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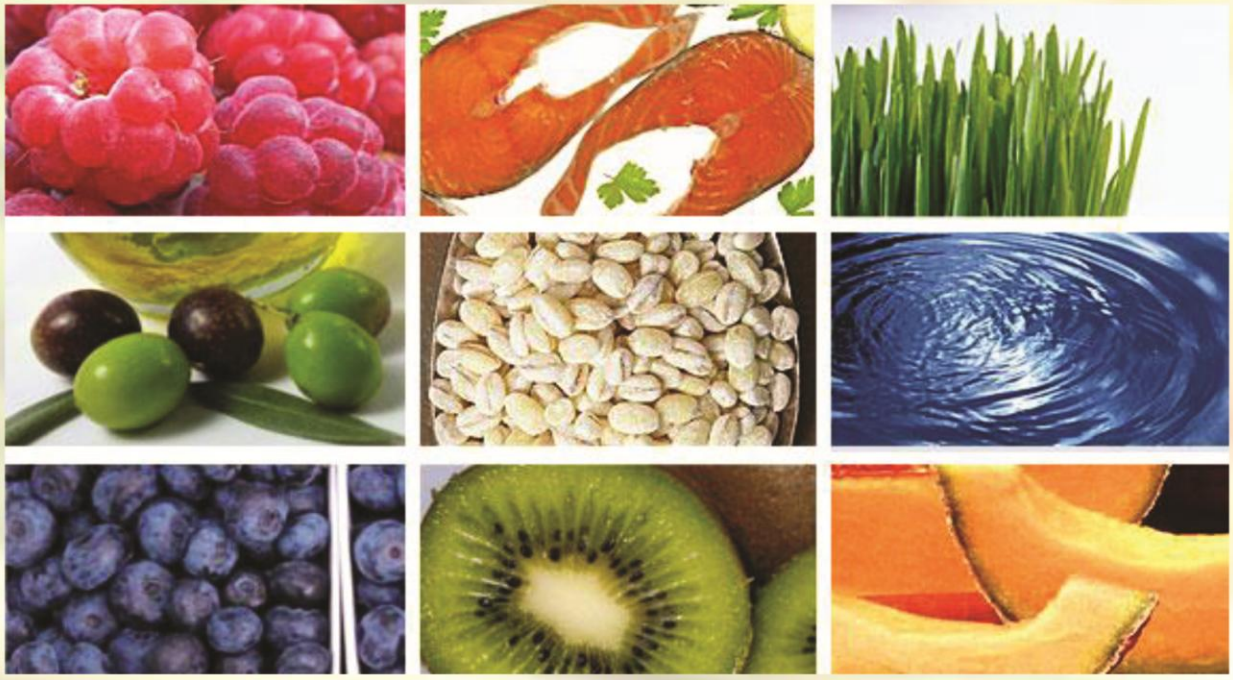

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MICROBIAL QUALITY ASSESSMENT OF STREET-VENDED GOL GAPPA AND BHELPURI SOLD IN JAIPUR CITY OF RAJASTHAN

Saxena. G[1] and Agarwal. M

Department of Home Science, The IIS University, Jaipur, Rajasthan, India, P.G. Department of home science, University of Rajasthan, Jaipur, India

[1]Corresponding author: saxena_agam@rediffmail.com

ABSTRACT

Street foods are sold mainly on the streets in crowded public places. The street food vendors generally stand in cluster at unhygienic place and crowded areas where facilities of water and waste disposal are not proper. Among various street foods sold in Jaipur city, *Gol gappa* and *Bhelpuri* are very commonly sold. *Gol gappa* is a traditional *chat* product and is preferred widely. It comprises of 3 different articles, i) *gol gappa /patasha /puri/papri* ii) filling/*masala* iii) spicy water. *'Bhelpuri'* consists of a mixture of various ingredients viz '*bhel*' or puffed rice, boiled and chopped potatoes, chopped tomatoes, onions, green coriander, green chillies, '*papri'* or '*puri'* made from refined wheat flour or semolina, two different types of *chutneys* (coriander and sweet and sour *chutney*), spices, roasted peanuts, *sev*, etc. The *gol gappa* and *bhelpuri* samples were procured from street food vendors located at six different areas of Jaipur city. Twelve samples of each were collected aseptically and microbial quality was assessed by SPC, total Coliform count, total staphylococcal count and hazard analysis. Five pathogenic bacterias' were also isolated. All the samples analyzed were heavily contaminated by bacteria's. *E.coli* was isolated from all the samples. *Staphylococcus aureus, Bacillus cereus* and *Shigella* were reported in majority of samples. *Salmonella* was not present in *gol gappas* but was reported in 8.33% of *bhelpuri* samples. The hazard analysis of *gol gappa* samples reported that potato filling or *masala* was the hazardous stage. In the case of *bhelpuri*, the chopped raw vegetables were found to be the culprit of causing food poisoning. Thus, the result revealed that *gol gappa* and *bhelpuri* sold by street food vendors of Jaipur city was highly contaminated by pathogenic bacterias' because of unsafe handling of food right from gathering raw materials to serving to the consumers.

