RESEARCH ARTICLE

Bacterial Identification and Profiling of Selected Street Foods

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Abstract

India is renowned for its diverse and vibrant street food culture, with a substantial portion of the population regularly indulging in these local delicacies. This study evaluates the bacteriological quality of a variety of street foods sold across different regions of Jabalpur city. A total of 48 samples—including pani puri, chaat, mango shakes, and sugarcane juice—were aseptically collected from various locations and analyzed within one hour of collection. Microbiological analyses involved serial dilution, pour plate techniques, selective and differential media, and biochemical characterization to identify bacterial contaminants.

Results revealed that sugarcane juice exhibited the highest total viable count (58.8–156.6 × 10^{-5} CFU), followed by pani puri (masala pani: 58.6–121.3 × 10^{-5} CFU; matar: 48–119.3 × 10^{-5} CFU), chaat (41–117 × 10^{-5} CFU), and mango shake (34.6–117 × 10^{-5} CFU). Several pathogenic microorganisms were detected in these samples, including *Enterobacter faecalis*, *Enterobacter aerogenes*, *Salmonella* spp., *Pseudomonas fluorescens*, *Streptococcus* spp., *Escherichia coli*, *Klebsiella pneumoniae*, *Shigella* spp., *V. vulnificus*, *V. parahaemolyticus*, *V. cholerae*, *Micrococcus luteus*, and *Proteus mirabilis*—all of which are known to cause foodborne illnesses. These findings underscore the widespread presence of pathogenic bacteria in street foods, posing significant public health concerns. The study highlights the urgent need for health education programs targeting street food vendors to promote safe food handling and hygiene practices. Enhancing awareness and training among vendors can substantially reduce the risk of foodborne diseases and improve the overall microbiological safety of street food.

Keywords: Street food; Foodborne pathogens; Microbiological contamination; Hygiene practices, Public health.

Highlight

- Samples of street food from Jabalpur city exhibited a high bacterial presence.
- A variety of pathogens, including *Escherichia coli, Salmonella, and V. cholerae,* were identified in the samples.
- Among all samples analyzed, sugar cane juice demonstrated the highest total viable count.
- Findings highlight the importance of health education for vendors and better food handling practices.
- Contaminated street food poses a risk of foodborne infections, underscoring the importance of proper hygiene and regulation.

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Introduction

A principal determining factor of health is the consumption of nutritious food. Food quality encompasses two significant aspects. Firstly, the food must possess substantial nutritive value, and it is equally important that it remains free from contamination by harmful agents and deleterious constituents that could compromise health and lead to disease. Consequently, ensuring food safety is a crucial cornerstone in preserving health.

Food serves as the most essential requirement for humans. Eradicating world hunger is recognised as one of the sustainable development goals. Simply having food available is not sufficient; it also must be safe and devoid of harmful microorganisms to support growth and development. Food offers nutrition only when pure, fresh, and free from dangerous substances like pathogenic bacteria. Contaminated food poses health risks and diminishes the quality of life. Recognising this vital issue, the WHO-themed World Health Day 2015 is about food safety, focusing on ensuring food is safe from 'farm to plate.' The WHO also outlined five essential keys for safer food: having clean facilities, keeping raw and cooked items separate, thoroughly preparing food, ensuring safe temperatures, and using safe water and ingredients (WHO, 2015).

The Eat Right Movement, initiated by the Food Safety and Standards Authority of India, aims to encourage individuals to choose healthier food and dietary options. Additionally, it ensures food safety from procurement to consumption and disposal (FSSAI, 2018). In India, significant economic expansion is occurring due to shifts in lifestyle and food consumption habits. Consequently, "eating out" has become a vital aspect of everyday life, particularly in urban settings (Kumar *et al.,* 2022). This trend drives the swift growth of street food.

