

Hygienic Assessment of Tools Used for Juice Extraction by Street Juice Vendors in Close Vicinity of Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad, Uttar Pradesh, India

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Abstract

This study was conducted to assess the hygiene of tools used for juice extraction by street vendors in close vicinity of Sam Higginbottom Institute of Agriculture, Technology and Sciences (India) and the quality evaluation of juice prepared. Structured questionnaires and observational checklist was used in the data collection. A total of 18 juice vendors were interviewed followed by swab test of tools used by the vendors such as; knives, extractors, collectors and sieve used during extraction. General hygiene of the juice vendors that is the sanitary practices in the extraction of juice and washing of tools and utensils were observed to be very poor. The total coliform counts on knives, collectors, sieve and extractors were above the recommended level of TPC. The mean coliform count on extractor was 1.56×10^3 cfu/cm². The mean coliform count on utensils (collectors) was 1.02×10^3 cfu/cm². The mean coliform count on sieve was 1.08×10^3 cfu/cm² and the mean coliform count on knives was 0.19×10^3 cfu/cm². The maximum coliform count was found on extractors and the minimum was found on knives. Most of the tools had total coliform count above the recommended maximum levels which is 1.0×10^3 cfu/cm².

Keywords: Swab test; Microbial quality; Microorganisms; Fruit juices; Tools

Introduction

In developing countries, fruit juices sold by street vendors are widely consumed by millions of people. These juices provide a source of available and affordable source of nutrients to many sectors of the population, especially to the poor. From the survey of the population, it is evident that unpasteurized fruit juices are preferred because of the fresh flavor it has, hence its increase in demand. Fresh blended juices are preferred to the pasteurized by most consumers because of the fear of added preservative to the pasteurized fruit juices. They are simply prepared by extracting the liquid and pulp out of ripped fruit. Despite the potential benefits offered by street fruit juices, concerns over their safety and quality have been raised. Preparation of unpasteurized fresh fruit juices can easily get contaminated due to its exposure to poor environmental conditions and without any quality control checks, careful hygienic measures such as proper washing and keeping of fruits and extraction equipment's must be done and kept during the preparation of such. Hygiene is the least considered factor by the fruit vendors due to their low illiteracy level. They have no idea about the importance of hygiene with respect to the vending of juices. Street fruit vending doesn't have any specificity as to where to be locate. Vendors could easily be located; sometimes more than a single vendor could be seen at a particular location rendering the same services. Getting a place to sell is a vendor's priority than the hygienic condition of the location. Hence, the compromised consideration of selling fruits at the roadsides. Heavy traffic causes lot of dust in the environment and the dust ends up accumulating on the surfaces of the tools used for the preparation of juices which cause cross contamination of the fresh juice prepared, most of the places where the juices are being sold are close to refuse dumps and sewages which increases the contamination fidelity of pathogens making consumption of such juices harmful. It has been observed that most of the fruit vendors do not wash their tools thoroughly after preparation of the juices, they rather use water to rinse and dangerously exposes tools like knives, sieve, and utensils (collectors) to atmospheric conditions, such as dust and pathogens. Juice extraction equipment ranges from hand operated crushers to tones/hour mechanical extractors and the most commonly used by

the street vendors in rural areas are the hand operated crushers. The construction of the extractor should be made to reduce the interactions between the fruits and the extractor; to reduce the contaminations which may be caused by wear and tear of the extraction machine, to reduce fruit-extractor interactions, corners and edges of the extractor during manufacturing should be smooth in lieu of rough and sharp edges which could trap some of the fruit particles and if not washed properly, could cause growth of microbes within. This, therefore brings about the fact that equipment should be easy to wash and clean. The surface of the equipment should not react with detergents used for washing the equipment.