KEYWORDS: *Gol gappa, Bhelpuri, street-vended food, Salmonella, Shigella, E.coli, Bacillus cereus, Staphylococcus aureus.*

INTRODUCTION

Street foods are common and important features of urban centers in many developing countries. Street foods are defined as ready-to-eat foods and beverages prepared and/or sold by vendors and hawkers especially in the street and other similar places. These foods are convenient for busy urban dwellers and constitute a ready source of relatively cheap and nutritious food. Food is one of the three essentials for maintenance of life.

With vast changes in the social and cultural milieu, increase in the buying power and long hours spent away from home make eating out a necessary part of people's daily life [2]. Street foods have many advantages. They provide good amount of energy at low cost, are tasty, and easily available, provide an easy solution to time starved working women, provide variety and are a source of employment, as they require minimal capital and expertise[2]. They are also important because they provide a source of economic activity for low-income men and women [3]. Though these street foods are consumed by all sections of the society and all age groups, In spite of having so many advantages, its consumption can lead to food borne diseases or food poisoning as vendors are not aware of hygienic practices; proper storage and handling, which in turn results in contamination of foods[4]. Statistics for food borne illnesses in various industrialized countries show that up to 60% of cases

may be caused by poor food handling techniques and by contaminated food served in food service establishments[5].Microbial contamination of street food is an indicator of poor sanitary practices in the preparation and storage of the food. It has also been reported that higher the education level of the food handlers or vendors, the better were their personal hygiene and the food handling practices.

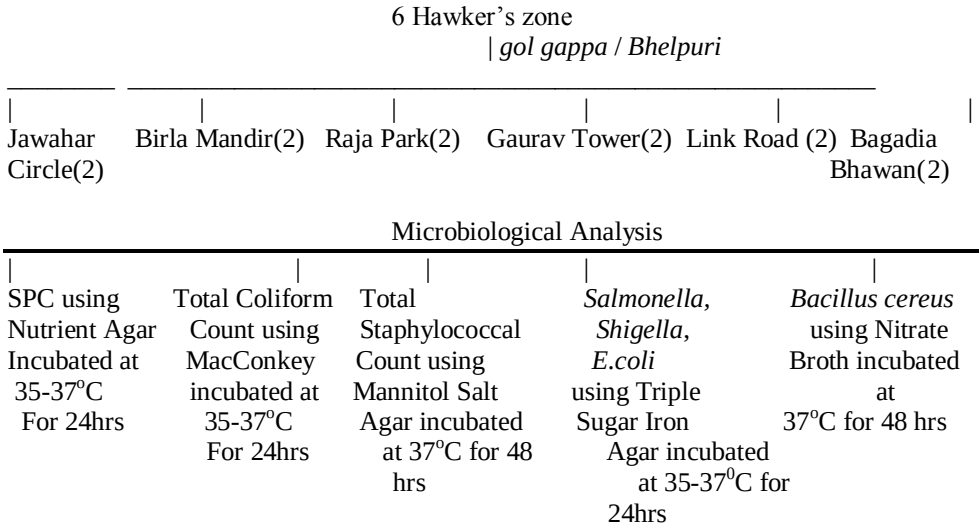
Gol gappa is a traditional *chat* product and is preferred widely. It comprises of 3 different articles, i) *gol gappa /patasha /puri/papri* ii) filling/*masala* iii) spicy water. The *gol gappa* is a fried product made from semolina or refined wheat flour. The filling or *masala* consists of boiled and mashed potatoes with spices. The spicy water is the water to which spices like salt, pepper, mango powder, *jaljeera* etc are added. Potato filling is added in every *gol gappa* after making a hole in it and then spicy water is filled in this *gol gappa* with potato filling and served.

