

Full Length Research Paper

Microbiological quality of selected street-vended foods in Coimbatore, India

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Quality analysis of street-vended food enterprises and street food vendors from the Coimbatore city, Tamil Nadu, India was carried out. This research reveals that, handling and trading practices of street vendors are not hygienic enough to obtain a safe food. These street-vended foods are easily contaminated by food borne pathogens, due to the poor quality of water used and the poor sanitary procedures in preparation and storage of foods. Street-vended foods (10 items) sold by street vendors obtained from the locale were found to have microbial load representing *E. coli* and *Salmonella* sp. 70% of the food samples collected from street vendors have shown high bacterial load. Results have demonstrated the non-hygienic quality of most popular types of street vended foods. The pressing need as indicated by WHO is that, there must be measures imposed by the Food Safety Authorities, to follow proper control measures to improve microbial quality of the street vended foods.

Key words: Microbiological food quality, street vended foods, food safety indicators.

INTRODUCTION

In India, street vended foods are gaining overwhelming momentum; hence strong efforts with broader dimensions are needed, to explore the safety of street food establishments (Chadrsekhar et al., 2003). In recent years, street foods have become part of urban modern day life. They provide inexpensive, economic and often nutritious foods for urban and rural poor. They are the major source of income and opportunity for self-employment for a great number of people (Chadrsekhar et al., 2003). These foods satisfy the people, serving specially to the taste of the consumer, with little attention bestowed on hygiene, food safety or nutritional aspects (Bhat, 2004).

However among all other kinds of foods consumed by

human being today, the street foods are exposed to abundant sources of contamination, as from unclean water, unhygienic preparation and storage, space constraint, raw food, infected handlers and inadequately cleaned equipment etc. Hence, the chances of food borne illness associated with these street foods are increasing (WHO/FNU/FOS/96.7, 1997). WHO and Food safety organization's studies on street foods in developing countries have shown a high microbial count and are commonly contaminated with pathogens such as *E. coli*, *Salmonella*, *Shigella*, *Vibrio cholerae* and *Staphylococci* which are responsible for serious food poisoning outbreaks (Bryan et al., 1992). Hence the present study was planned to assess the microbiological

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quality and safety of selected street foods.

METHODOLOGY

Selection of the area and outlets

Five busy areas of Coimbatore city, Tamil Nadu, India, where the common street vended foods are available were selected for the study. The number of outlets in each area ranged from a minimum of five to a maximum of fifteen and the total number of outlets selected for the present study were fifty outlets.

Collection of samples of food items sold at street food outlets

Ten (10) different food items sold in the outlets were collected for the microbial analysis. Two samples each were collected from the selected outlets based on different methods of cooking and medium used (Table 1).

Table 1. List of food items selected for the study.

Food item	Method of cooking
Idli	Steaming
Idiyappam	Steaming
Bhelpuri	Ready mixing of raw ingredients
Panipuri	Ready mixing of raw ingredients
Bonda/Bhajji	Deep Frying
Fish fry	Deep Frying
Tandoor chicken	Sauteing and Deep frying
Chilly mushroom	Sauteing and Deep frying
Fried rice	Cereal based / starch food
Vegetable noodles	Cereal based / starch food

Microbiological examination of the selected food items

Being ubiquitous in distribution, microorganisms can gain entry into the food chain from various sources during different stages of their processing, storage and serving. Besides providing a suitable nutritional and physical environment for growth and multiplication of microorganisms, the food possesses the inherent capacity to sustain them in rare numbers. Representative samples of street foods were collected from the selected outlets in recyclable LDPE (Low-density polyethylene) covers. The samples were immediately taken to the laboratory. They were analyzed for the following criteria; all the analyses were carried out following FAO 1992 procedures (FAO, 1992; Tambekar et al., 2011).

Total plate count

The test was used to determine the total number of viable bacteria in street foods which is an indication of the sanitary conditions in which these foods were prepared and stored.

