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"PURIFIED" JAR WATER AT ROADSIDE TEA-STALLS IN DHAKA CITY PURE ENOUGH?

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Abstract

Due to high demand of pure water, in densely populated Dhaka city, "Jar" water business by private suppliers has hiked up in recent years. And currently negative reports on the purity of these jar water had been evident in social and print media. Therefore, checking microbial contamination in these jar water used in various road side tea stalls known as "Tongs", was the aim of this study. In this study, a total of 55 jar water samples were collected from 30 tea stalls. Membrane filter was used to extract the bacteria, which were later grown on m-FC agar (for total coliform) and m-FC agar with Rosolic acid (for fecal coliform). A total of 190 bacterial colonies was isolated and from them 19 were E.aerogenes, 30 were Escherichia Coli, 3 were Klebsiella, 28 were Salmonella and 11 were Shigella. The presence of these five bacteria are the clear evidence of contamination in the supplied jar water at road-side tea stalls of Dhaka; indicating robust quality check for water purity is required by the supplier. Awareness amongst the customers and stall owners should be made for the safety of the stake holders from water-borne diseases.

Keywords: Water Purity; Coliform; Bacterial Contents; Tea-Stall; Dhaka.

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1. Introduction

Water is an irreplaceable entity for any living organisms, given that, it is pure. However, scarcity of pure water in Bangladesh, leading to severe waterborne disease as well as death is reported almost every year [1,2]. Dhaka city which is the capital of Bangladesh is one of the densely populated country in the world. In this densely populated city, demand of water is very high. To comply with this problem of increased demand, various firms have been developed in recent years with the promise of giving pure water in jars. And it had been an established business nowadays. Their customer range includes local shops, house, office, restaurants especially roadside tea-stalls known as "Tongs". These tea stalls are often crowded with customers from various socio-economic background, due to availability, open space and less expensive compared to restaurants.

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Almost every local tea stalls use these jar water supplied by various firms and the customers drink them with confirmation that they are safe. These companies have stated that they use ultra-violet (UV) and reverse osmosis (RO) technologies to filter the water. However, there had been few videos and reports on social media showing few illegal filling of these jars with water from ponds, lakes even drain which would eventually lead to the customers [3]. According to a news report published by The Daily Star on March 22, 2014, three illegal jar water factories had been sealed and the owners had been penalized for selling contaminated water in jars [4–7]. There is a huge number of city dwellers who consume these jar water daily, at roadside tea stalls and restaurants, it is necessary to check the purity of these jar water; as safe drinking water is one of the basic human rights and.

Although there have been many works regarding the finding of the microbiological content of water but all of those were done on supply water and a maximum of these was done in rural areas [8–11]. Therefore, based on the complaints and reports in the social and news media, this study was aimed to determine the bacterial contamination level of the jar water in roadside tea stalls due to large customer range compared to restaurants.

2. Materials and Methods

As there is a wide range of bacteria available in nature, the presence of only five types of bacterial species *Escherichia coli (E.coli)*, *Enterobacter aerogenes (E.aerogenes)*, *Klebsiella*, *Salmonella* and *Shigella* have been targeted, as they are the most well-known cause of water-borne diseases; according to the guideline provided by WHO [6,7,12,13].

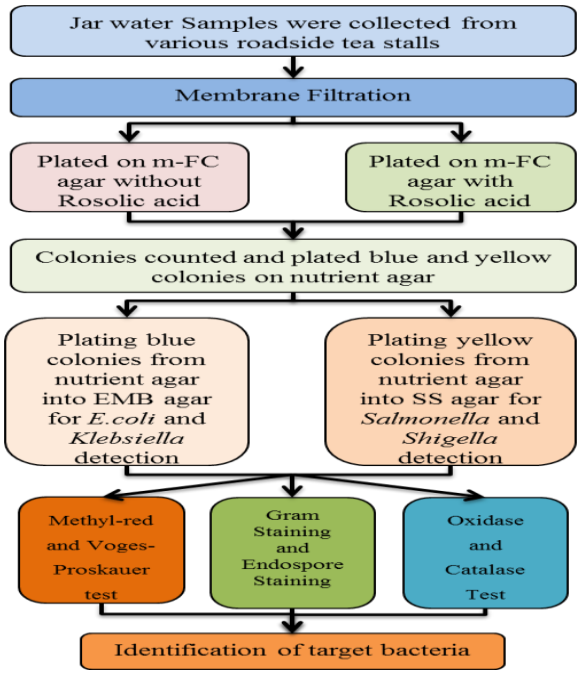

Figure 1: Workflow of the research

Jar water samples were collected from 10 major areas of Dhaka. The areas include Mirpur (Mr), Tejgaon (Tj), Mohakhali (Mk), Banani (Bn), Uttara (Ut), Gulshan (Gl), Bashundahra (Bs),

