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Research Article

Is There a Need for Regular Surveillance for Bacterial Contaminants in Street Foods of Kathmandu?

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Abstract

Background: Ready-to-eat street food is common around the world. Unsafe food becomes a source of infection for consumers. This study aimed to investigate the status of bacterial contaminants, antibiotic-resistant patterns and hygiene practices among street-food vendors in Kathmandu, Nepal.

Methodology: A total of 50 ready-to-eat food samples (Momo with soup, Smashed potato, Panipuri, Watermelon and Papaya) were collected from inside Kathmandu city. Collected samples were then cultured in different agar mediums and incubated under controlled laboratory conditions. Bacterial identification was performed via colony morphology, staining and biochemical tests. Identified bacteria were subjected for antibiotic susceptibility test and hygiene practices data were also collected.

Results: Out of 50 samples, the prevalence of bacterial isolates was 70 with six distinct bacterial species identified. The mean bacterial count in ready-to-eat momo with soup was 4.8 X106 cfu/g and mean 4.2 X 106 cfu/g in crushed potato. Polymicrobial growth was observed in more than 62.0% of samples. Momo and Papaya contained the equally highest prevalent of bacterial isolates and Panipuri the least contaminated. Overall, the predominant organism was Staphylococcus aureus followed by Klebsiella pneumoniae, Citrobacter species, and Escherichia coli. Most of the isolates were resistant to Amoxicillin whilst 3 isolates were multidrug resistant. On the other hand, Salmonella species and Acinetobacter species were sensitive to all the tested antibiotics. Also, there was a lack of hygiene practices with a dearth of basic equipment and infrastructure.

Conclusion: This indicates that prompt and periodic quality monitoring and bacteriological examination of ready-to-eat street foods of Kathmandu is utmost necessary.

Keywords: street food; momo; fruits, staphylococcus aureus; klebsiella pneumoniae; antibiotic resistance

Introduction

According to the Food and Agriculture Organization (FAO) street food is “ready-to-eat foods and beverages prepared and/or sold by vendors and hawkers especially in streets and other similar public places"[1]. Street-food eating practice is prevalent in every corner of the world. However, consumption of unsafe food leads to acute to long term diseases, disabilities and deaths. Globally, one in ten people becomes ill due to the consumption of contaminated food [2]. Microorganisms such as non-typhoidal Salmonella enterica, Salmonella Typhi, Taenia solium, Hepatitis A virus, enteropathogenic Escherichia coli and aflatoxin are mainly responsible for foodborne illness [3]. Data shows that 41 and 200 people were severely affected due to consumption of contaminated food and water respectively in Nepal [4,5] and the burden associated with consumption of unsafe food has been reported elsewhere at different time periods [6-8].

Nowadays, street-food has become the first choice for the customers due to its low cost, easy availability and taste. In developing countries, street foods are consumed by millions of people [6,9]. Likewise, inside Kathmandu valley, over 30 thousand street-food stalls serve food everyday [10]. Poor preparation practice, improper handling, lack of personal hygiene, insufficient awareness, lack of cold storage facilities, inadequate clean water supply for cleaning and drinking purposes are the prominent culprits for transmission of pathogenic microorganism. Also, drug-resistant superbugs have been identified in street meals [11]. Multitude research articles from different countries like Ethiopia [12,13], Bangladesh [14,15], India [16], and Nepal [17] advocate that the food we

consume acts as a vehicle for pathogen transmission. Meanwhile, contaminated water supply [18] and raw food [19] are the vital source of pathogens even if all preventive measures are taken by vendors. Annually, around 0.4 million people succumb due to consumption of unsafe food [2]. These circumstances pose an additional serious threat for general public. In Kathmandu, millions of people daily consume ready-to-eat street foods. However, its quality of is unknown and very limited reports have been published regarding the same. Hence, the present study is designed to investigate the bacterial prevalence, antibiotic resistance pattern and hygiene practices in street foods inside Kathmandu.

Methodology

A cross-sectional study was conducted from August 2019 to January 2020 (6 months). A total of 50 ready to eat food samples (Momo with soup, Panipuri, Smashed potato, Watermelon and Papaya) were collected from street vendors at different locations of ring road (around 27 kilometers range) in Kathmandu via convenient sampling technique. Informed verbal consent was taken from street-vendors. About 10 gram of each sample was collected in a sterile leak-proof container, and transported maintaining cold chain to Department of Medical Laboratory Technology, Janamaitri Foundation Institute of Health Science, Hattiban. Samples were then homogenized for 2 minutes in 9 ml of 1% phosphate buffer saline and vortex to dislodge adhered bacteria. Exactly 0.1ml of sample was transferred into Blood agar, Mac-conkey agar, and Mannitol salt agar and incubated in aerobic condition at 37°C for 24 hours. Isolated bacteria were further identified by their colony, staining and biochemical characteristics. The isolated bacteria were subjected for antimicrobial susceptibility testing in Mueller hinton agar as per the Clinical and Laboratory Standards Institute guidelines [20]. Furthermore, antimicrobial agents were selected based on the availability and frequency of prescription for the treatment of bacterial infections by clinicians in Nepal. ATCC 25922 Escherichia coli was used as reference organism for quality control. The obtained data were entered and analyzed using Statistical Package for the Social Sciences (SPSS) version 20 and interpreted according to frequency distribution and percentage table.