Street food offerings present a wide array of fresh and delectable culinary choices that are easily accessible at economical prices. These offerings include various "ready-to-eat" meals and beverages prepared and sold by vendors and hawkers, predominantly in public areas such as streets (FAO, 2011). The street food sector is crucial in individuals' lives by

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providing various affordable, ready-to-eat meals, renowned for their distinctive flavours and convenience. (Rajeshwari *et al*., 2024; Asefa *et al.,* 2016). Approximately 2.5 billion people enjoy street food daily. (Alfiero *et al.,* 2019), rendering it a substantial aspect of our everyday existence. This cuisine is readily available on the streets, in public spaces, bustling markets, educational institutions, university campuses, and taxi stands. Notable street foods in India include pani puri, chaat, momo, noodles, pav bhaji, and chole bhature. Ensuring food safety is essential for quality, but it often raises concerns regarding street food. (Kharel *et al.,* 2016). Street vendors in developing nations constitute a significant source of foodborne illnesses. Conventional methods of processing and packaging, inappropriate holding temperatures, and poor personal hygiene among vendors are standard during preparation and sales. Food handlers play an important and crucial role in ensuring food safety throughout the entire food production and storage process. (WHO, 2000). Poor handling of food and neglected hygienic measures by vendors may facilitate pathogenic microorganisms to come into contact with food. In some cases, these microorganisms survive and multiply in large numbers to trigger the illness in the customer.

The primary factors contributing to microbial contamination encompass inadequate infrastructure, poor food preparation methods, substandard storage practices, the quality of cooking and cleaning utensils, water quality, and the hygiene standards maintained by food handlers. (Sufia *et al.,* 2015). Additional sources of contamination include the preparation area and surfaces, dust and debris on exposed food, poor wastewater drainage, limited access to clean water, inadequate reheating of cooked meals, and unsanitary practices by vendors (Nazni & Jaganathan, 2014). Consequently, the unhygienic conditions related to these foods' preparation, storage, and serving raise concerns about their microbial safety.

In India, research on street foods has shown that these items often fail to meet microbiological standards and are contaminated with different harmful pathogens. A study analysing 37 street food samples collected in Silchar City, Assam, India, has reported the identification of isolates of *Escherichia coli, Salmonella, Shigella*, and other microbial species. (Sharma & Mazumdar, 2014). These pathogens are recognized as causing severe foodborne illnesses. For example, *Escherichia coli* may lead to gastrointestinal complications, *Salmonella* can induce typhoid fever, *Shigella* can result in dysentery, and *Vibrio* species can result in cholera. The 12 panipuri samples collected in Orissa detected *Escherichia coli, Klebsiella* species, *Salmonella paratyphi, Shigella dysenteriae*, and *Vibrio* species. (Das *et al*., 2012a).

The present study focuses on four popular street food items: pani puri, chaat, mango shake, and sugar cane juice. These items were selected due to their widespread consumption, availability, and popularity among consumers in Jabalpur city, making them representative samples for assessing the microbiological quality of street food in the region.

Materials and Methods

Materials

Nutrient agar and various selective and differential media, such as MacConkey agar, Salmonella Shigella (SS) agar, thiosulphate citrate bile salt sucrose (TCBS) agar, eosin methylene blue (EMB), blood agar, soybean digest agar, Simmons citrate agar, and the IMVic Test Kit were procured from Hi-Media, Mumbai, and prepared according to the manufacturer's instructions.

Sampling

Street food samples, specifically pani puri, chaat, mango shakes, and sugarcane juice, were procured from street food vendors located in four distinct zones of Jabalpur City, Madhya Pradesh. Food samples were gathered in sterile plastic containers, sealed, and then transported to the laboratory, where they were processed within one hour of being collected.

