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Street food vending: A case study from Assam, India

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Abstract

Food safety of street vended foods is an integral part to reduce the risk of adverse health outcomes amidst customers. The present investigation was undertaken with specific objective to assess the handling and vending practices of the street food vendors and microbiological analysis of food samples. Presence of high microbial in collected food samples, hand and utensil swabs ranging from 1×10^3 to 172×10^3 cfu g^{-1} or ml^{-1} clearly indicates poor vending and handling practices of the street food vendors, which can be related to their poor knowledge and attitude towards food safety.

Keywords: Street food, traditional cuisines, street food vendors, outcomes amidst

1. Introduction

From decades Indian food culture is known for its diverse traditional cuisines. From salads to sauces, from vegetarian to meat, from breads to desserts, Indian cuisine is invariably complex. Though eating out was not common in India as in the West (McGee, 2004) ^[15], but in recent years, there is a paradigm shift in the dining culture of India. The trend of eating outside becomes a regular form of entertainment, especially in the cities, due to rise in income, changing life style and urbanization (Srividhya, 2014) ^[26]. With growth in informal street food sector there has been an increasing trend towards the sale and consumption of street foods (Rao *et al.*, 2012) ^[22]. But it was also found out that street foods are frequently associated with various diseases due to improper handling and serving practices (Barro *et al.*, 2006) ^[3]. Consequently, serious concerns do exist about the safety of street food. WHO has recognized food safety as an essential public health function (WHO, 2010) ^[30]. Food safety has been defined by Schmidt and Rodrick (2003) ^[24] as - "the probability of not suffering some hazard from consuming a specific food." Food handling personnel play an important role in ensuring food safety throughout the chain of food production and storage (WHO, 2010) ^[30]. Negligence of proper hygienic measures by street food vendors may enable pathogenic bacteria to come into contact with food, survive and multiply in adequate numbers to cause food borne illness among consumer (Gadi and Kumar, 2013) ^[9]. Street foods are often displayed on open work area which can be easily contaminated by dust, smoke, insects, and hands of the vendor and buyers. Lack of awareness about food safety and hygiene among vendors also results in food contamination (Rane, 2011) ^[21]. Microbial contamination of ready-to-eat foods sold by street food vendors and hawkers has become a major health problem (Tambekar *et al.*, 2011) ^[27]. *Bacillus cereus*, *Clostridium perfringens*, *Staphylococcus aureus* and *Salmonella* spp. are the most common bacterial pathogens identified and isolated from street foods which may cause diarrhoea, typhoid fever, cholera and food poisoning (Rane, 2011) ^[21]. In several places in India, food borne illness associated with the consumption of street vended foods has been reported in the last few years (Das *et al.*, 2010) ^[7]. Research studies on food safety knowledge, handling and vending practices and microbial contamination of street vended foods were reported from different parts of the world as well as from several parts of India, but no such documented research studies have been found from north-eastern states in general and Assam in particular. Therefore, the present study was undertaken to study the overall scenario of street food vending in Jorhat city of Assam, India.

2. Materials and methods

2.1 Selection of street food vendors

Present study was undertaken on the street vended foods which were either vended or stalled in the major streets, near colleges, schools and markets of Jorhat city of Assam. Four sites namely Baruah Chariali, A.T. Road, K.B. Road and Garali were selected as these places were frequently visited by the customers. Fifty four street food vendors were randomly selected from these sites for the interview to elicit information on their handling, vending practices and food safety knowledge and attitude.

2.2 Assessing handling and vending practices of selected street food vendors

Handling and vending practices of street food vendors were determined using a standardised pretested questionnaire consisting of relevant questions and an observational study under the following heads

- (i) Demographic data
- (ii) Information about the vending stall
- (iii) Food handling practices
- (iv) Supplies and storage practices
- (v) Personal hygiene
- (vi) Environmental hygiene.