Salmonella, a commonly infections associated with animal-derived foods, such as meat, seafood, dairy, and egg products was also associated with fresh juice, occurred as far back as 1922 in France [1,2]. Early outbreaks resulting in typhoid fever were associated with poor hygiene by asymptomatic *S. typhi* shedding food handlers. In USA, more recent outbreaks of non-typhoidal salmonellosis in fresh juice have been attributed to fecal-associated contamination of fruit or poor processing practices [1,2]. In 2005, 152 cases of *S. typhimurium* infection associated with commercially distributed unpasteurized orange juice were reported in USA. Upon inspection by Food and Drug Administration (FDA), it was found that the production facility did not comply with the HACCP plan and that noncompliance likely contributed to this outbreak [3,4]. Hygienic assessment on the equipment and tools used in the extraction of the juice is equally

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important as assessment on the juice prepared but many times, apathy has been observed towards the quality of street fruit juices. This work seeks to check the sanitary practices on the tools used in extraction of street juices produced in close vicinity of Sam Higginbottom Institute of Agriculture, Technology and Sciences mainly in Mahewa, Dandi and Naini.

Objectives

1. To assess the sanitary practices on tools used for street fruit juice extraction.
2. To evaluate the microbiological quality of the tools.

Materials and Methods

Materials required

Chemicals and reagents: Nutrient Agar, Red Bile Agar and Salmonella-Shigella Agar were used for microbial testing. Distilled water was used for preparation of the agar and buffered peptone water was used as a pre-enrichment medium for recovery of injured Salmonella species.

Methodology

Description of study area: The study was conducted from 3 different locations (Mahewa, Dandi and Naini) which are in close vicinity of SHIATS in Allahabad district, in the state of Uttar Pradesh, India. The study was conducted from February to June, 2016.

Collection of samples: Swab samples of the tools were collected from 2 street vendors from each location that is Mahewa, Naini and Dandi. It was taken from juice vendors who were available at the time of collection and also those who were willing to participate in the study and ready to give required information. Swap samples were taken from the extractors, knives, utensils and sieve. The swabs was put in sterile containers and then taken to the laboratory for microbial testing. a total of 18 respondents were involved in the study. The experiment was repeated twice for each tool.

Data collection

Questionnaires: Structured questionnaires were used to collect information from the juice vendors. Most questionnaires were made with closed and open-ended questions. The questionnaires were used to collect sociological information from the respondents as regards to demographic characteristics, as well as serving tools and vending sites.

Observational checklists: The observational checklist was made with some of the Codex recommended general principles (CAC/RCP 1-1969, Rev.4-2003) of food hygiene for food preparation settings, washing processes, general hygiene of the vendors and premises, waste management and general sanitary practices on juice making. On the other the checklist was provided with a YES and NO sections for each parameter for observation [5].

Swab testing procedure for tools

Swab test was done to determine the compliance with the requirements given in individual specification. It is the counting of total number of aerobic bacteria, yeast and molds on any surface. This test was used to check the hygienic condition of tools and other accessories used during the extraction of the juices. A cotton swab was moistened with normal saline (0.9% NaCl) and was placed in a suitable test tube. The mouth was closed with a cotton plug and rapped with aluminum foil. The test tube containing the swab was then sterilized

by autoclaving at 121°C, for 15 mins. The swab was then taken from the test tube carefully, wearing hand gloves and the surface of the equipment and other accessories was swab. The swab was then carefully put in the test tube and closed and taken to the laboratory for microbial analysis.

Microbiological testing

10 ml of Ringer's solution was added to the test tube containing the swab. It was well shaken and 1 ml of the solution was transferred to Petri dishes and the media was added. Nutrient Agar, Red Bile Agar and Salmonella- Shigella Agar were used. The cultures were incubated for about 24 hrs at a temperature of 37°C.

Counting of colonies: After the incubation, the numbers of colony forming units were counted

$$\text{Number of colonies} = \frac{(\text{colonies present on agar} \times 10 \text{ mL neutralizer in swab})}{(\text{area swabbed}) 25 \text{ cm}^2} \quad (1)$$

Statistical analysis

All experiments were repeated three times with duplicate samples and data were analyzed by analysis of variance using the ANOVA procedure with replication. The null hypothesis states that the mean coliform count value of the tools from the 3 different locations is equal. When the p-value is greater than the tabulated value, the null hypothesis is rejected which indicates that there are no significant differences of the mean coliform count from the three locations.

