemistry, Pragati Engineering College, Surampalem-533437, A.P, India

[3]Department of Chemistry, Government College, Rajahmundry, A.P, India

Abstract: ***Water pollution due to Metal ions is one of the serious environmental problems, which has great impact on human health. The aim of the present study is to characterize the waters from Rural Water Supply scheme collected after treatment from Mandal Head Quarters of Buttayagudem and Gopalapuram of Jangareddygudem Revenue Division in West Godavari District, A.P, India. The water samples were collected during pre and post monsoon seasons to assess the metal toxicity. The Metal ions viz., Li, Be, Al, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Rb, Sr, Ag, Cd, Cs, Ba, Tl, Pb and U were characterized by Inductively Coupled Plasma Mass Spectrometry (ICP-MS).The research results revealed that the metal ion concentrations in waters of both the seasons are within the permissible limit of Indian drinking water standards and confirmed that the waters are free from metal toxicity.***

Keywords: Drinking water, Characterization, Metal ion, Toxicity

1. Introduction

Water plays a significant role in sustenance of life and it is a key pillar of health determinant, since 80% of diseases in developing countries are due to lack of good quality water[1]. Human population growth poses a great pressure on supply of safe drinking water especially in developing countries [2]. The quality of drinking water is a powerful environmental determinant of health [3]. Drinking water quality management has been a key pillar of primary prevention and it continues to be the foundation for the control of water borne diseases [3]. The safety of water supplies is of paramount public health importance. An estimated 13% of the world population lacked access to improved drinking-water sources [4] in 2008, and almost 10% of the total burden of disease worldwide could be pre-vented by improving drinking-water supply, sanitation, hygiene, and the management of water resources [5]. Inadequate quantity, poor quality of drinking water, and poor sanitation are the main reasons in incidence and prevalence of diseases in the world [6].

Water may contain toxic inorganic chemicals which may cause either acute or chronic health effect. Acute effects include nausea, lung irritation, skin rash, vomiting and dizziness, sometime death usually occurred. Chronic effect, like cancer, birth defects, organs damage, disorder of the nervous system and damage to the immune system are usually more common [7]. Inorganic chemicals like lead may produce adverse health effect which include interference with red blood cell chemistry, delay in normal physical and mental development in babies and young children, slit deficit in attention span, hearing and learning abilities of children and slight increase in blood pressure in some adults. Chemicals in water supplies can be related to health risks, generally when associated with long-term exposures [8].

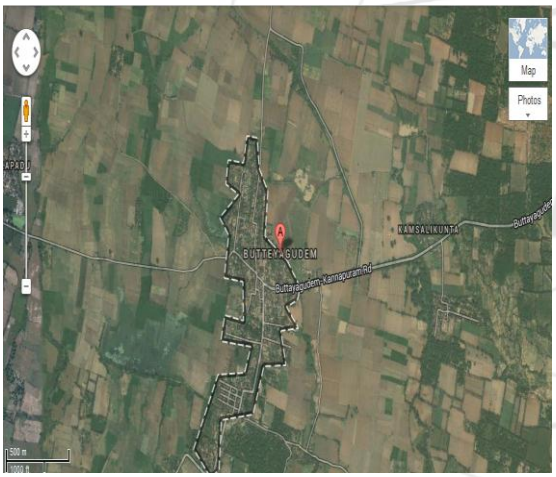
Heavy metals are widespread pollutants of great environmental concern as they are toxic, non-degradable and can cause concern on aquatic ecology [9] [10].The excessive ingestion of all metals which include Cd, Cr, Co, Hg, Ni, Pb and Zn has carcinogenic effects on human health [11]. Because of the importance of the heavy metal ions on human metabolism, trace heavy metal analysis is an important part of public health studies [12], [13], [14], [15] & [16] .

2. Materials & Methods

The sampling locations are identified in the Revenue Mandal Head Quarters of Buttayagudem and Gopalapuram of Jangareddygudem Revenue Division in West Godavari District, A.P, India. Buttayagudem Revenue Mandal Head Quarters in between the coordinates of latitude and longitude $16^0.85^1$ N and $81^0.31^1$ E while Gopalapuram Revenue Mandal Head Quarters is located in between the coordinates of latitude and longitude $13^0.05^1$ N and $80^0.25^1$ E respectively. The study area maps are presented in figure-1.

Andhra Pradesh

West Godavari District



Buttayagudem Mandal

Gopalapuram Mandal

Figure 1: Study Area Maps

Sampling and Sampling Frequency

Representative drinking water samples from Rural Water Supply scheme of Buttayagudem and Gopalapuram Mandal Head Quarters of Jangareddigudem Revenue Division in West Godavari District, A.P, India were collected for characterization of metal ions. The sampling frequency is for two times one during pre monsoon and another from post monsoon season.

Principle and Procedure for Metals ions

Analysis of drinking water sample is possible using the 7700, ICP-MS. Samples are diluted with milli equivalent water, maintain conductance less than 1000 µs/cm and acidified with 100 µL of supra pure HNO_3. Rh used as Internal Standard (ISTD) and the samples are processed as per the manual instructions of the instrument and introduced into the instrument and analyzed. The instrument has capacity of generating the concentration levels of 23 Metal ions at a time.

Characterization of Metal ions

Representative drinking water samples collected during both pre and post monsoon period were analyzed for the metal ions viz., Li, Be, Al ,V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, As, Se, Rb, Sr, Ag, Cd, Cs, Ba, Tl, Pb & U by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) of Model-7700 Make-Agilent Technologies. The analytical data generated in ppb was converted to ppm and the details are presented in table-1.

