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A STUDY OF BACTERIOLOGICAL CONTAMINATION OF DRINKING WATER IN ALIGARH CITY U.P INDIA

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ABSTRACT

The paper highlights bacteriological contamination of drinking water in Aligarh city. The main water supply of Aligarh city is groundwater, as there is no surface water supply nearby. The groundwater is being used to meet all the requirements of the domestic as well as industrial water supply. To investigate the possible contamination of ground water by the percolation of wastewater, water samples from hand pumps near by major drains and lagoons were analysed using standard methods. All the samples were compared with the previous studies and standard desirable limit in drinking water. The results from the analysis show the presence of E.Coli and found above the permissible limit by several times in drinking water. Results pin points the source of contamination and it also presents several remedial measures to counteract the contamination in groundwater.
Key Words: Drinking water, E. Coli, Drains and Lagoons.

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1.0 INTRODUCTION

Water is the most precious natural resource available in the universe and that life without water is impossible. The demand for good quality drinking water has increased with the increasing development in the human community. At the beginning of civilization non turbidity and free flow were the only parameters of concern but with the growth of population there has been an increase in global attention focused on resolving water quality issue (Chakrabatarty et al.2010).
Groundwater has historically been considered as reliable and safe source of water protected from surface contamination by geological filters that remove pollutants from water as it is percolate through the soil (Prasad et al. 1997). Pollution of fresh water occurs due to three major reasons which are excess nutrients from sewage, wastes from industries (Jamode et al. 2004) mining and agriculture. Groundwater is threatened with pollution from the sources of domestic wastes, industrial wastes,

runoff from urban areas, suspended and dissolved soils, organics and pathogens other potential sources of groundwater contamination are wastewater treatment lagoons, mine spills, urban and rural garbage's, earthen septic tanks, refuse dumps, barnyard manures etc. Industrial process employs variety of chemicals depending upon the nature of raw material and products. Environmental problems by these industries are mainly caused by the discharge of effluents (Rathore et al 2009). The problem of drinking water contamination, water conservation and water quality management has assumed a very complex shape (Bodhaditya et al 2008). Attention on water contamination and its management has become a need of the hour because of its far reaching impact on human health (Sinha et al. 1995).

Bacteria originate from faecal matter and pollute streams and groundwater. Most bacteria are only 1 micrometer in diameter, but some bacteria range in size from 0.1 to 10 micrometers. Bacteria of the coliform group are considered the primary indicators of fecal contamination and are often used to assess water quality. Coliform is used to describe a group of Gram-negative, facultative, anaerobic, rod-shaped, non-spore-forming bacteria, capable of growing in bile salts and other surface active agents and able to ferment lactose to produce acid and gas within 48 hours at 35'C. Coliform bacteria, having the same properties at 44'C, are referred to as thermo-tolerant coliforms or E. coli (Escherichia coli).This is nothing but faecal coliform bacteria, found in the intestines of warm-blooded animals, including humans. Coliform bacteria generated from the waste of warm-blooded animals, may get into the river or groundwater through surface runoff, especially after a heavy rainfall. Water contaminated with faecal matter can seep into bigger bodies of water, which may ultimately affect drinking water. A spring, hand-dug well, buried well, cistern, etc. are all very likely to be contaminated with coliform bacteria. Thus, contamination of water sources by the spread of such bacteria is the leading cause of water quality impairment in rivers. These bacteria may cause a serious health threat to humans, causing diseases like typhoid fever, hepatitis, gastroenteritis, dysentery, etc. Even a very small percentage of faecal coliform bacteria may cause intestinal distress and in more severe cases nausea, vomiting and even death. It is often difficult to detect specific disease-causing organisms in water that we drink everyday. Therefore, indicator organisms are detected in drinking water, which are of faecal origin. Smoke is an indicator of fire. Similarly, bacteria of faecal origin (coliforms / E. coli) are indicators of pollution from faecal sources, thereby warning that there may be more dangerous organisms like Cholerae, Salmonella, Hepatitis virus etc, present in water.