Results and Discussion

Analysis of questionnaire

Equipment handling practices: Observational study was first done concerning this objective. It was observed that most of the vendors do not wash their equipment and utensils after use. It was observed that the sieve, collector and knives were just lying on the table with houseflies all around them. Some were just covered with a red cloth which is also not clean and could cause cross contamination of microbes. The vendors were also asked and most of them admitted not washing their equipment after use. Out of 18 vendors interviewed, 9 of them admitted not washing their equipment at all and the rest of them wash it once only at the end of the day. Lakshmanan and Schaffner [6] in the study of orange squeezing machines found that, some of the machines had scraps of oranges in internal tubing which were then reflected in the formation of bacteria biofilms. Tambekar et al. [7] found that street fruit juices could often prove to be a public health threat due to their quick methods of cleaning utensils, handling and extraction.

Microbial assessment of tools: Very few guidelines have been published on the acceptable level of microorganisms on surfaces. The US Public Health Service recommends that cleaned and disinfected food service equipment should not exceed 10 viable microorganisms per cm². The Public Health Laboratory Service (PHLS) in the UK recommends guidelines for cleaned surfaces ready for use: less than 80 cfu/ cm² is satisfactory, 80- 10³ cfu/cm² is borderline and over 10³ cfu/ cm² is unsatisfactory. The microbial analysis of fruit juice contact surfaces on extractors is shown in Table 1. In Table 1, the maximum mean value recorded for the total coliform count on extractors was 1.75 × 10³ cfu/ cm² from Mahewa and the minimum mean value obtained was from Naini which had a mean coliform count of 1.45 × 10³ cfu/ cm². with respect to locations, the extractors from Dandi recorded a minimum total coliform count of 1.3 × 10³ cfu/ cm² and a maximum total coliform count of 1.7 × 10³ cfu/ cm². The extractor from Mahewa recorded a minimum total coliform count of 1.4 × 10³ cfu/ cm² and

a maximum total coliform count of 2.1×10^3 cfu/ cm². Finally, the extractors from Naini recorded a minimum total coliform count of

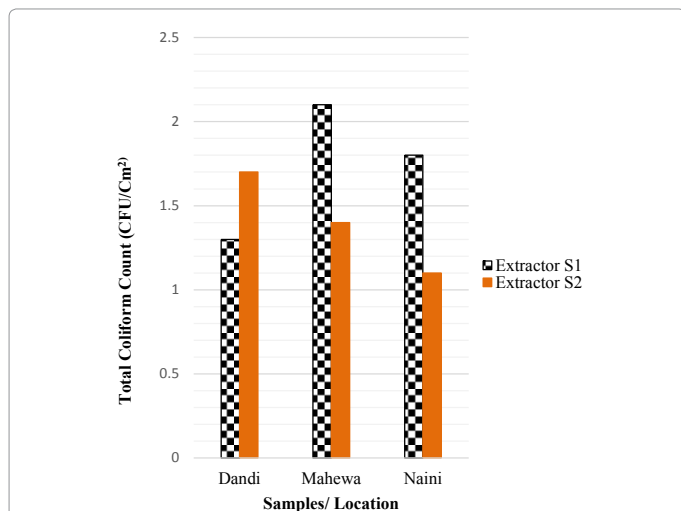


Figure 1: Total coliform count of the fruit juice contact surfaces on extractor.

Location	Total Coliform Count $\times 10^3$ (cfu/ cm ²)		
	Extractor		Mean
	S1	S2	SM
Dandi	1.3	1.7	1.5
Mahewa	2.1	1.4	1.75
Naini	1.8	1.1	1.45
Critical Difference			0.501

Table 1: Total coliform count of the fruit juice contact surfaces on extractors.

Location	Total Coliform Count $\times 10^3$ (cfu/ cm ²)		
	Collector		Mean
	S1	S2	SM
Dandi	1.0	0.8	0.9
Mahewa	0.9	1.1	1.0
Naini	1.4	0.9	1.15
Critical Difference Value			0.5

Table 2: Total coliform count the fruit juice contact surfaces on utensils (Collectors).

