



Microbial Contamination of Street vended Fruit Juices In Kolkata City

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Abstract

Microbial contamination of freshly squeezed fruit juices sold by street vendors poses a great health problem throughout the world. There are reports of food borne illness associated with the consumption of fruit juices at several places in India. Hence a rapid review was undertaken to analyse the microbial quality of the street vended juices sold in different places in Kolkata city, India.

Total viable count, Yeast and mold count, Coliform count, vibrio count and salmonella count was analyzed using standard methods. The total viable counts (TVC) were high ranging from $265-700 \times 10^4$ CFU/1000ml. Yeast count varied between $1.8-360 \times 10^4$ CFU/1000ml where as Mould varies between $1.1-620 \times 10^4$ CFU/1000ml. Coliforms include both the presence of fecals ($.5-45 \times 10^4$ CFU/1000ml) and non fecals ($.15-76 \times 10^4$ CFU/1000ml). Again presence of *Vibrio* ($1.1-536 \times 10^4$ CFU/1000ml) and *Salmonella* ($.12-200 \times 10^4$ CFU/1000ml) were also observed in most of the tested samples. The number and type of microorganisms recovered from the freshly squeezed fruit juices made them unsafe for drinking. Unhygienic fruit handling in the poorly sanitized environmental conditions under which vendors operate the juices become contaminated with harmful bacteria.

Attempts were taken to reduce down the number of microorganisms by using ultraviolet radiation (UV-C). A great reduction in the bacterial count was achieved with exposure time of 60 mins. Though fungal members were not much affected by this radiation, but optimization is needed for juice treatment. This treatment may be an alternative technology other than thermal pasteurization and sterilization treatment for decontaminating the fruit juices.

Key words: Fruit Juices, Street vendors, Microbial Contamination, Total viable count, UV-C

Introduction

To be labeled as a fruit juice, the Food and Drug Administration (FDA) mandates that a product should be a 100% fruit juice. Any beverage that is less than 100% fruit juice must list the percentage of the product that is fruit juice, and the beverage must include a descriptive term, such as 'drink', 'beverage' or 'cocktail'. Generally it contains 10-90% juice with added sweeteners, flavors, Vit. C etc. and according to FDA the ingredients should be clearly listed on the label.

Fruit juices sold by street vendors are widely consumed by millions of people in tropical countries. They are rich source of various nutrients, minerals, vitamins and most importantly the phytochemicals. 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). Food borne diseases are harmful illness mainly affecting the gastrointestinal tract (Tambekar et al. 2009).

Pathogenic microorganisms can enter fruits through damaged surfaces that occurs during growing or harvesting. But the main sources of contamination in fruit juices are untidy instruments and utensils, unhygienic water for

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dilution, dressing with contaminated ice, prolonged preservation without refrigeration, unhygienic surroundings often with swarming houseflies and fruit flies and airborne dust. 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; Lewis et al. 2006).

There are various reports on the outbreaks of illness in humans associated with consumption of unpasteurized fresh fruit juices. In 1995, unpasteurized fresh orange juice contaminated with salmonella was linked to an outbreak in Florida Theme Park, USA, where more than 60 visitors were affected (Schmidt et al. 1997).

In Kolkata (West Bengal, India) there is always a great demand for fresh fruit juices as the climate remains hot and humid for most part of the year and street vendors serve a great portion of this demand. But their hygiene practices and microbial quality are questionable. In view of the high demand during summer and over crowded street vended shops in many areas in the city, a rapid review of the street vended fruit juices was undertaken during June–August, 2008 and 2009 with a view to assess their safety for human consumption and as possible sources of bacterial pathogens. An attempt was also taken to lower down the microbial load of the street vended fruit juices with non-thermal treatments. Among Non thermal treatments Ultra Violet –C light is considered to be germicidal against various microorganisms (Bintsis et al. 2000). The wave length of 254 nm was, therefore, used for the disinfection of surfaces, water and various liquid food products (Guerrero and Barbosa, 2004, 2005). The advantages with UV-C radiation used as a non thermal method is that no known toxic or significant non toxic by products are formed during the treatment, certain organic contaminants can be removed, no off taste or odor is formed when treating water and very little energy is required than thermal pasteurization or sterilization processes (Keyser et al. 2008). Fruit juice that undergo thermal treatment tend to change color and lose some of its aroma and vitamin content. (Choi and Nielsen, 2005) unlike juices that are treated with UV radiation which maintain color and aroma (Tran and Farid, 2004).

