

## Bacteriological Analysis of Street Vended Fresh Fruit and Vegetable Juices in Nagpur City, India

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**Abstract :** Fruit juices are an important part of the diet of all age groups due to the associated health benefits. Fresh squeezed juices of pineapple, sweet lime and vegetable juices sold by street vendors in Nagpur city were analysed for their microbiological quality. The samples were randomly collected from local vendors in the city. A total of 38 samples were analysed for total viable count, total and fecal coliforms, staphylococci on mannitol salt agar and salmonella. The total viable count in all the fruit and vegetable samples were in the range of  $2.0 \times 10^4$ –  $4.6 \times 10^6$ . There was no significant difference between the total coliform and staphylococcal counts in juices collected from different locations. Almost 50% of the fruit and vegetable juices also showed the presence of *Salmonella*. The findings in the present study indicate poor handling practices and therefore the risk presented to the consumers suggest the urgent need for spreading awareness and measures to improve microbial quality of street vended juices. Adherence to the HACCP system should be made a mandatory requirement to improve the quality of fruit juices. Programs to educate the fruit juice vendors need to be initiated.

**Key words:** Pineapple juice, Vegetable juice, Sweet lime juice, Coliforms, Salmonella, Staphylococcus, Street vendors.

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### Introduction

In developing countries like India especially in metropolitan and other cities a large population of all income and age groups consume freshly squeezed fruit and vegetable juice because of the health and nutritional benefits. These juices are also reported to have various therapeutic properties in some physiological ailments for faster recovery.

Most of the fruit juices like pineapple, sweet lime, orange etc and vegetable juices like carrot, spinach, wheat grass cucumber and bottle gourd are sold by the street vendors. In Nagpur the consumption of fresh fruit and vegetable juices is on the rise and people from all age and income groups consume the juices throughout the year. As the fresh fruit and vegetable juices have a very high consumer preference due to health effect throughout the country.

Earlier Cook (1998) et al and Cody et al (1999) studied outbreaks of infections caused due to consumption of unpasteurized fruit juices. Ryu and Beuchat 1998 studied survival and growth characteristics of acid-adapted, acid-shocked and control cells of *Escherichia coli* O157:H7. Documented outbreaks related to consumption of fresh juices have not been reported in Nagpur city probably due to lack of traceability of food borne infections.

In India the presence of coliforms and staphylococci in kinnow and mandarin juices in Patiala city could be reported. (Abhijit Ganguli et al. 2006).

Buchanan et al 1998 studied the effect of low-dose gamma irradiation for eliminating *Escherichia coli* O157: H7 from apple juice to characterize the effect of inducing pH dependent, stationary phase acid resistance on radiation resistance.

In view of the flourishing demand for such street vended juices and the potential threat posed, the present work was undertaken to assess the microbiological quality of fresh fruit and vegetable juices sold by the street vendors of Nagpur city.

## Materials and Methods

The juice samples were collected randomly on the basis of their sale i.e. from the shops and street vendors having a sale of more than 50 glasses of each type per day. 10 samples each of pineapple and sweet lime and 3 samples each of carrot, wheat grass, ginger, bitter gourd, cucumber and bottle gourd were collected in sterile bottles and held at 4°C before analysis.

The samples were analyzed within two hours from procurement. 5ml sample was aseptically removed about 5ml for pH measurement and 2ml for enrichment of *Salmonella* in tetrathionate broth.

All samples were serially diluted in a set of tubes containing 9ml phosphate buffer and 0.1ml from the dilutions were plated on different media for enumeration of microorganisms. Total viable count on nutrient agar, total coliforms using violet red bile agar, the presence of fecal coliforms using eosine methylene blue agar and for staphylococci using mannitol salt agar. Inoculated plates were incubated at the requisite time-temperature combination. For detecting the presence of *Salmonella* portions of juice samples were enriched in tetrathionate broth and enumerated on xylose lysine deoxycholate agar.

## Results & Discussion

The pH of all pineapple and sweet lime juices was found to be acidic i.e. < 3, whereas for all vegetable juice samples the pH was in neutral range.

The quantitative analysis of samples for viable count (TVC) revealed that the range for TVC were between  $1.0 \times 10^4$  to  $4.0 \times 10^6$  cfu/ml, since the pH of samples were acidic only those which survive acidic pH are able to survive indicating the acidophilic nature of the organisms.

Counts of  $0.88-33.6 \times 10^4$  CFUs/100 ml; TC  $0.8-22.2 \times 10^4$  CFUs/100 ml have been reported in street vended fruit juices by Joy E. Lewis et. al. Aerobic plate counts of 6 log cfu /g in beans collected from a vendor in the Dominican Republic were reported (Bryan et al. 1988). In addition, aerobic plate counts of chickpeas collected from 3 vendors at a railway station in Pakistan were found to range up to 7 log cfu/g (Bryan et al. 1992).