A new study has found that people who contract gastroenteritis from drinking water contaminated with E. coli are at an increased risk of developing high blood pressure, kidney problems and heart disease in later life. The findings underline the importance of ensuring a safe food and water supply and the need for regular monitoring for those affected.

2.0 STUDY AREA

Aligarh is known mainly for its seat of learning-the Aligarh Muslim University (AMU). The city, spread over an area of 34 square kilometres, is also an important centre of lock smithy. The town has a population of more than half a million, according to the 2001 census. On account of its being an important centre of lock smithy, and other allied industrial functions like electroplating, casting, the town is besieged with rural migration. However, the town's infrastructure is such that it is unable to take on the extra load thereby resulting in a major breakdown of sanitary conditions.

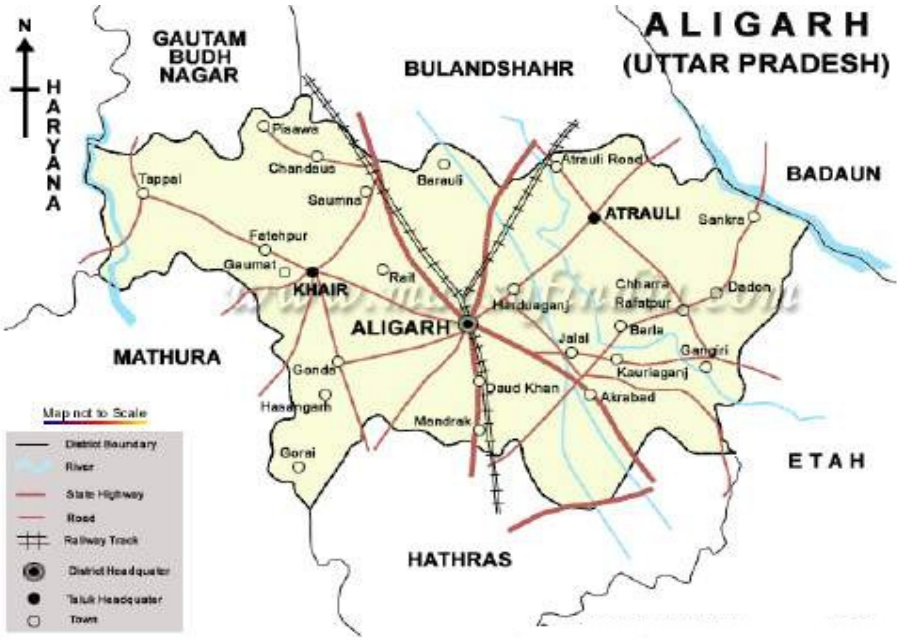

Fig 1. Map of Aligarh

2.1 WATER SUPPLY

Ground water is the main source of water supply in Aligarh city and there is no surface water supply. The water supply is being met by means of tube wells. According to the city standards the requirement of per capita water is 250 litres opposite to which 72 litres per capita is being supplied. At present the city has two 15800 kilolitre capacity overhead water tanks and three 2780 kilolitre CWR. There are total of 45 tube wells which supply around 43 MLD for domestic water supply in addition to this there are 34300 residential connections and 800 non residential connection meant for water supply (Master Plan 2001-2021).

2.2 RESERVOIRS/PONDS/LAGOONS:

All the natural water reservoirs, ponds and lagoons have been identified as Achal Taal, Lal Taal and Laal Diggi as natural water bodies and developing as recreational areas (Master Plan 2001-2021).

2.3 SEWAGE FARM:

25% of the city area has been connected by sewers.. Rest of the water is disposed by means of open drains. There is no sewage treatment plant in the city and all the sewage is being pumped by pumping stations to the sewage farm situated on Mathura road (Master Plan 2001-2021).

2.4 DRAINAGE:

At present sewage pumping stations have been established at Mathura road and Charra bus stand. Mathura station have one pump of 120 Hp, two pumps of 110Hp and one pump of 50 Hp, which pumps most of the sewage coming from the city to the sewage farm for irrigation purpose. Charra bus stand pump station have two 40 Hp and two 20Hp pumps which pumps the sewage coming from civil lines and its neighbouring areas to the drains which goes to the sewage farm situated on Mathura road.

