Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 6, Issue, 03, pp.5647-5651, March, 2014

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

PHYSICOCHEMICAL AND BACTERIOLOGICAL STATUS OF DRINKING WATER IN PEDABIDA, AGENCY AREA, ANDHRA PRADESH

***Sandhya Deepika, D., Laxmi Sowmya, K., Ratna Kumar, P. K. and Ashok, P.**

Department of Botany, Andhra University, Visakhapatnam- 530003, Andhra Pradesh

ARTICLE INFO

Article History:
Received 18th December, 2013
Received in revised form
16th January, 2014
Accepted 15th February, 2014
Published online 25th March, 2014

Key words:

Drinking water,
Quality assessment,
Pathogenic bacteria,
Pedabida panchayat.

ABSTRACT

The present study was undertaken to evaluate the water quality of the Pedabida panchayat of Ananthagiri mandal in Visakhapatnam district with affable means. The physicochemical and the microbial studies are most important regions by which we are able to test the portability of water. The isolation and characterization of the pathogenic microorganism from the water sample collected were the main emphasized area of the study. In this study drinking water samples were collected from a bore, a well and a stream for a period of one years i.e., from April 2011 to March 2012. The various constituents monitored include the physicochemical characters, the bacterial parameters like Total plate count (TPC), Most probable number (MPN) and isolation and identification of pathogenic bacteria. The physicochemical characters of all the three drinking water samples were within the recommended permissible level of WHO. The total plate count was above the WHO guidelines values (<10CFU's/ml) in the three water samples studied and the highest count was during August. The bacteria isolated were *E. coli, Salmonella, Shigella, Staphylococcus, Group D Streptococcus, Vibrio cholera and V. parahaemolyticus and Pseudomonas.* The samples were inoculated and were incubated at 37^0C for 24 hrs or 48hrs.for appropriate bacterial growths. Thus we can use this study for the assessment of the water and to resolve the hygienic problems of the water.

INTRODUCTION

"No life without water" is a common saying, as water is the essential requirement of all life supporting activities. Human beings were aware of the water pollution problems which might have forced them to move their settlements frequently. Thus human beings became aware of air and water pollution problems only from bitter experiences called "pollution episodes". Most of the developed countries suffered from the pollution problems in the last few decades. Fortunately, the developing countries are at a stage of taking advantage of the awareness created by the scientists of their countries and can take proper steps that are necessary to mitigate the damage that would possibly be done to the ecosystem in the process of development. India is at least a few decades behind the developed countries in the race for technological supremacy. Almost 70% of the water in India has become polluted due to the discharge of domestic sewage and industrial effluents into natural water sources (Sangu and Sharma, 1987). The improper management of water systems may cause serious problems in availability and quality of water (Subba Rao and Subba Rao, 1985). During the past decade, widespread reports of ground water contamination have increased concern about drinking water quality (Yanggen and Born, 1990). Several researchers have attempted to estimate the total burden of waterborne disease worldwide. Huttly (1990) reported a total number of 1.4 billion annual cases of diarrhea in children less than five year of age, with an estimation 4.9 million children dying as a result of water related disease. Even then, the environment in the cities in India is polluted by a high rate of industrialization. Pruss et.al 2002 estimated that water, sanitation and hygiene were responsible for 4.0% of all deaths and 5.7% of the total disease burden occurring world wide. The disease most frequently associated with water are enteric infection that are also often associated with food. Even then, the environment in the cities in India is polluted by a high rate of industrialization. A number of cities throughout the world, especially in India, are now on the threshold of emerging into metropolitan centers as a result of the rapid industrialization and urbanization. Hence, the bacteriological quality of drinking water is important and periodical monitoring is essential for potable water. The present paper deals with the physicochemical and bacteriological quality of different sources of water used for drinking during April 2011 to March 2012 in Pedabida panchayat, a tribal area of Ananthagiri mandal in Visakhapatnam district.