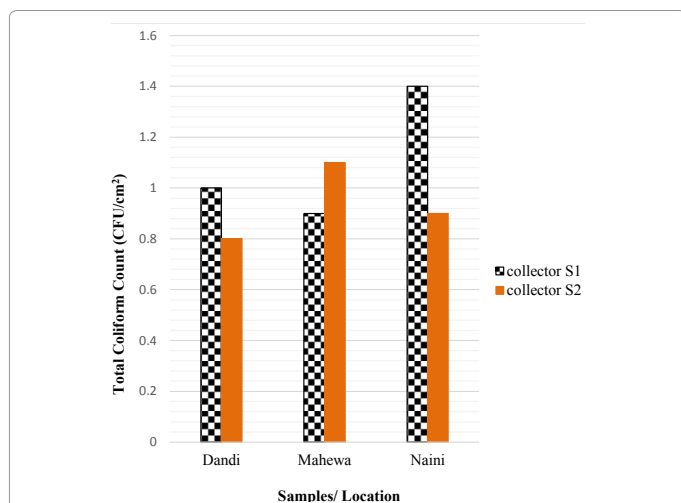


Figure 2: Total coliform count of the fruit juice contact surfaces on utensils (Collector).

Location	Total Coliform Count $\times 10^3$ (cfu/ cm ²)		
	Sieve		Mean
	S1	S2	SM
Dandi	1.2	1.0	1.1
Mahewa	0.9	1.9	1.4
Naini	0.4	1.1	0.75

Table 3: Total coliform count of the fruit juice contact surfaces on sieve.

1.1×10^3 cfu/ cm² and a maximum total coliform count of 1.8×10^3 cfu/ cm². Comparing these results to the recommended guidelines for cleans surfaces with respect to food contact, it can be seen that it is above the standard required. This indicates that, the sanitary practices on extractor is very poor, thus causes cross contamination of the fruit juices prepared. This means the juice is unhygienic and not safe for human consumption and could cause harm to the consumer (Figure 1). In these results, the null hypothesis states that the mean coliform count value of the utensils (collectors) from the 3 different locations are equal using ANOVA. From Table 1, with respect to location, the p-value is 0.459 which is less than the calculated value 0.826. Thus the null hypothesis is accepted which indicates that there are no significant differences of the mean coliform count value in the extractors from these three locations. With respect to the replication of samples, the p-value is greater than the calculated value ($0.796 > 0.256$), thus the null hypothesis is accepted. Which means that there are significant differences in each replication of sample thus critical value for each sample was calculated. The critical value calculated was 0.501. Comparing the tested mean of each samples which were 0.25, 0.30 and 0.05 to the critical value 0.501, they were lesser than the critical value thus differs significantly among each other. The microbial analysis of fruit juice contact surfaces on utensils (collectors) is shown in Table 2.

In Table 2, the maximum mean value recorded for the total coliform count on collectors was 1.15×10^3 cfu/ cm² from Naini and the minimum mean value obtained was from Dandi which had a mean coliform count of 0.9×10^3 cfu/ cm². With respect to locations, the collectors from Dandi recorded a minimum total coliform count of 0.8×10^3 cfu/ cm² and a maximum total coliform count of 1.0×10^3 cfu/ cm². The collectors from Mahewa recorded a minimum total coliform count of 0.9×10^3 cfu/ cm² and a maximum total coliform count of 1.1×10^3 cfu/ cm². Finally, the collectors from Naini recorded a minimum total coliform count of 0.9×10^3 cfu/ cm² and a maximum total coliform count of 1.4×10^3 cfu/ cm². Comparing these results to the recommended guidelines for cleans surfaces with respect to food contact, it can be seen that it is above the standard required. This indicates that, the sanitary practices on collector is very poor, thus causes cross contamination of the fruit juices prepared. This means the juice is unhygienic and not safe for human consumption and could cause harm to the consumer (Figure 2).

