INTERNATIONAL JOURNAL OF ADVANCES IN PHARMACY, BIOLOGY AND CHEMISTRY

Research Article

Effect of Seasonal Variations on Physicochemical and Microbial Analysis of Utility Water in Andhra University, Visakhapatnam

N.S.M JYOTHI, *SANDHYA DEEPIKA D and LAXMI SOWMYA K.

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

ABSTRACT

Seasonal variations of Physico Chemical and Bacteriological properties of water samples from different pump houses in certain selected areas of Andhra University, Visakhapatnam have been studied. Five different sites were selected for the study includes Library Pump House, Main Pump House, Maharanipeta Girls Hostel Pump House, Andhra University Girls Hostel Pump House and Gandhi Bhavan Pump. The criteria considered for the selection on various parameters viz., PH, Fluoride, TDS, TPC and MPN (Physico Chemical and Microbial Analysis). The microbial isolation was done by streak plate method on nutrient agar and on selective media for their identification was done accordance to the Bergy's manual. The isolation and characterization of the pathogenic micro organisms from the water sample were collected were the main emphasized area of the study. The physico chemical and microbial characters of all the water samples were within the recommended permissible level of WHO. The Total Plate Count was above the WHO permissible values (10 CFU's/ml) in all the five samples. Highest total plate count was observed in S_5 sample during rainy and winter season. Highest MPN was observed in S_3 sample during rainy and winter season. The study reveals the unfavorable influence of various anthropogenic activities and hence six isolates of bacteria namely Escherichia coli, Enterobacteriaceae, Staphylococcus, Klebsiella, Salmonella, Shigella families were isolated which are highly pathogenic and not safe for drinking and utility purposes. Hence result of this study indicated that the water in Andhra University pump house are highly contaminated and therefore stress on the need to control the faecal pollution of water bodies. Thus we can use this study for the assessment of the water sample and to resolve the hygienic problem of the water and recommended for an improved rural water supply scheme is suggested. Hence the present study was undertaken to evaluate the water quality of the Andhra University, Visakhapatnam by an affable means.

Keywords: Drinking water, Utility water, Pathogenic bacteria, Faecal pollution.

INTRODUCTION

Water is most important for all living organisms. Health of human and other organisms directly related with safe water. Water that is safe to drink, pleasant to taste and usable for domestic purpose is termed potable water while contaminated water is one that contains microorganisms, chemicals, industrial or domestic waste or sewage so that it is unfit for its intended use (Pelczer 1999)[12]. Water that is absolutely pure is however not found in nature because natural water from all sources are associated with some kind of contaminants, their nature and amount varying with the sources of the water. There is therefore the need to subject raw source waters to treatment before consumption. Environmental risk assessment today reveals that the exposure to biological contaminants especially water-borne microbial pathogens needs to be given higher priority in treatment and regulatory programs for domestic water supplies. Water is a resource that has many uses, including recreation, transportation and hydro electric power, domestic, industrial and commercial uses. Water also supports all forms of life and affects our health, lifestyle and economic well being. Although more than three quarters of the earth

surface is made up of water, in that only 2.8% of earth's water is available for human consumption. The effectiveness of biofilters as a treatment for waste water is used now ever days. At present, approximately one third of the World people live in countries with moderate to high water stress and the World wide fresh water consumption raised six fold between the years 1900 and 1995 more than twice the rate of population growth. Thus, many parts of the World are facing water scarcity problem due to limitation of water resources coinciding with growing population. As per UNCED WORLD WATER DAY was declared on 22nd March. The improper management of water system may cause serious problem in availability and quality of water. Since water quality and human health are closely related. Water Analysis before usage is primary important. Certain Physical, Chemical and Microbiological Standards which are designed to ensure that the water is potable and safe for drinking before it can be designed as potable (Tebutt T.H.Y., Principles of Quality Control, Pergamon, England 235, 1983)[19]. The present study was aimed to check the utility water quality evaluation from 5 different pump houses in AU Visakhapatnam with it is a combination of both municipality and bores by considering physical,chemical and microbiological quality.. The bacteriological quality of drinking water is of paramount importance and monitoring must be given highest priority (Bharti N. and Katyal D 2011)[3].Generally physical parameters includes P^H, odour, turbidity, colour and temperature. Chemical parameters like fluoride, arsenic, lead, nitrate, sodium, calcium, chloride and etc. Microbial analysis includes Total plate count (TPC), Most probable number (MPN).For the isolation and identification of bacteria staining, biochemical tests in according to the Bergy's Manual (Holt et al 1984) and growth on selective media were performed.

