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Water Quality Assessment of Major & Minor Food Establishments of Patiala

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ABSTRACT: Safe and hygienic water is a key to increase human productivity and long life. In India and other countries, water has never been as unsafe as it is today. The inadequate water supply and poor sanitation services led to contamination of water supply through the input of sewage water effluents into ground water. If we leave some areas of municipal water supply, the others sources have been reported to have coliform count. In continuation of these observations, a study was conducted in Patiala on water quality by taking water samples from five eating establishments i.e. EE-1 (Jaggi Sweets), EE-2 (Gopal Sweets), EE-3 (Canteen of Thapar University campus), EE-4 (Dhaba at Adarsh Nagar), EE-5(Dhaba near Thapar University). Water samples collected at monthly intervals were analyzed for physico-chemical and bacteriological analysis. It was observed that water provided at EE-1 and EE-2 was superior in quality. EE-3 was of moderate quality. Rest parameters were in range except coliform count (4-5). Municipal surface water and ground water provided to customers at EE-4 and EE-5 were objectionable from dissolved solids and coliform levels point of view suggesting some essential treatment steps prior to serving.

I. INTRODUCTION

Water is vital natural resource, essential for many purposes like drinking, cooking and other domestic uses, industrial cooling, power generation, agriculture, transportation and waste disposal. The key to increase human productivity and long life is good quality water [1]. The provision of good quality drinking water is regarded as an important means of improving health [2].

The groundwater in contrast to surface water occur recharge from excess irrigation, seepage from canals, leakages from reservoirs etc. It is slowly moving in the lateral direction to some point of escape. Groundwater is generally treated pure than surface water. But water that looks colorless, odorless and tasteless may not be safe for consumption. It may contain some natural impurities or contaminants like magnesium, calcium, chloride, nitrate, arsenic, etc. Its quality also depends on depth of water table, quality of new water entering into it and chances of being polluted by municipal, industrial or agricultural wastes, etc.

Rural India has about 1.42 million habitats in which more than 700 million people reside and these are spread over 15 diverse ecological regions. Despite an estimated total of Rs. 1,105 billion spent on providing safe drinking water since the First Five Year Plan was launched in 1951, lack of safe and secure drinking water continues to be a major hurdle and a national economic burden. Around 37.7 million Indians are affected by waterborne diseases annually; 1.5 million children are estimated to die of diarrhea alone and 73 million working days are lost due to waterborne disease each year. The resulting economic burden is estimated at $600 million a year [3].

While traditional diseases such as diarrhea continue to take a heavy toll, 66 million Indians are at risk due to excess fluoride and 10 million due to excess arsenic in groundwater. In all, 195,813 habitations in the country are affected by poor water quality. It is clear that the large investments have not yielded comparable improvements in health and other socioeconomic indicators. Mohapatra *et al.* (2009) indicated that Fluoride in drinking water has a profound effect on teeth and bones. Lower range leads to dental fluorosis and higher range leads to skeletal fluorosis [4].

Drinking water quality standards describes the quality parameters set for drinking water. Many developed countries specify standards to be applied in their own country.

In Europe, this includes the European Drinking Water Directive and in the USA the United States Environmental Protection Agency (EPA) establishes standards as required by the Safe Drinking Water Act. For countries without a legislative or administrative framework for such standards, the World Health Organization (WHO) publishes guidelines on the standards that should be achieved. Food and Drug Administration (FDA) regulations establish limits for contaminants in bottled water that must provide the same protection for public health.

Generally, water quality is determined by the characteristics contributing to water such as pH, turbidity, hardness, total suspended and dissolved solids, micro-organisms as fecal coliform (MPN), chlorides, fluorides etc; water quality criteria is decided by keeping the purpose of use whereas water quality standards are established by keeping what could be achieved.

The overall flow of ground water in Patiala is from northeast to south-west direction. The drinking water supply is mainly through groundwater. The shortfall in water supply is met by installing submersible/hand pumps by public individually. The shallow tube-wells tap unconfined aquifer varies from 20 to 70m. Hundreds of eating and drinking establishments varying from minor Dhaba to major units have been set up in the city. Mittal *et al.* (1997) evaluated the groundwater quality in Patiala, Punjab. Higher concentrations of various inorganic ions were observed in the sewage. Leaching of contaminants from the sewers was the only cause of groundwater pollution [5]. The water supplied in Patiala is treated, although a few city dwellers extract the water directly from underground. Very few studies have been performed in this connection yet. Hence an attempt is made to study water quality at the eating and drinking establishments located at different parts of city.