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Rampura (Rm), Dhanmondi (Dh) and Motijheel (Mj). From each area, samples were collected from 3 different tea-stalls at a distant and two samples were collected from each tea stall. All the samples were collected in autoclaved 250 ml glass bottles; one running through the dispenser machine tap (A) and another one directly from the container (B). After collection these bottles were tightly sealed, put in a zip lock bag and placed in ice, and brought to the laboratory on the same day to be tested. As from 5 teastalls sub-sample type B were uncollectable so that made a total of 55 sub-samples. Sterilized water was used as a control in this study and was subject to the entire test as below. Each sample (100 ml) was drawn twice through two 0.45µm pore nitrocellulose membrane filter using membrane filtration apparatus [14,15]. Of the two nitrocellulose filter paper one was placed on m-FC agar, (Oxoid™) with Rosolic acid (m-FCR), for fecal coliform and another one on m-FC without Rosolic acid (m-FC) for total coliform. They were incubated overnight at 44°C and 37°C respectively [16]. On the next day colonies were counted in the culture plates followed by calculations of the bacterial density of the water samples. To calculate density (CFU per 100 ml) the formula below has been used [14]:

$$\text{CFU} = \frac{\text{Number of colonies on membrane x 100}}{\text{Volume (ml) of undiluted sample filtered}}$$

Identification of Bacteria: From each m-FCR plates of 55 sub-samples, colonies had been isolated for further identification of both coliform and non-coliform bacteria. A total of 190 bacterial colonies has been isolated. Every isolated bacteria was tested with Gram staining, Endospore staining, oxidase test, catalase test, Methyl Red and Voges-Proskauer Test (MRVP) and citrate test and a total of 91 had been identified as the bacteria from the target list *E.coli, E.aerogenous, Klebsiella, Salmonella and Shigella* [17–19]. Bacterial colonies had also been plated onto Eosine-Methylene Blue (EMB) agar and *Salmonella-Shigella* agar for the confirmation of *E.coli, Klebsiella, Salmonella* and *Shigella* respectively.

3. Results and Discussion

Presence of Coliform: There was no bacterial growth on sterilized water. Also there was no bacteria colony formation from samples collected from Mr 1. Mr 2A, Mr 2B and Tj 2B on m-FC and Mk 2B on both agars showed no coliform. Mr 3B, Tj 3A, on both agars showed uncountable bacterial growth. Whereas, Mr 3A, Bn 2B and Bn 3A on m-Fc, and Mr 3B, Tj 2B on m-FCR showed uncountable growth. Except for Mr 1A and Mr 1B, all other showed the presence of non-coliforms.

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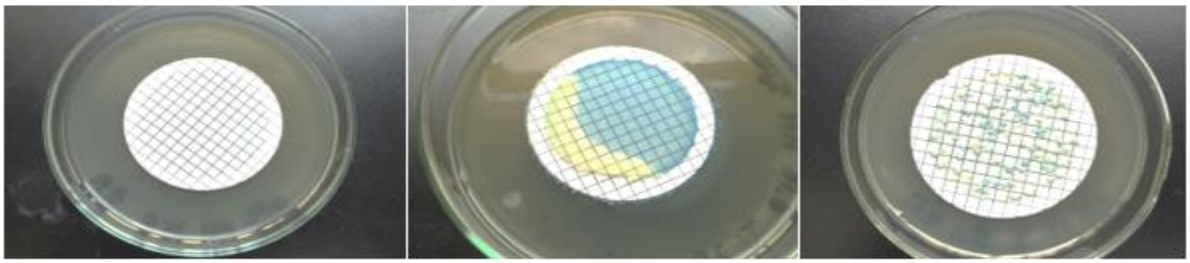

Figure 2: Showing bacterial growth. (a) No growth on Mr 1; (b) Tj 3 showing uncountable growth; and (c) Bn 2B showing excessive growth

Sample collected from Ut 1B, Bs 1A, Bs 2B, Gl 1A and 3B, Dh 1B and 2B and Mj 2A and 2B on both agars showed no coliform. Except for Bs 1B, no other samples from Bs showed coliform on m-FCR. Gl 1A, 1B and 3B, Rm 1A, Dh 1A, 1B and 2B, and Mj 2A and 2B showed no coliform on m-FCR. Rm 3A showed coliform on m-FC. Bs 3A and 3B on m-FCR, Gl 2A on both agars, and Mj 1A and 1B on m-FC showed uncountable coliform growth. All samples from these places showed the presence of non-coliforms. A summarized version of the number bacterial colony from the samples in both m-FC and m-FCR is graphically represented in Fig 3.

