

Research Article

Hygienic and Sanitary Quality in Street Food Stalls Located in a University Sector of Barranquilla, Colombia

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Abstract: Foodborne diseases are one of the main public health problems worldwide, especially due to the consumption of foods that made with poor hygienic practices, such as those prepared on a public thoroughfare. Some factors that contribute to its contamination are the use of non-potable water, inadequate handling, cross-contamination and environmental contamination. This study aimed to perform a sanitary profile with the completion of a survey of 12 food stalls to evaluate their hygienic and sanitary quality and through observation. Four samples of food were taken from each stand, for a total of 48 samples such as hamburger, hot dog, pizza, meat empanada, stuffed potato, stuffed arepa, chicken skewer, chicken finger, fruit salad and orange juice. Coliforms, *Escherichia coli* and *Staphylococcus aureus* were analyzed. 83.3% of the samples exceeded the acceptable limits of coliforms and in the 16.7%, it was detected *Escherichia coli*. No *S. aureus* was detected in any sample. Eighty-three point three percent of the vendors do not wear appropriate clothing, 75% use accessories and 83.3% do not use potable water for hand washing. Thirty-three point three percent of the stalls do not have surface with sanitary material, 100% do not have access to sanitary service and drinking water, 58.3% have the presence of animals in their surroundings, 50% have uncovered garbage containers, 91.7% store food at high temperatures and 100% do not have a sanitary authorization of operation. The lack of good hygiene practices in the food stalls on this public thoroughfare affects the quality and safety of food, making it a risk to the health of consumers.

Keywords: Coliforms, food safety, hygienic practices, microbiological quality, street food vendors

INTRODUCTION

Foodborne diseases are a major cause of morbidity and mortality worldwide (WHO, 2015). These are caused by eating foods or beverages contaminated with microorganisms in amounts that affect the health of the consumer at an individual level or in a population. Most of these diseases are infections, caused by different bacteria, viruses and parasites transmitted by food, or intoxications caused by toxins produced by microorganisms, especially by some bacteria and fungi (Jay *et al.*, 2005; Ray and Bhunia, 2010).

Foods most commonly associated with these diseases include street foods, defined by the FAO as ready-to-eat foods and beverages sold by vendors especially in street and other similar public places. They can be found in clusters around places of work, schools, universities, hospitals, etc., (FAO, 1997). The

consumption of food sold on streets is very common and increased due to factors such as urban customs, affordable food prices, easy access to fast food, women working outside the home, great distances between home and workplace, family eating habits outside the home, among others. However, in the preparation of these foods, there are some factors related to food safety such as non-potable water use, poor hygiene practices, inadequate handling and storage, cross-contamination and environmental contamination, representing a public health risk (Costarrica and Morón, 1996; Benny-Ollivierra and Badrie, 2007; Sareen, 2011).

In Colombia, the manufacture of food sold on the public thoroughfare is carried out with little or no control increasing the contamination with microorganisms due to the lack of training in the proper handling of food (Bayona, 2009). Low-income people

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with little education in food safety and Good Manufacturing Practices (GMP) work on many of these street food stalls.

Investigations related to microbiological contamination of street foods worldwide reported the presence of pathogenic microorganisms such as *Salmonella*, *Listeria monocytogenes*, *Escherichia coli* O157: H7, *Staphylococcus aureus* and *Vibrio cholerae* (Quispe and Sánchez, 2001; Félix-Fuentes *et al.*, 2005; Cho *et al.*, 2011). Hygiene in these street sales generates concerns regarding the production of food free of microorganisms so, the microbiological quality of street food stalls is unknown and there is an insufficiency of scientific studies in Colombia, especially in the city of Barranquilla. This study aimed to evaluate the hygienic conditions of food preparation and to determine the microbiological quality to know the risk of exposition of the consumer.

