

MICROBIOLOGICAL PROFILE OF STREET VENDED FOODS IN COCHIN, KERALA INDIARashmi H Poojara^{1*} and Krishna G2

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ABSTRACT

This study was undertaken to investigate the availability of street foods in the city of Cochin. A survey was done to determine the availability in the selected ten wards. The data collected revealed that a total of 66 street food outlets were present which served more than fifty different preparations. The focus of the study was to examine the microbiological profile of street foods. The street foods were classified on the basis of degree of processing as unprocessed, semi processed and processed foods. From each category two food stuffs were selected and three samples were collected for the assay. Apart from the food samples five, water and ice samples from the outlets were collected. Microbiological parameters assayed were *S aureus*, *V cholerae*, *Salmonella*, Total coliforms and *E coli*. Majority of the water and ice samples were not potable. Microbiological assay revealed that high temperature processing of foods make them microbiologically safe for human consumption by killing pathogenic organisms. The results reveal high degree of contamination in unprocessed foods and semi processed foods. Processed foods that have undergone processing at high temperatures are less contaminated. Water and ice used by street food vendors was microbiologically unsafe.

Key words: Street foods, Semi processed Unprocessed, Processed, microbiological swab test, HACCCP.

INTRODUCTION

Street foods are defined as ready to eat foods and beverages sold by vendors and hawkers especially in the streets and other similar places (FAO, 2000). Street foods exist because of their easy availability, variety, prevailing socio economic conditions and also the influx of unorganized labour. Though the appearance of street foods was unwelcome initially. They persist to exist because of several contributing factors like increasing labour force and consumer demand due to rapid industrialization (Chakravarty, 1995).

Safety of street foods is questionable as in most cases they are prepared under unsanitary conditions by the vendors who are by and large illiterate and have poor personal hygiene. The chances of contamination of these foods increase greatly due to extremely poor environmental condition in which they are prepared and served (Sheth M, 2005). Street foods are the cause of several types of food - borne disease. The water used for drinking and cleaning purposes is often contaminated due to unhygienic storage and handling. Moreover use of artificial colours, like metanil yellow, are the cause of serious health

hazards. Proper garbage removal facilities are also not available, thus leading to poor environmental condition (Chakravarty, 2003).

Studies on street food in developing countries have shown that such foods were responsible for serious food poisoning outbreaks as these foods are sometimes found to be contaminated with pathogens (Sheth *et al.*, 2005). So, far in India only very few organized attempts have been made to study urban street foods. Although sporadic attempts have been made to find out the pattern of street foods available in major Indian cities, detailed studies on the availability, consumption pattern and food safety aspects of street food remain unexplored (Chandrasekhar *et al.*, 2000). Choudhury *et al.*, 2010 conducted a study on the socioeconomic profile and food safety knowledge of street food vendors in Guwahati and found the scenario to be quite dismal and recommended steps to improve matters. So the present study was conducted in Cochin with the following specific objectives.

- 1) To obtain an insight into the availability of street foods in ten randomly selected wards of Kochi Corporation.

2) To perform microbiological assay on selected street food samples, which are classified on the basis of degree of processing undergone as unprocessed, semi processed and fully processed foods.

MATERIALS AND METHODS

Availability of Street Foods:

In order to determine the availability of street foods ten wards were randomly selected from the total seventy one wards of the city and a survey was conducted.

Sampling: A total of eighteen food samples undergoing different degrees of processing were aseptically collected. The street foods were classified into three categories, Unprocessed Foods., Semi processed Foods and Processed Foods. Unprocessed food is foods which have not undergone any heat treatment. Carrot and Watermelon juice samples were selected from this category. Semi processed Food includes foods where the preparation includes ingredients which are processed as well as added raw to the final preparation. Coconut chutney and Bhelpuri samples were selected from this category. Processed Food which have been completely processed and subjected to high temperature treatment. Samosa and Kozhukatta samples were selected from this category. Six samples from each of the above categories were collected under aseptic conditions from street food outlets to assess their microbiological quality. Apart from food samples a total of five ice and water samples each were aseptically collected from five different street food outlets in Cochin. The samples were transported to the laboratory and were analyzed within one hour of collection.

