

Microbial Quality and safety of street vended fruit juices: A case study of Amravati city

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Abstract : There are reports of food borne illness associated with the consumption of fruit juices at several places in India and elsewhere. Hence a rapid review of the street vended fruit juices was undertaken to assess the safety for human consumption and as possible sources of bacterial pathogens. A total of 52 samples were analyzed and dominant bacterial pathogen recorded was E.coli (40%), followed by Ps. aeruginosa (25%), Salmonella spp. (16%), Proteus spp. (9%), S. aureus (6%), Klebsiella spp. (3%) and Enterobacter spp. (1%). The highest bacterial contamination was observed in sweet lemon (35%), pineapple (29%), and pomegranate, apple, orange (12% each). The contamination is mainly due to poor quality of water used for dilution as well as prevailing unhygienic conditions related to washing of utensils, contaminated water and ice, poor personal and domestic hygiene, peeling of fruits before hand, shop in crowded place, dust particles in the evening and maintains of premises. The location by the side of a busy road with heavy vehicular traffic (airborne particles) or by the side of the waste disposal system and over crowding seems to add to the contamination. However Health education of the vendors and implementation of standard hygienic practices may reduce contamination of fruit juices. Regular monitoring of the quality of fruit juices for human consumption must be introduced to avoid any future bacterial pathogen outbreak.

Key words: vended fruit juice, Bacterial contamination, Food safety, E.coli, hygiene

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Introduction

Fruit juices are well recognized for their nutritive value, mineral, and vitamin content. In many tropical countries they are common man's beverages and are sold at all public places and roadside shops. There are reports of food borne illness associated with the consumption of fruit juices at several places in India and elsewhere (Chumber *et al.*, 2007; Muinde and Kuria, 2005; Lewis *et al.*, 2006, Ghosh *et al.*, 2007; Mosupye and Holy, 2000). In view of their ready consumption, quick methods of cleaning utensils, handling and extraction; they could often prove to be a public health threat. However, sources of contamination vary. One potential source of entry of microorganisms into fruits and fruit-juices is by environmental exposure. Food borne diseases are harmful illness mainly affecting the gastrointestinal tract and are transmitted through consumption of contaminated food or drink. Improper washing of fruits add bacteria to extracts leading to contamination. 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 act as sources of contamination. Such juices have shown 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.*, 2001; Barro *et al.*, 2006).

In Amravati City (Maharashtra State, India) there is always a great demand for fresh vegetable and fruit juices. While most restaurants and café serve juices in apparently hygienic conditions, but in the roadside shops and recreational areas (parks) and busy market places (shopping malls, bus stations etc.) their microbiological quality remains questionable. In these shops, juices extracted by squeezing from a variety of

fresh fruits namely oranges, grape, pomegranate, apple, pineapple, watermelon, papaya, carrot etc. are served after considerable dilution with water and ice. Despite periodic quality control checks and closure of shops, outbreaks of gastroenteritis caused by pathogenic *E. coli*, *Salmonella* and *Shigella* are not uncommon in these areas although a specific correlation has not been shown between outbreaks of gastroenteritis and consumption of these juices ((Lewis *et al.*, 2006, Mensah *et al.*, 2002, Bhaskar *et al.*, 2004; Burt *et al.*, 2003). In view of the high demand for fresh fruit 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 June–December 2007 with a view to assess their safety for human consumption and as possible sources of bacterial pathogens.