Results

Out of 50 samples, 70 bacterial isolates were detected with six distinct bacterial species. Staphylococcus aureus was the most commonly isolated organism followed by Klebsiella pneumoniae, Citrobacter species and Escherichia coli. Proteus species and Salmonella species were the least isolates seen so far. Ready-to-eat Momo with soup accounted for the highest mean bacterial count (4.8 X106cfu/gm) followed by Watermelon (mean 4.0 X105cfu/gm), Panipuri (mean 3.2 X105cfu/gm), and Papaya (mean 2.8 X105cfu/gm) as shown in Table 1.

Organisms	Momo	Panipuri	Potato	Watermelon	Papaya	Total isolates
E. coli	3	1	2	2	1	9
K. oxytoca	3	0	0	1	3	7
K. pneumoniae	2	3	3	4	4	16
Citrobacter species	3	2	1	2	3	11
Salmonella species	0	0	1	0	0	1
Acinetobacter species	0	0	0	1	1	2
Proteus species	1	0	0	0	0	1
Staphylococcus aureus	5	3	5	5	5	23
Total isolates	17	9	12	15	17	70
Mean bacterial count (CFU/g)	4.8 $X10^6$	3.2 $X10^5$	4.2 $X 10^6$	4.0 $X10^5$	2.8 $X10^5$	-

Table 1: Distribution of isolates from the samples

Overall, in this study, Amoxicillin resistant organisms were found to be most prevalent one. Salmonella species and Acinetobacter species were sensitive to all the antibiotics. Surprisingly, all the isolated Klebsiella oxytoca were resistant to Amoxicillin, and 50.0% isolates were resistant to Nitrofurantoin. In Staphylococcus aureus, out of 23 isolates, 22 were resistant to Amoxicillin of which two were MDR. Also, one isolate of E. coli was MDR (Table 2).

Organisms	AMX	CFX	GM	TE	NIT	COT	CHL	CEX	E	CM
E. coli (9)	8 (88.9%)	0 (0.0%)	1 (11.1%)	3 (33.3%)	1 (11.1%)	0	0	-	-	-
K. pneumoniae (7)	6 (85.7%)	1 (14.2%)	0 (0.0%)	0	2 (28.6%)	0	0	-	-	-
K. oxytoca (16)	16 (100.0%)	3 (18.7%)	2 (12.5%)	0	8 (50.0%)	1 (6.2%)	3 (18.8%)	-	-	-
Citrobacter species (11)	10 (90.9%)	0	0	0	4 (36.4%)	0	0	-	-	-
Salmonella species (1)	0	0	0	0	0	0	0	-	-	-
Acinetobacter species (2)	0	0	0	-	0	-	-	-	-	-
Proteus species (1)	0	0	0	0	0	0	0	-	-	-
Staphylococcus aureus (23)	22 (95.7%)	-	0	2 (8.7%)	-	2 (8.7%)	-	4 (17.4%)	8 (34.8%)	0
Note:*Acinetobacter* species were tested for Ampicillin_sulbactam, Imipenem and Ciprofloxacin ;AMX, Amoxicillin; E, Erythromycin;COT,Cotrimoxazole;TE, Tetracycline,; NIT: Nitrofurantoin; CEX, Cefoxitin; CM, Clindamycin; CFX, Ceftazidime; CHL, Chloramphenicole; GM, Gentamycin; NA, Naldixic acid; NOR, Norfloxacillin;; - = not tested										

Table 2: Antibiotic-resistant pattern of isolated organism

In this study, 62.0% of vendor personnels did not maintain nail hygiene and 96.0% worked with bare hands and 100.0% without food safety training. Majority of the vendors mobile, i.e. not fixed in a particular location. Also, there was a lack of proper freezer or cold storage, water supply, closed dustbins, hand washing facility, utensils cleaning, and covered facilities (Table 3).