Excluding the above Sarai Rehman situated between G.T. road and Gular road direct pumping is taking place from the drains itself for discharging of the sewage. Gular road pumping station consist of 50 Hp and 40 Hp each capacity pumps which pumps

the sewage coming from Ashok Nagar and its neighbouring areas. In the same manner G.T. Road pumping station consist of three 30 Hp and two 15 Hp pumps which pumps the sewage coming from a portion of civil lines, areas of Laal diggi, Malkhan Singh state hospital and areas of Nai Basti to the open drain of Soot mill which ultimately goes to sewage farm located on Mathura road. From the above it is clear that the sewage pumping station located on Mathura road handles the most of the sewage of Aligarh for its ultimate disposal (Master Plan 2001-2021).

A study was carried out in year 2001 nearly a decade ago in different wards of the city to know the ground water contamination by E. coli (Tarique, M 2001). The maximum concentration of E. coli was 116MPN/100ml in ward no 6 for municipal water supply and 62 MPN/100ml in ward number 59 for hand pumps. The study was concluded that the drinking water of Aligarh city was bacteriological contaminated. Out of total samples analysed 67% of hand pump and 70 % of municipal supply were contaminated above the permissible limit, thus it can be said that the water quality of the city was very poor as far as bacteriological quality is concerned. Besides this there are few areas where drinking water quality is good and free from bacteriological contamination (Tarique, M 2001).

3.0 SAMPLING LOCATION, COLLECTION AND DESCRIPTION

Separate drinking water samples from the hand pumps existing near by major lagoons and drains were taken in clean and sterile 1-1 polythene cans rinsed with dilute HCl to set a representative sample and stored in an ice box. The samples were protected from direct sunlight during transportation to the laboratory and the test was conducted immediately. The instrument was used in the limit of précised accuracy and chemicals used were of analytical grade. Double distilled water was used for all the purposes.

3.1 Bacteriological Examination:

Standard Plate Count Test: - Broths and dilution water were sterilized in autoclave at 121ºC for 15 minutes and pipettes in metal containers in sterilizer oven at 170ºC for 2 hrs. The samples were shake about 25 times. Required portion was withdrawn with a sterile pipette, and introduced into petri dish. In preparing plates, such amount of water was planted for dilution which gives from 30-300 colonies per plate. For most water samples, plates suitable for counting was obtained by plating 1ml and 0.1 ml undiluted sample and 1ml of the 0.01 dilution. Two or more plates were used for each sample. 1 ml or 1ml of other suitable dilutions was used for platting in the petri dish. Then 10-15 ml of melted nutrient agar medium at a temperature of 43 – 45ºC (tolerable to skin) was added to the Petri dish. The agar and the sample were thoroughly mixed over bottom of the Petri dish by tilting and rotating the dish several times. The plates were allowed to solidify and were placed immediately in the incubator in an inverted position. Plates were incubated at 37ºC for 48 hrs. Autoclave Type RT-110 Pb, Manufacture S.M. instruments (P) Ltd. Incubator Cl- 12S Manufactured by REMI instruments and MAC Horizontal Laminar Flow Bench CAT No.: MSW-1611 was used in the present study.

3.2 SAMPLING LOCATIONS

S.No	Location Name	Location designated
1.	CHAUTAAL	(A)
2.	LOCO COLONY	(B)
3.	JAMALPUR CULVERT	(C)
4.	DHORRA CULVERT	(D)
5.	KAALIDEH	(E)
6.	ETAH CHUNGI PUPMING STATION	(F)
7.	ETAH CHUNGI LAGOON	(G)
8.	CHANDANIYA GANDHI EYE HOSPITAL	(H)
9.	MATHURA PUMPING STATION	(I)
10	GULAR ROAD PUMPING STATION	(J)
11	SHAHJAMAL	(K)
12	GULAR ROAD	(L)

4.0 RESULTS AND DISCUSSION

Almost all the water samples from hand pumps around the vicinity of major lagoons and drains meet above the current standard for E. coli count, the E. coli count in 100 ml of any water sample should be zero according to bacteriological Indian standards (BIS 10500:1991). The results of the study depicted a very highly deteriorated quality of groundwater used for drinking purpose around these areas.