Identification and counting of coliform bacteria

The process of identification of the disease causing contaminant bacteria from foods and especially counting of coliforms was done

for assessing the adequacy of sanitation of these street vended foods. Coliform counting becomes important as it indicates the contamination of food by disease causing bacteria from fecal contamination. Among the coliforms, *E. coli* is a valid index organism indicating faecal contamination of water that is being used for food preparations. This indicates inadequate processing and/or post process contamination due to cross contamination by raw materials, improper cleaning, and use of contaminated water for washing and preparation, use of dirty equipment or poor hygienic handling (Mbah et al., 2012).

Fungal count

The presence of yeasts and moulds is indicative of improper storage of food stuffs or long term storage of food stuffs. The presence of which indicates that food is unfit for consumption.

Salmonella count

This was used to determine the *Salmonella* group of bacteria which if present in food substances at levels of $10^5/g$ is highly suggestive of food poisoning to occur. *Salmonella* also enters through contaminated water for use in cooking, improper cleaning and unhygienic handling and storage practices in food items.

RESULTS AND DISCUSSION

Microbiological quality of street foods

Routine examination of foods for the complete range of pathogenic microorganisms is impractical. In order to assess the microbiological safety of food borne pathogens, indicator organisms are used which indicate the presence of pathogens of intestinal origin as a result of direct or indirect faecal contaminations and they are usually used to assess food hygiene (FAO, 1997; Chandi and Sonali Patra, 2012; WHO, 2002).

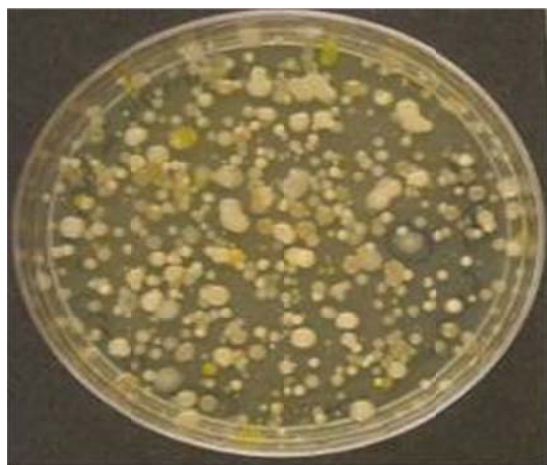
The identification criteria for indicator organisms have been done in four methods in the present study to determine the contaminating conditions to which the foodstuffs were exposed to during handling. (i) Total plate count, (ii) Enteric Indicator bacteria (iii) *E. coli* and *Salmonella* sp. and (iv) yeasts and molds were the tests done to identify the microbial quality of foods.

Table 2, Plates 1 and 2 showed the bacterial count of different street foods. The highest plate count for different products were as follows, chilly mushroom (8.4×10^5), fish fry (9.1×10^5), kuska rice (6.4×10^5). Average standard plate count is 4.0×10^5 cfu/gm. High counts in foods indicate contaminated raw materials and also indicate inappropriate time/temperature storage conditions.

The next order of microbiological contamination was found in vegetable noodles (2.3×10^5), Egg bonda (2.1×10^5), Idly (1.3×10^5), and Idiyappam (2.5×10^5). Standard plate count of these food samples were found to be less, presumably due to heat treatment (frying, steaming) during its preparation. Plates with different colonies on nutrient agar and EMB agar have been presented with

Table 2. Bacterial counts of different street foods

Food sample	Standard plate count cfu/g
Bhelpuri	1.4×10^5
Chilly Mushroom	8.4×10^5
Tandoori Chicken	4.8×10^5
Idiyappam	2.5×10^5
Idli	1.3×10^5
Panipuri	1.8×10^5
Fish Fry	9.1×10^5
Kuska Rice	6.4×10^5
Egg Bonda	2.1×10^5
Vegetable Noodles	2.3×10^5

**Plate I.** High microbial counts in Tandoori chicken.**Plate II.** High microbial counts in Kuska rice.

different pathogens found in street foods. Standard plate count has been done on street foods at Tirumala and similar results have been observed in a study done by Suneetha et al. (2011). The study by Suneetha et al.