***Corresponding author: Sandhya Deepika, D.** Department of Botany, Andhra University, Visakhapatnam- 530003, Andhra Pradesh.*

MATERIALS AND METHODS

The water quality of the three water samples (stream, bore and well) from the pedabida panchayath of Ananthagiri mandal, Visakhapatnam, Andhra Pradesh were studied for

physicochemical and bacteriological parameters. In the present study, water samples were collected from three sources i.e., a well, a bore and stream once in a month for a period of 12 month from April 2011 to March 2012, in white plastic bottles, which were previously rinsed with distilled water and sterilized with 70% alcohol. At the collection point, the containers were rinsed thrice with the sample water before being used to collect the samples. The collected samples were placed in a thermocol box. The temperature in the box was maintained at 4^{o}C by using ice packs. The P^{H} of the water samples was measured by using the electrometric methods and other physicochemical parameters such as Total dissolved solids and Fluoride content were analyzed by standard methods given in APHA(1998). The microbial isolation was done by streak plate method on nutrient agar and on selective media for their identification (Sherman Cappuccino, 2009). The final identification of resulted isolates was done by the biochemical tests in accordance to the Bergey's Manual (Holt *et al*., 1984).

RESULTS AND DISCUSSION

Water samples collected from Pedabida panchayat for a period of one year i.e., during April 2011 to March 2012 were analyzed for physical, chemical and bacteriological characteristics. The physical characteristic measured is P^{H}. Among the chemical characteristics Total dissolved solids (TDS) and fluoride contents were measured. For total number of viable bacteria total plate count (CFU/ml), for faecal and total coliforms most propable number (MPN/100ml) and for isolation and identification of bacteria staining, biochemical and growth on selective media were performed. The mean P^{H} value of stream water was in the range 7. In bore water it was in the range of 7.0-7.2 with the mean P^{H} value 7.06. In well water it was in the range of 6.92-7.1 with mean P^{H} value 7.005. The P^{H} value in the three water samples is in the safe limit as recommended by WHO. The amount of total dissolved solids of the stream water was on the average 107.84mg/l and Fluoride content on the average was 0.1mg/l. The amount of total dissolved solids of the bore water on the average was 273.25mg/l and Fluoride content on the average was 0.104mg/l. The amount of total dissolved solids of the well water on the average was 175.08mg/l and Fluoride content on the average was 0.109mg/l. Both the values in the three samples were in the permissible limits as recommended by WHO. Physical parameters such as P^{H}, TDS and fluoride content have a major influence on bacterial population growth. P^{H} values ranging from 3 – 10.5 could favour both indicator and pathogenic organism's growth (Zamxaka *et al*., 2004). P^{H} provides the information about the acidity or alkalinity of water (Katyal and Satake, 1990). It also provides a means of clarifying and for collecting other characteristics or behavior such as corrosive activity (Ghandour *et al*., 1985). Eye irritation and exasperation of skin disorders have been associated with P^{H} values greater than 11. With respect to the water samples the P^{H} values were in safe limit. High TDS was commonly objectional or offensive to taste. A higher concentration of TDS usually serves no health threat to human until the values exceed 10,000mg/l (Anonymous, 1997). The TDS values of the all the three water samples were within the permissible limit.