MATERIALS AND METHODS

STUDY AREA

Andhra University in Visakhapatnam, north east coastal Andhra Pradesh, is one of the older premier universities in India with a broad focus. Andhra university (170 431 45. 380 N 830 191 17.610 E) is located in Visakhapatnam north east coastal of Andhra Pradesh (urban area). The university contains two sections, the south and north campus. The south campus houses the arts, humanities and science department along with the administrative block. The north comprises the engineering college. It was established in 1926 and shared affiliating responsibilities with Madras University in the initial years. Andhra University is one of the most prestigious educational institutions in the country devoted to post-graduate teaching and research. The educational jurisdiction of the University spreads across five districts of Andhra Pradesh namely Visakhapatnam, East Godavari, West Godavari, Vizinagaram and Srikakulam. University of Andhra has been recognized by University Grants Commission (UGC) and is also an active member of the Association of Indian universities (AIU). It has also been awarded with an ISO 9001-2000 Certificate (http://www.highereducationinindia.com/universities/andhra-university.php)

In the present study water samples, were analyzed monthly to get the seasonal changes of the above said microbial groups for their bacteriological quality. These investigations were carried out for a period of 12 months (one year i.e., April 2013 to March 2014), from the five(5) different pump houses- Library pump house with 3 bores and no municipality, Main pump house with 6 bores and municipality, Maharanipeta girls hostel having only municipality connection (new pump house), AU girls hostel pump house with no municipality and only 3 bores and finally Gandhi bhavan pump house with 5 bores and no municipality connection in Andhra University Visakhapatnam. For utility purpose the above pump houses connects to all the departments hostels(Arts, Commerce, Science and Engineering college hotels) and offices in Andhra University Visakhapatnam (Table 1).

At every water source, water was sampled in the form usually consumed by inhabitants. Water from the collection point is aseptically collected into sterile side mouth glass bottles. At the time of collection, the source and the name of the sample was noted on the sample bottle. In order to protect the sample from contamination, the water samples were taken in a closed sterilized glass container (300 ml capacity) and the collected samples are stored at 4^0C on ice and transported aseptically for parceling within 24 hrs. The microbial isolation was done by streak plate method on nutrient agar and on selective media for their identification (Sherman Cappuccino, 2009)[18]. The final identification of resulted isolates was done by the biochemical tests in accordance to the Bergey's Manual. The study was carried in accordance with the method of the Environmental Protection Agency (EPA) of the United States of America.

RESULTS

The following are the results of physicochemical characters and microbial analysis of water samples were analyzed monthly to get the seasonal changes of the above said microbial groups for their

bacteriological quality. These investigations were carried out for a period of 12 months (one year i.e, April 2013 to March 2014), from the five different pump houses in Andhra University Visakhapatnam are reported.

Physicochemical analysis of water samples

During summer season on an average P^H (Fig 1) of S_1 contains 7.25, S_2 has 7.11, S_3 has 7.32, S_4 has 7.24 and S_5 has 7.31. During rainy season S_1 contains 7.20, S_2 has 7.12, S_3 has 7.24, S_4 has 7.24 and S_5 has 7.33. During winter season S_1 contains 7.26, S_2 has 7.21, S_3 has 7.24, S_4 has 7.27 and S_5 has 7.22. Highest P^H was observed during summer season in S_5 samples (Fig 1). During summer season on an average fluoride content of S_1 contains 0.2, S_2 has 0.1, S_3 has 0.1, S_4 has 0.2 and S_5 has 0.1. During rainy season S_1 contains 0.2, S_2 has 0.1, S_3 has 0.1, S4 has 0.2 and S_5 has 0.1. During winter season S_1 contains 0.2, S_2 has 0.1, S3 has 0.1, S_4 has 0.2 and S_5 has 0.1. All the Fluoride content was under the permissible range (Fig 2). During summer season on an average total dissolved salts of S_1 contains 251.5, S_2 has 378.5, S_3 has 147.1, S_4 has 564.1 and S_5 has 647.3. During rainy season S_1 contains 324.5, S_2 has 378.4, S_3 has 147.2, S_4 has 564.0 and S_5 has 647.4. During winter season S_1 contains 324.5, S_2 has 378.4, S_3 has 147.0, S4 has 564.1 and S_5 has 647.4 (Fig 3).