Microbiology Analysis

One gram of each sample was ground using a pestle and mortar for the microbiological analysis of food samples. This sample was dissolved in 9 mL of sterile distilled water and thoroughly shaken with a vortex shaker to obtain a 10^1 dilution. 1 mL of this solution is transferred to a second tube containing 9 mL of sterile water, resulting in a 10^{-2} dilution of spore mass in the original material. The process was repeated to yield dilutions of 10^{-3}, $10^{-4,}$ and $10^{-5,}$ and up to 10^{-9} from each sample dilution will be prepared (Agarwal & Hasija, 1986). After serial dilution, the pour plate technique was applied to the nutrient agar media. After solidification, Petri plates were incubated upside down at 37°C for 24 hours in the B.O.D. incubator. After incubation, the plates with the highest number of colonies were selected, and the number of colonies on these plates was counted. The isolated colonies of organisms were placed on a nutrient agar slant for both maintenance and further identification. This process was repeated for each sample, ensuring thorough and accurate analysis.

Identifying and isolating bacteria

Gram staining, growth on the selective and differential media, and biochemical analysis tests, including catalase, citrate, indole, oxidase, urease, MR (methyl red), VP (Voges pressure), motility, amylase, casein, and carbohydrate utilization (glucose and sucrose) for various bacterial isolates were performed to identify bacteria. Once identified, the pure culture is preserved in the laboratory's culture collection center for future use and maintenance.

Results and Discussion

In developing nations, street food vendors serve millions of individuals. These foods offer a cost-effective source of essential nutrients for low-income populations, who value them for their flavor, affordability, and convenience. (Winarno and A. Allain, FAO, 1988; Nazni and Jaganathan, 2014). Notwithstanding these advantages, there exists an increasing concern regarding their safety and quality. Street foods are often linked to foodborne diseases that result from inadequate handling and serving practices (Tambekar *et al*., 2008b). Foodborne illnesses stem from pathogenic bacteria, viruses, protozoa, and chemical contamination, which are recognized as paramount public health challenges.

This study examined 48 street food samples, including pani puri, chaat, mango shakes, and sugarcane juice, from various

regions in Jabalpur for the presence of bacterial pathogens using the pour plate method with multiple serial dilutions. For the pani puri evaluation, each sample was divided into two portions (the liquid khatta paani and the boiled matter masala) for detailed analysis. The total viable count (CFU/mL) at various dilutions is shown in Table 1.

Table 2 presents the mean and standard deviation of the bacterial counts (CFU × 10^5) for the selected street food items. Figure 1 reveals that sugar cane juice exhibited the highest total viable count (58.8–156.6×10^{-5} CFU) among all areas in Jabalpur, followed by pani puri (masala pani 58.6-121.3×10^{-5} CFU and matar 48119.3×10^{-5} CFU), chaat (41–117×10^{-5} CFU), and mango shake (34.6-117×10^{-5} CFU).

Higher bacterial count in sugar cane juice might result from the use of unhygienic water in dilutions, ice-dressing, extended retention without refrigeration, and unhygienic conditions, frequently characterized by stench and surroundings swarming with houseflies, fruit flies, and airborne dust. Furthermore, microbial contamination of sugarcane juice can occur at various stages, such as through contamination of the sugarcane, the roller drum crusher machine, the container used for collecting juice, ice added to the sugarcane juice, filters, and the hands of handlers. According to the Food Safety Standard Authority of India (2011), the recommended limits for bacteria should be no more than 50 CFU/mL, which were found to be significantly higher in this study.

Panipuri often becomes contaminated due to the unsanitary conditions in which it is prepared and sold. Vending sites frequently lack running water, leading to hand and dishwashing in buckets, and occasionally without soap (Baruah *et al*., 2022; Das *et al*., 2012a). The high microbial load in chaat may be attributed to the addition of boiled potatoes, peas, sour, chili,