MATERIALS AND METHODS

Identification of the sanitary conditions of the stalls:

The present investigation was carried out in the public thoroughfare of a university sector in the city of Barranquilla, Colombia, during the months of May and June of 2017. Of the total number of food stalls located in the sector (16), only 12 vendors agreed to sign free consent forms and participate in the study. To identify the hygienic and sanitary conditions of the stalls, a sanitary profile format was applied based on government regulations for the sale of food on the public thoroughfare. The data were collected through visual inspection and with the implementation of a survey, verifying the compliance of 5 categories such as personal presentation and sanitary practices of the vendor, vendor training, conditions of the stall, storage, serving and transportation of food and sanitary license of operation. The data obtained were subjected to a frequency analysis that determines the percentage of compliance with each criterion investigated in the total of the food stalls.

Sampling and microbiological analysis of food:

Forty-eight samples of food sold at the different stalls (4 samples/stall) were taken, maintaining aseptic conditions through the use of sterile gloves, hat, mask and appropriate clothing. Samples were collected between 9:00 a.m. and 12:00 p.m., which is a very usual period for food handling. Food sampled were meat empanadas, stuffed potatoes, hot dogs, cheese fingers, stuffed arepas, chicken skewers, hamburgers, pizzas, fruit salad and orange juice. Both hot dogs and hamburgers were sampled at two food stalls. The food was packed in sterile bags and stored in a portable cooler maintaining a temperature of 4°C until transportation to a certified microbiological laboratory in the city of Barranquilla. The samples were processed for Coliform MPN (Most Probable Number) and *Escherichia coli* MPN analysis according to the methodology established by AOAC 966.24 and for

coagulase-positive *Staphylococcus* count according to the methodology stipulated by the Colombian rule NTC 4779.

Statistical analysis: The data obtained were subjected to a frequency analysis that determines the percentage of compliance with the investigated criterion in all the stalls. Regarding the samples that had microorganisms, it was considered those containing only quantities superior to the microbiological limit.

RESULTS AND DISCUSSION

As shown in Table 1, based on an observational approach, most vendors (83.3%) do not comply with the appropriate attire consisting of a clean white blouse and a cap that completely covers the hair. In contrast, they use common clothes of different colors and do not show personal hygiene habits. Some of the male vendors have a beard and some of the female use loose hair. Eighty-three point three percent of the handlers do not wash their hands properly, do not use soap and dry their hands with dirty cloth towels which are used in the same way to clean the work area.

On the other hand, it was observed that most vendors (75%) use jewelry and have long nails as well (66.7%) which contributes to the accumulation of dirt that can contaminate the food. Another usual practice of vendors is smoking, eating, coughing or sneezing on food (Table 1). Similar results were found by Bayona (2009) in street food stalls in a sector of Bogotá, Colombia, where only 13% of vendors complied with good manufacturing practices. Moreira Da Silva *et al.* (2011) also reports that most street vendors in a university sector in Brazil did not have good hygiene and personal presentation practices.

Vendor or manipulator training: The training of vendors in food handling is very important because the knowledge acquired must be applied to ensure the safety of food. One hundred percent of the vendors reported to have received training in food handling (Table 2) and 83.3% reported to have received the food-handling license. However, even with the knowledge of proper food handling, vendors engage in poor hygiene and handling practices exposing food to contamination. Besides, it was evidenced that the manipulators did not have information about the pathogenic microorganisms and the diseases that these can produce by the consumption of foods with bad handling. Similarly, Bayona (2009) reports that 73% of vendors did not have this knowledge. During the survey process, no manipulator carried a food-handling license, so there is no evidence of the information provided by them.