2.3 Assessing food safety knowledge and attitude of the selected street food vendors

A modified three point knowledge scale was adopted as followed by Ansari-Lari *et al.* (2010) [2] to assess the food safety knowledge and attitude of the vendors. The scale was divided into two sections

- i) Food safety knowledge and
- ii) Food safety attitude. Each section contained 15 sets of statements with 3 possible answers “yes”, “no” and “do not know” for each section. A correct answer is

considered as one point while an incorrect answer or a “do not know” answer was regarded as zero points. The score was then converted to its equivalent on a basis of 15 = 100. A score less than 50 was considered as poor food safety knowledge and attitude, 50 to 75 was considered as average and more than 75 was considered as having a good level of food safety knowledge and attitude.

2.4 Microbiological analysis of street foods

A total of 44 samples, 16 food samples (Four samples of each *Panipuri*, *Chanachur*, *Aloo chaat* and *Papri chaat*), 4 *panipuri* water samples, 12 hand swabs and 12 utensil swabs were collected. Hand and utensil swabs were collected by rubbing sterile cotton swabs on palm, fingers of the vendors and utensils used by the vendors. All the samples were collected in sterilized HDPE zip lock plastic bags from the vending sites. The food samples collected were homogenised in mixer grinder (Kenstar classique) and all the samples were kept in freezer of refrigerator (LG, Model number: GL-N292RDSY) till further estimations. Selective media (SRL Co.) were used for microbial analysis. All media used in the study were prepared as per standard method. The hand and utensil swabs were dipped in 10 ml of sterile water and 1g or 1ml of the food samples were added to a test tube containing 9 ml of sterile water and vortexed properly. 1 ml of each sample was then serially diluted up to 5 fold. Finally, 1ml of suspension of dilution 10^{-3} , 10^{-4} and 10^{-5} were placed in sterile petri-dishes in triplicates and molten media was poured on the plate and mix thoroughly by rotating the media clockwise and anti-clockwise. After solidification plates were incubated at $28 \pm 1^\circ\text{C}$ in BOD incubator (ICT) for a period of 48 hr to 72 hr. The colonies appeared were counted as colony forming units (cfu) per gram/ml of the sample. Confirmations of microbial isolates were made by following methods:

Microorganism	Confirmation test
<i>Bacillus cereus</i> and <i>Escherichia coli</i>	Microscopic examination
<i>Pseudomonas aeruginosa</i>	Gelatin liquefaction test
<i>Clostridium perfringens</i>	Lactose gelatin test
<i>Staphylococcus aureus</i>	Carbohydrate fermentation test (mannitol)
<i>Salmonella</i> spp.	Biochemical test by using test kit (KB001, HiMedia)

3. Results and discussion

3.1 Demographic profile of the selected street food vendors

The demographic profile of the respondents (Table 1.) depicts that the street food vendors in Jorhat city were predominantly male (100%). Studies conducted by Cortese *et al.* (2016) [6] and Loukieh *et al.* (2018) [13] also revealed that majority of the vendors were male. This may be due to social and cultural influences of the region as well as the role of women as a support provider rather than a bread winner. Age wise distribution of the street food vendors revealed that 51.85% belong to the age group of 35-45 years, followed by 22.22%, 20.37% and above 5.56% belong to the age group of above 45 years, 25-35 years and 15-25 years respectively. These results were in conformity with studies conducted by Moreb *et al.*, 2017 [17] which shows that middle age mostly able-bodied, economically active population in the peak of their economic pursuit years was involved in this sector. Educational qualification of the selected street food vendors revealed that 81.50% of the respondents were below matriculation, the findings of the present study was similar to the studies conducted by Loukieh *et al.* (2018) [13] and Nayansi *et al.* (2014) [20]. Poor education of street food vendors may result in

inappropriate handling of food leading to food poisoning outbreaks (Bhat and Waghray, 2000c) [4].