Practices	Status	Frequency (n)	Percentage (%)
Nail hygiene	Yes	19	38.0%
	No	31	62.0%
Glove use	Yes	2	4.0%
	No	48	96.0%
Cold storage facility	Yes	1	2.0%
	No	49	98.0%
Water supply	Yes	6	12.0%
	No	44	88.0%
Waste disposal facility	Yes	28	56.0%
	No	22	44.0%
Workers cloth hygiene	Yes	33	66.0%
	No	17	44.0%
Hand washing facility for consumers	Yes	7	14.0%
	No	43	86.0%
Utensils clean and covered	Yes	13	26.0%
	No	37	74.0%
Pest and flies control	Yes	12	24.0%
	No	38	76.0%
Food safety training	Yes	0	0.0%
	No	50	100.0%
Literacy	Illiterate	21	42.0%
	Literate	29	58.0%
Food stall type	Fixed	8	16.0%
	Mobile	42	84.0%

Table 3: Food handling and hygiene practices by vendors

Discussion

Several factors such as microorganisms, toxins, heavy metals, chemicals, pesticides, etc. make food unsafe to consume [21]. The trend of consumption of street food is escalating tremendously all over the world due to its easy accessibility, inexpensive and attractive nature [22]. Globally, food-associated illness accounts for significant morbidity and mortality. The burden of food-borne diseases is reported higher in developing countries [3]. However, all the microorganisms isolated from street-food may not cause serious illness. Out of 70 bacterial isolates, 32 isolates were detected from Fruit salad with 15 from Watermelon and 17 from Papaya. S. aureus and K. pneumonia was most commonly found bacteria from the fruits. In this study, foodborne pathogens like E. coli, S. aureus, Citrobacter spp., Salmonella spp., Klebsiella spp., and Proteus spp. were isolated. Among them S. aureus was the most predominant bacteria (32.8%) and 6.2% isolates were MDR. A study from India have reported virulent methicillin-resistant S. aureus from street-vended foods [23]. Similarly, a study conducted in Chitwan, Nepal revealed that out of 50 S. aureus isolates, 4 (8.0%) isolates were MDR, and out of 30 (36.6%) E. coli isolates, 11 were MDR bacteria. Overall, out of 164 bacteria isolates, 29 (14.6%) were MDR isolates [17]. Likewise, a study conducted in Rishikesh, India, in street fruits, the most common bacteria were Klebsiella spp., E. coli, Citrobacter spp., P. aeruginosa, S. aureus, Streptococcus spp., and Enterococcus spp., but they had not isolated a single Salmonella spp. from fruits which is similar to our result [24]. However, we found one isolates of Salmonella spp. from smashed potato. Different studies conducted around the world advocate that the variety of pathogens are predominant in street foods [25-30].

Food handling, hygiene status and appliances were seemed to be compromised by the street vendors. The data showed that vendors did not maintain nail hygiene (62.0%), working with bare, hands (96.0%), lack of cold storage (98.0%), lack of water supply (88.0%), lack of clean cloth hygiene (66.0%) and lack of food safety training (100.0%) that may directly affect the quality of food (Table 3). A study from Zimbabwe revealed that the food is mainly contaminated during the handling or processing [31]. Also, a study from Colombia unveiled that 30.0% of food handlers carry pathogenic bacteria such as S. Typhi, S. aureus, S. enteritidis, and Shigella [32]. Likewise, lack of a proper cold storage facility could escalate the microbial population in foods. Other findings showed that bacterial count increased 1-3 log cycles after 16 and 24 hours in ambient temperature [33]. Food handlers also transmit microorganisms from faces, nose and skin into the food [34]. It has been found that Salmonella spp., non-typhi salmonella, Campylobacter and E. coli could even survive on the fingertips [35].

On the other hand, the location of food stall may also affect the quality of food. In Kathmandu, most of the street-food stalls are mobile and some are established nearby garbage or dumping sites. Environmental conditions also play a prominent role in food quality. Uncovered foods, uncontrolled flies, and wind-dust could deteriorate the food. In Africa, 75.0% vendors prepare foods in unhygienic conditions [36]. Meanwhile, semi-cooked or uncooked eating tradition in some food items also increases the probability of infection. Additionally, supply of contaminated drinking water with E. coli, Aichi virus-1, Human Adenoviruses, Enteroviruses and Noroviruses in Kathmandu become a offender for pathogen transfer [37]. In Kathmandu valley, around 92.0% of jar water, 77.0% of tanker-water and 69.0% of filtered water are unsuitable for drinking purpose due to soaring number of coliforms [18]. Therefore, lack of knowledge, practice, sanitation, utensils and infrastructure makes the street foods more vulnerable.

In this light, Government and local personnels should take responsibility for its legislation and implementation of effective policy in this sector by providing adequate facilities, periodic monitoring of food quality, sanitation training to the street-food vendor and minimize the irrational use of antibiotics in food products in order to reduce the burden of food-borne diseases and to improve the health of consumers [38-41].

Conclusion

In this study, six distinct types of bacterial species were isolated and few of them were multidrug resistant. Higher number of bacteria in ready-to-eat food may persuade a serious life-threatening burden to the consumers. Thus, there is a need of decisive action and periodic surveillance to improve the quality of street foods.

Abbreviations

Spp: Species

MDR: Multidrug resistant

ATCC: American Type Culture Collection

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Conflict of interest:

We do not have any conflict of interest.

Authors' contribution

B S designed the study. B S, P D, G P, NA carried out data collection, laboratory work, and data analysis. B S, G P, NA prepared the manuscript. VS, AL and R B made critical comment on the manuscript. All the authors finalized and approved the manuscript.

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