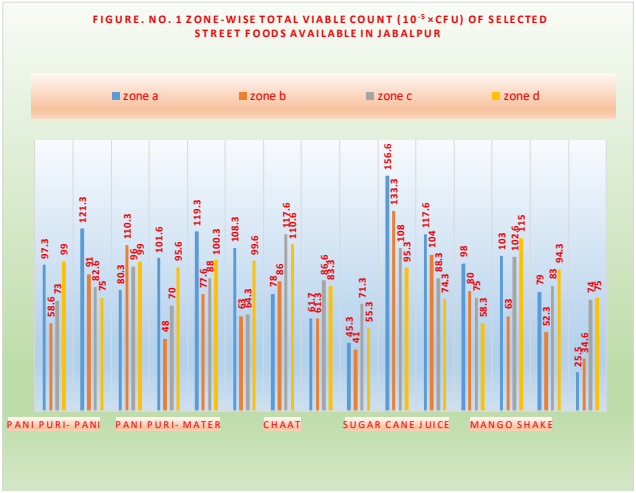


Fig. 1: Zone-wise total viable count (10-5 ×CFU) of selected street foods available in Jabalpur

and sweet chutney. Additionally, onions and coriander leaves, which are often cut well before use, are used as toppings and garnishes, potentially contributing to bacterial contamination.

This elevated count is likely attributable to contamination factors, which may include unsanitary equipment, open containers, improperly positioned garbage bins, infrequent hand hygiene practices, inadequate food processing and cooking procedures, using tainted and dirty water for preparation and washing, and cross-contamination from utensils like chopping boards, knives, and serving tools (Derbew *et al*., 2013; Mahale *et al*., 2008 and Wei Q *et al*., 2006).

The elevated levels of bacterial load in mango shakes are closely associated with the environmental microflora present

Table 1: Zone-wise Bacterial Count (CFU) of Selected Street Food Samples in Different Dilutions Factors

Food samples	*Zone A*			*Zone B*			*Zone C*			*Zone D*		
	10-4	10-5	10-6	10-4	10-5	10-6	10-4	10-5	10-6	10-4	10-5	10-6
Pani puri - pani	110	79	61	61	50	48	97	76	43	132	101	77
	100	97	76	119	89	65	119	84	81	96	74	49
	127	112	95	134	109	87	124	99	74	124	99	71
pani puri-Matar	107	100	98	82	42	16	102	90	58	114	97	56
	121	109	90	99	76	45	120	72	68	128	103	89
	109	89	73	78	62	39	87	69	57	120	103	93
Chaat	68	60	53	76	49	36	118	95	73	120	93	65
	87	71	45	84	55	40	129	89	80	113	82	59
	79	54	38	98	80	47	106	76	61	99	75	42
Sugar cane juice	195	140	119	145	110	87	98	65	56	80	65	49
	153	114	100	123	94	70	108	99	75	97	73	62
	122	99	76	132	108	83	118	101	94	109	85	64
Mango shake	85	61	30	45	31	20	79	56	47	112	94	73
	101	79	53	81	69	43	89	74	59	108	87	64
	123	97	81	63	57	41	140	119	116	125	102	88

Table 2: Mean and SD of bacterial count (CFU×10-5) of selected street food samples

Food samples	*zone a*	*zone b*	*zone c*	*zone d*
	97.3 ± 2.5	58.6 ± 2.5	73 ± 3	99 ± 2
Pani puri- pani	121.3 ± 5.13	91 ± 2	82.6 ± 1.5	75 ± 1
	80.3 ± 1.5	110.3 ± 2.5	96 ± 2.6	99 ± 2
	101.6 ± 4.7	48 ± 1.5	70 ± 2	95.6 ± 1.5
Pani puri- mater	119.3 ± .1.52	77.6 ± 2	88 ± 2	100.3 ± 2.5
	108.3 ± 3	63 ± 4.5	64.3 ± 5	99.6 ± 3
	78 ± 9.5	86 ± 11.1	117.6 ± 11.5	110.6 ± 10.6
Chaat	61.7 ± 8.6	61.3 ± 16.4	86.6 ± 9.7	83.3 ± 9
	45.3 ± 7.5	41 ± 5.56	71.3 ± 9.6	55.3 ± 11.9
	156.6 ± 36.6	133.3 ± 11	108 ± 10	95.3 ± 14.5
Sugar cane juice	117.6 ± 20.7	104 ± 8.7	88.3 ± 20.2	74.3 ± 10
	98 ± 21.5	80 ± 8.8	75 ± 19	58.3 ± 8.1
Mango shake	103 ± 19	63 ± 18	102.6 ± 32.7	115 ± 8.8
	79 ± 18	52.3 ± 19.4	83 ± 32.4	94.3 ± 7.5
	25.5 ± 54	34.6 ± 12.7	74 ± 36.8	75 ± 12.1