Table 1: Distribution of respondents according to age, sex and educational qualification

Parameter	Number (n=54)	Percentage (%)
Sex		
Male	54	100
Female	0	0
Age (years)		
15-25	3	5.56
25-35	11	20.37
35-45	28	51.85
45 and above	12	22.22
Educational qualification		
Illiterate	0	0
Below matriculation	44	81.5
Matriculation and above	8	14.8
Graduate	2	3.7

3.2 Food handling and vending practices of the selected street food vendors

Food safety has been an important issue in the street food

vending sector for decades. There is a need for training of vendors on the basic principles of sanitation, manufacturing quality and safety to enable them to voluntarily adopt the hygienic practices to improve the quality of food served and the concept of 'Clean and Tasty' street food (NASVI, 2011)^[19]. The present study reveals that none of the selected street food vendors had acquired any sort of training on food safety (Table 2.) which may be due to lack of awareness among street food vendors or lack of effort on part of government authorities. Loukiah *et al.* (2018)^[13] also reported similar findings. However, all the street food vendors had license under FSSAI provided by Directorate of Health Services, Jorhat. The food preparation practices of the street food vendors showed that % of the vendors washed food thoroughly before peeling and cooking. Proper washing of food prior to peeling and cooking remove dirt and pesticide residue from the surface of fruits and vegetables and also reduces microbial load. Regarding the source of water used for preparation of food, 42.59% of the vendors use river water, 31.48% use tube well water and only 25.93% use water supplied by municipality. Contaminated water is a well-

known vehicle for enteropathogens such as *E. coli* and *Salmonella* spp. and can create a public health risk when it is used for washing of foods, incorporated in the food as an ingredient and used in the preparation of food. From **Table 2.** it was observed that 79.63% of the vendors brought pre prepared food to the stall for sale. Pre-cooked food kept in ambient temperature increases the chances of growth of harmful microorganisms in food. It was also revealed that 44.44% of the vendors properly cover their prepared food and only 27.78% frequently clean the food preparation area. Similar findings were reported by Cortese *et al.* (2016)^[6], Ma *et al.* (2019)^[14] and Thi *et al.*, (2021)^[29]. Improper covering of foods and dirty preparation surfaces can harbour harmful microorganisms like *Salmonella* spp. and *E. coli*. Moreover, only 20.37% of the selected street food vendors served food with ladles or spoons and remaining 79.63% of the vendors served with bare hands. According to the WHO, food should be preferably handled with clean tongs, forks, spoons or disposable gloves to reduce risk of cross contamination (FAO, 2009)^[8].

Table 2: Food handling and vending practices of the street food vendors

Parameter	Number (n=54)	Percentage (%)
Food safety training		
Yes	0	0.00
No	54	100.00
Registration of the vending stall		
Yes	54	100.00
No	0	0.00
Sources of water for food preparation		
River water	23	42.59
Tube wells	17	31.48
Municipality supply	14	25.93
Peeling and thorough washing of raw materials	54	100
Pre prepared food brought to stall	43	79.63
Covering of prepared food	24	44.44
Clean preparation surface	15	27.78
Vendors serving food with spoon/ladles	11	20.37

3.3 Personal hygiene of the selected street food vendors

Personal hygiene of vendors also plays an important role in food safety. Poor personal hygiene can facilitate the transmission of pathogenic bacteria found on environment and on vendors hand via food to consumers (WHO, 2010)^[30]. The personal hygiene of selected street food vendors (Table 3.) showed that only 20.37% wore gloves while serving food whereas, none of them wore apron and hair cover. Moreover, it was also observed that only 26.7% of the vendors have short and clean nails. Findings revealed that *Salmonella* spp. and *E. coli* can survive on finger tips for varying periods of

time and in some cases even after washing (Rane, 2011)^[21]. Hand washing is the vital way in preventing contamination of food by food handlers. Unwashed hands are the most significant pathway to pathogen transfer. It was observed that all street food vendors wash their hands only with plain water after using toilets and none of them wash their hands after handling money. Similar findings were reported by Mwove *et al.* (2020)^[18] and Ismail *et al.* (2016)^[10]. From the present investigation the personal hygiene of the street food vendors was found to be unsatisfactory.