Material and Methods

Collection of Samples.

During the study, collection of samples were done from 8 locations in the Kolkata City. Six varieties of fruit juices namely mango, pineapple, sweet lime, lemon, pomegranate, and sugarcane were chosen based on the consumer demand. All samples were collected in sterile containers, refrigerated until further analysis. Two packaged juice samples like branded pineapple juice and branded mango juices were also analysed to know their microbiological quality. pH of the samples were analyzed with pH meter.

Microbial analysis of the fruit juice samples.

For analysis serial dilution and plate count method was applied. Various selective media was used, like nutrient agar for Total Viable Count (TVC), Eosine methylene blue agar (EMB) for coliforms, Thiosulfate citrate bile sucrose agar (TCBS agar) (Kobyashi et al. 1963) for *Vibrios*, *Salmonella Shigella* Agar (SS-Agar) for *Salmonella*, Yeast Extract-Dextrose Peptone Agar (YEDP Agar) for Yeasts and Sabouraud Agar for Molds. All the plates were incubated at 37° C for 48 hours. Fecal and non fecal coliforms were determined by IMVic test.

Decontamination of fruit Juice using UV- C light.

UV –C light at 254nm was used to decontaminate the fruit juice samples. The juice samples was exposed to the radiation for different time intervals like 30, 45, 60 mins under continuous stirring. Then they were plated in specific medium using specific dilution and incubated as before. The number of colonies was counted using colony counter.

Results and Discussion

Street vended fruit juices are well appreciated by the consumers because of their taste, low price, and availability at right time (Ohiokpehai, 2003). In spite of the potential benefits offered by fruit juices, concerns over their safety and quality have been raised; as freshly prepared juices have no process or steps to minimize the microorganisms if they are contaminated (Mahale et al. 2008).

In the present study the juice samples were collected from most populated market places of Kolkata city and summarized account of the results obtained for the microbiological analysis of the juices are given in Table 1. Total viable counts (TVC) were high ranging from $265-700 \times 10^4$ CFU/1000ml. Yeast count varied between $1.8-360 \times 10^4$ CFU/1000ml where as Mold varies between $1.1-620 \times 10^4$ CFU/1000ml. Coliforms include both the presence of fecals ($0.05-45 \times 10^4$ CFU/1000ml) and non fecals ($0.15-76 \times 10^4$ CFU/1000ml). Again presence of *Vibrio* ($1.1-536 \times 10^4$ CFU/1000ml) and *Salmonella* ($0.12-200 \times 10^4$ CFU/1000ml) were also observed in most of the tested samples. Pineapple Juice followed by Mango juice showed huge contamination by various types of microorganisms not only by bacterial population but also by fungal populations. A number of factors are responsible for the contamination of freshly-squeezed fruit juices. Most fruit contains bacterial counts of 1×10^5 cfu/cm² on their surface (Splittstosser 1979; Harrigan 1998; Al-jedah et al. 2002). Improper washing of fruits adds these bacteria to juices leading to contamination. In addition lack of appreciation of basic safety issues by vendors contribute to augmentation of the microbial loads (Mahale et al. 2008). These include unavailability of running water for dilution and washing, prolonged preservation without refrigeration, unhygienic surroundings with swarming flies and airborne dust. (Lewis et al. 2006). It is contended that the unhygienic location of the shops like heavy vehicular traffic near

railway station, located near by the hospitals, by the side of sewage collection point, by the side of heavily crowded market place are responsible for such huge contamination. In comparison canned and preserved fruit juices sold in the market showed no microbial contamination and appeared clean and safe for human consumption.