'Bhelpuri' consists of a mixture of various ingredients viz '*bhel*' or puffed rice, boiled and chopped potatoes, chopped tomatoes, onions, green coriander, green chillies, '*papri'* or '*puri'* made from refined wheat flour or semolina, two different types of *chutneys* (coriander and sweet and sour *chutney*), spices, roasted peanuts, *sev*, etc.

MATERIALS AND METHOD

Initially mapping of Jaipur city was done to identify location where street food vendors stand in cluster. Out of many sites six sites namely Jawahar circle, Birla mandir, Raja Park, Bagadia bhawan, Gaurav Tower and Link road were selected based on their popularity among consumers. It was observed that almost at every site where street food vendor's stand in cluster, *Gol Gappa* and *Bhelpuri* was sold. As the turnover rate was observed to be very high, so they were selected for analysis. The samples were collected in sterilized zip lock plastic bags and immediately kept in ice bucket. After reaching the laboratory they were transferred to freezer and stored at temperature below 0^0 C till estimations were performed. The Knowledge and practices of street food vendors related to food hygiene and personal hygiene was assessed using a structured interview schedule.

Figure 1: Experimental design of the study



BIOCHEMICAL CONFIRMATION OF THE PATHOGENS

Catalase test*: E.coli, Bacillus cereus, Salmonella*
Methyl Red Voges Proskauer test (MRVP)*: Bacillus cereus, E.coli, Salmonella, Shigella*
Carbohydrate Fermentation test (CFT)*: Staphylococcus aureus (mannitol).*
Hazard Analysis was also done for each step of preparation of *gol gappa* and *Bhelpuri*. Stages at which samples were drawn were raw ingredients, equipments and utensils used working surface, duster, serving crockery, food prepared at various stages. The methods used were same as for microbial quality assessment.

RESULTS AND DISCUSSION

The result of the present study revealed that almost all the vendors selling *gol gappa* and *Bhelpuri* were males in the age group of 30-45years.
Improper handling and storage of raw vegetables are generally known to harbor large number of harmful organisms. In the present study, it was found that potatoes were boiled without washing 2-5hours in advance prior to starting work and were used till late night throughout the year irrespective of season. Vendors bring unpeeled potatoes to the stall and there they peel few potatoes in advance and store them in covered or uncovered containers. *Chutneys* were prepared daily at home by all the vendors and were brought to the stall in closed steel container. It was observed that *chutney* containers were kept closed at the stall.

The stalls were cleaned only ones a day and soap/detergent was not used in cleaning by majority of vendors. The dusters which were used throughout the day were washed only ones at the end of the day. Majority of the vendors (90%) used municipality water for all purposes. The spicy water was stored in steel or pitcher. None of the vendor used filtered or boiled water for making spicy water.

All the vendors selling *gol gappa* used disposable bowl (dried leaves *dona*) or steel bowls as per customers demand for serving. The leftover *puri* or *papri* were stored well for use the next day. Generally the entire *chutney* was consumed by the end of the day and if not then used on next day. The vendors do not use leftover spicy water on the next day.

About the disposal of garbage, 92 percent reported that they threw it in personal dustbin and later on vacant it in municipal dustbin, kept a few meters from their stalls. None of the vendor was found to wear disposable gloves, apron and head gear. They used bare hands for peeling boiled potatoes, mashing them and adding spices. They don't even use spoon for adding spices. The same hand which was used for peeling and mashing potatoes and adding spices was used for filling *puri* or *papri* and later on dipped in spicy water for serving *gol gappa*. The number of pieces of *gol gappa* served in a day was equal to number of times the hands were dipped in spicy water. After serving the *gol gappa* to the customers, they just wipe their hands with duster instead of washing with water. They don't use soap and water the entire day for cleaning hands no matter what they do ie whether they sneeze, cough, smoke, go to toilet etc.

MICROBIOLOGICAL ANALYSIS

Gol Gappa: It was observed that all the plates were heavily loaded. The Standard Plate Count ranges from $2.8x10^7$ to $>2.5x10^8$ and the Total *Coliform* count ranges from $0.5x10^6$ to $8.9x10^7$. Total *Staphylococcus aureus* Count ranges from $0.5x10^3$ to $1.5x10^8$. *E.coli* was present in all 100 percent samples. A pathogenic bacterium, Shigella was reported in 75 percent samples and *Bacillus cereus* was found to be present in 91.67 percent samples. *Staphylococcus aureus* was reported in 83.33 percent samples. *Salmonella* was not present in any of the *gol gappa* sample collected from street food vendors of Jaipur city.