Table 3: No. of isolates, gram staining, morphological structure and identified bacteria from selected street food samples

Food sample	*No. of isolates*	*Gram staining*	*Morphological structure*	*Identified bacteria*
Pani puri – masala pani	6	-	Rod chain	Enterobacter faecalis
		-	Rod	Salmonella sp.
		-	Rod chain	Pseudomonas fluorescence
		-	Rod chain	Protease sp.
		+	Coccus	Streptococcus sp.
		-	Rod	E. coli
Mater	4	-	Rod	Enterobacter aerogenes
		-	Rod	e. coli
		-	Rod	Klebsiella pneumonia
		-	Rod	Salmonella sp.
Chaat	7	-	Rod chain	Pseudomonas sp.
		+	Rod	Lactobacillus
		-	Rod	Shigella sp.
		+	Rod	Bacillus sp.
		-	Rod	V. vulnificus
		+	cocci	Micrococcus luteus
		+	Round	Streptococcus aureus
Sugar cane juice	4	-	Rod	Klebsiella pneumoniae
		-	Rod	V. parahaemolyticus
		-	Rod	Salmonella sp.
		-	Rod	V. cholerae
Mango shake	3	-	Rod	Protease mirabilis
		-	Rod	Enterobacter aerogenes
		-	Rod	Salmonella sp.

on the surfaces of mangoes and utensils, which may be contaminated with dirt heavily influenced by vehicular traffic. This contamination significantly affects the quality of the mango shake. Additionally, unsanitary practices in food handling, particularly insufficient washing of mangoes and tumblers prior to the preparation of shakes, are likely to exacerbate contamination, leading to a high microbial load in mango shakes. Moreover, the ice used by vendors serves as a substantial contributor to microbial contamination. Besides ice and milk, water may also represent a potential source of microorganisms.

A significant portion of the samples demonstrated the presence of various pathogenic bacterial species, indicating a compromise in the bacteriological quality of the food samples. Utilizing selective and differential media in conjunction with biochemical tests led to the identification of several bacterial isolates, including Salmonella spp., Pseudomonas fluorescence, Protease spp., Enterobacter faecalis, Streptococcus spp., E. coli, Enterobacter aerogenes, Klebsiella pneumonia, Salmonella sp., Pseudomonas sp., Lactobacillus, Shigella sp., Bacillus sp., V. vulnificus, Micrococcus luteus, Streptococcus aureus, V. parahaemolyticus, V. cholerae, and Protease mirabilis. The morphology of the isolates was assessed through gram staining, as depicted in Table 3, with the results of biochemical tests presented in Table 4. The master plates of isolated bacteria from selected street foods, cultured in selective and differential media, are shown in Fig. 2.

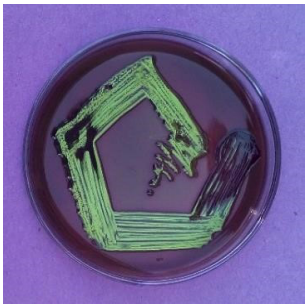
The growth and identification of bacterial isolates on selected and differential media involve various species, as shown in Figure 2, which exhibit *Klebsiella* sp. on MacConkey agar Fig.2 (a), *E. coli* in EMB agar Fig.2 (b), *Enterobacter aerogenes* in MacConkey Agar Fig.2 (c), Protease Sp. in blood agar Fig.2 (d), *Salmonella* sp. in SS Agar Fig.2 (e), *Pseudomonas* fluorescence in Cetrimide Agar Fig.2 (f), *Streptococcus* sp. in Blood Agar Fig.2 (g), *Enterobacter faecalis* in Mac. Agar Fig.2 (h), *V. cholerae* in TCBS Agar Fig.2 (i), *V. parahaemolyticus* in TCBS Agar Fig.2 (j), *V. vulnificus* in TCBS Agar Fig.2 (k), *Micrococcus luteus* in blood Fig. 2 (l), *Protease mirabilis* in Blood Agar Fig.2 (m), and *Bacillus* sp. in blood Agar Fig.2 (n).