The total coliforms count (TCC) was in the range of log of 3-4 in almost all the samples tested. The total staphylococcal count on mannitol salt agar were in the range of log of 2-3. The entry of staphylococci in the samples may be due to severe contamination through handling. Survival of food borne pathogens on surfaces of fruits and vegetables has been demonstrated earlier (Beuchat 1998 & Ghosh et al. 2004).

The presence of fecal coliforms in range of log of 3 indicates use of contaminated water during handling and washing etc. The presence of *Salmonella* in juices

is a cause for concern, it may have gained entry through water used for diluting the juices or contamination with improperly treated irrigation water could also be the source of contamination. Ice used for addition to fruit juices could also be a source of contamination.

The results in the present study clearly indicate the poor hygienic conditions of these juices and the consumers are at risk of contacting food borne infections. Food hawkers in India are generally unaware of food regulations and have no training in food-related matters. They also lack supportive services such as water supply of adequate quality and rubbish disposal systems, which hamper their ability to provide safe food. If such facilities were provided to food vendors, as has been done in countries such as Malaysia and Singapore, India might be more successful in ensuring that this sector is able to maintain acceptable standards of hygiene and cleanliness.

While the practice of consumption of juice can not be stopped on nutritional grounds nor the street vendors be stopped from selling such items since it is there only source of livelihood, measures should be taken to spread awareness amongst the vendors about the safe and hygienic practices and Government agencies and NGOs can take initiatives in this direction to lay out guidelines for selling of fresh and unpasteurized juices.

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Table 1. Microbiological analysis of fresh juices of Pineapple and Sweet lime collected from street shops and street vendors in Nagpur city

| S. No. | Sample | pH           | TVC<br>(CFUml <sup>-1</sup> ) | TCC<br>(CFUml <sup>-1</sup> )                | FC | Staphylococcus       | Salmonella<br>Growth on x LD |
|--------|--------|--------------|-------------------------------|--|----|----------------------|------------------------------|
| 1      | p1     |              | 1.9x10 <sup>5</sup>           | 8.0x10 <sup>3</sup>                          | +  | 5.0x10 <sup>2</sup>  | +                            |
| 2      | p2     | < 3          | 2.2x10 <sup>5</sup>           | 5.2x10 <sup>3</sup>                          | -  | 1.4x10 <sup>2</sup>  | -                            |
| 3      | p3     | For          | 1.68x10 <sup>6</sup>          | 1.45x10 <sup>4</sup>                         | +  | 12.4x10 <sup>2</sup> | +                            |
| 4      | p4     | all          | 1.64x10 <sup>6</sup>          | 2.74x10 <sup>4</sup>                         | -  | 6.8x10 <sup>2</sup>  | -                            |
| 5      | p5     | from         | 12.2x10 <sup>5</sup>          | 5.4x10 <sup>4</sup>                          | -  | 1.3x10 <sup>3</sup>  | -                            |
| 6      | p6     | P1 to        | 4.0x10 <sup>6</sup>           | 1.6x10 <sup>4</sup>                          | -  | 8.0x10 <sup>2</sup>  | -                            |
| 7      | p7     | P10          | 1.08x10 <sup>6</sup>          | 1.6x10 <sup>4</sup>                          | +  | 1.3x10 <sup>3</sup>  | +                            |
| 8      | p8     |              | 3.6x10 <sup>6</sup>           | 2.4x10 <sup>4</sup>                          | +  | 1.65x10 <sup>3</sup> | +                            |
| 9      | p9     |              | 2.5x10 <sup>6</sup>           | 9.5x10 <sup>3</sup>                          | +  | 4.0x10 <sup>3</sup>  | +                            |
| 10     | p10    |              | 1.05x10 <sup>6</sup>          | 8.0x10 <sup>3</sup>                          | +  | 2.3x10 <sup>2</sup>  | -                            |
| 11     | SL1    |              | 4.85x10 <sup>4</sup>          | 5.2x10 <sup>3</sup>                          | +  | 7.9x10 <sup>2</sup>  | +                            |
| 12     | SL2    | <3 for       | 6.8x10 <sup>4</sup>           | 8.0x10 <sup>3</sup>                          | -  | 4.2x10 <sup>3</sup>  | -                            |
| 13     | SL3    | all          | 9x10 <sup>3</sup>             | 5.2x10 <sup>3</sup>                          | +  | 3.0x10 <sup>3</sup>  | -                            |
| 14     | SL4    | SL1-<br>SL10 | 1.9x10 <sup>4</sup>           | 1.45x10 <sup>4</sup><br>1.58x10 <sup>4</sup> | -  | 7.1x10 <sup>3</sup>  | +                            |
| 15     | SL5    |              | 1.0x10 <sup>4</sup>           | 2.74x10 <sup>4</sup>                         | -  | 9.0x10 <sup>2</sup>  | +                            |
| 16     | SL6    |              | 2.3x10 <sup>4</sup>           | 5.4x10 <sup>4</sup>                          | -  | 5.1x10 <sup>2</sup>  | +                            |
| 17     | SL7    |              | 1.92x10 <sup>4</sup>          | 1.6x10 <sup>4</sup>                          | +  | 6.8x10 <sup>2</sup>  | -                            |
| 18     | SL8    |              | 7.5x10 <sup>3</sup>           | 1.8x10 <sup>4</sup>                          | +  | 9.2x10 <sup>2</sup>  | -                            |
| 19     | SL9    |              | 2.3x10 <sup>4</sup>           | 2.4x10 <sup>4</sup> ss                       | +  | 2.4x10 <sup>3</sup>  | -                            |
| 20     | SL10   |              | 5.2x10 <sup>3</sup>           | 9.5x10 <sup>3</sup>                          | +  | 13.5x10 <sup>2</sup> | +                            |

Each juice sample was analysed in triplicates and the values are average of all 3 counts.