Microbiological analysis

Sample preparation: For the microbiological assay 25g of food samples were taken and for water, ice and juices 100g of sample were taken. Presence of faecal coliforms were determined using Brilliant Green Lactose Bile broth (44.50C/48hrs.), followed by confirmation of gas positive tubes using Eosin methylene Blue agar Inoculated plates were incubated at requisite time-temperature combinations [FAO 1979, USFDA BAM, 2001]. *Escherichia coli* were isolated and enumerated using MacConkey's agar with crystal violet and

eosin methylene blue (EMB) agar (37°C, 24 - 48 h). Colonies on MacConkey's agar were small, round and pink, whereas colonies were round with a typical metallic sheen on EMB agar. Two to three characteristic colonies were labelled and transferred to nutrient broth for further identification. Microscopic examination was carried. Characterization and identification of organisms was done using biochemical tests (indole, methyl red, Voges Proskauer test, urease,).

Staphylococcus aureus was determined by the spread plate method using Baird-Parker agar with egg yolk tellurite emulsion (Oxoid Ltd.). The plates were incubated at 37°C for 48 h. In order to determine *Staphylococcus aureus* counts, random isolates from suitable plates were picked, purified and tested for gram stain, catalase activity, modified oxidase test, coagulase activity and thermo-stable nuclease activity (Lancette and Tatini, 1992). For detecting the presence of *Salmonella*, portions of sample were pre-enriched with Universal preenrichment broth, inoculated in to selective enrichment medium (Tetra thionate broth + Iodine solution + Brilliant green) and enumerated on Xylose –Lysine Deoxycholate agar. For detecting the presence of *Vibrio cholerae* incubate the alkaline Peptone broth at 37° c for 18 hrs. At 6th, 15th and 18th hr. of incubation streak a loopful of culture on thiosulphate citrate bile salts sucrose agar (TCBS) and incubate at 37°c for 18–24hrs.

RESULTS AND DISCUSSION

The study highlighted that the eating habits of a considerable number of people in Cochin have changed and the street food sector of the city is mushrooming. A total number of sixty six outlets were observed in the selected ten wards. Beverages, chats, snacks and main meals were the main categories of street foods sold in Cochin. In all, nearly fifty different preparations were sold on the streets in the ten wards studied. In the present study, selected street food samples are assayed microbiologically. Carrot and Watermelon juice samples obtained from three street food outlets were analyzed. Microbiological quality of carrot and watermelon juice is reported in Table 1. As evident from the table, a high count in the range of 10⁵ cfu/ml *Staphylococcus aureus* was observed in all the samples of both the beverages.

Table 1: Microbiological quality of unprocessed foods

Parameters (cfu/ml)	Carrot Juice			Watermelon juice		
	S ₁	S ₂	S ₃	S ₁	S ₂	S ₃
<i>Staphylococcus aureus</i>	23×10 ⁵	81 ×10 ⁵	106×10 ⁵	42 ×10 ⁵	7 ×10 ⁵	27 ×10 ⁵
<i>Vibrio cholerae</i>	Absent	Absent	Present	Present	Present	Present
<i>Salmonella</i>	Present	Present	Present	Present	Present	Present