Due to such heavy microbial contamination, attempts were taken to decontaminate or to reduce the microbial load of the fruit juice. Various thermal and non thermal treatments were found to be effective in decontaminating the fruit juices (Raso et al. 1998; Yen and Lin 2003). Inactivation by using UV-C light gives a huge reduction in various microbial populations (Table 2). In both the juice tested TVC, coliform count (both fecal non fecal), *Vibrio* and *Salmonella* count decreased to a certain level after exposure time of 60 mins. But yeast and molds are not profoundly affected by the radiation. In comparison to heat pasteurization, juices treated with UV did not change in taste and color profiles. Ultraviolet dosage levels (JL-1) of 0, 230, 459, 689, 918, 1148, 1377, 1607, 2066 were reported to reduce microbial loads in different juice products (Keyser et al. 2008). Results presented in Table 2 clearly showed that UV-C radiation, may be successfully

applied to reduce the microbial load in different fruit juices. But optimization of the parameters is essential for different juices treated to ensure the maximum reduction of the microbial load without affecting the taste of the product.

From this overall study it may be concluded that all street vended fruit juices in many parts of the city were contaminated by various types of microorganisms. It is contented that contamination is mainly due to poor quality of water used for dilution as well as prevailing unhygienic conditions related to washing utensils, contaminated water, ice, poor personal and domestic hygiene, peeling of fruits long before squeezing, shop in crowded places etc (Tambekar et al. 2009). Such conditions should be avoided. Use of UV-C light exposure may give certain beneficial result in reducing the number of microbes in fruit juices in such shops also.

Again it may be concluded that consumption of fresh fruit juices cannot be stopped on unhygienic grounds and not the street vendors prohibited from selling such items. Regular monitoring and precaution should be taken by Government agencies to maintain the quality of fruit juices for human consumption.

Table 1: Microbial Count of various freshly prepared fruit juice samples collected from different places of Kolkata City ($\times 10^4$ CFU/1000ml)

| Types | Location | pH | TVC* | Yeast | Molds | Coliform | | <i>Vibrio</i> | <i>Salmonella</i> |
|-------------------|------------------|-----|------|-------|-------|----------|-----------|---------------|-------------------|
| | | | | | | Fecal | Non Fecal | | |
| Mango | Park Circus | 3.5 | 350 | 1.8 | 1.1 | 0.05 | - | - | - |
| | Nat. Med. Coll. | 4.2 | 265 | 200 | 172 | 0.3 | 76 | 1.2 | 95 |
| | Gariahat | 3.6 | 650 | 300 | 460 | 0.05 | 10 | 500 | 145 |
| Pineapple | Sealdah market | 3.8 | 600 | 360 | 430 | - | 60 | 14 | - |
| | Anandapalit | 4.1 | 700 | 350 | 620 | 4.0 | 20 | 536 | 200 |
| Lemon | Sealdah Rly. St. | 3.5 | 300 | 250 | 50 | 1.5 | - | - | - |
| Sugarcane | Raja Bazar | 5.6 | 600 | 70 | 4.35 | 45 | 30 | 1.1 | 1.2 |
| Sweet lime | College Street | 3.8 | 500 | 260 | 180 | 45 | - | 0.45 | 145 |
| Pomegranate | Esplanade | 4.5 | 530 | 137 | 41.2 | 44 | 0.15 | - | 0.12 |
| Branded Mango | Not tested | | - | - | - | - | - | - | - |
| Branded Pineapple | Not tested | | - | - | - | - | - | - | - |

*Total viable count

Table 2: Effect of UV-C Treatment on the microbial count of the fruit Juices ($\times 10^4$ CFU/1000ml)

| Types of Juice | Time Exposure | TVC | Yeast | Molds | Coliform | | <i>Vibrio</i> | <i>Salmonella</i> |
|----------------|---------------|-----|-------|-------|----------|-----------|---------------|-------------------|
| | | | | | Fecal | Non Fecal | | |
| Mango | 0 | 650 | 300 | 460 | .05 | 10 | 500 | 145 |
| | 30 | 450 | 250 | 400 | .02 | 8 | 300 | 100 |
| | 45 | 200 | 210 | 380 | .017 | 4 | 160 | 84 |
| | 60 | 35 | 200 | 382 | - | 3 | 50 | 60 |
| Pineapple | 0 | 700 | 350 | 620 | 4 | 20 | 536 | 200 |
| | 30 | 600 | 350 | 600 | 1 | 10 | 278 | 113 |
| | 45 | 450 | 335 | 593 | .03 | 4 | 130 | 78 |
| | 60 | 200 | 327 | 599 | .01 | - | 35 | 47 |

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