II. MATERIALS AND METHODS

Sampling: A preliminary survey was made in Patiala at different locations. 5 eating establishments were selected out of which 2 were major, 2 were minor and 1 was medium. Water was collected at fortnight intervals from medium and minor establishments but once in a month from major type of establishments (due to technical problems) during the study period from Jan – May 2014.

Table 1: Sources of Eating Establishments and types of water use.

S.NO.	Name	Source of water use
EE-1	Jaggi Sweets, 22 No. phatak	RO treated water
EE-2	Gopal Sweets, Leela bhawan	RO treated water
EE-3	Jaggi Canteen TU campus	RO treated water
EE-4	Dhabha, Adarsh Nagar	Municipal tap water
EE-5	Dhabha near TU campus	Hand pump water

Samples were preserved at 4°C refrigeration prior to the analysis in the laboratory of Thapar University Patiala. Acid rinsed polyethylene (Jerry Cans) containers of 2Ltr capacity were used in sample collection.

Characterization: Samples of tap water, hand pump water and RO treated waters collected were analyzed for various characteristics by using standard methods for examination of water and wastewater, (APHA, 1999).

III. RESULTS AND DISCUSSION

Table 2: Characteristics of Eating Establishments Studied.

S.No	Name	No. of users per day	Major Activities	Source of Water	Type of Treatment	General Observations
1)	EE-1	500	Preparing and serving meals & selling own bakery products & sweets.	Bore well water	RO System (Cxl Titon Purifiers)	Clean food service practices, well maintained RO; Sanitized utensils; Ventilated premises.

S.No	Name	No. of users per day	Major Activities	Source of Water	Type of Treatment	General Observations
2)	EE-2	250	Preparing and serving meals & selling own bakery products & sweets.	Bore well water	RO System (Shakti RO purifiers)	Clean food service practices, well maintained RO; Sanitized utensils; Ventilated premises.
3)	EE-3	350	Preparing and serving meals.	Ground water at TU Campus.	RO system	Moderately good food service practices, outdated RO system.
4)	EE-4	70	Preparing and serving meals	Municipal Tap Water	No Treatment	Unsatisfactory methods of food preparation; Handling & service of food is improper; poor sanitation in premise, kitchen; flies & dust nuisance.
5)	EE-5	150	Preparing and serving meals, sweets etc.	Hand pump Water	No Treatment	Unsatisfactory methods of food preparation; Handling & service of food is improper; poor sanitation in premise, kitchen; flies & dust nuisance.

A. Comparative analysis

pH variation

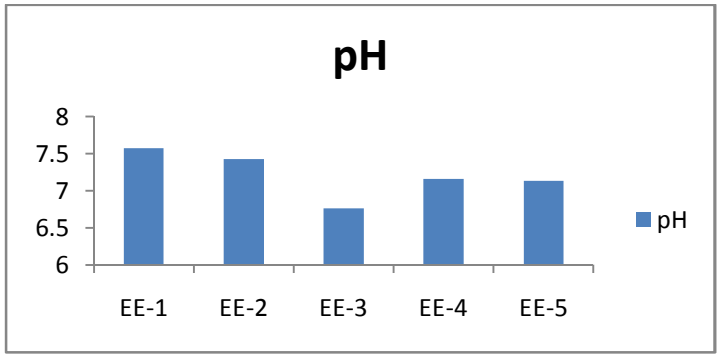

Fig. 1. Variation in pH of water at 5 outlets.

For drinking water, pH should be between 6.5-7.5. pH is considered necessarily in various treatment steps such as disinfection, corrosion control, alum coagulation etc. pH was slightly alkaline for water at EE-1 and EE-2 and neutral at EE-4 & EE-5.