Table 2: Microbiological quality of semi processed foods

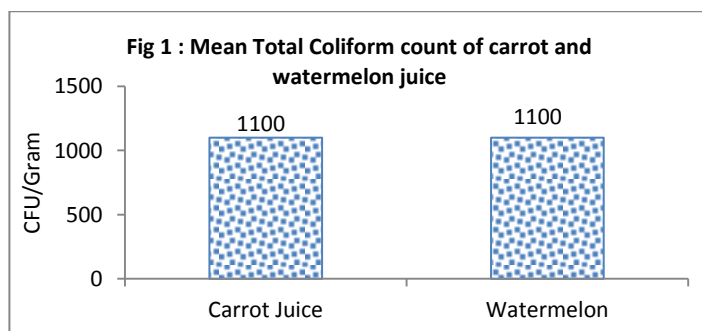
Parameter (cfu/g)	Bhelpuri			Coconut chutney		
	S ₁	S ₂	S ₃	S ₁	S ₂	S ₃
<i>Staphylococcus aureus</i>	3 × 10 ⁵	7 ×10 ⁵	38×10 ⁵	86 ×10 ⁶	77×10 ⁵	109×10 ³
<i>Vibrio cholerae</i>	Present	Present	Present	Present	Absent	Present
<i>Salmonella</i>	Absent	Absent	Absent	Absent	Absent	Absent

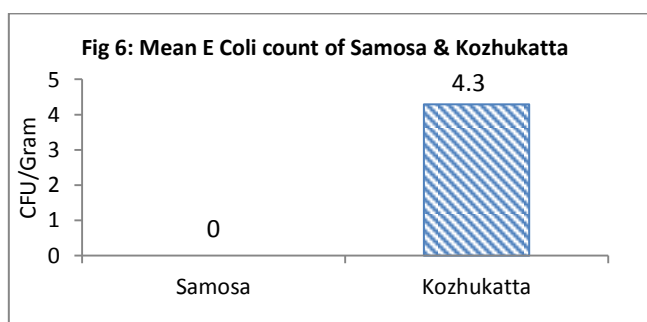
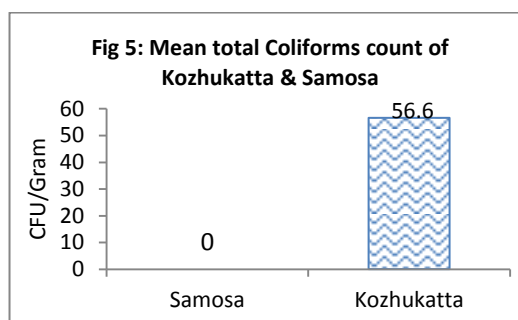
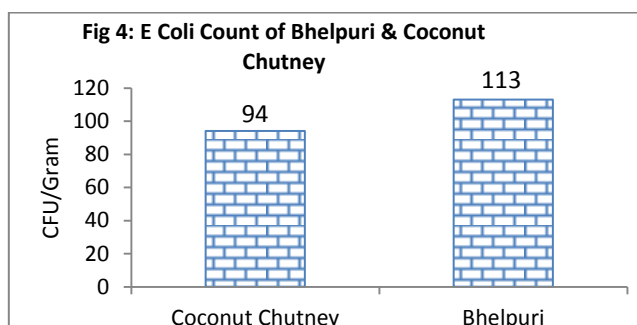
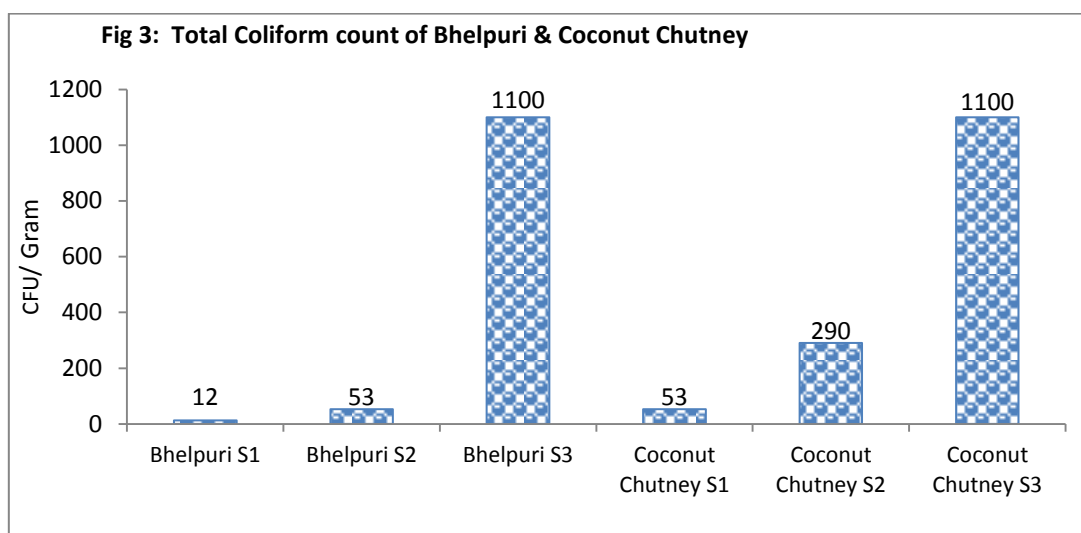
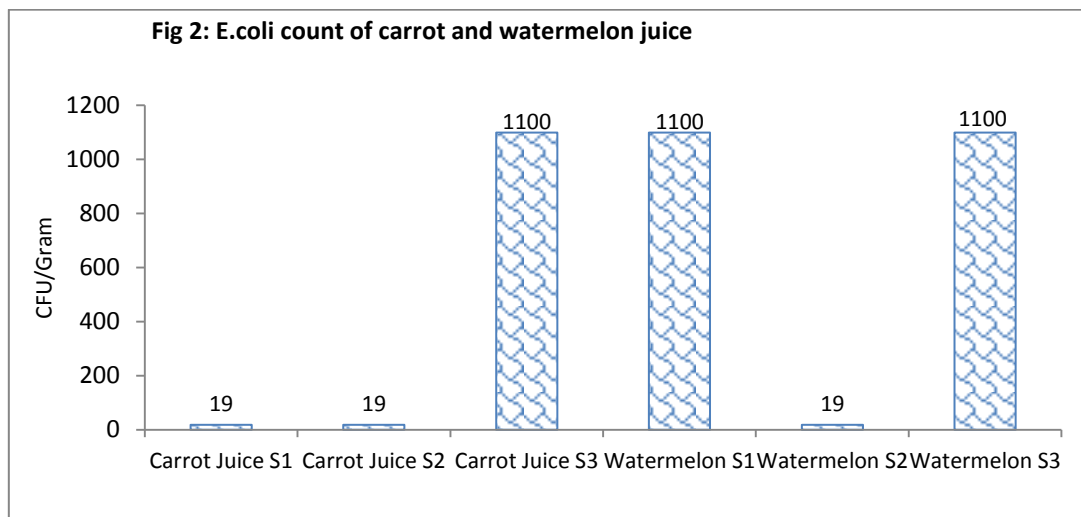
Table 3: Microbiological quality of processed foods