HACCP: The results of Hazard Analysis revealed that all the ingredients of *Gol Gappa* were found to be highly contaminated. They were also positive for human pathogenic bacteria i.e. *E.coli* (faecal contamination), *S.aureus* (nasal, throat, wound and cut discharges), *B.cereus* (from dust and dirt) *and Shigella* (excreta of infected man and animals). The swabs collected from surface of stall, napkin or duster, container and serving disposable crockery (*dona*) were also highly contaminated and found positive for pathogenic bacteria's. None of the ingredient and the swab was found positive for *Salmonella.*
The present study indicated that the most critical stage at which contamination was found was potato filling probably because of improper handling and storage of boiled potatoes and the way in which spicy water was filled in *gol gappa's*. In Jaipur, all the vendors serve *Gol* Gappa using bare hands. Hand washing with soap and water before handling food material was not followed. Every time the *puri* or *papri* was filled with spicy water, all the dirty fingers were dipped in the container of spicy water which further aggravates the microbial count. Before conducting the study, it was

thought that the spicy water would be more contaminated, as the bare fingers are dipped in water again and again during service of *Gol Gappa's*. After conducting the study, it was found that the spicy water had a low microbial count as it is acidic in nature due to the presence of tartic acid or citric acid or lemon or tamarind or any other source used to make it sour. The microbial load of spicy water further could be reduced by the use of disposable gloves during the service by the street food vendors. Other option is the use of spoon with a long handle to fill the *puri* or *papri* for serving. Though the use of spoon will be a time consuming job but is a better way to reduce contamination as contact of contaminated filling with spicy water will also be reduced. These wrong and unhealthy serving practices contribute a lot to the microbial load of *gol gappa's*.

Bhelpuri: All the samples of *bhelpuri* collected from vendors were found to be heavily contaminated. The average total bacterial count as assessed by SPC was ranging from $1.1x10^8$-$6.6x10^{10}$ cfu/g. The total Coliform count ranges from $1.1x10^8$ -$3.8x10^{10}$ cfu/g and total Staphylococcal count ranging from $1x10^7$ to $2x10^8$. It was alarming to see that *E.coli* which is indicative of faecal contamination was isolated in all the samples studied. *Staphylococcus aureus* was found in 83.33 percent samples. *Shigella* and *Bacillus cereus* were found in 75 percent of *bhelpuri* samples.

The HACCP results revealed that at each step of processing microbes invade and thus finally make the food item heavily loaded with microorganisms. The HACCP of *bhelpuri* revealed that chopped green coriander added to *bhelpuri* was the main ingredient contaminating it, followed by the chopped tomatoes, long frimes, puffed rice (because of exposure to dirt and dust as it was kept in open poly bags). The *chutney*, chopped boiled potatoes, knife used for chopping vegetables added to *bhelpuri* also contribute to microbial growth to a greater extent. The swab collected from the container (in which *bhelpuri* was mixed) and spoon, napkin or duster, chopping board and working surface also add to contamination. *E.coli* was reported in all the samples and swabs collected for HACCP analysis. *S.aureus* was found in all the samples and swabs except puffed rice. The presence of *Shigella* was studied in all samples and swabs except long frimes, puffed rice and canapees'. *B.cereus* was reported at the working surface, chopped green coriander, green chillies, and swab from lemon squeezer, long frimes, *chutney*, puffed rice, canapees, *bundi* and *sev* (prepared from bengal gram flour). *Salmonella* was not reported in any of the sample and swab collected for HACCP analysis.

Reasons for contamination could be the location of the stall (surroundings), poor personal hygiene, poor practices followed during cooking and storing, source of drinking water, its storage, uncovered container, improper practices of taking out water from the pitcher, long hours of storage of boiled potatoes at room temperature, storage of peeled potatoes (unmashed and mashed). *Staphylococci* reached the cooked potatoes during peeling, cutting and other handling. High contamination on the surfaces of knives, plastic bags and employees' plastic gloves after they were used has also been reported. They also reported heavy contamination on the surfaces of wood and plastic cutting boards before they were used. *E.coli* was detected on the surfaces of knives and plastic bags. Washing hands with soap and water must be practiced by all vendors after urinating and sneezing, itching touching hair, etc. Hand washing with soap and water is also required before starting work vending site.

Thus, food handlers need to be trained in safe and hygienic catering operations. Simple precautions like keeping cooked food and raw food covered, minimizing handling especially with bare hands, keeping the surrounding of the stall clean, holding of foods at appropriate temperature and storage conditions can ensure safe food for consumer. An understanding needs to be developed of importance of personal hygiene, cross-contamination and environmental sanitation.