Variation in Alkalinity. Alkalinity measures the neutralizing capacity of an acid. In drinking water bicarbonate, carbonate is common in causing alkalinity. The alkalinity for water at EE-4 accounted for a high value of 350 mg/l of $CaCO_3$.

Variation in Turbidity. Turbidity is the resistance offered by a sample to the passage of light through it. It is contributed by suspended solids and colloidal solids and presence of it is objectionable in filter operation and efficiency of disinfection. The drinking water is permitted to contain turbidity value 0.5-10 NTU. EE-3 was found to be most turbid and EE-5 was least turbid.

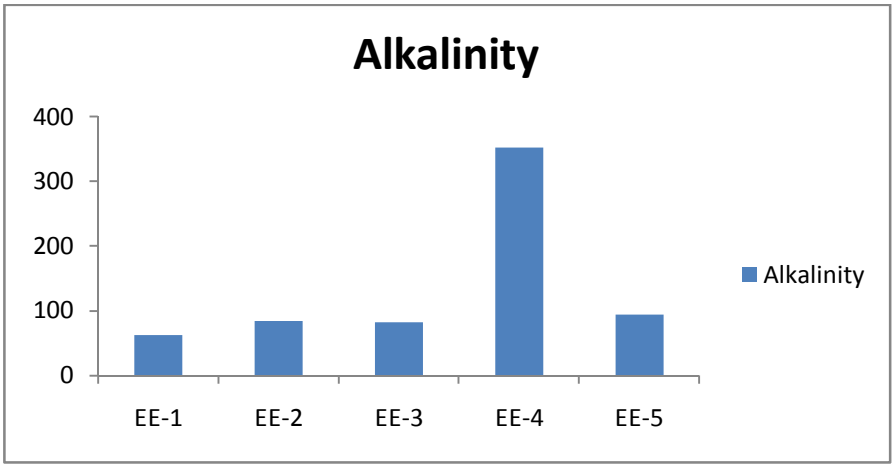

Fig. 2. Variation in Alkalinity of water.

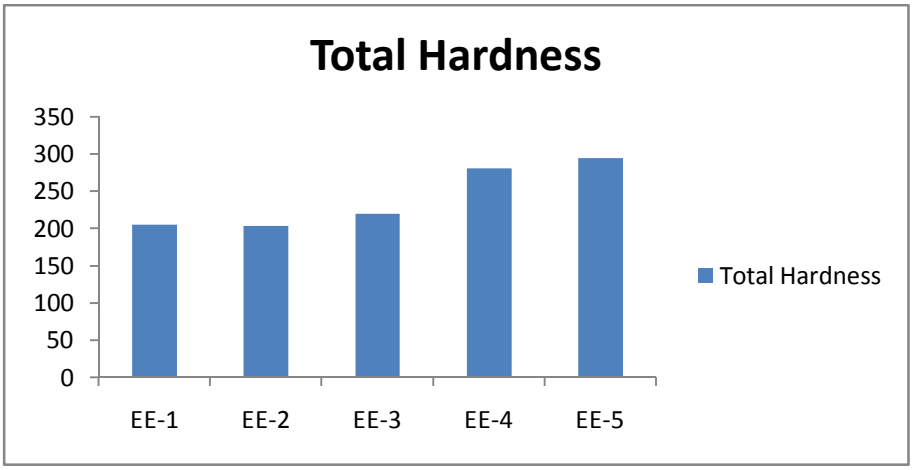

Fig. 3. Variation in Total Hardness of water.

