

Evaluation of Quality Parameters of Street-Vended Fruit Juices and their Public Health Implications

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Abstract

Fresh fruit juices are widely consumed for their refreshing properties and nutritional benefits, specially as rich sources of Vitamin C, organic acids, and natural sugars; however, their quality and microbiological safety largely depend on hygiene practices, handling, and storage conditions maintained by vendors. The present study was conducted to evaluate the physicochemical and microbiological quality of commonly consumed fruit juices collected from street-vended juice centers located near Bharatiya City, Bangalore, Karnataka, India. Juice samples, including sweet lime, orange, and pineapple, were collected aseptically and analyzed for quality parameters such as pH, total soluble solids (TSS), titratable acidity (TA), Vitamin C content, and total plate count using standard analytical methods. The pH of the samples ranged from 3.42 to 4.00, indicating acidic conditions, while TSS values ranged from 11 to 16 °Brix, reflecting variation in sugar content due to fruit type, maturity, and possible dilution practices. Titratable acidity ranged from 0.03% to 0.11%, with citrus juices showing relatively higher acidity. Vitamin C content varied significantly among the samples, ranging from 33.4 to 133.6 mg/100 ml, with orange juice showing the highest content, followed by sweet lime and pineapple juices. Microbial analysis revealed total plate counts ranging from 3.4×10^2 to 9.1×10^2 CFU/ml, with higher microbial loads observed in samples with comparatively higher pH and poor hygiene conditions, indicating favourable environments for microbial growth and possible contamination due to improper handling and sanitation. The results demonstrate that hygiene practices, raw material quality, and handling conditions significantly influence both the nutritional quality and microbiological safety of fresh fruit juices. The study highlights the importance of proper sanitation, hygienic preparation, and regular monitoring of street-vended juice centers to ensure safe, high-quality, and nutritionally valuable fruit juices for consumers.

Keywords: Hygiene practices; Microbial load; Physicochemical quality; Street-vended fruit juices; Vitamin C.

1. Introduction

Freshly vended fruit juices are widely preferred by consumers due to their refreshing taste, nutritional value, and low cost (Asha et al., 2014). These beverages are especially popular in tropical and developing countries where they are readily available and affordable. However, when fruit juices are prepared and sold under unhygienic conditions, they may pose significant public health risks. The safety standards for food products generally do not permit the presence of coliform bacteria; nevertheless, harmful microorganisms such as *Escherichia coli* and *Salmonella* may contaminate fruit juices through

water, raw fruits, ice, utensils, and improper handling practices (Asha et al., 2014). Street-vended fruit juices are often associated with microbial contamination due to poor hygiene during preparation, lack of proper sanitation of equipment, and exposure to environmental contaminants such as dust and flies (Tambekar et al., 2009). In addition to microbial hazards, fruit juices may also contain toxic heavy metals such as lead, cadmium, and arsenic, which can originate from contaminated water, soil, or processing equipment (Alamgir et al., 2020). The presence of antimicrobial-resistant bacteria in such

beverages has also been identified as an emerging public health concern (Khan et al., 2020). Unlike commercially processed fruit juices, street-vended juices generally do not undergo pasteurization or other preservation treatments, allowing microorganisms to proliferate during storage and handling. Among various street-vended beverages, sugarcane juice is one of the most commonly consumed drinks in tropical regions because of its refreshing nature and affordability. Sugarcane juice contains a high concentration of sugars and typically has a near-neutral pH, which creates a favorable environment for microbial growth. Contamination may occur during crushing, through the use of contaminated water, or due to unhygienic handling of equipment and raw materials (Ed-Dra et al., 2025). Therefore, evaluating the physicochemical properties and microbial safety of street-vended fruit juices is essential to assess their quality and potential health risks to consumers (Srineetha et al., 2024).

2. Method

The quality parameters of fresh fruit juices sold on the street and their potential effects on public health were assessed in this study using a cross-sectional analytical design. The study was conducted over a 450-meter stretch of Bhartiya City Road, where a number of street vendors sell freshly made fruit juices. The area was chosen because street-vended beverages were widely available and consumed there. Convenience sampling was used to include street vendors selling freshly made fruit juices in the study. At the time of preparation, juice samples were obtained straight from suppliers. Nine samples of various fruit juices, including orange, pineapple, and sweet lime, were gathered [1-5]. Each sample was collected aseptically in juice containers provided by vendors and appropriately labeled with the location, date of collection, and sample number. To avoid alterations in the physicochemical and microbiological properties, the samples were brought to the lab in a hygienic manner and examined quickly. The environmental conditions at the vending locations and the vendors' hygienic practices were evaluated using following considerations:

- The vendor's personal hygiene
- Sanitation of utensils and equipment
- The water's source and quality

- Keeping the vending area clean
- Is the kitchen closed or open?
- Juice preparation technique
- The number of customers

These findings aided in locating possible microbial contamination sources. The collected juice samples were analyzed to determine their physicochemical characteristics such as pH, titratable acidity (TA), total soluble solids (TSS), Ascorbic Acid (Vitamin C) and among which the samples are evaluated for total plate count for selected on the basis of pH range where growth of microorganisms is optimum microbiological parameter as total plate count.