Fluoride testing in water quality analysis should be given importance because fluoride is know to cause a variety of health problems viz dental fluorosis and non skeletal manifestations when the level beyond 1.5ppm. Fluoride has come to stay as number one parameter in causing toxicological and geo-environmental problems in various countries. The fluoride content of all the three water samples was within the permissible limit. The results of physico–chemical analysis of the present study are in agreement with the study of Germs *et al*. (2004) who reported that the chemical quality of the Chunies River in South Africa was acceptable for domestic as well as for agriculture. Similary, Nevondo *et al*. (1999) revealed that the chemical quality of all water samples was acceptable. The chemical analysis of water samples from Egypt carried out by Fadaly *et al*., (1999) showed that the measured parameters were found within the permissible limits. The total plate counts of bacteria in the three water samples are given in Figure1. In stream water the total plate count fell in the range of 39-76 CFU's/ml. The water sample showed the maximum number of CFU's (76CFU's/ml) in August and minimum number was noted in March and June (39 CFU's/ml). In bore water the total plate count fell in the range of 58-139 CFU's/ml. The water sample showed the maximum number of CFU's (139CFU's/ml) in August and minimum number was noted in March (58 CFU's/ml). In well water the total plate count fell in the range of 97-236 CFU's/ml. The water sample showed the maximum number of CFU's (236CFU's/ml) in August and minimum number was noted in May (97 CFU's/ml). Total plate count for bacteria performed for all water samples showed that the bacteria in all the samples were above the WHO guideline values(<10CFU's/ml). The total plate count in all the three water samples was highest during the rainy season i.e., August and was due to the contribution of all the pathogenic bacteria. However the water samples of tap showed relatively higher plate count throughout the year. This may be due to the presence of sewage surrounding the well which continuously seeps into the well water. This study is in conformation with the result of Zaky *et al*., (2006) who reported increased bacterial content in the water of Manzala Lake, Egypt which is polluted by drainage and sewage.

The MPN values for Coliforms present in all the water samples are presented in Figure 2. In stream water the MPN index ranged from 4-28/100ml. The maximum MPN index was recorded in (28/100ml) August. The minimum MPN index was recorded in (4/100ml) March. In bore water the MPN index ranged from 9-64/100ml. The maximum MPN index was recorded in (64/100ml) August. The minimum MPN index was recorded in (8/100ml) March. In well water the MPN index ranged from 20-210/100ml. The maximum MPN index was recorded in (210/100ml) August. The minimum MPN index was recorded in (20/100ml) June. During the study period all the three water samples (i.e. stream, bore and well) showed the presence of the eight pathogenic bacteria such as *Escherichia coli, Klebsiella pneumoniae, Salmonella typhi, Shigella dysenteriae, Staphylococcus aureus, Group D Streptococcus, Vibrio cholerae* and *V. parahaemolytics*. (Table 1 & 2). Most common and wide spread health risk associated with drinking water is the bacterial contamination caused either directly or indirectly by human or animal excreta. In the present study the heterotrophic plate count was used to estimate the total amount