Samples P1 to P10 are pineapple juice samples and SL1 to SL10 are sweet lime juice samples.

TVC = Total visible Count, TCC = Total Coliform Count, FC = Fecal coliform,

TCS = Total staphylococcal count.

Table 2. Microbiological analysis of vegetable juice sold through street vendors in Nagpur city

| S. No. | Sample no. | pH      | TVC<br>(CFUml <sup>-1</sup> ) | TCC<br>(CFUml <sup>-1</sup> ) | FC | Total Staphylococci<br>count (TSC) | Salmonella on<br>x LD |
|--------|------------|---------|-------------------------------|-------------------------------|----|------------------------------------|-----------------------|
| 1      | C1         |         | 1.52x10 <sup>5</sup>          | 1.02x10 <sup>4</sup>          | +  | 7.4x10 <sup>2</sup>                | +                     |
| 2      | C2         |         | 1.34x10 <sup>6</sup>          | 2.51x10 <sup>4</sup>          | +  | 4.8x10 <sup>2</sup>                | +                     |
| 3      | C3         |         | 3.85x10 <sup>6</sup>          | 1.68x10 <sup>4</sup>          | +  | 2.1x10 <sup>2</sup>                | +                     |
| 4      | W1         |         | 1.6x10 <sup>5</sup>           | 1.9x10 <sup>4</sup>           | +  | 6.9x10 <sup>2</sup>                | +                     |
| 5      | W2         |         | 3.15x10 <sup>6</sup>          | 3.0x10 <sup>4</sup>           | +  | 7.0x10 <sup>2</sup>                | -                     |
| 6      | W3         | Neutral | 2.2x10 <sup>5</sup>           | 2.3x10 <sup>4</sup>           | -  | 3.49x10 <sup>3</sup>               | +                     |
| 7      | CB1        | pH for  | 7.3x10 <sup>5</sup>           | 1.39x10 <sup>4</sup>          | +  | 1.84x10 <sup>3</sup>               | +                     |
| 8      | CB2        | all     | 2.28x10 <sup>6</sup>          | 1.26x10 <sup>4</sup>          | +  | 1.19x10 <sup>3</sup>               | +                     |
| 9      | CB3        | samples | 1.03x10 <sup>6</sup>          | 2.41x10 <sup>4</sup>          | -  | 1.0x10 <sup>2</sup>                | -                     |
| 10     | G1         |         | 3.75x10 <sup>6</sup>          | 5.35x10 <sup>4</sup>          | -  | 5.6x10 <sup>2</sup>                | -                     |
| 11     | G2         |         | 4.3x10 <sup>5</sup>           | 4.31x10 <sup>4</sup>          | -  | 8.9x10 <sup>2</sup>                | -                     |
| 12     | G3         |         | 2.8x10 <sup>5</sup>           | 7.5x10 <sup>3</sup>           | +  | 1.34x10 <sup>3</sup>               | +                     |
| 13     | BG1        |         | 4.8x10 <sup>5</sup>           | 7.8x10 <sup>3</sup>           | -  | 1.39x10 <sup>3</sup>               | +                     |
| 14     | BG2        |         | 1.17x10 <sup>6</sup>          | 1.53x10 <sup>4</sup>          | -  | 1.94x10 <sup>3</sup>               | -                     |
| 15     | BG3        |         | 1.45x10 <sup>6</sup>          | 1.48x10 <sup>4</sup>          | +  | 1.38x10 <sup>3</sup>               | -                     |
| 16     | BGL1       |         | 1.0x10 <sup>5</sup>           | 1.4x10 <sup>3</sup>           | +  | 2.0x10 <sup>2</sup>                | +                     |
| 17     | BGL2       |         | 1.35x10 <sup>6</sup>          | 2.4x10 <sup>3</sup>           | +  | 9.5x10 <sup>2</sup>                | -                     |
| 18     | PGL3       |         | 2.9x10 <sup>5</sup>           | 1.45x10 <sup>4</sup>          | +  | 2.7x10 <sup>2</sup>                | +                     |

All juices samples were analyzed in triplicates and each reported value is a mean of three.

Samples C1-C3 – Carrot juice, W1-W3 –Wheat grass, G1-G3 Ginger, B1-B3 – Bitter guard, CB1-CB3 – Cucumber, BGL1 – BGL3 – Bottle gourd.