The Fig. 4.1 covers Chautaal Inlet (A), Loco colony (B), Jamalpur culvert (C) and Dhorra culvert (D). All of these locations lies in the civil line residential area of the city and receives mainly domestic wastewater as it is a residential area.

The study finds out tht the groundwater contamination was higher owing to lagoons then from the drain. The highest E. coli count was reported from Chautaal lagoon which was 200/ml and least from Dhorra culvert 105/ml. The contamination at Loco colony was lesser then Chautaal possibly due to population density is lesser at Loco colony then around Chautaal, Loco colony was located on opposite side of coal unloading railway depot so the resulting coal dust was possibly performing adsorption.

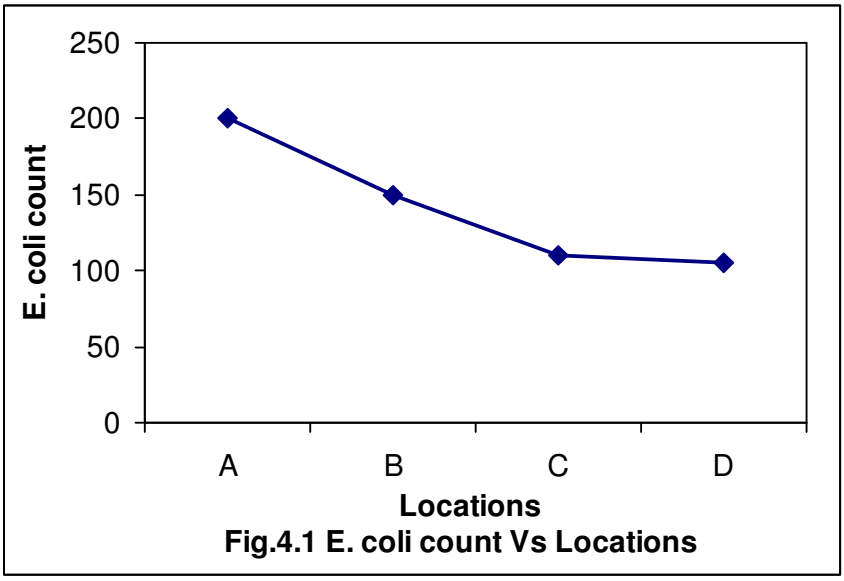

Fig.4.1 E. coli count Vs Locations

The Fig. 4.2 covers the civil line area Chandaniya (H) as well as city area i.e. Kaalideh (E), Etah chungi pumping station (F) and Etah chungi final lagoon (G). The highest E coli count 270/ml was found around Kaalideh i.e. 270/ml E.Coli. concentration and least around Etah chungi final lagoon i.e. 120/ml E.Coli. concentration.

The Kaalideh and Chandaniya have a higher contamination rate because the water remains stagnant in the lagoons and there was no drainage system to carry out the water from them. This results in higher percolation as compared to Etah chungi pumping station and Etah chungi final lagoon. The water from Etah chungi pumpnig station was pumped regularly on daily basis to Etah chungi final drain. This prevents the stagnantation of water, thus resulting in lessere percolation and contamination of groundwater.