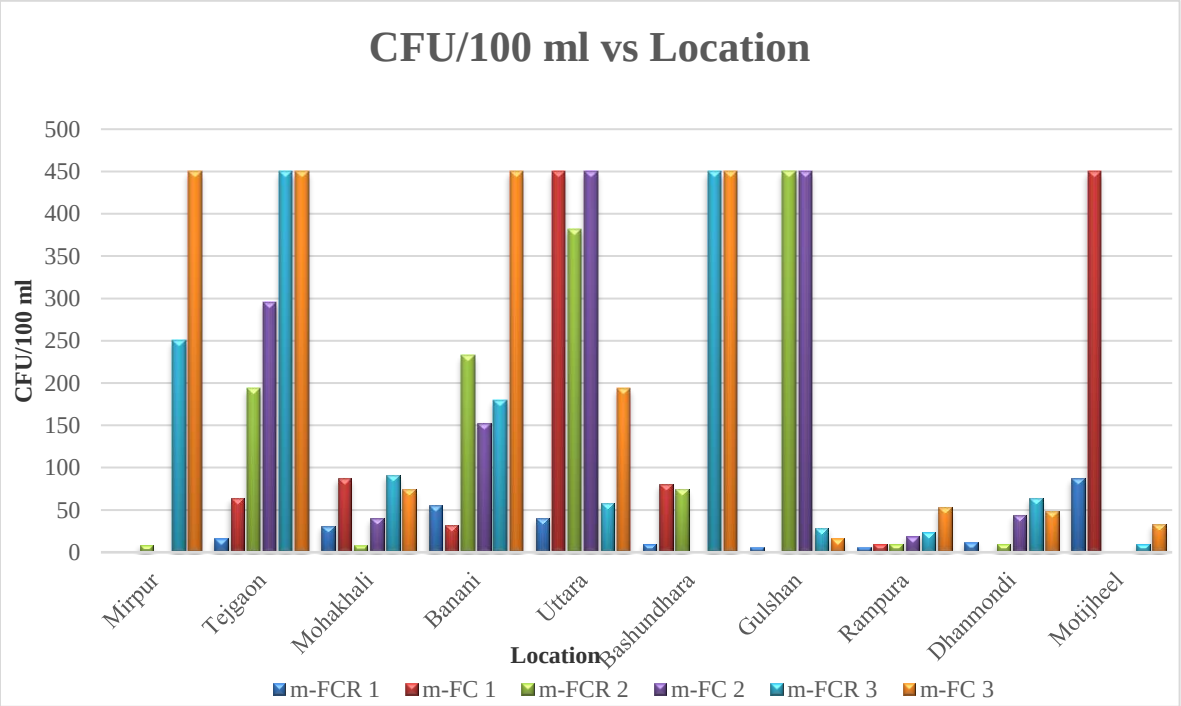

Figure 3: CFU/100 ml of coliform and fecal coliform in the targeted area (450 cfu/ml considered as uncountable number of colonies)

Out of 190 isolated colonies, 91 of them proved to be from the targeted bacteria. A summarized version of the number of target bacterial colony from the samples is graphically represented in Fig 4. It is visible that highest numbers of isolated bacteria have been biochemically identified as

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Escherichia coli (30) and least was *Klebsiella* (3). Second highest is *Salmonella typhimurium* (28) followed by *E.aerogenes* (19) and *Shigella dysenteria* (11).