Table 3. Testing for the presence of indicator organisms

Food sample	<i>E. coli</i>	<i>Salmonella</i> sp	Fungus
Bhelpuri	-	-	+
Chilly mushroom	-	-	-
Tandoori chicken	+	-	+
Idiyappam	-	-	-
Idli	-	-	-
Panipuri	-	-	+
Fish fry	+	-	-
Kuska rice	+	-	+
Egg Bonda	-	+	-
Vegetable noodles	-	-	-

**Plate III.** *E. coli* isolated from Tandoori chicken

(2011) stated that breakfast items and fruit juices among street foods were contaminated with Coliforms, *Bacillus cereus*, *Staphylococcus aureus* and Yeast / Moulds as indicated by standard plate count. Lack of awareness on requirement for basic safety issues by vendors add up the microbial loads. Unhygienic practices such as use of rudimentary stands and carts, nonavailability of running water for dilution and washing, extended preservation without refrigeration, unhygienic ambiance with teeming flies and airborne dust (Lewis et al., 2006) result in severe contamination of food.

From Table 3, it can be interpreted that presence of *E. coli* which has been widely accepted as indicator of faecal contamination of water, denoted the possible presence of pathogens of enteric origin. However substantial numbers of *E. coli* in foods such as Tandoor chicken, Fish Fry and Kuska Rice (Plate III, IV and V) suggested lack of hygiene and cleanliness in handling and improper storage. While the presence of large numbers

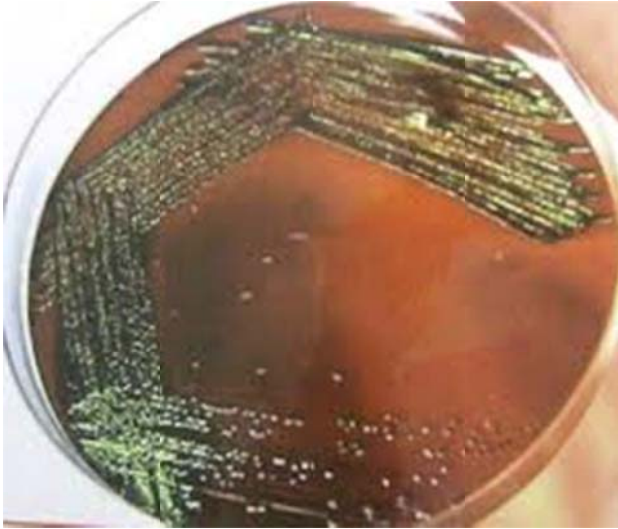


Plate V. *E. coli* isolated from Kuska Rice.



Plate IV. *E. coli* isolated from fish fry.

of *E. coli* in foods is highly undesirable, it would be virtually impossible to eliminate all of them. From the standard plate count, characteristic colonies were picked from each food sample and plated on Eosin Methylene Blue agar and Salmonella Shigella agar for identification of *E. coli* and *Salmonella* sp. Eosin Methylene Blue (EMB) agar was used to selectively identify *E. coli* that showed greenish metallic sheen of colonies, *Salmonella* showed colonies with black pointed centre on Salmonella Shigella (SS) agar (Plate VI). A similar study on hazard analysis of street vended foods was carried out by Sharmila (2011).

Though low numbers of coliforms are usually permitted in sensitive foods at numbers ranging from 1 to not

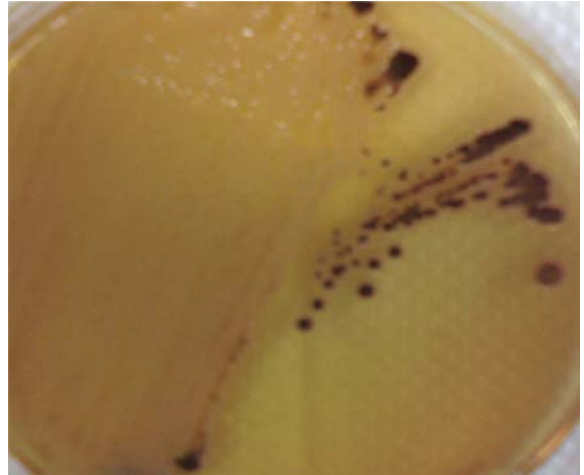


Plate VI. *Salmonella* isolated from egg bonda.