Note: Ind-indole, Mr-methyl red, vp- Voges-Proskauer, Cat-Catalase, glu-glucose, suc-sucrose, cit- citrate, mot-motility, amy-amylase, ure-urease, cas- casinase, Oxi-Oxidase v- 11-89% positive *E. Escherichia coli, Enterobacter faecalis, Enterobacter aerogenes, Salmonella species, Pseudomonas fluorescens, Proteus species, Streptococcus species, and Klebsiella pneumoniae* were identified in panipuri samples. *Escherichia coli, Enterobacter species*, and *Klebsiella pneumoniae* may result from vendors' inadequate personal hygiene, unsanitary food handling practices, insufficiently cleaned dishware, and the incorporation of raw vegetables such as onions. Contamination can occur due to tainted water sources. Utensils cleaned and washed with contaminated water or water used in food preparation can lead to outbreaks of *Escherichia coli* and other coliform bacteria, which may be caused by improper hand washing by food workers, a lack of adherence to good manufacturing practices, and the use of contaminated water during food preparation (Tambekar *et al.,* 2011a). The presence of *Pseudomonas aeruginosa* may be linked to poor personal hygiene, unsanitary surroundings, transmission in vehicles, and insufficient sewage management.

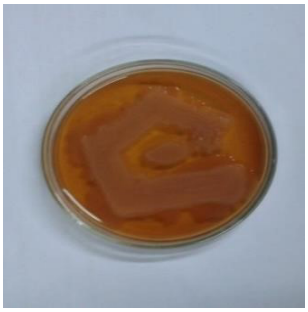
Table 4: Biochemical test results of identified bacteria from different street food samples

	gram stain	*ind*	*mr*	*vp*	*Cat*	*glu*	*suc*	*cit*	*mot*	*amy*	*ure*	*cas*	*Oxi*
E coli	-	+	+	-	+	+	+	-	+	-	-	-	-
Salmonella spp.	-	-	+	-	+	+	-	-	+	-	-	-	-
Klebsiella spp.	-	-	-	-	+	+	+	+	-	+	+	-	-
Pseudomonas fluorescence	-	-	-	-	+	-	-	+	+	+	-	+	-
Pseudomonas spp.	-	-	-	-	+	-	-	+	+	+	-	+	-
Protease sp.	-	-	+	-	+	+	+	V	+	+	+	+	-
Protease mirabilis	-	-	+	-	+	+	-	-	+	-	+	-	-
Staphylococcus sp.	+	-	+	V	+	+	+	-	-	-	+	+	-
staphylococcus aureus	+	-	+	+	+	+	+	+	-	-	+	+	-
Enterobacter aerogenes	-	-	+	-	+	+	+	+	+	-	-	-	-
Enterobacter faecalis	-	-	-	+	+	+	+	+	+	-	v	-	-
V. cholerae	-	+	-	v	+	+	+	+	+	+	-	+	+
V. vulnificus.	-	-	+	-	+	+	-	+/v	+	+	-	-	+
V. parahaemolyticus	-	+	-	+	+	+	-	+	+	+	-	+	+
Micrococcus luteus	+	-	-	+	+	-	-	-	-	+	+	-	+
shigella species	-	V	+	-	+	+	-	-	-	-	-		-
Bacillus spp.	+	-	-	+	+	+	+	+	+	+	-	+	V
Lactobacillus Spp.	+	-	+	-	-	+	+	-	-	+	-		-