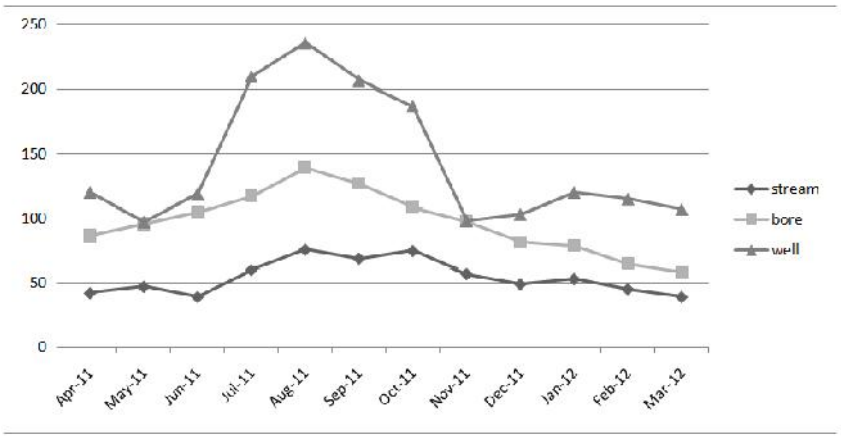

Figure 1. Total Plate Count (CFU/ml) of Bacteria in three water samples

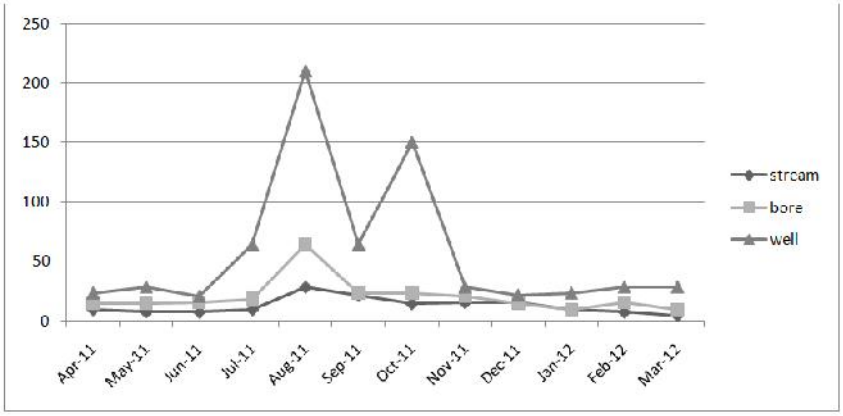

Figure 2. Most Probable Number (per 100ml) of Coliforms in three water samples

Table 1. Morphological and Cultural characteristics of Organisms

Morphological & Cultural characters	Organism	Disease caused by the organism
Gram negative rod, forms circular, low convex mucoid, opaque colonies with entire marginal growth on nutrient agar. Green metallic sheen colonies were observed on EMB agar.	*Escherichia coli*	Causal agent of gastroenteritis, urinary tract infections, and neonatal meningitis.
Gram positive coccus, non spore forming and non- motile bacteria. It forms circular, low convex with entire margin, smooth, medium opaque colony on nutrient agar. It forms yellow coloured colonies on mannitol salt agar.	*Staphylococcus aureus*	*S.aureus* incidence ranges from skin, soft tissue, respiratory, bone, joint, endovascular to wound infections. It causes a range of illnesses, from minor skin infections, such as pimples, impetigo, boils (furuncles), cellulitis folliculitis, carbuncles, scalded skin syndrome, and abscesses, to life-threatening diseases such as pneumonia, meningitis, osteomyelitis, endocarditis, toxic shock syndrome (TSS), bacteremia, and sepsis. It is still one of the five most common causes of nosocomial infections and is often the cause of postsurgical wound infections.
Gram positive coccus. It forms thin, even growth on nutrient agar. Black (or) Brown coloured colonies were observed on bile esilin agar.	*Group D Streptococcus*	*Group D Streptococcus* causes urinary tract infections, meningitis, neonatal sepsis, spontaneous bacterial peritonitis, septic arthritis, and vertebral osteomyelitis diseases.
Gram negative curved rod. It forms abundant, thick, mucous white coloured colonies on nutrient agar and yellow coloured colonies on TCBS agar.	*Vibrio cholerae*	*Vibrio cholerae* is responsible for the occurrence of cholera.
Gram negative curved rod. It forms abundant, thick, mucous white coloured colonies on nutrient agar and green coloured colonies on TCBS agar.	*Vibrio parahaemolytics*	*V. parahaemolytics* is responsible for gastrointestinal illness in humans.
Gram negative rod. It forms slimy, white somewhat translucent, raised growth on nutrient agar and dark pink coloured colonies on mac - conkey agar.	*Klebsiella pneumoniae*	*Klebsiella pneumonia* is responsible for pneumonia, thrombophlebitis, urinary tract infection (UTI), cholecystitis, diarrohea, upper respiratory tract infection, wound infection, osteomyelitis, meningitis, and bacteremia and septicemia.
Gram negative rod. It forms thin even grayish growth on nutrient agar and dark green colonies on SS agar.	*Salmonella typhi*	*Salmonella typhi* causes typhoid.
Gram negative rod. It forms grayish growth on nutrient agar and colourless colonies on SS agar.	*Shigella dysenteriae*	*Shigella dysenteriae* is the bacillary dysentery causing bacterium.