Conditions of the food stall: Table 3 shows the results of the evaluated criteria of the conditions of the stalls. Sixty-six point seven percent of the stalls have an area covered with a sanitary material in good condition. However, some posts have wood surfaces which

Table 1: Personal presentation and sanitary practices of the vendor

Criteria	Compliance (%)	
	Yes	No
Use of appropriate attire (clean white apron and cap)	16.7	83.3
Has personal grooming habits (his appearance is clean)	16.7	83.3
Does not use accessories (rings, watches, bracelets, earrings, necklaces)	25.0	75.0
Hand wash with clean water and soap before and after preparing or serving food	16.7	83.3
Does not smoke, eat, cough or sneeze on food	50.0	50.0
Clean hands and short nails	33.3	66.7

Table 2: Vendor-manipulator training

Criteria	Compliance (%)	
	Yes	No
Vendor received training in food handling	100.0	0.0
Vendor has a food-handling license	83.3	16.7

Table 3: Conditions of the food stall

Criteria	Compliance (%)	
	Yes	No
Surface with sanitary material	66.7	33.3
Access to sanitary service and potable water	0.0	100.0
Accessories of the stall in good condition (chairs, tables, showcases, etc.)	83.3	16.7
No animal presence	41.7	58.3
Clean stall and adjacent areas (perimeter of 2 m)	75.0	25.0
Supply of potable water or water tank (20 L) in sanitary material	25.0	75.0
Water supply containers remain covered	25.0	75.0
Garbage container with lid and away from food	50.0	50.0
No wastewater is thrown on the thoroughfare or around the stall	41.7	58.3

facilitate the contamination of food since they are surfaces prone to the formation of microbial niches. Moreover, they present plastic ceilings or tents in a deteriorated state.

One hundred percent of the vendors do not have sanitary service and drinking water and perform their physiological needs in the bathroom of a gas station in the area which has drinking water but does not have soap for hand washing. Other studies report the absence of sanitation facilities in areas close to food stalls, which often forces vendors to use isolated areas to relieve themselves without properly washing their hands afterward (Azanza *et al.*, 2000; Bhat and Waghray, 2000).

Animals and insects were present in the area of the food stalls (58.3%), which contributes to food contamination, especially since 50% of them present garbage containers without cover exposed to the environment and close to the food area. Bayona (2009) reported a higher percentage where 73% of the food stalls had an improper handling of garbage exposed to the environment with the presence of flies.

According to the Colombian rule 604 of 1993, the sales stall must have a supply of potable water preferably in the amount of at least 1 L/serving daily. In case of not coming from the public supply network, the stall must have a water tank of at least 20 L, built in sanitary material properly protected and equipped with a faucet. Seventy-five percent of the stalls did not comply with this provision since they did not have stored water and in some cases, it was uncovered. It was seen that none of the food stalls had a piped water supply at the point of operation. Benny-Olliviera and Badrie (2007) reported from a study in Trinidad that the

water supply for the preparation of foods was supplied from a faucet, which was attached to a water storage container and in some cases, there was no storage of water.

With regard to wastewater management, 58.3% of the places threw dirty water in the streets. Similarly, Bayona (2009) reports that 87% of sales did not meet adequate water supply and management. The lack of facilities for drainage and disposal of wastewater and garbage causes the waste to be thrown into the streets and nearby channels favoring the increase of pests such as flies and rodents (Rane, 2011).

Preparation, storage, serving and transport of food:

Table 4 shows the evaluation of food preparation, storage, serving and transportation practices. The storage temperature of food is a major factor in the growth of microorganisms because if they remain for more than 2 h at temperatures between 4.4 and 60°C, their proliferation is fast, posing a risk to the consumer health (Jay *et al.*, 2005; Benny-Olliviera and Badrie, 2007). This range of temperatures is often called the Danger Zone. Ninety-one point seven percent of the stalls did not comply with food storage at adequate temperatures. The lack of refrigeration in the street food is very common and constitutes one of the major factors predisposing the onset of foodborne diseases (Barro *et al.*, 2007).