In these results, the null hypothesis states that the mean coliform count value of the utensils (collectors) from the 3 different locations are equal using ANOVA. From the Table 2, with respect to location, the p-value is 0.497481 which is less than the tabulated value 0.675676. this means that the null hypothesis is rejected which indicates that there are no significant differences of the mean coliform count value on the utensils (collectors) from these three locations. With respect to the replication of samples, the p-value is greater than the tabulated value ($0.6607 > 0.5134$), thus the null hypothesis is accepted. Which means that there are significant differences in each replication of sample thus critical value for each sample was calculated. The critical difference value calculated was 0.5. the tested mean of each samples were 0.1, 0.25 and 0.15 which were all less than the critical value 0.5 thus not

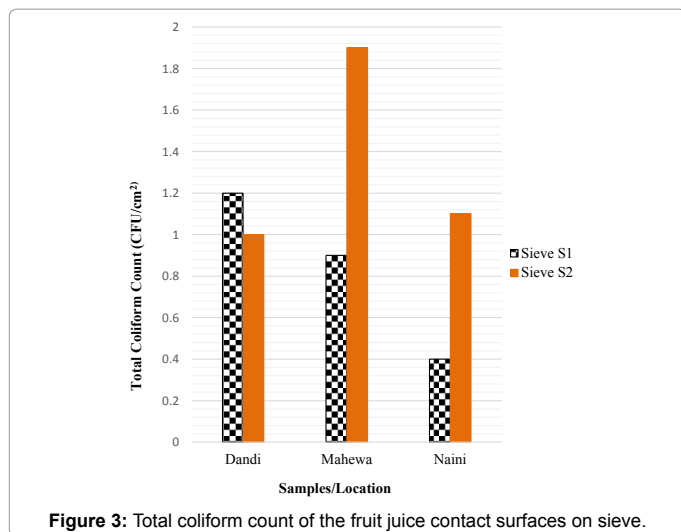


Figure 3: Total coliform count of the fruit juice contact surfaces on sieve.

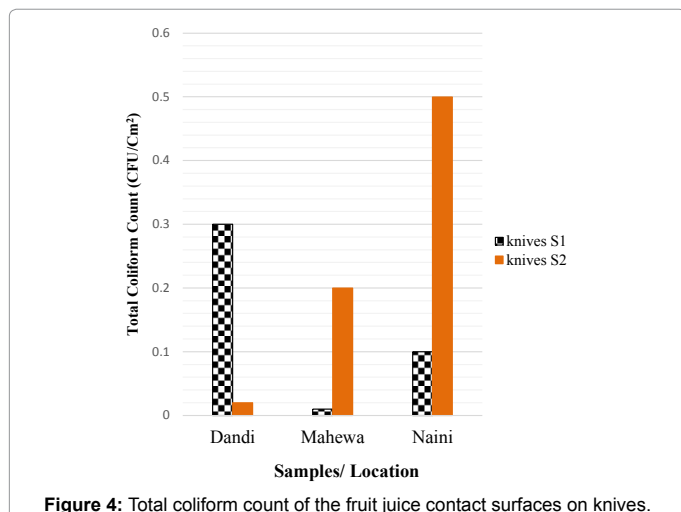


Figure 4: Total coliform count of the fruit juice contact surfaces on knives.

Location	Total Coliform Count × 10 ³ (CFU/ cm ²)		
	Knives		Mean
	S1	S2	SM
Dandi	0.3	0.02	0.16
Mahewa	0.01	0.2	0.11
Naini	0.1	0.5	0.3
Critical difference			0.496

Table 4: Total coliform count of the fruit juice contact surfaces on knives.

significantly different from each other. The microbial analysis of fruit juice contact surfaces on sieve is shown in Table 3.

In Table 3, the maximum mean value recorded for the total coliform count on the sieves was 1.4×10^3 cfu/ cm² from Mahewa and the minimum mean value obtained was from Naini which had a mean coliform count of 0.75×10^3 cfu/cm². With respect to locations, the sieve from Dandi recorded a minimum total coliform count of 1.0×10^3 cfu/ cm² and a maximum total coliform count of 1.2×10^3 cfu/ cm². The sieves from Mahewa recorded a minimum total coliform count of 0.9×10^3 cfu/ cm² and a maximum total coliform count of 1.9×10^3 cfu/ cm². Finally, the sieve from Naini recorded a minimum total coliform count of 0.4×10^3 cfu/cm² and a maximum total coliform count of 1.1×10^3 cfu/ cm². Comparing these results to the recommended guidelines

for cleans surfaces with respect to food contact, it can be seen that it is above the standard required. Few of the sieves had total coliform count on the borderlines while most had unsatisfactory counts. This indicates that, the sanitary practices on sieve is very poor, thus causes cross contamination of the fruit juices prepared. This makes the juice unhygienic and safe for consumption and could cause harm to the consumer (Figure 3).