a. *Klebsiella* sp. in Mac. Agar



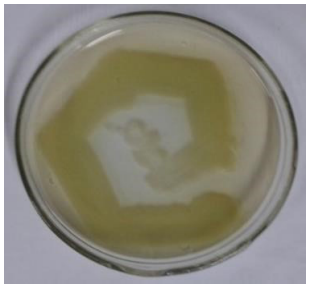
b. E. coli in EMB agar



c. Enterobacter Aerogenes in MacConkey Agar

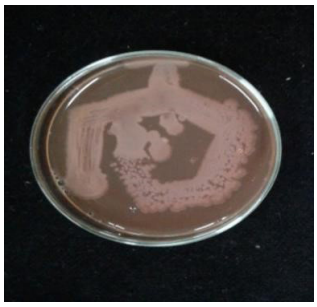
d. Protease Sp. in Blood Agar

e. Salmonella sp. in SS Agar



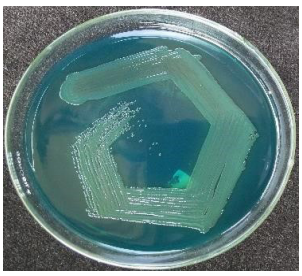
f. Pseudomonas fluorescence in Cetrimide Agar

g. Streptococcus sp. in Blood Agar



h. Enterobacter Faecalis in Mac. Agar

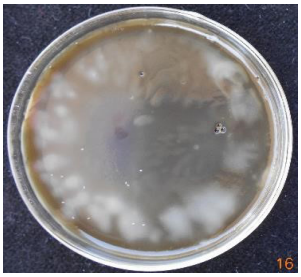
i. V. cholerae in TCBS Agar



j. V. parahaemolyticus in TCBS Agar

k. V. vulnificus. in TCBS Agar

l. Micrococcus luteus in blood Agar



m. Protease mirabilis in Blood Agar

n. Bacillus spp. in blood Agar

Fig 2: Master Plates of Bacterial Isolates in Selective and Differential Media

(Tamberkar *et al.,* 2011a). The presence of respiratory pathogens like *Klebsiella sp*. in panipuri is linked to bacterial aerosols produced by sneezing and coughing in public spaces. (Das *et al.,* 2010b). A study done by Gulati and Chakraborty (2017) and Saxena *et al.,* (2016) also observed high microbial load in panipuri samples, and they also found that harmful pathogenic bacteria like *E. coli, Bacillus cereus, Staphylococcus aureus, and Shigella spp. Staphylococcus spp.* Usually, they demonstrate resistance to various temperature ranges and pH levels, which explains the existence of these bacteria in the highly acidic conditions of masala pani, attributed to tamarind, lemon, or any other source used to make it sour. Handling money by street vendors also

serves as a vector for transmitting *Pseudomonas sp.* into the panipuri. Although curd was not included in the food sample of chaat, the detection of Lactobacillus spp. may be due to its spread from the same spoon and utensil used during the preparation and serving of chaat. Bacteria such as *Shigella spp.* and *V. vulnificus* can contaminate the food through contact with sewage and contaminated water. (Das *et al*., 2010b). Studies done by Kharel *et al*., (2016), Sharma and Mazumdar (2014), Rath and Patra (2012), and Das *et al*., (2012a) reported the occurrence of *Pseudomonas spp., Shigella spp., V. vulnificus, Micrococcus luteus, and Streptococcus spp.* in their studies and are also following the present findings. Occurrence of *E. coli, Enterobacter aerogenes, Klebsiella p., V. cholerae, Vibrio v., V. parahaemolyticus, Proteus vulgaris and Salmonella sp.* in sugarcane juice can be linked to poor water quality used for dilution, contaminated ice, poor level of personal hygiene, peeling of sugarcane long before squeezing, dirty shop location, and high vehicular traffic. Additionally, unsanitary practices related to washing utensils, like the glasses for sugarcane juice, involve dipping them in the same bucket without soap. This method of washing results in juice being served in inadequately cleaned glasses, creating a path for harmful substances and bacteria.

