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Microbial Quality and Safety of Ready to Serve Street Foods vended in Allahabad City, India

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Abstract

Contamination of ready-to-eat foods and beverages sold by street vendors and hawkers rendering them unacceptable for human consumption has become a global health problem. A study aimed at examining the quality and safety of milk based foods in Allahabad city was done wherein a total of 40 samples were analysed including Ice cream, Kulfi, Mango Shake and Colour ice bar. The samples were classified in satisfactory, acceptable and unsatisfactory categories according to PHLS (Public Health Laboratory Services, UK) guidelines. None of the samples screened in the present study were in satisfactory grade however, 40% ice cream samples, 50% mango shake samples, 10% kulfi samples and 60% colour ice bar samples were within acceptable range. More than 50% samples of ice cream, kulfi, mango shake and 40% samples of colour ice bar samples were unsatisfactory as TPC count was 10^5 CFU/g/ml. The results showed that in most localities the street vended foods remained hygienically poor since bacterial loads (Yeast and Mold counts and Total coliforms) on the whole were abnormally high (YMC: 1910 x 10^4 CFUs/ ml; TC: >2400 MPN/g). Majority (80%) of ice cream samples whereas 30-50% of kulfi, mango shake and flavoured milk samples were positive for *E. coli*. More than 50% of all food samples analysed were positive for *S. aureus. E. faecalis* was encountered in 60% samples of colour ice bar, 50% samples of mango shake and 10% samples each of ice cream and kulfi. Based on the presence of pathogens, it is concluded that street foods in certain areas inside the city are highly unsafe and unfit for human consumption.

Key words: street food, microbial quality, pathogens, coliform count, contamination

Introduction

Street food may be defined as "ready to eat" food prepared and sold by vendor and hawker especially in street and other similar public for immediate consumption. In many tropical countries like India, street vended foods are common man's choice and are sold at all public places and roadside shops.

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The traditional processing methods that are used in preparation, inappropriate holding temperatures and poor personal hygiene of food handlers are some of the main causes of contamination of street-vended foods. In addition, use of unhygienic water for dilution, dressing with ice, prolonged preservation without refrigeration, unhygienic surroundings often with swarming houseflies and fruit flies and airborne dust can also act as sources of contamination (Mensah et al. 2002; Muinde and Kuria 2005; Barro et al. 2006). Food borne illness associated with the consumption of street vended beverages has been reported in several places in India and elsewhere (FAO 1988; Estrada et al. 2004; Chumber et al. 2007; Ghosh et al. 2007). Street foods

are frequently associated with diarrhoeal diseases which occur due to improper use of additives, presence of pathogenic bacteria, environmental contaminants and disregard of good manufacturing practices (GMPs) and good hygiene practices (GHPs). Such foods have shown to be potential sources of bacterial pathogens notably *E. coli*. Being tropical in location hot weather continues for a greater part of the year (February-September) increasing the need for these commodities. In view of the high demand for cool beverages and juices during summer and over crowding of street vended shops in many areas in the city, a rapid review of the street vended fruit juices was undertaken during March to June 2010 with a view to assess their safety for human consumption and as possible sources of bacterial pathogens.

Material and Methods

Collection of samples. For collection of samples, the whole of Allahabad city was divided into ten zones, samples were collected from vendors in each of these zones. All samples were collected in sterile containers held at 4^0 C and analyzed within 2 hours from procurement. A total of 40 samples were analysed which included Ice cream, Kulfi, Mango Shake and Colour ice bar. The study was carried out during March to June 2010.

Sample Analysis. For analysis 10 ml of each sample was diluted as 1:10 with 90 ml of buffered peptone water and was filtered through sterile whatmann No. 1 filter paper to remove the solid particles if any. One ml of filtrate was used for inoculation.