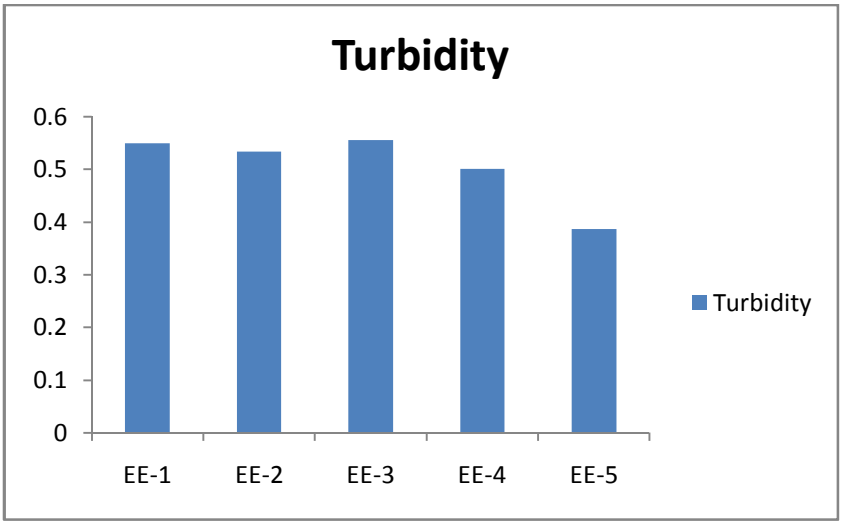

Fig. 4. Variation in Turbidity of water.

Variation in Total Suspended Solids.

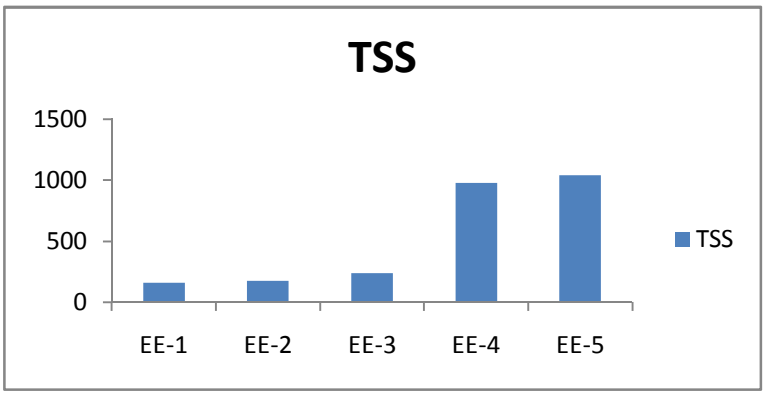

Fig. 5. Variation in TSS of water,

Suspended solids are immiscible and picked up during erosions of rocks. They affect the passage of light and bring sedimentation of water bodies. Clearly TSS proportion was large for EE-4 & EE-5 where as it was small for EE-1 to EE-3.

Variation of Total Dissolved Solids. Dissolved solid enters into water due to solubility action and make water saline. In drinking water, dissolved solids of level 500 mg/l are permitted. TDS was found to be higher for minor eating establishments and higher for major establishments.

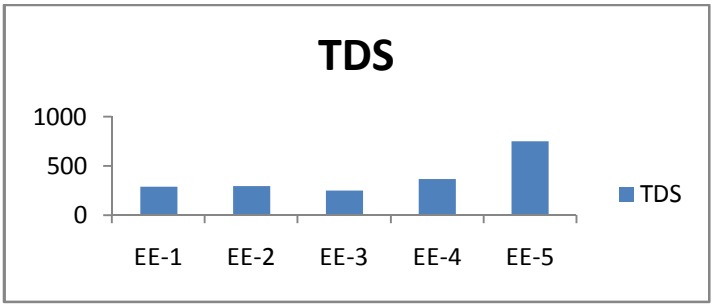

Fig. 6. Variation of TDS in water.

Variation in Chloride level. Chloride is a form of dissolved solids which enters into water through domestic sewage, oceanic water, and excess pumping. The high chlorides for water at EE-3 (80 mg/l) compared to others was noticeable.

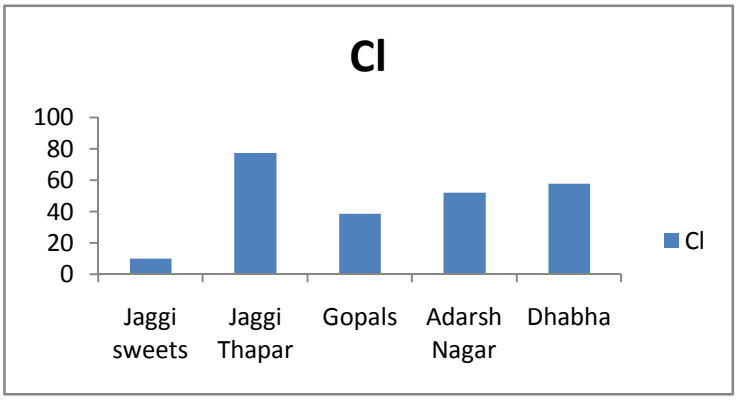

Fig. 7. Variation in Chloride of water.