Table 2. Biochemical Characteristics of isolates

Test						
Catalase	+	-	+	+	+	+
Oxidase	-	-	-	+	-	-
Motility	-	-	+	+	-	
Indole	-	-	+	+	-	+
Methyl-red	-	+	+	-	+	+
Voge-Proskauer	+	-	-	+	-	-
Citrate Utilization	-	-	-	+	+	-
Urease	+	-	-	-	-	-
Hydrogen sulphide	-	-	-		+	-
Starch hydrolysis	-	-	-	-	-	-
Nitrate Utilization	-	-	+	+	+	+
Gelatin liquefication	-	-	-	+	-	-
Lactose fermentation	-	A	AG	AG	-	-
Glucose fermentation	A	A	AG	AG	AG	A
Sucrose fermentation	A	A	A(+)	AG	AG	A+/-
Organism	*Staphylococcus*	*Streptococcus*	*E. coil*	*Vibrio*	*Salmonella*	*Shigella*

A=Acid production only; AG =Acid and gas production; +/- = Variable reaction; + =Positive; – = Negative; (+) =Late Positive

of bacteria in water and indicates the overall microbial status of water. The factors responsible for high microbial counts in the water samples may be due to technically ill planned sewerage network, damaged sewer lines, rust water pipe lines and poorly maintained disinfection system. Muhammad Anjum Zia *et al*., (2005) found that the ground water of Faisalabad city showed high bacterial counts. The pathogenic bacteria thus isolated were mostly belonging to the Enterobacteriaceae. The presence of Enterobacteriaceae members in the tested water samples indicates the faecal pollution. High level of contamination of ground water with faecal coliforms was found in urban areas of Karachi (Zubair and Rippy 2000). Khan *et al*., 2000 was also found that more than 50% water samples of Peswar, Nowshera and Charsada were polluted with faecal coliforms. These faecal coliforms were also reported from Umian lake water (Rajurkar *et al*., 2003) and also in different water samples at Sivakasi (Radha Krishnan *et al*., 2007). Water sources used for drinking or cleaning purpose should not contain any organism of faecal origin (Sabongari 1982, Fonseca *et al*., 2000).

Conclusion

Water is the valuable natural resources which is facing depletion and pollution due to increase in consumption by ever growing population and industrial activities. This calls for active need for water management which requires water quality analysis as the initial step. Water quality standards vary significantly due to different environmental conditions. The study provided information about the water quality status of the Pedabida panchayat of Ananthagiri mandal in Visakhapatnam. The physicochemical parameters are within the permissible standard limits. The microbial level render them unfit for human consumption though they can be used for other purposes water should meet different quality specification depending on the particular uses. Open defecation, water – logging environment, poor drainage facilities and unscrupulous dumping of domestic waste resulted in the deterioration of water quality in the study area. Water quality should be controlled in order to minimize acute problem of water related diseases which are endemic to health of man. Thus, an effective and thorough sanitary condition should be given to these water bodies in order to maintain a good water quality. Thus, potable and domestic water should be harmless for the health of man and should have organoleptic properties and should be suitable for domestic use. Water quality should be controlled in order to minimize acute health problems of water related disease in humans. The following three points approach is suggested for improving the quality of water supplied to the tribal communities of pedabida panchayath studied.

- Investigate the source of contamination of pipe borne water supplies to delineate the roles of the water delivery system and of household water storage system.
- Institute a system to monitor the quality of untreated water sources so that water collection can be restricted to uncontaminated sources and or water treatment advisories can be issued appropriately.
- Educate the public on appropriate water handling storage and treatment methods. It is evident that until these recommendations are implemented water supplied to the tribal communities in pedabida panchayath of ananthagiri mandal, Visakhapatnam district will continue to pose a health hazard to the population.

REFERENCES

Anonymous. (Internet) 1997. Groundwater quality. Ohio department of natural resources division of water fact sheet. 1997 October 14- Available from: http:// www.dms.state.oh.us/water/pubs/pdfs/fctsht42.pdf.

Apha 1998. Standard methods for the examination of water and wastewater. Ame.Pub. Hea. Asso. Wash. DC. 20:853.

Fadaly, E.H; Defrawy, E.W; Zawawy, E.F; and Makla, D. 1999. Microbiological and chemical aspects on some fresh water industrial waste water samples. *Pak.J.Biol.Sci*. 2(3):1017-1023.

Fonseca 2000. Concentration of Hardness, Alkalinity and Nitrate in Water Used for Cleaning Milk Equipment. 'Brazilian Dairy Farm' Proceedings of 10th ISAH conference, Maastricht, the Netherland.