Table 3: Percentage distribution of respondents according to personal hygiene

Parameter	Number (n=54)	Percentage (%)
Wearing gloves	11	20.37
Aprons	0	0
Hair cover	0	0
Nails	15	27.77
Washing with plain water after using toilet	54	100
Washing after handling money	0	0

3.4 Overall hygiene of the selected vending stall premises

Environmental hygiene pertains to the hygiene practices that prevent or minimize disease and the spreading of disease in the surrounding in everyday life (FAO, 2009)^[8]. Table 4. depicts the environmental condition around the selected street

vended food stalls. It was observed that majority of the street food vendors (81.48%) were mobile. It was reported that quality of street food sold by stationary vendors are generally better than those sold by ambulatory vendors as because moving from one place to another place may result in contact

of food to environmental dirt and dust leading to contamination (Taylor *et al.*, 2000) [28]. It was also evident that most of the vending sites (68.51%) were found to remain open which may lead to contamination of food due to dust, dirt, automobile emission, human crowding etc. Only 14.80% of the vending sites had clean surroundings with 18.52% having dustbin to dispose waste materials. Similar findings were also reported by Nayansi *et al.* (2014) [20] and Ma *et al.* (2019) [14]. According to FAO (2009) [8] adequate drainage and

waste disposal system should be provided in street food industry. Because of the lack of adequate waste disposal facilities, street vendors dispose of their garbage in the street which in turn attracts more flies, insects and rodents which are potential vectors of pathogens. In the present study 62.96% percent of the selected street food vending stalls had presence of flies in and around the surroundings and 3.70% of the vendor encountered rodents around their vending site.

Table 4: Distribution of the respondents according to characteristics of the vending stall

Parameter	Number (n=54)	Percentage (%)
Type of stall		
Mobile	44	81.48
Stationary	10	18.52
Covering of the unit		
Permanent cover	17	31.49
Covered with tent	0	0
Remains open	37	68.51
Clean surrounding	8	14.81
Use of disposable bin	10	18.52
Presence of flies around the stall	34	62.96
Encounter with rodents	2	3.70

3.5 Food safety knowledge and attitude of the selected street food vendors

WHO emphasized that it is important that vendors should be acquainted with appropriate food safety knowledge and attitude to improve food safety of street vended foods (WHO, 2010) [30]. The food safety knowledge and attitude of the street food vendors were presented in Table 5 which reveals that 50.00% of the selected street food vendors had poor knowledge, 44.44% had average knowledge and only 3% of the vendors had good knowledge on food safety. Regarding food safety attitude of the selected street food vendors, results revealed that 37.04% of street food vendors had an average understanding on food safety. 59.26% of the vendors had poor attitude towards food safety and only 3.70 percent had good

attitude. Knowledge and attitude are key attributes of concern in hawker food handling practices. Improper practices and lack of knowledge by food handlers are contributing factors for the spread of food borne outbreaks (Sharif *et al.*, 2013) [25]. When statistically analysed it was observed that age of the selected street food vendors was negatively co-related with their food safety knowledge and attitude. However educational level was positively related to their food safety knowledge and attitude and the relation was significant at 0.01 level of significance. McIntrye *et al.* (2013) [16] and Lazou *et al.* (2012) [12] also reported similar findings. Intensive education on food hygiene and safety principles is a key necessity to provide safe food to the consumers.

Table 5: Food safety knowledge and attitude of the vendors and its association with their age and education

	Number (n=54)	Percentage (%)	Age	Education
Food safety knowledge				
Good (>75)	3	5.56	-.0280 ^{NS}	0.912**
Average (50-75)	24	44.44		
Poor (<50)	27	50.00		
Food safety attitude				
Good (>75)	2	3.70	-0.253 ^{NS}	0.905**
Average (50-75)	20	37.04		
Poor (<50)	32	59.26		