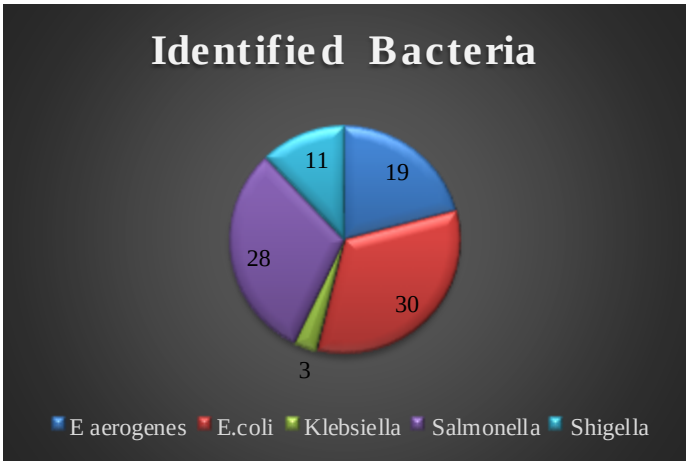

Figure 4: Amount of targeted bacteria identified from the samples

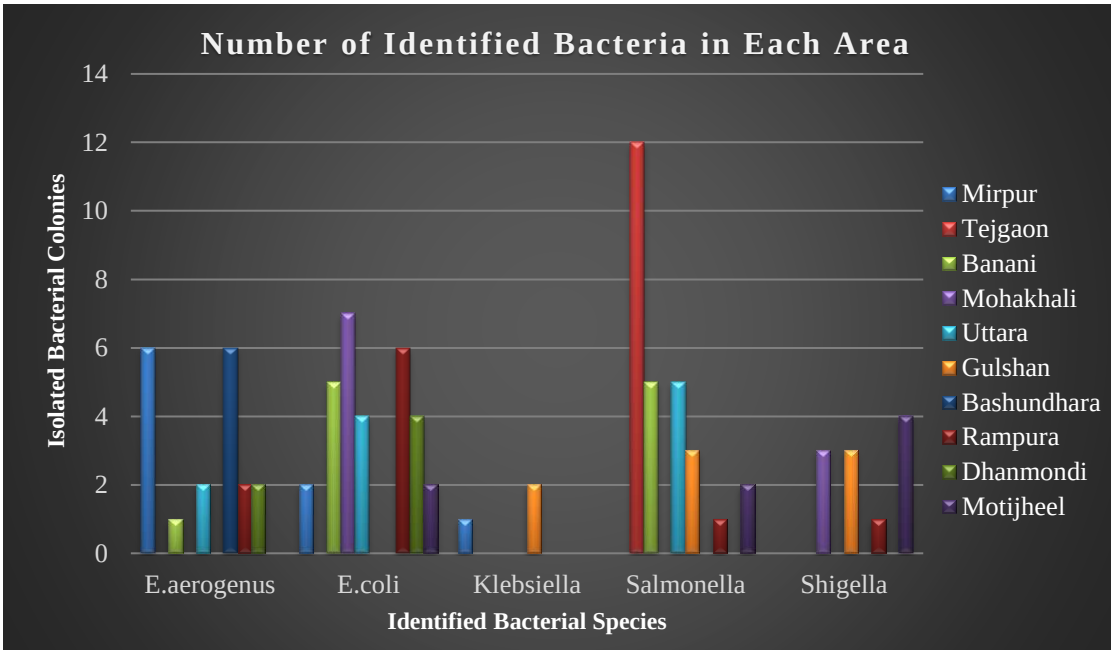

Figure 5: Number Target Bacterial Colonies Found in Each Area

Fig 5 was generated by recording individual bacterial count in each area. It can be seen that samples of Mirpur contained *E.aerogenes*, *E.Coli*, and *Klebsiella*. Highest amount of *Salmonella* was found in Tejagon. From the samples of Banani, *E.aerogenus*, *E.Coli*, and *Salmonella* were evident. However, samples from Mohakhali showed highest (7) amount of *E.Coli*, and presence *Shigella* was also noticed. In case of Uttara, *E.aerogenus*, *E.Coli*, and *Salmonella* were seen to be present. *Klebsiella*, *Salmonella*, and *Shigella* were seen in Gulshan samples. Whereas, samples of Banshundhara showed presence of Enterobacter only. Excluding *Klebsiella*, all other target bacteria were seen in Rampura. Samples of Dhanmondi had *E.aerogenus* and *E.Coli* present. On the other hand samples from Motijheel had *E.Coli*, *Samlonella* and *Shigella* present in them.

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4. Conclusion

Although there have been many works regarding the finding of microbiological content of water but all of those were done for supply water and maximum of these were done in rural areas, water supply such as rivers and canals also in restaurants [9][20-22].However, no specific study was done dispenser or jar water in road side tea stalls of Dhaka city. Therefore, this study was based on bacterial contamination in dispenser/jar water used in roadside tea stalls known as "Tong". As because mass mixture of customers from various socio-economic background drinks water from these tea stalls, hence these stalls was targeted in our study.

Presence of significant amount of the five targeted bacteria, which causes water-borne diseases were confirmed in this study (Fig 5) and it is to be noted that these bacteria should not be present in drinking water according to WHO drinking water guidelines. This study gives an illustration of the contaminated water generally found in roadside tea stalls, giving a validity to the reports in social media about jar water; if not all but most of them. Therefore it can be concluded that, though these jar water were supposed to be pure water, actually they are not "pure" enough to drink. It can be due various reasons including stall owners not maintaining hygiene properly and using illegal acts in filling out the same jar with water from other source to save money. From the results of the study, it is highly recommended to monitor these jar water used in various tea stalls as well as restaurants and preferably the firms supplying the jar water. However, further studies needed to be done focusing on the quality control of the jar water supply companies.

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