In these results, the null hypothesis states that the mean coliform count value of the sieve from the 3 different locations are equal using ANOVA. From the Table 3, with respect to location, the p-value is 0.299 which is less than the tabulated value 1.923. This means that the null hypothesis is rejected which indicates that there are no significant differences of the mean coliform count value on the sieves from these three locations. With respect to the replication of samples, the p-value is also less than the tabulated value ($0.479 > 1.085$), thus the null hypothesis is also rejected. Which means that there were also no significant differences in each replication of samples. The microbial analysis of fruit juice contact surfaces on knives is shown in Table 4. In Table 4, the maximum mean value recorded for the total coliform count on the knives was 0.3×10^3 cfu/ cm² from Naini and the minimum mean value obtained was from Mahewa which had a mean coliform count of 0.11×10^3 cfu/ cm². With respect to locations, the knives from Dandi recorded a minimum total coliform count of 0.02×10^3 cfu/ cm² and a maximum total coliform count of 0.3×10^3 cfu/ cm². The knives from Mahewa recorded a minimum total coliform count of 0.01×10^3 cfu/ cm² and a maximum total coliform count of 0.2×10^3 cfu/ cm². Finally, the knives from Naini recorded a minimum total coliform count of 0.1×10^3 cfu/ cm² and a maximum total coliform count of 0.5×10^3 cfu/cm². Comparing these results to the recommended guidelines for cleans surfaces with respect to food contact, it can be seen that most if the knives had total coliform count on the borderlines while some had satisfactory counts. This indicates that, the sanitary practices on knives is very poor, thus causes cross contamination of the fruit juices prepared (Figure 4).

In these results, the null hypothesis states that the mean coliform count value of the sieve from the 3 different locations are equal using ANOVA. From the Table 4, with respect to location, the p-value is 0.658 which is greater than the tabulated value 0.264. This means that the null hypothesis is accepted which indicates that there are significant differences of the mean coliform count value on the knives from these three locations. With respect to the replication of samples, the p-value is greater than the tabulated value ($0.749 > 0.020$), thus the null hypothesis is accepted. Which means that there are significant differences in each replication of sample thus critical value for each sample was calculated. The critical value calculated was 0.496. Comparing the tested mean of each samples to the critical value which were 0.19, 0.14 and 0.05 which are all less than the critical value, hence does not differ significantly from each other.

Conclusion

Even though the dangers of these unpasteurized fruits could be as a results from contamination due to exposure of tools and even the fruits to poor atmospheric conditions such as dust, flies and other airborne pathogens. The business of unpasteurized juice production by street vendors has increased dramatically due to the following factors (a) it is inexpensive to establish (b) no special skill is required (c) no certificate is required from any governmental quality control agency to commence such business and lastly (d) it is the preferential business avenue for the less privileged especially in the rural communities in

India. The findings, as recorded in diagrams above, it will be noticed that it is evident that the tools used by these street fruit juice vendors are easily contaminated by dust, flies and other air-borne pathogens and the juice prepared, even though are fresh, could be harmful for human consumption. It can be concluded that the handling practices toward juice preparation, extraction methods and washing of equipment were observed to be very poor. General hygiene of vendors and premises were poor. Poor waste management within preparation and vending sites encouraged contamination of the juices. It is therefore recommended that (a) sanitation sensitization task force be formed by the local government to educate these fruit juice vendors about the harmful effects of exposure of their extraction tools to unfavourable atmospheric condition which could cause contaminations and sickness to patrons of these fruit juices (b) because the fruit juice vending is the livelihood of the poor population, tougher sanction could collapse their business, hence the need for hygienic sensitization.

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