Microbial Analysis of water samples

During summer season on an average TPC of S_1 contains 43.2, S_2 has 48.5,S_3 has 40.2,S_4 has 45.2 and S_5 has 54.5. During rainy season S_1 contains 50,S_2 has 52,S_3 has 41.2,S_4 has 46 and S_5 has 53.5. During winter season S_1 contains 43.2, S_2 has 48.5,S_3 has 40.2,S_4 has 45.2 and S_5 has 54.5. All the values for TPC were above the WHO standards (Fig 4). During summer season on an average MPN of S_1 contains 0.2, S_2 has 5.7, S_3 has 9.7, S4 has 3 and S_5 has 3.5. During rainy season S_1 contains 6, S_2 has 5.5, S_3 has 11.3, S_4 has 2.2 and S_5 has 3.25. During winter season S_1 contains 7.5, S_2 has 3.7, S_3 has 12.7, S_4 has 2.5 and S_5 has 4.25. All the samples were above the WHO standards (Fig 5).

During the study period all the three water samples (i.e. stream, bore and well) showed the presence of the six pathogenic bacteria such as *Escherichia coli, Klebsiella pneumoniae, Salmonella typhi, Shigella dysenteriae, Staphylococcus aureus,* and *Enterobacteriaceace (auogens)* (Table 2)

Seasonal variations

All samples were analyzed monthly to get the seasonal changes of the above said microbial groups for their bacteriogical quality. These investigations were carried out for a period of 12 months (one year i.e, April 2013 to March 2014). The pattern of seasonal distribution can be considered by water works officials in designing an effective disinfection schedule. The highest numbers during these seasons may be due to flooded rainy water, runoff from rural animal husbandry and agricultural grounds and open air defecation along the margins of canal by rural people. Based on these results it is suggested that the water released by the pump houses during these seasons may not be used for direct supply to the drinking water works for storage. Bahador et al., (2005)[2] also investigated that population of faecal coliforms in the monsoon was maximum followed by winter and summer. In the same way the microbial populations in this study was found very high during the August and September i.e, end of monsoon and start of post monsoon. Present investigations revealed that open water is not safe for drinking purpose in any season as it was found to contain a variety of bacteria including the coliforms in high loads. Microbial populations found were variable from location to location and peak values were during monsoon and post monsoon seasons. It might be due to percolation of water from sanitary land filled areas and leachares from septic tanks. The present findings are at the par with the observations of Khannan et al., (2001)[5], who have reported high load of coliform counts for open well water. The open wells are found to be the most sensitive to contamination in the study area. This might be due to previous inner wall of the well. Another reason for contamination of bore well and open well water may be due to seepage of domestic waste water from nearby areas and from the soak pits adjacent to the wells. The fact that open wells, which were exposed to environment and are on the upper strata, are expected to have higher microbial contamination than bore wells,

CONCLUSION

Water is the elixir of life and abounds on earth, but this natural resource has been depleted and turned into scarce commodity because of increased usage catering to the needs of ever-expanding population. Water of good drinking quality is of basic importance to human physiology and man's continued existence depends very much on its availability. The provision of a safe water supply is high priority issue for safe guarding the health and well being of humans. According to the reports of WHO and USEPA water from most of the taps, boreholes, streams and rivers which are in use are not safe for drinking due to heavy industrial and environmental pollution. Toxic chemicals, heavy metals and bacteria in water make people sick when exposing them to long term health condition. The microbial level render they unfit for

human consumption though they can be used for other purposes. Water should meet different quality specification depending on the particular uses. Another way through which bacteria can enter the water supply is through inundation or infiltration by flood waters or by surface runoff. Flood water commonly contains high level of bacteria. Small depressions filled with flood water provide excellent breeding ground for bacteria (Ley and Samanth, 2003)[6].Portable and domestic water should be harmless for the health of man and other domestic uses (Rajini et al., 2010[13]; Okonko et al., 2008[10]). The present study revealed the most of the water samples have failed to meet bacteriological quality parameters. Bacterial contamination was observed in monsoon season (Higher densities of indicator organisms during monsoon season were observed due to seepage of rain water contaminated with sewage leakage through the pipes of the water supply) and during sudden cyclones (in the month November and December 2013). The sewage disposal practices like soak pit system and septic tank near the bore wells are also contributing to increase in the bacterial contamination. The factors responsible for high microbial counts in the water samples may be due to technically ill planned sewerage network, damage sewer lines, rust water pipe lines and poorly maintained disinfection system.