**Significant at 0.01 level of significance; NS- Not significant

3.6 Microbiological analysis of collected street vended foods

Six different microorganisms' viz., *Pseudomonas aeruginosa*, *Bacillus cereus*, *Escherichia coli*, *Clostridium perfringens*, *Staphylococcus aureus* and *Salmonella* spp. were isolated from sample tested and confirmed by standard protocol (Fig. 1-6.). Among the collected food samples *B. cereus* was found highest in panipuri water, *P. aeruginosa* and *Salmonella* spp. was found highest in *Chanachur*, *C. perfringens* was found highest in *Panipuri* sample, *E. Coli* was found highest in *aloo chaat* and *Staphylococcus aureus* was found highest in *papri chaat* (Table 6.). All the food samples were high in microbial load this may be due to preparation of food long time before and also due to poor temperature control (Saxena and Agarwal, 2013) [23]. Further improper handling and storage of

pre-cooked foods and serving with bare hands contributes to cross contamination of the food. Presence of *E. coli* in such a heavy amount indicates poor personal hygiene and lack of proper hand hygiene. It was revealed that *E. coli* and *Salmonella* spp. were found in more numbers in hand and utensils swabs compared to food samples because these organisms can survive on finger tips and other surfaces for varying periods of time and is a major carrier of microbes. Moreover, washing of utensils by contaminated water and handling of money during preparation and serving of food may be another reason. Improper preparation and handling of foods at food service establishments are primary factors in *Salmonella* outbreaks (Jay, 1992) [11]. It was also revealed from the tables that all the samples were loaded with *B. cereus* which may be due to improper food covering and

exposure of food to environmental dust and dirt. In general, the presence of mesophilic spore-formers *B. cereus* in food is of great significance since this organism produces heat-sensitive (diarrheal) and heat-stable (emetic) toxins associated with food poisoning (Bryan *et al.*, 1992b) [5]. *S.*

aureus was isolated from all samples which can be introduced into the street foods during handling, processing or vending indicating poor handling and hygienic practices of the vendors. Similar findings were also reported by Salamandane *et al.* (2021) [1], Thi *et al.*, (2021) and Mwove *et al.* (2020) [18].