Materials and Methods

Collection of Samples. During the study, 10 locations in the Amravati City catering to different age groups and communities were chosen for collection of samples and 52 samples of fresh fruit juices were picked up during June to December 2007. Six varieties of fruit juices namely apple, orange, sweet lemon, pineapple, pomegranate, and mix fruit were chosen based on the 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 sample was 10 times diluted with sterile distilled water. From this diluted sample 0.5 mL was inoculated in 4.5 mL MacConkey broth and incubated for 4-5 h. The microbial growth observed as turbidity in broth was then subcultured on the Cysteine Lactose Electrolyte Deficient agar (CLED) and incubated at 37°C for 24h. Tentative identification of isolates were made 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 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 various special biochemical tests. For confirmation of the pathogens, typical colonies were inoculated into Rapid Microbial Limit Test kits, which are a combination media in liquid and solid phase in a single

bottle for simultaneous enrichment, isolation, and confirmation of pathogens. These MLT kits are recommended in diagnostic microbiology for accurate identification of pathogen and are supplied by Himedia Laboratories Limited, Mumbai, India. Biochemical tests were performed using conventional methods to confirm pathogen identification whenever necessary (Collee *et al.*, 1996).

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 & Discussion

In developing countries, drinks, meals, and snacks sold by street food vendors are widely consumed by millions of people. These street foods provide an affordable source of nutrients to many sectors of population. Street-vended fruit juices are well appreciated by consumers, because of their taste, low price, and availability at right time (FAO, 1988; Ohiokpehai, 2003). However, street foods are frequently associated with diarrhoeal diseases due to their improper handling and serving practices (Barro *et al.*, 2006; WHO, 2002). Street Juice trade vendors are mostly uninformed of good hygiene practices (GHP) and causes of diarrhoeal diseases (Mensah *et al.*, 2002), which can increase the risk of street food contamination (Bhaskar *et al.*, 2004).

Therefore, the conditions of street food preparation and vending raise many concerns for consumer's health. In most cases, running water is not available at vending sites; hands and utensils washing are usually done in one or more buckets, and sometimes without soap. Wastewaters and garbage's are discarded nearby, providing nutrients for insects and rodents. Some of the juices are not efficiently protected against flies, which may carry food borne pathogens. Safe food storage temperatures are rarely applied to street vended juice. In addition, there are potential health risks associated with initial contamination of foods by pathogenic bacteria as well as subsequent contamination by vendors during preparation, handing, and cross contamination (Mosupye and van Holy, 2000). The present study aims to establish the hygienic status of street vended juices and their impact in street foods contamination.

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

Area	Sweet Lemon	Pineapple	Apple	Orange	Pomegranate	Mix fruit	Total samples	Bacterial 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

Table 2: bacterial Pathogens Isolated from various Fruit Juices

	Total isolates	<i>E. coli</i>	<i>P. aeruginosa</i>	<i>Proteus</i> spp	<i>Salmonella</i> typhi	<i>S. aureus</i>	<i>Klebsiella</i> spp.	<i>Enterobacter</i> 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%)

A total of 52 samples were analyzed (Table 1). All samples were found contaminated and 77 bacterial pathogens were isolated. The highest contamination was recorded in juice vended at Rajapeth (14%) followed by Sai Nagar (13%), Nawathe plot and Camp area (12% each), Gandhi square (10%), Dasara Maidan and Rukmini Nagar (9% each), Maltekadi road (8%), Panchavati square ((6%) and S.T. Stand (4%) (Table 1). . Among isolated organisms; *E.coli* (40%) was most dominant followed by *Ps. aeruginosa* (25%), *Salmonella* spp. (16%), *Proteus* spp. (9%), *S. aureus* (6%), *Klebsiella* spp. (3%) and *Enterobacter* spp. (1%) (Table 2). The maximum contamination of *E.coli* was recorded in the study, similar findings were also recorded by Subbannayya et al., (2007) in street vended juices and indicating possible risk of infection involved with drinking of such juices. The main source of *E. coli* contamination might be through contaminated water supplies. The utensil washed by contaminated water or water that used for dilution of juices is contaminated then the outbreak of *E. coli* may occur. The presence of

E. coli and other coliform bacteria could be due to inadequate hand washing by food workers and the absence of good manufacturing practices (Tambekar et al, 2007).