Table 1
Source of Sample collection

Sample Code	Collection of sample points	Remarks
S1	Library pump house	This pump house has 3 bores and a municipality connection and a library septic tank is constructed nearer to the pump house.
S2	Main pump house	This pump house has Municipality and 6 bores connection where dispensary is located nearer to the bores.
S3	Maharanipeta girls hostel pump house	This pump house has only municipality connection and no bores where girls hostel septic tank is present and the pump house tank is not covered.
S4	AU Engg. girls hostel pump house	No municipality, and only bores connection is available where mass contamination is observed and hygiene conditions are not observed nearer the bores.
S5	AU Engg. boys hostel pump house	No municipality, and only bores connection is available where mass contamination is observed and hygiene conditions are not observed nearer the bores.

Table 2
Morphological & cultural characteristics of isolates

Morphological & cultural characteristics	**Organism**	**Disease caused by the organism**
Gram negative bacillus, forms green metallic sheen colonies observed on EMB agar	Escherichia coli	Causative agent for diarrhea, gastro interitis urinary tract inful & neonatal meningitis
Gram negative bacillus on MAC plates growth with lactose & glucose fermentation	Enterobacteriaceace (auogens)	Causes, GIT & UTI & specially cystits and meningitis (in adults)
Gram positive, non-sporing, non- motile bacteria. Shows yellow coloured colonies on mannitol salt agar	Staphylococcus (aureus)	S.aureus ranges from skin, soft tissue, respiratory, bone, joint endovascular to wound infection.
Gram negative non fermentative shows dark pink coloured colonies on macconkey agar	Klebsiella	Responsible for pneumo… urinary & upper respiratory tract infection
Gram negative non fermentative bacillus bacteria shows green colonies and SS agar	Salmonella	Causes typhoid
Gram negative non motile, non fermentative bacillus bacteria and shows colourer colonies an SS agar	Shigella	Causes shigellosis, diarrhea, fever, seetal, bleeding, seizure, encephalotathy