Bacterial enumeration and confirmation. Isolation and enumeration of bacteria were made using the growth in selective media such as nutrient agar for Total Viable Counts (TVC), acidified potato dextrose agar for Yeast and Mold Count (YMC) and Most Probable Number (MPN) Technique for total coliforms (TC) (APHA 1998). Identification of pathogens was done by visualizing cultural characteristics on Hi Touch Hexachrome Flexi plate (Himedia Laboratories) such as pink red colored colonies of *Escherchia coli*, small blue colony of *Enterococcus faecalis*, bluish purple mucoid colony of *Klebsiella pneumonia*, light brown colony of *Proteus mirabilis*, colourless colony of *Pseudomonas aeruginosa* and golden yellow colony of *Staphylococcus aureus*. All the media were obtained from Hi media Laboratories Limited, A-406 Bhavaeswar plaza; LBS Marg, Mumbai, India and protocols followed were as per the guidelines given by the APHA (1998). Since this is a one time study, 3 samples were collected from each location and surface plates were made in triplicates in appropriate selective media.

Results and Discussion

Microbiological quality of food samples on the basis of CFU is summarized in Table 1. PHLS (Public Health Laboratory Services, UK) guidelines were used to classify the samples in satisfactory, acceptable and unsatisfactory categories. None of the samples screened in the present study were in satisfactory grade, however, 40% ice cream samples, 50% mango shake samples, 10% kulfi samples and 60% colour ice bar samples were within acceptable range. More than 40% samples of ice cream, kulfi, mango shake and flavoured milk were unsatisfactory as TPC count was 10^5 CFU/g or /ml.

Hygenic quality of these milk based RTS food products on the basis of coliform and yeast and mold count with their maximum, minimum count and mean value is given in Table 2. It is clear from the Table that 90% samples of ice cream, kulfi and 40% samples of mango shake are of poor quality. Coliform count in these samples exceeds the recommendations of BIS (> 100 coliform/g for ice cream). Higher coliform count in these products indicates higher level of contamination and inappropriate storage conditions. Yeast and mold count was comparatively higher in colour ice bar and mango shake samples. Anuranjini et al. (2008) studied bacteriological analysis of ice cream in Magalore city. The results showed that total aerobic bacterial counts in these contaminated ice cream samples were $>10^7$ cfu/g and Coliform count was also $>10^7$ cfu/g in 80 samples.

Distribution of six pathogens in four food samples is shown in Table 3. All the food samples were positive for one or multiple pathogens. Majority (80%) of ice cream samples were found positive for *E. coli* whereas 30-40% of kulfi, mango shake and colour ice bar samples were positive for *E. coli*. All the samples of mango shake were positive for *Pseudomonas* and in the rest of food items more than 40% samples were positive for this organism. *P. mirabilis* was present in 70% samples of mango shake, 60% samples of colour ice bar and 10% ice cream samples whereas it was absent in kulfi samples. *K. pneumoniae* was not present in ice cream and kulfi samples whereas 60 and 70% samples of colour ice bar and mango shake were positive for this organism, respectively. More than 50% of all food samples analysed were positive for *S. aureus. E. faecalis* was encountered in 60% samples of colour ice bar, 50% samples of mango shake and 10% samples each of ice cream and kulfi. Tambekar et al. (2008) studied a total of 55 samples of street foods. The bacterial pathogens identified were *P. aeruginosa* (39%), *E. coli* (21%), *S. aureus* (16%), *Salmonella* sp. (12%) and *Proteus* sp. (12%). Anuranjini et al. (2008) analyzed 90 ice cream samples, out of which 19 showed the growth of *E. coli*. *Staphylococcus aureus* was isolated from four samples and two samples yielded the growth of *Enterococcus faecalis*. Enteric pathogens like *Salmonella* sp. and *Shigella* sp. were not detected in the samples screened.

Orallo et al. (1999) studied microbiological analysis of ice cream produced by big-scale and small-scale manufacturers in Manila. The results showed that the ice cream samples

from the small-scale manufacturers showed cfu/g ranging from 6.9 x 10^3 to 7.6 x 10^3 that were still within the standard which is 2.5 x 10^5. However, all of these ice cream samples from small-scale manufacturers were positive for fecal coliforms and total coliforms with MPN indices beyond those set by Bureau of Food and Drugs. They were also positive for coagulase positive *Staphylococcus*.