The majority of sales stalls prepare food with clean utensils and in good condition (66.7%). However, 33.3% of the stalls use utensils in bad condition that represents a risk of cross-contamination and unsafe food production, Barro *et al.* (2007). Fifty eight point three percent of the stalls use dirty and poorly designed

Table 4: Preparation, storage, serving and transport of food

Criteria	Compliance (%)	
	Yes	No
Storage of food at suitable temperatures	8.3	91.7
Preparation utensils remain clean and in good conditions	66.7	33.3
Prepared foods are protected with plastic display cases	41.7	58.3
Meals and beverages are served using disposable tableware	100.0	0.0
Foods are served using utensils (tongs, spoons) and not with hands	75.0	25.0
Does not offer unsold prepared meals on the following day	100.0	0.0
Food transported to the food stall comes in closed and protected containers	83.3	16.7

Table 5: Sanitary license of operation

Criteria	Compliance (%)	
	Yes	No
The vendor has a sanitary authorization of operation for selling food on the thoroughfare.	0.0	100.0

showcases which remain open. Bayona (2009) reports that 93% of the stalls did not comply with good food storage, they use glass showcases with built-in bulb, cotton fabrics and plastic lids.

With regard to food serving, 100% of the sales stalls serve food and beverages in containers of disposable material and 75% use tongs to serve. However, 25% handle food with their hands constituting a risk of contamination. The hands of the vendors are considered one of the main sources of food contamination. Eighty-three point three percent of the stalls carry food in closed containers protected from environmental contamination and insects, which is a good management practice. On the other hand, it was observed that some vendors use plastic bags and plastic containers in a poor state of conservation and hygiene.

Sanitary license of operation: With regard to the sanitary license, 100% of the stalls do not have a sanitary license (Table 5). Vendors emphasized that they did not require permission to sell food on this thoroughfare.

Microbiological analysis of food: Eighty-three point three percent of the analyzed samples presented unacceptable results because they exceeded the microbiological limits for Coliforms (120-1100 MPN/g for meat hamburger, 150 MPN/g for fruit salad and <3 NMP/g for the remaining samples), while 16.7% of the samples had *Escherichia coli*. No coagulase-positive *Staphylococcus* was detected in any of the analyzed samples.

Figure 1 shows the percentage of samples that exceeded the microbiological limits for coliform bacteria according to the type of food. The total samples analyzed for stuffed potato, hot dog, stuffed arepa, chicken skewer, meat hamburger and pizza presented coliform bacteria above the microbiological limit value (Jay *et al.*, 2005).

Most of these foods are meat products that imply practices such as insufficient cooking process,

inadequate handling after the cooking process and maintenance of the products at room temperature for prolonged periods, influencing the contamination and proliferation of these microorganisms. Lues *et al.* (2006) reported results in Africa slightly lower meat (74%), chicken (72%) and gravy (73%).

Seventy-five percent of the fruit salad samples did not meet the microbiological specifications for coliforms representing a public health problem because they are food that is consumed raw without any intervention that eliminates or reduces pathogens. The manipulation of these products when cutting the fruits increases the risk of contamination, as well as, the use of utensils and knives that are not washed, instead, they are cleaned with towels used for other practices such as cleaning hands or surfaces. Generally, knives are washed with stored water which is reused the entire day. Another practice that increases the contamination is the lack of washing the fruits. Félix-Fuentes *et al.* (2005) reported that 96% of the fruit salads were contaminated with coliforms and 100% of the samples presented *E. coli*, unlike this study, where *E. coli* was not found in any of the samples of fruit salad.

Seventy-five percent of the meat empanadas samples report coliforms above the limit, which is contaminated by handling after the cooking process.

E. coli was found in 50% of the analyzed samples of hot dogs and stuffed arepas and in 25% of the meat hamburger samples (Fig. 2). Both the hot dog and the meat hamburger are foods that require being prepared with the hands, so the absence of good hygiene practices imply an unavoidable food contamination. On the other hand, *E. coli* is the bacterium most associated with fecal contamination, so it is possible that poor hygiene in hand washing, especially after using the bathroom causes its presence in the foods. Lues *et al.* (2006) reported similar results of *E. coli* in meat (50%) and chicken (55%). Bayona (2009) reports that 25% of the samples of hot dogs, corn arepa, fruits and meat empanadas and 12.5% of hamburger samples were contaminated with *E. coli*.

