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Quality and safety of street vended fruit juices: a case study of Amravati city, India

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ABSTRACT

Objective: Due to reports of food borne illness associated with the consumption of fruit juices at several places in India and elsewhere, a study was undertaken to assess the safety of street vended fruit juices particularly as possible sources of bacterial pathogens.

Methodology and results: A total of 52 fruit juice samples were analyzed for presence of enteric bacterial pathogens. The dominant bacterial pathogen present in juices were *Escherichia coli* (40%), followed by *Pseudomonas aeruginosa* (25%), *Salmonella* spp. (16%), *Proteus* spp. (9%), *Staphylococcus aureus* (6%), *Klebsiella* spp. (3%) and *Enterobacter* spp. (1%). The highest bacterial contamination was observed in sweet lemon juice (35%), pineapple (29%), and pomegranate, apple and orange (12% each). The contamination is mainly due to poor quality of water used for dilution as well as unhygienic conditions related to washing of utensils, contaminated water and ice, poor personal and domestic hygiene, peeling of fruits much earlier before processing, shops located in crowded places, increased dust particles in the evening and poor maintenance of premises. Shop located alongside roads with heavy vehicular traffic or waste disposal systems, and over crowding further increase the degree of contamination.

Conclusion and application of findings: Health education of the fruit juice vendors and implementation of standard hygienic practices should be enhanced to reduce contamination of fruit juices. Regular monitoring of the quality of fruit juices should be introduced to avoid bacterial pathogen outbreaks in future.

Key words: Street vended fruit juice, bacterial contamination, food safety, *E.coli*, hygiene.

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INTRODUCTION

Fruit juices are well recognized for their mineral and vitamin content and high nutritive value. In many tropical countries juices are the common man's beverages and are sold at mostly in public places and roadside shops. There have been reports of food borne illness associated with the consumption of fruit juices in India and elsewhere (Mosupye & Holy, 2000; Muinde & Kuria, 2005; Lewis *et al*., 2006; Chumber *et al*., 2007; Ghosh *et al*., 2007). Food borne diseases mainly affect the gastrointestinal tract and are transmitted through consumption of contaminated food or drinks.

In view of their relatively rapid handling and extraction methods and rushed cleaning of

utensils, street vended fruit juices could prove to be a public health threat. The sources of contamination vary and one potential source of microbial contamination is by environmental exposure. Improper washing of fruits adds bacteria to extracts leading to contamination while use of unclean water for dilution, dressing with ice, prolonged preservation without refrigeration, unhygienic surroundings often with swarming houseflies and fruit flies and airborne dust can act as sources of contamination. Such juices have been found to be potential sources of bacterial pathogens notably *E. coli* 0157:H7, species of *Salmonella, Shigella,* and *S. aureus* (Buchmann *et al*., 1999; Sandeep *et al*., 2004; Barro *et al*., 2006).

In Amravati City (Maharashtra State, India) there is constant great demand for fresh vegetable and fruit juices. While most restaurants and café serve juices in apparently hygienic conditions, juices sold at the roadside shops and recreational areas (parks) and busy market places (shopping malls, bus stations etc.) are of questionable microbial quality. In these shops, juices are extracted by squeezing from a variety of fresh fruits, e.g. oranges, grape, pomegranate, apple, pineapple, watermelon, papaya, carrot, are served after dilution with water and ice. Despite periodic quality control checks of fruit juices by Food and Drug Department, outbreaks of gastroenteritis caused by pathogenic *E. coli, Salmonella* and *Shigella* are common, though a specific correlation has not been shown between infection and juice consumption (Mensah *et al*., 2002; Burt *et al*., 2003; Bhaskar *et al*., 2004; Lewis *et al.,* 2006).

In view of the high demand for fresh fruit juices during summer in Amravati City, a study of the street vended fruit juices was undertaken during June–December, 2007 with a view to assess safety for human consumption and as possible sources of bacterial pathogens.

MATERIALS AND METHODS

Collection of samples: Ten locations in Amravati City catering to different age groups and communities were chosen for the study and 52 samples of fresh fruit juices were collected between June and December 2007. Six types of fruit juices, i.e. apple, orange, sweet lemon, pineapple, pomegranate, and mix fruit were chosen based on consumer demand. All samples were collected in sterile containers, kept at 4°C and analyzed within an hour after procurement.