exceeding 100/g or ml of food quantity (Frazier 1994), the presence of enterobacteriaceae or coliforms indicate inadequate processing and or post process contamination due to cross contamination by raw materials, dirty equipments or poor hygienic handling and thus microbial proliferation could have allowed multiplication of a wide range of pathogenic and toxigenic forms. It is a common practice to handle both cooked and raw samples alternately during the roasting process thereby increasing the possibility of transmitting enteropathogens to cooked products (Mbah et al., 2012).

The proposed microbial specification to be used as guidelines for foods has been presented in Table 4. By comparing the bacterial counts in the street foods obtained in present study in Table 5 to the proposed food standard specifications given in Table 4, it was inferred that Fish fry and Kuska rice were poorest in Microbiological quality with high microbial load, indicating inadequate cleaning during preparation, unhygienic preparation procedures, use of contaminant water for cooking and washing that carries these contaminant indicator organisms and unhygienic storage conditions of these food items. Tandoori chicken was also poor in microbial quality, which prepared by mixing the ingredients with hands. The vendors who dip their hands in the vessel for rolling the chicken in the batter, and impure water used for the purpose were the sources that contaminate this food item.

Based on these findings, the study signifies the need for maintenance of proper hygiene in street food outlets and has suggested that provision of suitable facilities and training are prime requisites for the food vendors. Critical control points to avoid contamination should be identified and proper initiatives should be taken to reduce the contamination. Local authorities should take measures to go through planning, investment, mass media and also campaign on food safety and regulations.

Table 4. Microbiological specification of foods

Food type	Total viable count	<i>E. coli</i>	<i>Salmonella</i> sp	Yeast and molds
Fish	1000000/g	<500/100 g	0/20 g	-
Cooked Poultry	1000000/g	0/20 g	0/20 g	-
Egg and Egg products	<20000/g	<50/g	0/25 g	<200/g
Deep Fried Food Products	<10000/g	0/g	0/25 g	-
Starchy cereal cooked foods	<200000/g	0/g	0/25 g	>10000/g
Food items requiring further cooking	-	<10/g	0/25 g	-
Raw vegetables	-	0/g	0/25 g	-

Source: Guidelines for environmental health officers on the interpretation of microbiological analysis of food, Department of health directorate, food control, 1992.

Table 5. Microbial Load in different types of street vended foods

Food Sample	Standard plate count cfu/gm	<i>E. coli</i>	<i>Salmonella</i> sp	Fungus
Bhelpuri	1.4×10^5	-	-	0.5×10^5
Chilly mushroom	8.4×10^5	-	-	-
Tandoori chicken	4.8×10^5	1×10^5	-	0.8×10^5
Idiyappam	2.5×10^5	-	-	-
Idli	1.3×10^5	-	-	-
Panipuri	1.8×10^5	-	-	0.1×10^5
Fish Fry	9.1×10^5	1×10^5	-	-
Kuska rice	6.4×10^5	4×10^5	-	1.2×10^5
Egg Bonda	2.1×10^5	-	5×10^5	-
Vegetable noodles	2.3×10^5	-	-	-

Conclusion

Street foods are source of inexpensive, convenient and delicious food, providing significant quantities of nutrient level of calories, protein and fat. But they raise concern with respect to the potential hazards due to microbiological contamination adulterants and poor environmental sanitation and hygiene involved for their preparation. Simple precautions like keeping cooked and raw food separate and covered, minimizing handling with unhygienic hands and utensils, keeping the surroundings of stall clean, using clean water and holding foods at appropriate temperature for not longer than its required time period can ensure safe food delivery to the customers.

Conflict of interests

The authors did not declare any conflict of interest.

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