Germs, W; Coetzee, M.S; Rensburg, L.V and Maboeta, M.S. 2004. A preliminary assessment of the chemical and microbial water quality of the Chunies River – Limpopo. Water. SA. 30(2): 267-272.

Ghandour, E.I.M; Kahil, J.B and Atta, S.A. 1985. Distribution of carbonates, bicarbonates and P^H values in ground water of Nile Delta Region of Egypt. Ground Water. 23: 35-41.

Holt, J.G; Srieg, N.R; Senath, P.H.A; Staley, J.T. and Williams, S.T. 1994. Bergey's Mannual of Determinative Bacteriology 9th Ed. Baltimore Md. Williams and Wilkins.

Huttly, S.R.A. 1990. The impact of inadequate sanitary conditions on health in developing countries. World health statistics Quaterly, 118-126.

Katyal, M and Satake, M. 1990. Total Environmental Pollution. Annual. Pub. India: 57-59.

Khan, M; Ihsanullah, T.S; Fazal, M. and Abdus S. 2000 Ocurence of pathogenic microorganisms in food and water supplies in different areas of Peshawar, Nowshera and Charsada. *Pak. J. Food Sci.*, 2000; 10: 37-40.

Muhammad, A.Z; Rehman, K; Fozia, A. and Rizwana, L. 2005. Microbiological and chemical aspects of drinking water and treatment enhanced its quality. *Pak.J.Res*(Sci). 16(1): 11-18.

Nevondo, T.S and Clote, T.E. 1999. Bacterial and chemical quality of water supply in the Dertig village settlement. Water. SA. 25(2) 215-220.

Pruss, A; Kay, D; Fewtrell, L; and Bartram. J. 2002. Estimating the burden of disease due to water, sanitation and hygiene at global level. Environmental Health Prospective.

Radha Krishnan, R; Dharmaraj, K. and Ranjitha Kumari, B.D. 2007. A comparative study on the physicochemical and bacterial analysis of drinking, borewell and sewage water in the three different places of Sivakasi. *Ind. J. Environmental. Biology*., 2007; 28(1): 105-108.

Rajurkar, N.S; Nongbri, B. and Patwardhan, A.M. 2003. Physicochemical and microbial analysis of Umian (Brapani) lake water. *Ind. J. Environ. Protec*., 2003; 23(6): 633-639.

Sabongari, A. 1982. Drinking Water Quality" Proceedings of 3rd National Conference on Water Pollution. Port Harcourt, Nigeria. pp. 100-109.

Sangu, R.P.S and Sharma, S.K. 1987. An assessment of water quality of river Ganga at Garmukeshwar. *Ind. J. Ecol*., 14(20), 278-287.

Sherman Cappuccino 2009; Biochemical activities of microorganisms. Microbiology a Laboratory Manual 7th Ed. 143-203.

Subba Rao, C and Subba Rao, N. V. 1985: Ground water quality in residential colony. *Ind. J. Environ. Hlth*., 37(4), 295-300995).

Yanggen, D.A. and Born, S.M. 1990 Protecting ground water quality by managing local land use. *J. Soil. Water*. Conser. 1990; 45(2): 207-210.

Zaky, M.M. 2006. Environmental factors influencing multi drug resistant and harbouring plasmid DNA Aeromonas Hyrdophila isolated from polluted waters of Lake Manzala, Egypt, Proceeding of the 19th International Conference on Environment, Health and Sustainable Development, Sept. Alexandria, Egypt, pp 159- 160.

Zamxaka, M; Pironcheva, G and Muyima, N.Y.O. 2004. Microbiological and Physico-Chemical Assessment Of the Quality of Domestic Water Sources In Selected Rural Communities of The Eastern Cape Province, South Africa. Water. SA .30: 333.

Zuabair, A. and Rippy, B. 2000. Evaluation of shallows ground water quality in urban areas of Karachi (Pakistan)-Inorganic nutrients and bacterial contamination. *Pak. J. Sci. Ind. Res.*, 2000; 43: 221-225.

****