Table 1: Metal ion concentration in treated RWS waters

Metal ion Concentration (ppm)	Sample location (Mandal)			
	Buttayagudem		Gopalapuram	
	Monsoon		Monsoon	
	Pre	Post	Pre	Post
Li	0.001985	0.001819	0.001106	0.001019
Be	ND	ND	ND	ND
Al	0.023872	0.016467	0.005549	0.00911
V	0.000723	0.001033	0.000713	0.001087
Cr	0.000623	0.001033	0.000665	0.001613
Mn	0.001869	0.00092	0.00067	0.0024
Fe	0.022839	0.014625	0.002873	0.012957
Co	0.000033	0.000036	0.00008	0.000299
Ni	0.000825	0.001057	0.001016	0.00207
Cu	0.002919	0.002121	0.001028	0.001605
Zn	0.054671	0.01714	0.004337	0.007112
As	0.000089	0.00007	0.000117	0.000138
Rb	0.002052	0.001675	0.003048	0.002917
Sr	0.321829	0.423164	0.212294	0.246372
Ag	0.000058	0.000042	0.000022	0.000108
Cd	0.000103	0.000018	0.000019	0.000026
Cs	ND	ND	0.000052	0.000051
Ba	0.057134	0.061606	0.079879	0.093884
Tl	0.000003	0.000003	0.000193	0.000168
Pb	0.002585	0.000565	0.000466	0.000853
U	0.001505	0.001838	0.006489	0.007566

*ND-Not Detected

3. Results & Discussion

The concentration of metal ions viz., Li, Be, Al, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Rb, Sr, Ag, Cd, Cs, Ba, Tl, Pb and U in treated drinking waters of both pre and post monsoon

season were found to be within in the permissible limits of drinking water standards[18].

4. Conclusion

The research results revealed that the Metal ion concentrations in RWS drinking waters of Buttayagudem and Gopalapuram Mandal Head Quarters are below the permissible limits of drinking water standards indicating the non toxicity of metals in drinking waters of these Mandal Head Quarters.

5. Acknowledgement

The Authors express their gratitude to the Authorities of Bay of Bengal Research Institute, Andhra University, Visakhapatnam, A. P for extending technical support in analyzing the waters for metal ions.

References

[1] Cheesbrough M (2006). District laboratory Practice in Tropical Countries. Part 2 Cambridge University Press. pp. 143-157.
[2] Okonko IO, Ogunjobi AA, Kolawale OO, Babatunde S, Oluwole I, Ogunnusi TA, Adejoyi OD, Fajobi EA (2009). Comparative Studies and Microbial Risk Assessment of a Water Samples Used for Processing Frozen Sea foods in Ijora- Olopa, Lagos State, Nigeria. EJEAFChe. 8(6): 408-415.
[3] World Health Organization (WHO) (2010). Guidelines for Drinking-water Quality. Recommendation, Geneva, p: 1-6.
[4] UNICEF and World Health Organization. 2011. Drinking Water Equity, Safety and Sustainability.
[5] Prüss-Üstün A, Bos R, Gore F, Bartram J. 2008. Safer Water, Better Health: Costs, Benefits and Sustainability of Interventions to Protect and Promote Health. Geneva: World Health Organization.
[6] World Health Organization, *Guidelines For Drinking—Water Quality*, World Health Organization, Geneva, Switzerland, 3rd edition, 2004.
[7] Erah PO, Akujieze CN, Oteze GE (2002). A quality of ground water in Benin City: A baseline study on inorganic chemicals and microbial contaminants of health importance in boreholes and open wells. Trop. J. Pharm. Res. 1(2): 75-82.
[8] Thompson T, Fawell J, Kunikane S, Darryl Jackson D, Appleyard S, Callan P, et al. 2007. Chemical Safety of Drinking-Water: Assessing Priorities for Risk Management. Geneva: World Health Organization.
[9] Chopra, A.K., C Pathak and G.Prasad, (2009): Scenario of Heavy metals Contamination in Agricultural soil and its Management J. Applied Nat. Sci.,1(2):99-108.
[10] Jumbe, A.S and N. Nandini, (2009): Impact assessment of heavy metals pollution of Vantur lakes Banglore.J. Applied Nat. Sci, 1:53-61.
[11] Muhammad, S.,Shan, M.T., Khan, S., 2011.Health risk assessment of heavy metals and their sources apportionment in drinking water of Kohistan region, northern Pakistan. Microchem. J.98, 334-343.
[12] Gan W.E., Shi W.W., SU Q.D. Determination of cadmium by CVAAS using nebulous phase reaction vapor generation system. Atom. Spectrosc., 25, 245, 2004.
[13] Van Cauwernbergh R., Robberecht H., Van Vlaslaer V., Deelstra H. Comparison of the serum selenium content of healthy adults living in the Antwerp region (Belgium) with recent literature data. J. Trace. Elem. Med. Biol., 18, 99, 2004.
[14] Koc H., Mendil D., Tuzen M., Sari H., Hasdemir E. Trace metal levels of some medical and aromatic plants collected from high density traffic areas in Tokat, Turkey. Asian J. Chem., 16, 1089, 2004.
[15] Acar K., Boz B., Kurtulus A., Divrikli U., Elci L. Using of atomic absorption spectrometry for diagnosis of electrical injuries (an experimental rat study). Forensic Sci. Int., 146S, S3, 2004.
[16] Aremu D.A., Olawuyi J.F., Meshitsuka S., Sridhar M.K., Oluwande P.A. Heavy metal analysis of groundwater from Warri, Nigeria. Int. J. Envir. Health Res., 12, 261, 2002.
[17] Drinking Water Specifications: IS: 10500, 1992 (Reaffirmed 1993).