Sample analysis: For analysis, 1 ml of juice was diluted ten fold using sterile distilled water and 0.5 ml diluted sample inoculated into 4.5 ml MacConkey broth and incubated for 4 - 5 h. The microbial growth observed as turbidity in broth was then subcultured on Cysteine Lactose Electrolyte Deficient agar (CLED) and incubated at 37°C for 24h. Tentative identification of isolates was done by Gram staining, motility, oxidase test and cultural characteristics on CLED such as yellow colored colonies of lactose fermenting *E. coli,* greenish colour colonies of *Proteus* spp., greenish blue or blue colonies of *Ps. aeruginosa*, mucoid yellow to whitish blue colonies of *Klebsiella* spp and deep yellow opaque colonies of *S. aureus* (Hi-Media Manual, 2003).

Confirmation of the identities of various bacterial pathogens were made by subculturing on Xylose Lysine Deoxycholate agar (XLD agar; M1108, Himedia, Mumbai), *Salmonella-Shigella*-agar (S-S agar M108, Himedia, Mumbai) for *Salmonella*, Mannitol salt agar for *Staphylococcus aureus*, Cetrimide Agar for *Pseudomonas* spp., MacConkey agar for other enteric pathogens and other biochemical tests (Collee *et al*., 1996). For confirmation of the pathogens, typical colonies were inoculated into Rapid Microbial Limit Test kits (Hi-media Laboratories Limited, Mumbai, India), which are a combination media in liquid and solid phase in a single bottle for simultaneous enrichment, isolation, and confirmation of pathogens.

Along with fruit juice sample, information, or data on season, place, and site of shop, time of collection, hygienic status of vendor and their servants, number of servants and their clothes, method of juice preparation and hygienic condition of vending site were collected. All data were analysed with the Statistical Package for Social Sciences 15 for Windows (SPSS Inc.; Chicago, IL, USA) software.

RESULTS AND DISCUSSION

A total of 52 samples were analyzed and all samples were found to be contaminated with a total of 77 bacterial pathogens being isolated. The highest contamination was in juice vended at Rajapeth (14%) and lowest (4%) was at S.T. Stand (Table 1). Among isolated organisms; *E.coli* was most dominant at 40% and *Enterobacter* spp was lowest at 1% (Table 2). The high contamination of *E.coli* observed in this study is similar to that reported by Subbannayya *et al*. (2007) for street vended juices in Mangalore (Karnataka, India) indicating possible risk of infection from such juices.

Table 1: Bacterial pathogens isolated from various fruits juices collected from Amravati City.

Area	Sweet Leman	Pineapple	Apple	Orange	Pome Granate	Mix fruit	Total samples	Pathogen isolated
Camp Area	2	2	2	-	-	1	7	9 (12%)
Dasara Maidan	1	1	-	-	-	-	2	7 (9%)
Gandhi Square	1	2	-	1	1	-	5	8 (10%)
Maltekadi Road	1	3	-	-	1	-	5	6 (8%)
Nawathe Plot	1	1	1	1	1	-	5	9 (12%)
Panchwati Sq.	2	-	-	2	1	-	5	5 (6%)
Rajapeth	2	2	2	-	1	-	7	11 (14%)
Rukmini Nagar	2	2	-	2	-	-	6	7 (9%)
S.T. Stand	1	-	1	-	-	-	2	3 (4%)
Sai Nagar	4	3	-	-	1	-	8	12 (13%)
Total	17	16	6	6	6	1	52	77

The main source of *E. coli* contamination might be through contaminated water supplies used to wash dishes or to dilute juices. The presence of *E. coli* and other coliform bacteria could be due to inadequate hand washing by food workers and poor processing practices (Tambekar *et al.*, 2007).

Table 2: Bacterial pathogens isolated from various fruit juices.

Juice type	Total isolates	*E. coli*	*P. aeruginosa*	*Proteus* spp	*Salmonella* typhi	*S. aureus*	*Klebsiella* spp.	*Enterobacter* spp.
Apple	9 (12%)	3 (33%)	4 (44%)	0	0	1 (11%)	1 (11%)	0
Orange	9 (12%)	4 (44%)	2 (22%)	1 (11%)	1 (11%)	0	1 (11%)	0
Pineapple	22 (29%)	9 (41%)	5 (23%)	2 (9%)	5 (23%)	1 (4%)	0	0
Pomegranate	9 (12%)	3 (33%)	2 (22%)	0	4 (44%)	0	0	0
Sweet lemon	27 (35%)	11 (41%)	6 (24%)	4 (15%)	2 (7%)	3 (11%)	0	1 (4%)
Mix fruit	1 (100%)	1 (100%)	0	0	0	0	0	0
Total (%)	77	31 (40%)	19 (25%)	7 (9%)	12 (16%)	5 (7%)	2 (3%)	1 (1%)

The highest bacterial contamination was observed in juice from sweet lemon (35%) followed by pineapple (29%), pomegranate, apple, orange each with (12%) while all mix fruit juice samples were contaminated. The high contamination of sweet lemon and pineapple juices could partly be linked to their high demand, and thus the fruits are peeled and thus exposed well before when the juice is prepared. In both juices *E. coli* (40%) and *P. aeruginosa* (22%) were dominant organisms (Table 2). The occurrence of *P. aeruginosa* might be due to improper personal hygiene, unhygienic surroundings, vehicular activity and proximity to sewage. The presence of *S. areues* (20%) in pineapple juice could be through handling. The low contamination in apple and pomegranate juices could partly be due to

the fact that these juices have less demand and are thus peeled at the time of juice preparation.