The presence of coliform bacteria, notably fecal coliforms, indicates the presence of fecal contamination in the food. This suggests the possibility that other intestinal pathogens such as enteropathogenic *Escherichia coli*. Hepatitis A virus, poliomyelitis virus, *Entamoeba histolytica* may also be present in the food. These microorganisms are transmitted via the fecal-oral route. The presence of coagulase positive *Staphylococcus*, which is commonly *S. aureus* when transmitted from man and animal, can lead to staphylococcal food poisoning as a result of growth of the organism and release of enterotoxin into the food. Enterotoxin production and secretion occurs especially when ice cream products are not properly prepared and stored. The presence of starch and proteins also encourages enterotoxin production by the microorganism (Wistreich and Lechtman 1980).

Heavy contamination in the RTS samples sold in streets of Allahabad City has been found to be mainly due to poor water quality and hygiene during food preparation, improper washings of utensils, poor personal and domestic hygiene, peeling of fruits long before consumption and crowded dusty and poorly maintained shopping areas. The location of shop alongside busy roads with heavy vehicular traffic which increase air borne particles, or beside waste disposal sites and overcrowded dwellings adds to the contamination.

Conclusion

Overall the results of the study indicate that the majority of food samples studied in Allahabad city are probably contaminated with faecal water mainly used for preparation and dilution of these products. High coliform count, presence of *E. coli* and *E. faecalis* in their samples indicated faecal contamination, thereby suggesting possible risk of infection involved in the consumption of such food. Though the guidelines for food hawkers have been published by Indian Standards there is a need to implement these guidelines to ensure the safety and quality of food.

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Table 1: Yeast and Mold Count (YMC) and Total Coliforms (TC) in street foods sold through street vended shops in different areas of Allahabad city

Sample Area	Ice cream		Kulfi		Mango shake		Colour ice bar	
	YMC[1] (10^4)	TC[2]	YMC[1] (10^4)	TC[2]	YMC[1] (10^4)	TC[2]	YMC[1] (10^4)	TC[2]
Allahapur	3.8	1100	39	>2400	6.25	43	83.3	43
Chowk	32.5	>2400	37	1100	1830	150	1602	210
Civil lines	8.2	>2400	41	>2400	377.5	64	297	64
Colonelganj	3.4	>2400	36	07	81.6	39	84.8	64
Jhonsenganj	83	>2400	85	>2400	920	150	399	210
Katra	35.15	>2400	31	>2400	37.4	64	71.7	39
Prayag Station	4	23	45	460	85.0	75	478	210
Railway Station	44	460	94	93	1100	380	1910	460
Salori	10.8	1100	34	1100	48.0	150	95.9	64
Govindpur	25.8	210	61	>2400	73.5	64	72.05	64
Maximum	44	>2400	94	>2400	1830	380	1910	460
Minimum	3.4	23	31	07	6.25	39	71.7	39
Mean± SE	25.06± 25.22	579± 500.58	50.3± 22.3	552± 528.3	442.0± 197.12	117.9± 102.30	677.3±214 .35	142.8±133 .22

[1]Yeast and mold Count (CFU/g), [2]Total Coliform (MPN/g)

Table 2: Microbiological Quality (CFU/g) of samples vended in streets of Allahabad city on the basis of Total Plate Count (TPC).

Sample	Microbiological quality (CFU/g) on basis of TPC as per PHLS guidelines		
	Satisfactory $<10^4$	**Acceptable $10^4 \leq 10^5$**	**Unsatisfactory $\geq 10^5$**
Ice cream (10)	_	4 (40%)	6 (60%)
Kulfi (10)	_	1 (10%)	9 (90%)
Mango shake (10)	_	5 (50%)	5 (50%)
Colour ice bar (10)	_	6(60%)	4(40%)

Table 3: Pathogenic profile of street vended food samples of Allahabad city

Sample	**No. tested**	**No. contaminated**	***E. coli***	***Proteus mirabilis***	***Klebsiella pnemoniae***	***Pseudomonas aeruginosa***	***S. aureus***	***E. faecalis***
Ice cream	10	10	8 (80%)	1 (10%)	0	4 (40%)	5 (50%)	10 (10%)
Kulfi	10	10	3 (30%)	0	0	4 (40%)	7 (70%)	10 (10%)
Mango shake	10	10	4 (40%)	7 (70%)	7 (70%)	10 (100%)	6 (60%)	5 (50%)
Colour ice bar	10	10	4 (40%)	6 (60%)	6 (60%)	6 (60%)	7 (70%)	6 (60%)