The highest bacterial contamination was observed in sweet lemon (35%), pineapple (29%), pomegranate, apple, orange each with (12%) and mix fruit with a strain of bacteria showed (100%) contamination. Sweet lemon and pineapple juices were highly contaminated because it is maximally consumed and already peeled out quite before the juice preparation. In both the 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 transmission, and sewage. The presence of *S. aureus* (20%) in pineapple showed severe contamination through handling. Least contamination in apple and pomegranate juices was recorded as these fruits were peeled on time of juice preparation.

Juices from the crowded sites were more contaminated (55%) than that of the less crowded places (45%). The juice collected in the evening showed more contamination (60%) while samples collected at morning showed less contamination (40%). The dominant organism found in the samples collected at evening was *Proteus* spp. (86%) (Table 3). It might be due to the over crowding and more polluted environment or dust in the evening than in morning. Out of 77 microorganisms, 42 (61%) microorganisms were found in the monsoon and 35 (39%) were found in post monsoon period samples. The most dominating organism in monsoon season was *E.coli* (55%). The presence of *E. coli* also gets reduced to 45% in post monsoon period. Presence of *E. coli* may occur due to human sewage or contaminated water. In monsoon the fecal matters get mixed with water and causing contamination of *E. coli* (Tambekar et al., 2008).

Where there is only one servant or only owner, the degree of contamination in the juices was high (47%) as compare to having two servants (32%) or three servants (21%). It might be due to, a single servant or owner, who is doing all the works right from peeling, preparation juices, cleaning of glasses and dishes and serving, while doing these work, he is not washing or cleaning his hands frequently and contaminate the prepared juice. The fruits, which were already peeled out for juice preparation showed more contamination (61%) than fruits peeled on time (39%). Personal hygiene plays an important role in spread of infection. Poor personal hygiene of vendor showed (55%) contamination than fair (45%). The servants in shops with dirty clothing showed (55%) contamination in street vended juices (Table 3). Presence of *S. aureus*

(60%) may be due to dirty clothing and contaminated hands of vendor indicating lack of knowledge of hygienic practices and safety of food products. Hygienic surrounding of vending site also plays an important role in contamination of juices. More contamination was observed in the juices that were at poor hygienic vending site (74%) than fair hygienic conditions (26%). Unhygienic surroundings like sewage, improper waste disposal system, inadequate water supply causes contamination of food. Also houseflies and fruit flies due to sewage may contaminate juices as juices attract the flies (Subbannayya et al., 2007).

and over crowding seems to add to the contamination. Such locations should be avoided for establishing a street vended juice shop.

The practice of consuming fresh fruit and juice cannot be stopped on unhygienic grounds and not the street vendors prohibited from selling such items, as such activities provide them with a source of livelihood but Government Health Agencies must adopt measures to educate the vendors on food safety and hygienic practices and enforce adequate guidelines for street food vending. People should avoid street fruit juices. Health education of the vendors and implementation of standard hygienic protocols may reduce contamination of fruit juices. Regular monitoring of the quality of fruit juices for human consumption must be introduced to avoid any future bacterial pathogen outbreak.

Table 3: Bacterial pathogens isolated from different areas in various conditions

Parameter	Type	<i>E. coli</i>	<i>P.aeruginosa</i>	<i>Proteus spp.</i>	<i>Salmonella spp.</i>	<i>S. aureus</i>	<i>Klebsiella spp.</i>	Enterobacter spp.	Total	%
Place of Shop	Crowded	19	9	3	7	3	1	0	42	55%
	Less 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%
Method of juice preparation	Already peeled	19	5	7	10	4	1	1	47	61%
	Peeling 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%

Conclusion and Recommendations

The study indicated that all street vended fruit juices in many parts of the city were contaminated. It is contended that contamination is mainly due to poor quality of water used for dilution as well as prevailing unhygienic conditions related to washing of utensils, contaminated water and ice, poor personal and domestic hygiene, peeling of fruits before hand, shop in crowded place, dust particles in the evening and maintains of premises. The location by the side of a busy road with heavy vehicular traffic (airborne particles) or by the side of the waste disposal system

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