Parameter (cfu/g)	Kozhukatta			Samosa		
	S ₁	S ₂	S ₃	S ₁	S ₂	S ₃
<i>Staphylococcus aureus</i>	84×10 ⁴	34 ×10 ⁴	35×10 ⁶	1 ×10 ²	1 × 10 ²	32 ×10 ²
<i>Vibrio cholerae</i>	Present	Present	Absent	Absent	Absent	Absent
<i>Salmonella</i>	Present	Present	Absent	Absent	Absent	Absent

Table 4: Microbiological quality of water and ice samples

Parameter (cfu/ml)	water samples					Ice Samples				
	S ₁	S ₂	S ₃	S ₄	S ₅	S ₁	S ₂	S ₃	S ₄	S ₅
<i>Staphylococcus aureus</i>	Nil	Nil	18×10 ⁵	Nil	2 × 10 ⁴	12 × 10 ⁶	19 ×10 ⁶	Nil	7 ×10 ³	5 × 10 ⁴
<i>Vibrio cholerae</i>	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Present	Absent
<i>Salmonella</i>	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
Total coliform	1100	4	1100 ⁺	0	0	150	1100 ⁺	9	290	1100
<i>E Coli</i>	240	0	240	0	0	28	1100 ⁺	9	210	150





The mean count of *Staphylococcus aureus* in carrot and watermelon juice were found to be 7×10^6 cfu/g and 25.3×10^5 cfu/g respectively. The reason for the high prevalence of *Staphylococcus aureus* could be the poor personal hygiene of the food handlers and the lack of heat processing steps during the preparation. *Staphylococcus aureus* is one of the most common agents of food poisoning. *Salmonella* and *Vibrio cholerae* are known to be important food safety hazard associated with beverages. In the present study, *Salmonella* was qualitatively detected in all the samples. While, *Vibrio cholerae* was detected in sample S₃ of carrot juice and all the three samples of watermelon juice. The presence of both these pathogens indicates poor handling, and a potential for these beverages to cause food borne diseases.

Figure 1 and Figure 2, shows the Mean Total Coliform count and the *E coli* count of carrot and watermelon juice. A high mean Total coliform count of above 1100 cfu/ml was observed in both the beverages. The presence of high numbers of Coliforms indicates; inadequate processing and/or post process recontamination due to cross-contamination by raw materials, dirty equipment or poor hygienic handling as well as microbial proliferation allowing multiplication of a wide range of pathogenic and toxigenic organisms. It is evident from the figure that, from all the samples analyzed *E coli* count was above 1100 cfu/ml in sample S₃ of carrot and samples S₁ and S₃ of watermelon juice. While, all other samples showed an *E coli* count of 19 cfu/ml. The substantial numbers of *E coli* in foods suggest a general lack of cleanliness in handling and improper storage. *E coli* is an indicator of faecal contamination. *E coli* are most often spread from person-to-person. Both animals and people infected with the bacteria can be carriers. Therefore, proper hygiene, safe food handling and preparation practices are the key to preventing food -borne illness. If the vendor is infected with *E coli* bacteria or any other gastrointestinal illness, he should not prepare food for other people unless he wears disposable gloves and follows safe food handling procedures.

Microbiological profile of Bhelpuri and Coconut chutney were studied. As shown in Table 2, high count of *Staphylococcus aureus* were obtained for bhelpuri and coconut chutney samples. The mean *Staphylococcus aureus* count of

bhelpuri and coconut chutney samples was 16×10^5 cfu/g and 31269.6×10^3 cfu/g respectively. It was observed that *Salmonella* was absent in all the samples assayed. On the other hand, *Vibrio cholerae* was present in five samples except one, sample S₂ of coconut chutney. The presence of *Vibrio cholerae* indicates contamination due to poor handling.

Figure 3 and figure 4 highlights, the Total Coliform count and the mean *E coli* count of Bhelpuri and Coconut chutney. It is observed that sample S₃ of bhelpuri and coconut chutney has very high Coliform count of above 1100^+ cfu/g. All the other samples have comparatively lower coliform counts. On the other hand both the food stuffs showed high counts of *E coli*. The mean *E coli* count of bhelpuri and coconut chutney was found to be 113 cfu/g and 94 cfu/g, respectively. The presence of *E coli* and Total coliforms in the food samples indicate poor sanitary quality. *E coli* are indicative of faecal contamination of the food samples.

