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Ambulant Market Foods: Consumer Problem or Solution?

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ABSTRACT

Background: The sale of food by street vendors is an activity of economic, sanitary, and nutritional importance, but these foods can pose a high risk to the health of consumers in inadequate conditions of preparation and storage. The aim of this study was to investigate the preparation conditions and the hygienic-sanitary quality of food sold by street vendors in the vicinity of four campuses of a University Center in Maceió, Brazil. The aim was to verify the sanitary hygienic conditions of the preparation site as well as to carry out a microbiological analysis of the commercialized foods. **Methods:** In this cross-sectional study, the microbiological analyses were carried out on different foods following the multiple tube technique for coliforms and surface sowing method and pour-plate assay for Salmonella sp., molds, and yeasts. In addition, an observational checklist was applied involving 21 trailer tent owners in the vicinity of the four campuses of the University Center. Inclusion criterion included adult vendors selling food near four campuses at the Centro Universitário de Maceió, Brazil. Exclusion criteria consisted of street vendors due to the difficulty in locating them. **Results:** The findings showed high presence of microorganisms; a high degree of risk was observed in 100% of the studied places. **Conclusion:** Hygienic-sanitary interventions are necessary to train these vendors on the importance of good manufacturing practices, since this will probably not result in food-borne outbreaks.

Keywords: *Food safety; Coliforms; Good practice*

Introduction

Over time, the sale of food by street vendors has been considered as an activity of economic, sanitary, and nutritional importance. In developing countries, this type of trade is an important source of income due to the high rate of unemployment as well as limited access to education and formal labor market (Costarrica and Morón, 1996).

Regarding the nutritional aspect, street food is a reflection of the economic and social condition of a country, since it provides accessible and low cost food and nutritional alternative. According to the estimates, about 2.5 billion people around the world consume street food daily (Food and Agriculture Organization, 2001) .

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In many cases and for different age groups, these foods have replaced regular meals, fulfilling people's energy and nutrient requirements, so that individuals can perform their daily activities (Garcia-Cruz *et al.*, 2000).

However, provision of foods by street vendors is contradictory from the perspective of food security. On the one hand, it provides the population with access to work, income, and a better quality of life and on the other hand, it makes them vulnerable to different diseases transferred by lack of food hygiene (Estrada-Garcia *et al.*, 2002).

According to the studies carried out in different countries, these products are highly contaminated with pathogens and microorganisms such as total and fecal coliforms, Staphylococcus aureus, Clostridium perfringens, and Salmonella sp (Muleta and Ashenafi, 2001).

In this context, a number of aspects should be considered including the hygiene of selling points, the source of water for cleaning utensils and food preparation, the hygiene of original food preparation places, the way of preservation and protection against vectors, and the disposal methods of solid and liquid wastes resulting from the marketing activity (Palomino Huamán, 1996).

The literature showed that conducting educational programs for training vendors improved their food practices, developed handling techniques, and reduced contamination levels (2001).

Considering the large number of urban consumers who rely on street foods as part of their daily meals, the perishable nature of many foods, and the fact that these foods should stay in a ready-to-eat state for long hours, this topic is of great importance. Therefore, treatments that serve to reduce contamination levels should be monitored by official bodies to promote and protect public health (Clarke, 2000).

As a result, we aimed to investigate the sanitary aspects of marketing these products and their microbiological conditions.

Material and Methods

In this cross-sectional study, samples were collected from various foods obtained from 21 street vendors near four campuses of a university center, named I, II, III, and IV, located in Maceió and the Farol neighborhood from March to May 2013. The food samples were obtained from evening vendors, individually collected and packed in clean, disposable, polyethylene bags identified and transported in a Styrofoam box to the Research Center at Cesmac University Center immediately after purchase.

Inclusion criterion included adult vendors selling food near four campuses at the Centro Universitário de Maceió, Brazil. Exclusion criteria consisted of street vendors due to the difficulty in locating them.

Microbiological analyses: All microbiological analyses were performed according to the procedures recommended by Silva et al. (da Silva *et al.*, 2017).

Analysis of coliform bacteria: To this end, the most probable number technique (MPN/g or ml) was applied. The presumptive and confirmatory testing was applied by Lauril Sulphate Tryptose (LST), Bright Green (VB), and *Escherichia coli* (EC).