A study conducted by Das *et al.,* (2010b) found that various street foods, including paani puri, bhelpuri, and chaat, were contaminated with high levels of pathogens, including *Streptococcus faecalis, E. coli, Staphylococcus aureus, Bacillus sp., Klebsiella sp.,* and *Pseudomonas sp.* These findings are similar to the present results, as *V. parahaemolyticus, V. cholerae, Salmonella sp.,* and *Klebsiella pneumoniae* were detected in sugar cane juice. Bacterial contamination of sugarcane juice can arise from several sources, including the sugarcane itself, drum roller crushers, collecting utensils and vessels, the ice used in the juice, personnel's hands, and the filter. Additionally, sugarcane attracts flies that may contaminate the juice. Mahale *et al.,* (2008) analyzed street-vended sugarcane juice from Mumbai, revealing that 60% of the juice is contaminated with *V. cholerae* and *Salmonella sp.* These results further support the study by Batool *et al.,* (2013) on the microbial analysis of pasteurized and fresh fruit juice sold.

Protease mirabilis, Enterobacter aerogenes, and Salmonella sp. have been identified in mango shakes. The contamination of mango shakes results from using substandard fruits, inappropriate utensils, inadequate handling practices, and environmental factors such as dust, proximity to waste, sewage spills, and insects, including flies. Additionally, incorporating diluents such as water and ice is a concern. Furthermore, milk may also act as a potential reservoir for *Salmonella* in milk-based fruit blends, such as milkshakes. The utilization of unpasteurized milk is prevalent among street vendors, posing a risk as a source of pathogens, including *E. coli and Salmonella*. Moreover, it has been noted that several vendors dilute milk with water to increase profit margins, exacerbating the final product's unsatisfactory hygienic conditions. *(Akhtar et al., 2013*). These findings are corroborated by Pal and Jadhav (2013) in their investigation of microbial contamination in various Indian milk products.

The occurrence of *Escherichia coli, Salmonella species, Enterobacter faecalis, Klebsiella pneumoniae, Streptococcus species, Pseudomonas fluorescens,* and *Proteus mirabilis* may be attributed to the utilization of substandard water quality, unhygienic practices during shake preparation, improper washing of tumblers and utensils, inadequate personal hygiene among food handlers, the adulteration of milk with water, and ineffective waste disposal methods, which collectively create a conducive environment for the proliferation of pathogenic bacteria. Furthermore, these bacteria may penetrate fruits through damaged surfaces encountered during cultivation, harvesting, storage, and transportation. Additionally, using contaminated ice for food dressing and consuming unpasteurized milk could serve as significant sources of bacterial contamination.

Conclusion

The study's findings regarding the high bacterial levels in street-vended food are alarming, as they present a significant risk of foodborne illnesses to consumers. Several key factors contribute to this risk, including inadequate food preparation, insufficient cooling and reheating, contaminated processed ingredients, poor-quality raw materials, and undercooking. These elements underscore the necessity for improved food handling procedures among street food vendors. Consumers must be aware of freshness, quality, and hygiene when choosing street foods to help mitigate these risks. Education on recognizing safe food options and making informed choices is vital. Additionally, government authorities should train vendors on sanitary practices, emphasizing the importance of proper food handling, storage, and preparation methods. Routine inspections and monitoring are critical to ensure adherence to food safety standards. Authorities must periodically inspect food stalls, enforce regulations, and act promptly against vendors who do not comply with safety standards. Implementing these measures can enhance the safety of street foods, safeguard public health, and support the growth of the street food sector. Effective regulations and education can empower vendors to uphold high standards, diminishing the risk of foodborne illnesses. Ultimately, this can stimulate growth and bolster consumer confidence, benefiting the industry significantly. By taking appropriate measures, street food can be a safe and enjoyable choice for consumers, contributing to the local economy and cultural heritage. To conclude, tackling food safety in street-vended food demands a comprehensive approach. Educating consumers and vendors, enforcing regulations, and promoting safe food practices can minimize the risk of foodborne illnesses and lead to a safer, more enjoyable street food experience, protecting public health while fostering the growth and development of the street food industry.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this research study.

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