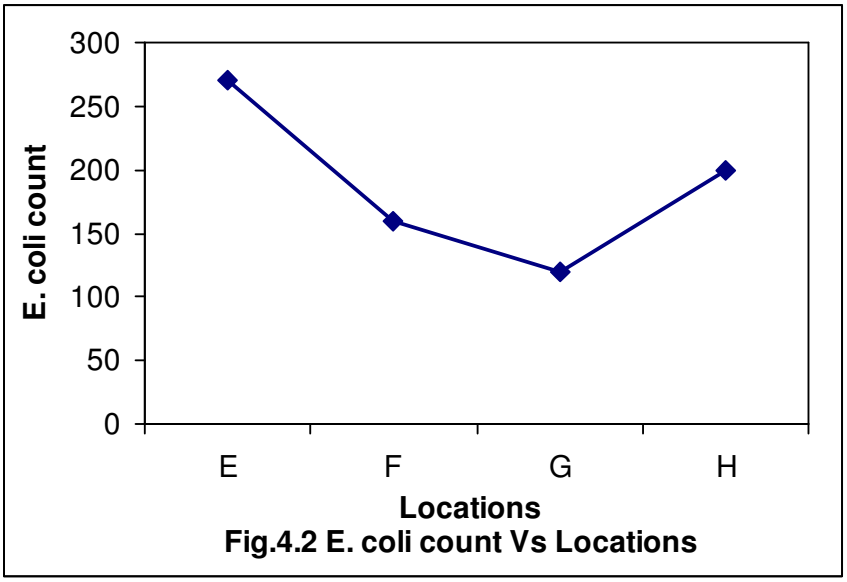

Fig.4.2 E. coli count Vs Locations

The Fig. 3.3 covers Mathura pumping station (I), Gular road pumping station (J), Shahjamal (K) and Gular road lagoon (L). the highest contamination was found from Shahjamal area i.e. 510/ml E.Coli. concentration and least at Gular road lagoon area i.e. 180/ml E.Coli. concentration.

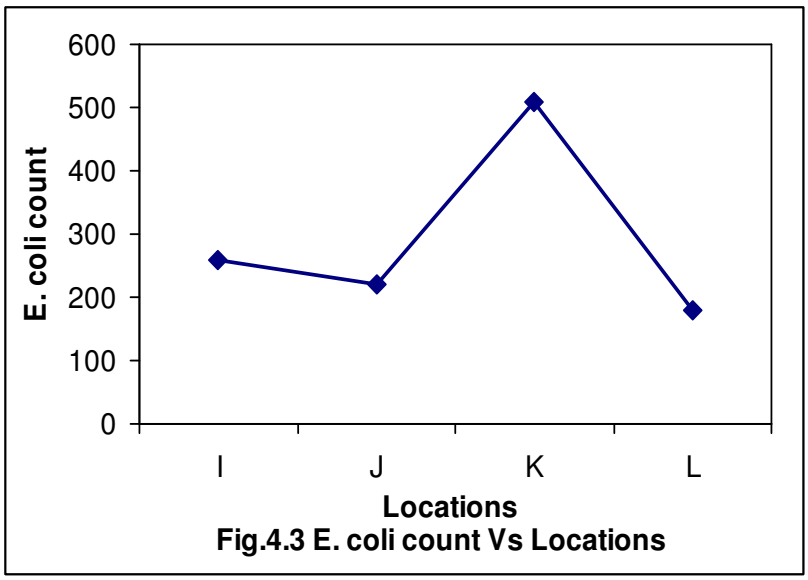

Fig.4.3 E. coli count Vs Locations

The Shahjamal area has such a high concentration because of poor draingae system. There was no natural draingae system the wastewater has to be pumped from location to location to drain out the wastewater. The constant stagnantation of wastewater over a long time has resulted in such a high contamination of groundwater in Shahjamal area.

CONCLUSION

It is very clear from the present study that the drinking water from hand pumps existing near by the drains and lagoons are highly contaminated. The minimum value of E. coli count was found 105 /ml, while E. coli count in 100 ml of any water sample should be zero according to bacteriological Indian standards (BIS 10500:1991). The drinking water in Shahjamal area in the city was found highly contaminated the E. coli count was found 510 / ml due to poor drainage system and constant stagnation of wastewater over long time. Further the analysis indicates over a period of 10 years the concentration of E. coli count was increased 100 times. The major source of contamination is due to percolation and seepage of wastewater from earthen lagoons and drains.

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