Analysis of Salmonella sp: Surface plating was performed on the Xylose Lysine Deoxycholate Agar (XLD), and Hectoen Agar (HE), as solid media. Later, the plates were incubated at 35 °C/24h. To determine whether a sample is positive for *Salmonella sp.*, biochemical tests were performed and the results were showed as Absence or Presence at 25 g or ml.

Filamentous and yeast fungal analysis: Depth of sowing was performed by a Dichloran Rose Bengal Clorafenicol (DRBC) culture medium. The plates were exposed to a temperature of 25 °C for five days. After this time, the Colony Forming Units (CFU/g or ml) were counted.

Check list application: During sampling, the hygiene of vendor as well as equipment, utensils, and environment were evaluated visually by the researcher using a 99-item checklist with three options: compliant, non-compliant, and not

applicable. The data obtained were transcribed into the Microsoft Excel 2013 spreadsheet and the **Equation 1** was used to identify its adequacy. Consequently, the food marketed was classified according to parameters of RDC 275 of October 21, 2002 (**Table 1**).

$$Adequacy\% = \frac{Total\ compliance}{Total\ Items - Total\ Not\ Applicable} \times 100$$

Equation 1. *Equation to obtain the adequacy percentage and risk groups of food sold by street vendors .*

Data analysis: Microsoft Office Excel was used to analyze the data. Descriptive statistics were performed using the Stata® 11.0 statistical program (StataCorp, College Station, TX, USA).

Results

Microbiological analysis: According to **Table 1**, of 21 (100%) sample foods analyzed, 11 (52.38%) presented coliforms at 45 °C outside the microbiological limits recommended by the current Brazilian legislation (RDC No. 12 of 01/2001).

These foods also showed high counts for the total coliforms (A1, A4, A5, A10, A11, A13, A14, A15, A16, A17, and A19). Foods A6 and A7 (**Table 2**) presented high values for mold and yeast, indicating poor sanitary hygienic conditions. Furthermore, 100% of the foods showed no presence of *Salmonella sp*.

Therefore, according to the microbiological results obtained, 13 (62%) of the food samples were unfit for consumption. It was also observed that the fruit salad, which was the common food item sold in all food selling places (I, III, and IV), presented high counts of coliform bacteria, indicating a product with high risk in terms of sanitary conditions. In food selling place II, although coliforms counts were within the standard limits, the number of molds and yeasts was high suggesting application of raw material without considering the required levels of hygiene and sanitation.

Fried pastries, common in all the studied food selling places, were within the standard limits for all surveyed microorganisms, except for food selling place III, which had high counts of coliform bacteria. The heatused in the preparation process is a preservation medium that eliminates microorganisms, which was observed in food selling place III, where the fried pastry was exposed to the environment for commercialization, suggesting its post-process contamination.

Check list assessment of good manufacturing practice: According to the risk classification (**Table 1**), all street vendors presented a high risk degree regarding the suitability of good manufacturing practices for marketing their products. Therefore, the microbiological analysis of food samples and observational application of the checklist in all food selling places suggested that the degree of food contamination was associated with the sanitary hygienic conditions of the vendor and the commercialization place. The mean of adequacy score has been shown in **Figure 1.**

Table 1. Classification of street vendors according to the number of items served in the checklist for good food production practices that make up ANVISA RDC 275/2002

Classification	Pointing
Group 1	76 a 100 low risk
Group 2	51 a 75 medium risk
Group 3	< 50 high risk

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Table 2. Microbiological result of street vendors by campus analyzed from March to May 2013

Campus	N°	Foods	Coliforms at 35 °C MPN/g or ml	Coliforms at 45 °C MPN/ g or ml	Mold and yeast CFU/g or ml	*Salmonella* 25g/mL
I	A1	Sandwich	> 1100	> 1100	<15	Absence
	A2	Fried pastry	< 3.0	< 3.0	<15	Absence
	A3	Salty	3.6	3,6	<15	Absence
	A4	Drumstick	> 1100	> 1100	<15	Absence
	A5	Fruit salad	> 1100	> 1100	Countless	Absence
	A6	Hot Dog	36	36	Countless	Absence
II	A7	Fruit salad	150	150	Countless	Absence
	A8	Fried pastry	3.6	3.6	<15	Absence
	A9	French fries	93	93	<15	Absence
III	A10	Fried pastry	> 1100	> 1100	<15	Absence
	A11	Fruit salad	> 1100	> 1100	Countless	Absence
	A12	Coco water	< 3.0	< 3.0	<15	Absence
	A13	Barbecue	> 1100	> 1100	<15	Absence
	A14	Broth	93	93	Countless	Absence
	A15	Broth	93	93	<15	Absence
IV	A16	Fruit salad	> 1100	> 1100	Countless	Absence
	A17	Hot-dog	> 1100	> 1100	<15	Absence
	A18	Green corn	3.6	3.6	<15	Absence
	A19	Salty	150	150	<15	Absence
	A20	Fried pastry	< 3.0	< 3.0	<15	Absence
	A21	Chinese pastry	< 3.0	< 3.0	<15	Absence