In particular, orange juice samples were acceptable for all microorganisms investigated indicating that the water and ice used for its preparation are of good quality, which has also been favored by the low pH of the product.

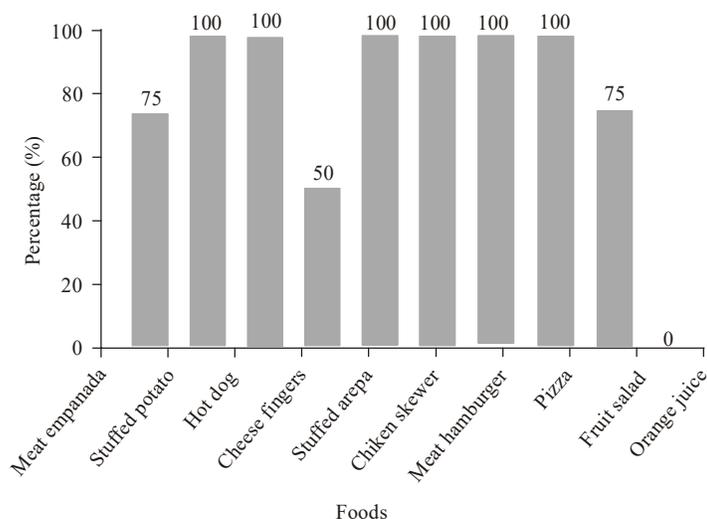


Fig. 1: Samples with values above the microbiological limit of *Coliforms*

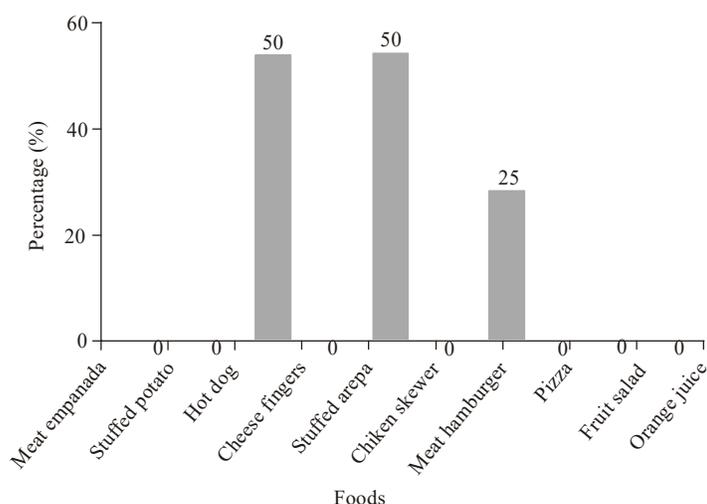


Fig. 2: Positive samples for *Escherichia coli*

CONCLUSION

The lack of hygienic practices in the handling and sale of food, as well as the poor conditions of the food stalls located in the public thoroughfare, are factors that reflect a high risk of contracting foodborne diseases by consuming contaminated food. Eighty-three point three percent of the vendors do not comply with the appropriate attire, the personal hygiene habits and with the adequate washing of hands. One hundred percent of stalls do not have sanitary service and drinking water. Fifty percent present garbage containers without cover and exposed to the environment and 91.7% did not comply with food storage at adequate temperatures.

An evidence of the risk mentioned above is shown in the microbiological results. Eighty-three point three percent of the samples exceeded the acceptable limits of coliforms and in the 16.7%, it was detected *Escherichia coli*. No *Staphylococcus aureus* was detected in any sample. These results make necessary to improve

infrastructure, sanitary and potable water service, waste disposal, refrigerated food storage and, adequate hygiene practices. It is necessary that the regulatory agencies perform a more effective control in the sales of foods on the public thoroughfare so that good practices of manufacture are applied and the innocuity of the food expended is guaranteed.

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