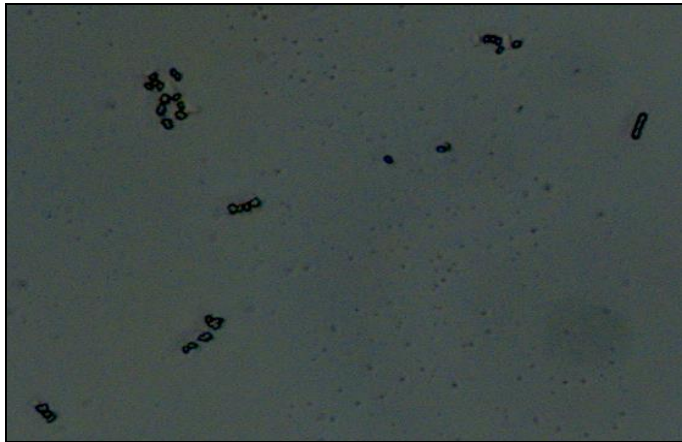


Fig 1: Microscopic view of *B. cereus*

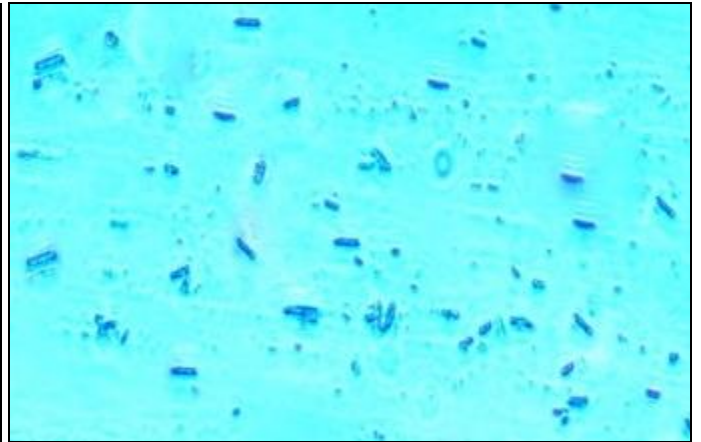


Fig 2: Microscopic view of *E. coli*



Fig 3: Lactose gelatin test for *C. perfringens*

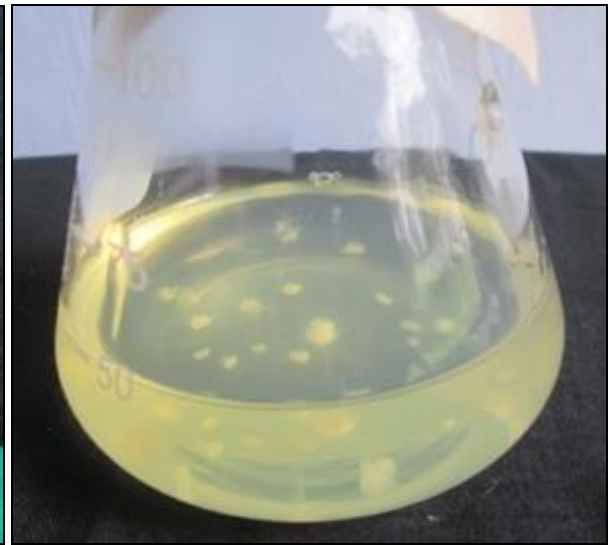


Fig 4: Gelatin liquefaction test (*P. aeruginosa*)



Fig 5: Carbohydrate fermentation test (mannitol) for *S. aureus*

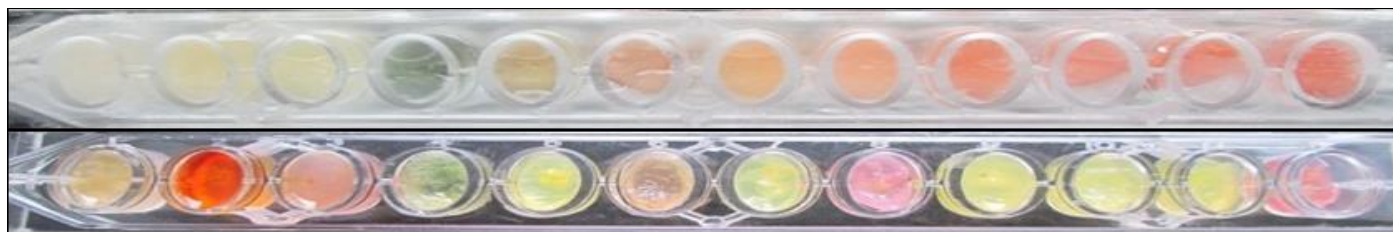


Fig 6. Biochemical test for *Salmonella* spp (KB001 HiLMViC™ kit) [Before and after inoculation]

Table 6: Microbial load in different samples collect from street food vendors

Organism Isolated	×10 ³ cfu/g or ml						
	Food samples					Utensil swab	Hand swab
	Panipuri Water	Panipuri	Chanachur	Aloo chaat	Papri chaat		
<i>B. cereus</i>	50±4	38±4	27±2	19±2	28±2	22±5	46±3
<i>P. aeruginosa</i>	26±4	113±8	152±3	107±4	29±3	111±3	163±4
<i>C. perfringens</i>	57±2	172±7	64±4	60±8	84±1	97±5	88±2
<i>E. Coli</i>	18±2	26±1	46±4	84±2	82±4	85±6	94±7
<i>S. aureus</i>	7±2	2±2	28±2	20±3	36±8	11±2	22±4
<i>Salmonella</i> spp.	1±1	0	15±3	4±1	4±3	31±3	35±3

Conclusion

The present investigation aims at determining the food safety of street vended foods of Jorhat city. The food handling and vending practices were found to be unsatisfactory. Poor personal hygiene in terms of hand washing, nail trimming, hair covering, use of aprons and hand gloves altogether increase the contamination of the street vended foods with microbes. Lack food safety knowledge and attitude on the part of the vendor and lack of food safety training are the limiting factors towards observance of safe food handling and vending practices. Microbiological analysis of collected food samples along with utensil swab and hand swab of the selected street food vendor showed high level of microbial load confirming the presence *Pseudomonas aeruginosa*, *Bacillus cereus*, *Escherichia coli*, *Clostridium perfringens*, *Staphylococcus aureus* and *Salmonella* spp. Food contamination is mainly due to poor water quality and hygiene during food preparation, preparation of food long before consumption, washing of utensils, poor personal hygiene, and crowded and dusty vending location.

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