3. Results and Discussion

The physicochemical and microbiological evaluation of street-vended fruit juice samples revealed variations in quality attributes, indicating inconsistencies in preparation practices and potential public health concerns. The titratable acidity (TA) of the samples ranged from 0.034% to 0.115% (as citric acid). These values are comparatively lower than standard values reported for fresh fruit juices, suggesting possible dilution practices such as addition of water or ice during blending, or the use of overripe fruits. Organic acids play a crucial role in inhibiting microbial growth; hence, reduced acidity may increase susceptibility to microbial contamination. Similar observations were reported in previous studies conducted by Srineetha et al., 2024 where low acidity in street-vended juices was associated with dilution and poor raw material quality. The results of the pH of the juice samples ranged from 3.42 to 4.00, which indicates an overall acidic nature typical of fruit juices. However, favourable conditions for microbial growth in samples can be observed with relatively higher pH values may provide especially when combined with reduced acidity. The fruit maturity, water addition, and handling practices are influenced by variations in pH among street-vended juices (Jayamma et al., 2017). The variability in sugar content among the samples are observed and total soluble solids (TSS) values ranged from 11 to 22 °Brix reflects the higher value observed in certain samples (22 °Brix) which is more than the moderate TSS values are expected in natural fruit juices indicating the addition of sugar or use of concentrated juice. Additionally, lower TSS values in some samples suggest dilution with water

or ice. Similar variations in TSS have been documented in investigations conducted by on street-vended fruit juices, where inconsistent practices among vendors contributed to differences in sugar content (Jayamma et al.,2017) shown in Table 1.

Table 1 Analysis of Physical Parameters of Juice samples

Sample	pH	TSS (°Brix)
S1M	3.65 ± 0.00	16.00 ± 0.00
S2M	3.54 ± 0.00	15.00 ± 0.00
S3M	4.00 ± 0.00	13.00 ± 0.00
S1O	4.00 ± 0.00	12.00 ± 0.00
S2O	3.54 ± 0.00	12.00 ± 0.00
S3O	4.00 ± 0.00	15.00 ± 0.00
S1P	4.00 ± 0.00	11.00 ± 0.00
S2P	3.70 ± 0.02	22.00 ± 0.00
S3P	3.42 ± 0.00	12.00 ± 0.00

The ascorbic acid (vitamin C) content ranged from 1.20 to 4.80 mg/100 mL, which is considerably lower than standard values reported for fresh juices. As Vitamin C is highly unstable and degrades rapidly under unfavourable conditions, the reduction can be due to oxidation caused by exposure to air, light, and temperature during preparation and storage of juices. The study conducted by Makhlof, et al., 2024 revealed that the significant losses of vitamin C in street-vended juices due to poor handling and prolonged exposure to environmental conditions. Microbiological analysis revealed that the total plate counts were in the range of 3.4×10^2 to 7.9×10^3 CFU/mL, indicating the presence of microbial contamination [11-15]. Poor hygienic practices, use of contaminated water or ice, unclean utensils, and exposure to open environments during juice preparation and sale may be result in higher microbial loads and similar findings have been reported by Ahmed et al., (2009) and Nagaroor, (2023) studies on street-vended fruit juices, where high microbial counts were associated with improper sanitation and handling practices during the preparation of juices [6-10]. Furthermore, the study conducted by Lakshmi Reddi et al., (2015) demonstrated that a lack of food safety knowledge

among vendors is significantly associated with poor hygiene practices and increased microbial contamination. Barro et al., 2006 also indicated in their study that the contamination of street-vended fruit juices may occur through multiple sources, which includes contaminated utensils, water, handlers' hands, and even currency handling during transactions shown in Table 2 and 3.

Table 2 Analysis of Chemical Parameters of Juice samples

Sample	TA (% as citric acid)	Vitamin C (mg/100 mL)
S1M	0.092 ± 0.004	3.18 ± 0.35
S2M	0.079 ± 0.004	1.62 ± 0.35
S3M	0.083 ± 0.000	3.00 ± 0.00
S1O	0.115 ± 0.000	4.80 ± 0.00
S2O	0.096 ± 0.000	3.60 ± 0.00
S3O	0.060 ± 0.004	4.20 ± 0.00
S1P	0.066 ± 0.007	2.40 ± 0.00
S2P	0.034 ± 0.004	2.22 ± 0.35
S3P	0.045 ± 0.000	1.20 ± 0.00

Table 3 Analysis of Microbial Quality of Selected Juice Samples.

Sample	Dilution	Colony Count	TPC (CFU/mL)
S1M	10 ²	79	7.9×10^3
S2M	10 ²	68	6.8×10^3
S3M	10 ¹	34	3.4×10^2

Conclusion

The study highlights the relationship between physicochemical and microbiological parameters and their association with safety and quality concerns in street vended juices. Samples with lower acidity and relatively higher pH provides favorable conditions to microbial growth, while dilution practices not only reduce nutritional quality but also compromise safety. The combined effect of low titratable acidity, reduced vitamin C content, variable TSS, and detectable microbial load indicates poor quality and potential health risks to consumers.

Overall, the findings of the present study are consistent with previous studies, demonstrating that street-vended fruit juices exhibit compromised quality and microbial safety due to inadequate hygienic practices, regulatory control and lack of knowledge regarding food safety. These results highlight the necessity of awareness of vendor, implementation of good hygienic practices, and regulatory bodies to conduct the inspections to monitor the safety and quality of street-vended beverages.

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