Table 1: The average microbiological quality of *gol gappa* and *bhelpuri* sold by street food vendors in Jaipur city

S.No.	Sample	Standard Plate Count	Total Coliform Count	Total Staphylococcal Count
1	*Gol gappa*	+++	$2.2x10^7$	$3.5x10^7$
2	*Bhelpuri*	$8.7x10^8$	$6.6x10^8$	$2.0x10^8$

Table 2: HACCP of *Gol Gappa* samples collected from street food vendors of Jaipur city

S. No.	Samples	Standard Plate Count	Total Coliform Count	Total Staphylococcus aureus Count	*Salmonella*	*Shigella*	*Staphylococcus aureus*	*E. coli*	*Bacillus cereus*
1.	*Gol gappa* with filling and spicy water	$4.2x10^{11}$	$1x10^{11}$	$1.9x10^{9}$	-	+	+	+	+
2.	*Puri* or *Papri (Gol Gappa)*	$5.8x10^{9}$	$4x10^{8}$	$6x10^{8}$	-	+	+	+	-
3.	Potato Filling (*masala)*	$8x10^{14}$	$2.6x10^{14}$	$8.2x10^{14}$	-	+	+	+	+
4.	Spicy water	$6.3x10^{9}$	$2.3x10^{7}$	$3x10^{8}$	-	+	+	+	+
5.	*Dona* swab	$8x10^{5}$	$2.8x10^{5}$	-	-	-	-	+	_
6.	Container swab	$5x10^{10}$	$1.2x10^{10}$	$5x10^{8}$	-	+	+	+	+
7.	Table (*thela)* swab	$1.3x10^{9}$	$3.7x10^{8}$	$9x10^{7}$	-	+	+	+	+
8.	Duster swab	$2.6x10^{11}$	$4.4x10^{10}$	$1.5x10^{6}$	-	+	+	+	+

Table 3: HACCP of *bhelpuri* samples collected from street food vendors of Jaipur city

S. No.	Samples	Standard Plate Count	Total Coliform Count	Total Staphylococcal Count	Salmonella	Shigella	Staphylococcus aureus	E.coli	Bacillus cereus
1.	*Bhelpuri*	$5.6x10^{10}$	$4.1x10^{7}$	$2.2x10^{12}$	-	+	-	+	+
2.	*Murmura*	$2.7x10^{12}$	$1.1x10^{8}$	-	-	-	-	+	+
3.	Canapee	$1.7x10^{4}$	$6x10^{2}$	$4.5x10^{4}$	-	-	+	+	+
4.	*Bundi+sev*	$1.6x10^{8}$	$1.9x10^{2}$	$3.8x10^{2}$	-	+	+	+	+
5.	Frimes	$2.7x10^{12}$	$3x10^{10}$	$1.4x10^{8}$	-	-	+	+	+
6.	Tomato	$3.7x10^{12}$	$2.3x10^{11}$	-	-	+	-	+	+
7.	Onion	$1.9x10^{8}$	$4.5x10^{7}$	-	-	+	+	+	-
8.	Potato (boiled)	$9.1x10^{8}$	$7.6x10^{7}$	-	-	+	-	+	-
9.	Green coriander	$7.8x10^{14}$	$4.2x10^{12}$	-	-	+	-	+	+
10.	Green chilli	$1.7x10^{8}$	$2.8x10^{10}$	$1.6x10^{12}$	-	+	+	+	+
11.	*Chutney*	$7.6x10^{9}$	$1.2x10^{12}$	$5.4x10^{8}$	-	+	+	+	+
12.	Knife swab	$6x10^{8}$	$3.2x10^{6}$	$6x10^{2}$	-	+	+	+	-
13.	Chopping board swab	$7x10^{6}$	$4.1x10^{3}$	$1.5x10^{3}$	-	+	+	+	-
14.	Lemon squeezer swab	$2.3x10^{8}$	$1.5x10^{7}$	$5x10^{4}$	-	+	+	+	+
15.	Table *(thela)* swab	$5x10^{6}$	$1x10^{5}$	$3x10^{2}$	-	+	+	+	+
16.	Container +	$1.9x10^{8}$	$1.5x10^{5}$	$8.5x10^{5}$	-	+	+	+	-

	Spoon swab								
17.	Duster swab	$1x10^7$	$2.5x10^5$	$1.2x10^3$	-	+	+	+	-

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