Figure 1: Left to right - Contaminating fruit juices by nonpotable water; dirty glasses, juicer and clothes harbors germs causing infections; peeling the fruits un-hygienically; un-hygienic condition around the street juice vendor.

Table 3: Bacterial pathogens isolated from fruit juices from different localities in various conditions.

Parameter	Type	*E. coli*	*P.aeruginosa*	*Proteus* spp.	*Salmonella* spp.	*S. aureus*	*Klebsiella* spp.	Enterobacter *spp.*	Total	%
Crowding status at Shop	Crowded	19	9	3	7	3	1	0	42	55
	not crowded	12	10	4	5	2	1	1	35	45
Season of collection	Monsoon	16	11	5	9	3	2	1	47	61
	Post monsoon	15	8	2	3	2	0	0	30	39
Time of collection	Morning	11	13	1	3	1	1	1	31	40
	Evening	20	6	6	9	4	1		46	60
Site of juice preparation	Inside shop	6	7	2	1	2	2	0	20	26
	On street	25	12	5	11	3	0	1	57	74
Number of Servant	One	13	10	4	6	1	1	1	36	47
	Two	10	7	0	5	3	0	0	25	32
	Three	8	2	3	1	1	1	0	16	21
Personal hygiene of vendor	Poor	19	5	4	10	3	0	1	42	55
	Fair	12	14	3	2	2	2	0	35	45
Cloths of servant	Dirty	19	5	4	10	3	0	1	42	55
	Clean	12	14	3	2	2	2		35	45
When fruit peeled for juice preparation	Peeled early	19	5	7	10	4	1	1	47	61
	On time	12	14	0	2	1	1	0	30	39
Hygienic conditions of vending site	Poor	26	13	4	10	3	0	1	57	74
	Fair	5	6	3	2	2	2	0	20	26

Juices from the crowded sites were more contaminated (55%) than those from less crowded places (45%). The juice collected in the evening was more contaminated (60%) than morning juice (40%). The dominant organism found in the samples collected in the evening was *Proteus* spp. (86%) (Table 3), possibly due to the over crowding and more polluted environment or dust in the evening than in morning. Out of 77 microorganisms, 42 (61%) were found during the monsoon season and 35 (39%) were found in post monsoon period. The most dominating organism during the monsoon season was *E. coli* (55%), possibly due to increased human sewage in contaminated water (Tambekar *et al.*, 2008).

In shops with only one servant or only the owner, the degree of juice contamination was high (47%) as compare to having two servants (32%) or three servants (21%). This can be explained by the fact that a single servant or owner does all the work right from peeling, preparing juices, cleaning of glasses and dishes and serving. While performing these multiple

tasks, one person does not wash or clean the hands frequently, and thus is likely to contaminate the juices.

Time of fruit preparation, hygiene of vendors and the area surrounding vending sites are other important factors. The fruits which were peeled long before consumption were more contaminated (61%) than fruits peeled at the time of consumption (39%). Vendors with poor personal hygiene had more contaminated juice (55%) than those with a fair level of hygiene (45%) (Table 3). Presence of *S. aureus* (60%) may be due to dirty clothing and contaminated hands of vendors, which indicates lack of knowledge of hygienic practices and food safety. More contamination was also observed in juices that were vended sites with poorly kept surrounding (74%) as compared to 26% for sites with fair hygienic conditions. Unhygienic surroundings include sewage, improper waste disposal system, inadequate water supply and flies that are attracted to the juices (Subbannayya *et al*., 2007).

The study indicated that all street vended fruit juices in many parts of Amravati city were contaminated, and numerous potential sources of contamination were identified. Since the practice of consuming fresh fruit and juice cannot be stopped based on unhygienic grounds, and neither can the street vendors be prohibited from selling such items which provide them with a source of livelihood, the Government Health Agencies must put in place measures to educate the vendors on food safety and hygienic practices and enforce adequate guidelines for street food vending. Regular monitoring of the quality of fruit juices for human consumption should be introduced to avoid infection while shop locations that predispose juices to contamination should be avoided.

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