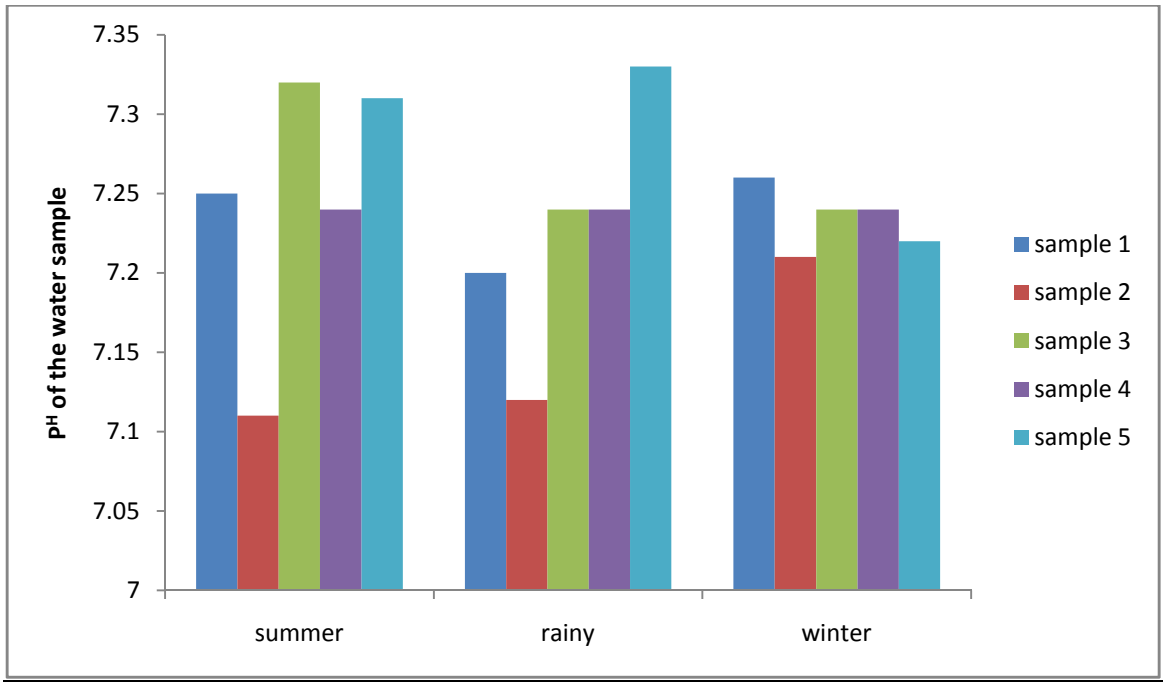

Figure 1
P^H of the water samples

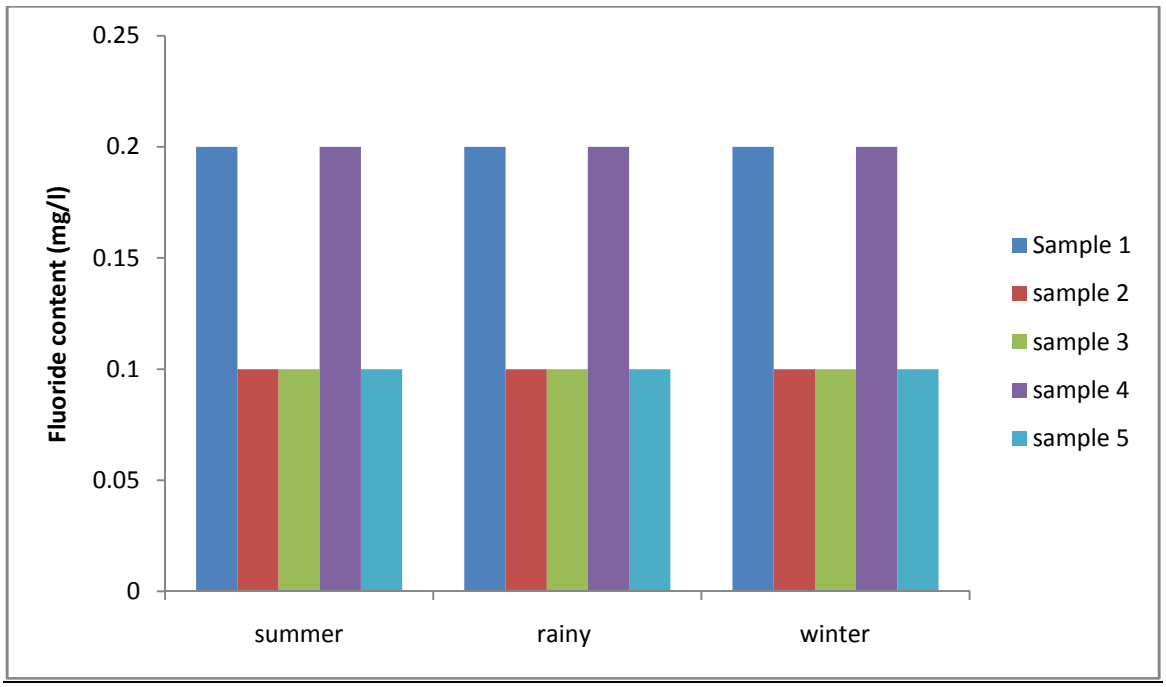

Figure 2
fluoride content (mg/l) of the water samples

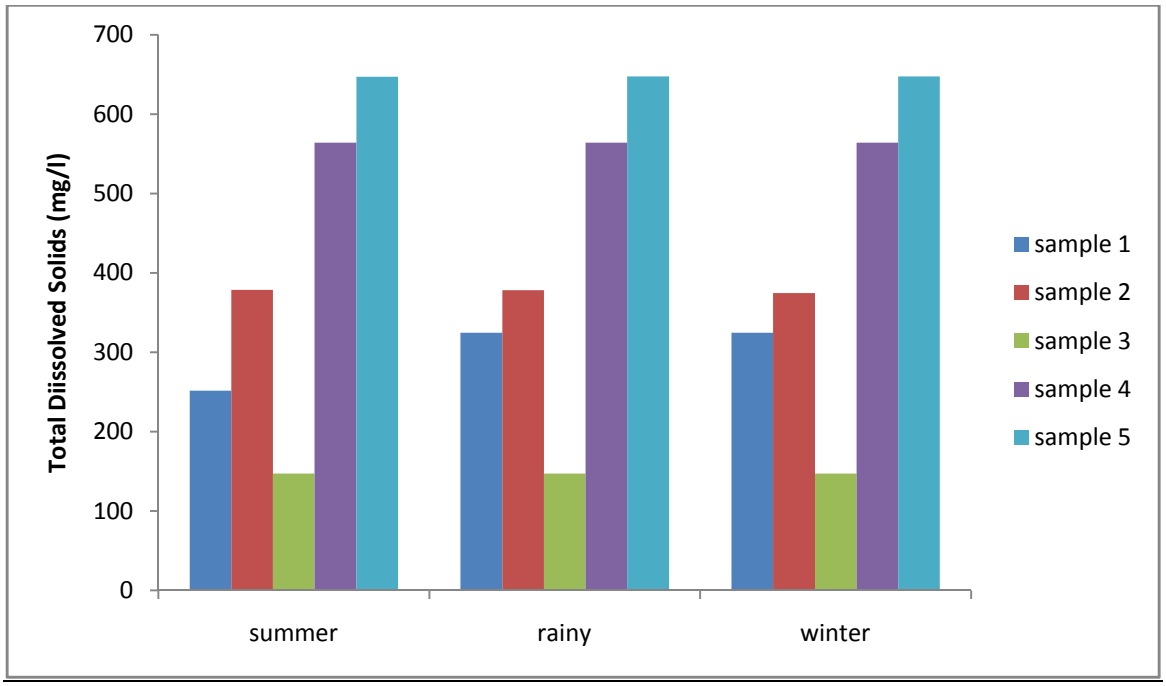

Figure 3
Total dissolved salts (mg/l) of the water samples

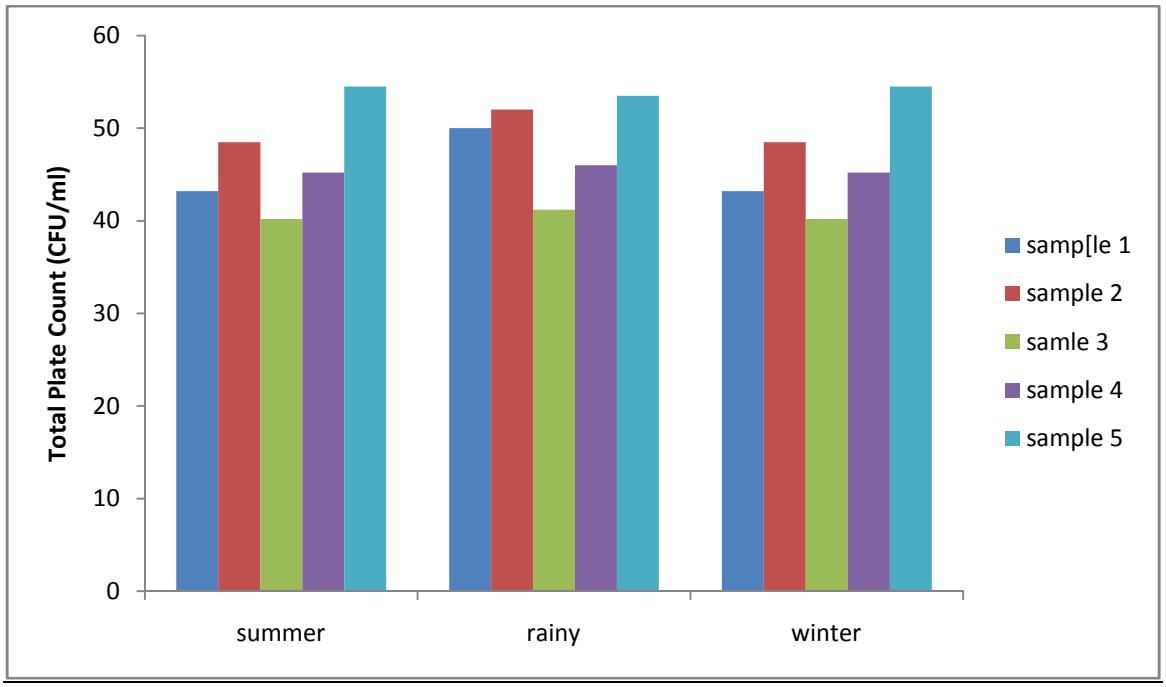

Figure 4
Total plate count (cfu's/ml) of the water samples

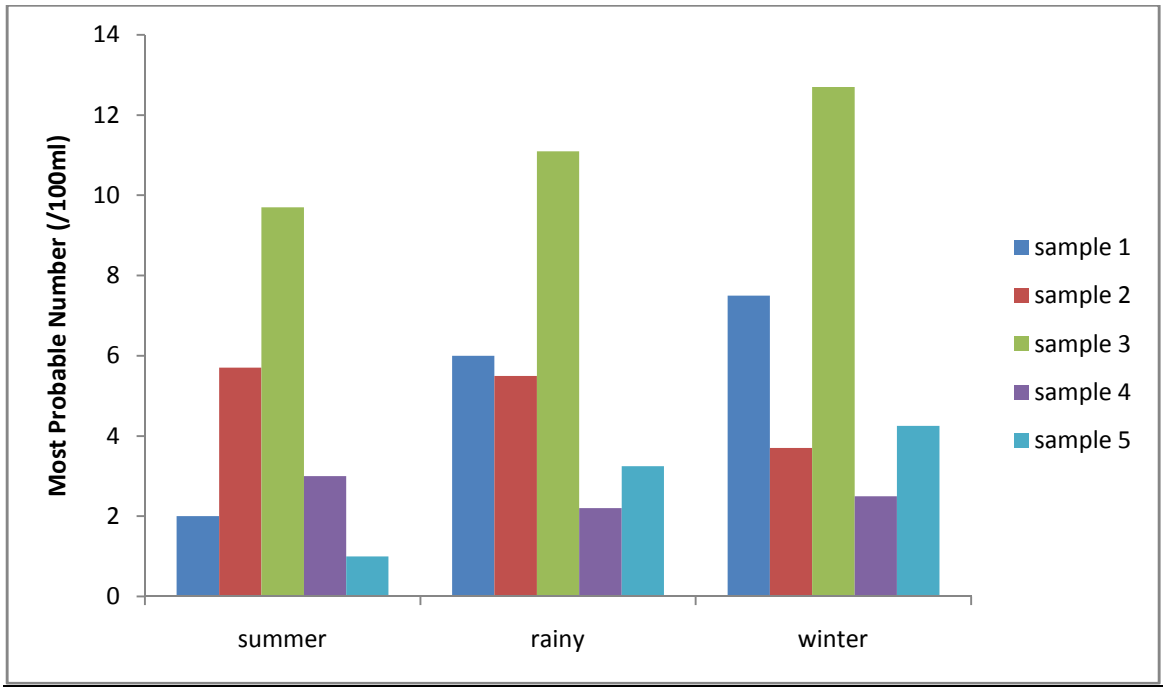

Figure 5
Most Probable Number (/100ml) of the water samples

As we are in sophisticated cyber age it is necessary to educate public on appropriate water distribution system and water handling storage treatment methods. It is evident that until these recommendations are implemented water supplied to the communities in Andhra University health hazard to the population. Thus the study reveals the water from pump houses are not safe for human consumption. In order to meet the potability of water it is recommended that continuous, effective treatment combined with constant monitoring is essential to ensure that it meets the standards of drinking water. The water sources used for drinking should be monitored from time to time for reducing disease epidemics. Hence water from the pump houses should be checked for purity before used for drinking or utility purposes in Andhra University. So, it is recommended that as a mitigation measure against endemic water pathogenic indicators causing diseases should be used to reduce the level of contamination in water from five different pump houses in Andhra University Visakhapatnam.