Kozhukatta and Samosa were the foodstuffs selected from the processed food category for the microbiological assay. Kozhukatta is a steamed snack made of rice flour with a stuffing of sweetened coconut while samosa is a deep fat fried snack prepared with refined flour and vegetable stuffing. Microbiological analysis of Samosa samples as shown in Table 3 reveals that, both the pathogens *Salmonella* and *Vibrio cholerae* were absent in all the three samples. But all the samples showed the presence of *Staphylococcus aureus*. The mean *Staphylococcus aureus* count obtained was 11.3×10^4 cfu/g. On the other hand, microbiological assay of Kozhukatta showed the presence of *Vibrio cholerae* and *Salmonella* in the two samples S₁ and S₂. While *Staphylococcus aureus* was present in all samples with a mean count of 1206×10^4 cfu/g. The Mean Total Coliforms Count of Kozhukatta and Samosa samples were found to be 56.6 cfu/g and 0 cfu/g respectively as shown in Figure 5. Whereas the Mean *E Coli* count of Kozhukatta and Samosa were 4.3 cfu/g and 0 cfu/g respectively as shown in Figure 6. The microbial analysis revealed that the levels of contamination were low in processed food stuffs since both the food stuffs were subjected to high temperature treatment. The samosa samples showed a superior microbial quality compared to kozhukatta.

This was due to the difference in the temperature treatments as well as degree of handling by the food handler to which the food is subjected. Samosas were subjected to a deep fat frying temperature of 155-185°C. On the other hand kozhukatta undergoes steaming at reasonably high temperature of 125°C. Kozhukatta were the foodstuff which is subjected to excessive handling by the food handler. The results of this study demonstrate that the microbiological quality of unprocessed food is extremely poor. Followed by semi processed foods which also shows a poor microbiological profile. Processed foods that have undergone processing at high temperatures are microbiologically safe.

Microbiological assay of water and ice samples collected from five street food outlets was performed. The drinking water served at the outlets was collected under aseptic conditions. As shown in table 4, all the water samples showed absence of *Vibrio cholerae* and *Salmonella*. Sample S₄, was devoid of any contamination. While S₅ showed only the presence of *Staphylococcus aureus* with a count of 2×10⁴ cfu/ml. Samples S₁, S₂ and S₃ shows the presence of coliforms and *E.coli* hence are not potable. On the other hand, Microbiological analysis of edible ice samples revealed, among the five samples, sample S₂ had a high *Staphylococcus aureus*, Total coliform and *E coli* count of 19 x 10⁶ cfu/ml, 1100⁺ cfu/ml respectively. *Salmonella* was absent in all the samples. While *Vibrio cholerae* was present only in sample S₂ and S₄. Since all the samples showed the presence of Coliforms and *E coli* none of them can be considered desirable for consumption.

In many cities, a faster pace of life and the migration of villagers to the city have resulted in the rapid proliferation of 'street foods' since they act as a convenient source of food. Cochin which is a prominent city is in the grip of sudden and unprecedented urban growth. Consequently, the

demand for non-traditional services like street food vending has increased. But only little is known about availability, consumption pattern and food safety aspects of street food in Cochin. Unfortunately, lack of attention to hygiene and poor access to clean water and waste disposal have made street food a source of significant public health problems. Hence steps must be taken to make street foods safer. Microbial contamination of ready-to-eat foods and beverages sold by street vendors has become a global health problem. Street vended foods like breakfast items and fruit juices sold in almost all the cities throughout India are consumed by huge Population. In a study to investigate the microbiological quality of street foods like breakfast items and fruit juices sold in Tirumala, India four breakfast items and two fruit juices samples were aseptically collected from six areas. The samples were analyzed by standard procedures within an hour of procurement. Analysis of the food samples revealed high loads of bacterial pathogens such as Total bacterial count, Yeast/Mould, coliforms, *Staphylococcus aureus* and *Bacillus cereus*. Total bacterial count in all the samples varied between 12.16-25.81x10⁶ cfu/g, coliforms between 0.28 -3.99x10⁶ cfu/g and Yeast/Moulds between 3.93-8.0x10⁶ cfu/g. *Bacillus cereus* and *Staphylococcus aureus* are also present all the food items. The presence of microorganisms indicated contamination of the processing water as well as the prevailing unhygienic conditions related to the location of the food stalls and especially in dusty road side locations (Suneetha *et al.*, 2011).

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