Variation in Fluoride level. Fluoride, an active anion, is harmful to human beings in causing dental problems, crippling etc. fluorosis is endemic by nature and the severity enhances with time of exposure and type of population. Fluoride value (.88 mg/l) at EE-5 for ground water compared to others was observed.

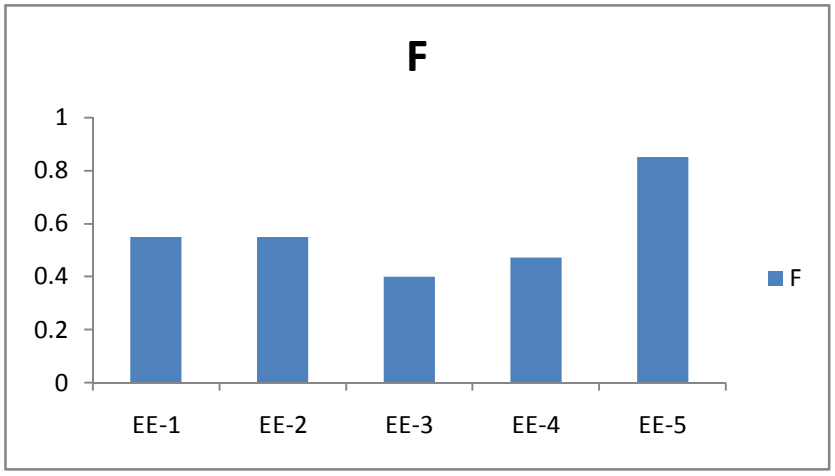

Fig. 8. Variation of Fluoride in water.

Variation in MPN. Coliforms, an indicator of presence of pathogens, are calculated by most probable number (MPN) test in the laboratory. Ideally, MPN count in treated water should be nil. Coliform values at EE-4 & EE-5 (60/100 ml, 110/100 ml) for surface and ground water was alarming observation.

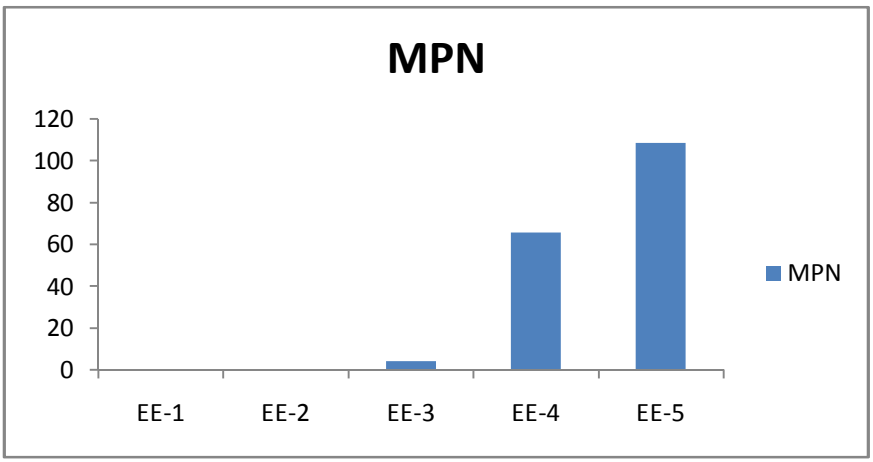

Fig. 9. Variation of MPN in water.

IV. CONCLUSIONS

Many of the parameters analyzed indicated the drinking water of good quality at EE-1 & EE-2. A small MPN count of 8/100 ml along with chlorides and fluorides of 78 mg/l and .41 ppm occurred at EE-3. The situation was worse at EE-4 & EE-5 for essential health related parameters in water. A simple settling followed by chlorination would enhance excess solids removal and destruction of coliform count. The authorities at EE-1 and EE-2 should maintain the water quality standards, better performance of RO purifiers by routine maintenance, timely servicing for customer satisfaction, feasible options for water treatments viz settling, chlorination are to be looked at EE-4 and EE-5.

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