REFERENCES

1. Kumar A, Rawat S, Srivastava M and Bhusan V. Physico-chemical analysis and isolation of bacteria from water samples of Maharana pratap sagar, Kangra district of Himachal Pradesh. Journal of Applied sciences in Enviromental sanitation. 2012; 7(3): 161-166.
2. Bahador, Baseri Salehi N, M.patil DN and Kapadnis BP. Seasonal variations of Microbial pollution in surface waters of Pune city. Nat. Environ.Poll. Technol., 2005; 4(1): 53-56.
3. Bharti N. and Katyal D. Water quality indices used for surface water vulnerability assessment, Inter. j. Envir. Sci., 2011; 2(1), 154.
4. Holt J.G., Srieg, N.R., Senath, P.H.A. Staley, J.T. and Willams, S.T. (**1994**); Bergey's Manual of Determinatiive Bacteriology 9th Ed. Baltimore Md. Williiams and Willkins
5. Khannan P, Sridhar SR, Sarvanan R, Rajasekhara Pandian M. Isolation of Vibrio sp. And a few coliforms from portable water of Rasipuram and Tiruchengodu taluks, Tamilnadu. EEcotoxicol. Environ. Monit. 2011; (11)1 : 43-46.
6. Ley V and Samant J. Bacteriological analysis of drinking water of Kolhapur City, Maharastra, India. Department of Enviromental Sciences, SubCentre, Mumbai University, Mirjole, M.I.D.C. Ratnagiri **2003**; 415 639, India, 24: 689-694.
7. Muhammad AZ, Rehman K, Fozia A, and Rizwana L. Microbiological and chemical Aspects of Drinking water and Treatment Enhancement Enhanced its Quality. Pak. J.Res(Sci).2005; 16(1): 11-18.
8. Nwadaiaro CS (**1982**). Preliminary survey of Drinking water Quality of some area in Imo and

Rivers states in proceedings of 3rd, National Conference on Water pollution, Port Harcourt, Nigrria.pp. 40-49.

9. Okrodudu-Fubara T Margeret **1998**. Water Resources protection chapter 6. Law of Environmental Protection 584-728; ISBN 9783165399 Caltop Publications(Nig)Ltd, p.988.
10. Okonko,IO; Adejoje, OD; Ogunnusi, TA; Fajobi, E; Shittu, O.B. "Microbiological and physicochemical analysis of different water samples used for domestic purposes in Abeokuta and Ojota, Lagos Nigeria. African Jounal of Biolechnology, 2008;7(5) 617-6721.
11. Oluyege Jacob Olaoluwa, Oluyege Adekemi Olubukola, Dada Oluwaseun Deborah, Ogunbanjo Oluwanike, Ilesanmi Oluwatoyin and Aregbesola Oladipo **2010**. Incidence of drug resistant bacteria and physicochemical properties of Ero Dam, Nigeria. Available from http://www.sciencepub.net/report.
12. Pelczar M, Michael M, Reud J **1999**. Microbiology of Domestic Water and Wastewater. General Microbiology. McGrawHill Books Company, New York, USA
13. Rajini K; Roland P; John C; Vincent R. Microbiological and physicochemical analysis of drinking water in George town. Nature and Science, 2010;8 (8)261-265. 59
14. Sandhya Deepika D, and Laxmi sowmya K. Physico-chemical analysis, isolation and identification of pathogenic bacteria from potable water in Kothuru Panchayath. Visakhapatnam, Andhra Pradesh. Int J Curr Sci 2013; E: 111-119.
15. Sandhya Deepika D, Laxmi Sowmya K, Ratna Kumar PK and Ashok P. Physicochemical and Bacteriological status of drinking water in Pedabida, agency area, Andhra Pradesh. International journal of current research 2014; 6(03);564-565.
16. Sapkota, Rajendra, Dasgupta, Rubin and Malik, Abhishek. "Microbiological quality of potable water in Dehradun city." IJRP 2012; 3(6): 130-137.
17. Saleem S, kamili AN, Kakru DK, Bandh SA and Ganai BA. Isolation, Identification and seasonal distribution of bacterial in Dal lake, Kashmir. Ind. J. Environ Sci 2011; 2(1) 185-193.
18. Sherman Cappuccino 2009; Biochemical activities of microorganisms. Microbiology a Laboratory Manual 7th Ed. 143-203.
19. Tebutt THY. *Principles of Quality Control*. England: Pergamon, 1983**;** p.232.