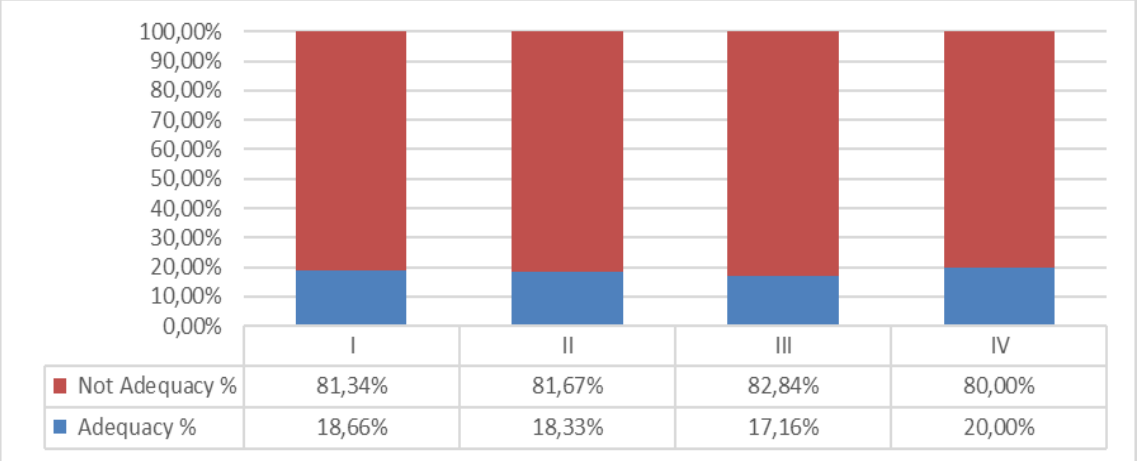

Figure 1. Mean adequacy and non-adequacy scores in the analyzed campus

Discussion

Findings of the present research are in the same line with other studies on the microbiological profile of street vendors, which also showed high counts of total coliforms and absence of Salmonella in foods such as sandwiches and hot dogs (Furlaneto and Kataoka, 2004). High counts of coliforms were also observed in fruit salads sold by street vendors (Magalhães, 2009, Pinheiro *et al.*, 2012).

However, according to the results of a study (Tavares *et al.*, 1996), absence of *Salmonella sp.* and coliforms was expected in pastries and salted snacks if adequate storage conditions were provided for the product. However, fecal coliforms were found in green maize (A18) sold by street vendors in Alagoas (Barroso *et al.*, 2012).

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The population and merchants' poor health knowledge can justify the low values of suitability and conformity among the street vendors (Mendonça *et al.*, 2002). Furthermore, some studies reported high levels of nonconformity and low conformity scores among the street vendors (Franco and Ueno, 2010, Furlaneto-Maia, 2008).

The administered checklist showed that of nine studied topics, evaluation of the product storage equipment and its handling after preparation received the highest non-conforming score, which is supported in the literature (Alves, 2011).

A survey conducted in the city of Franco et al. revealed that of 158 commercialized street food outlets, none met the standards required by the Sanitary Surveillance, 53.7% of the samples partially met the set criteria and 43.3% had poor hygiene conditions (Franco and Ueno, 2010) .

In a research in the city of Rodrigues et al., the hygiene and sanitary conditions of the street vendors revealed that the hygienic conditions were not at adequate levels, so that most snack samples had an unsatisfactory microbiological quality (Rodrigues *et al.*, 2003).

A survey conducted in Mendonça et al. found that 100% of the street vendors did not have a business license or authorization from the City Hall (Mendonça *et al.*, 2002). In a study carried out in Feira do Bom Jesus–Brazil, it was observed that most food traders did not meet the hygienic-sanitary standards (Sá *et al.*, 2010).

The hygiene of utensils and equipment is of great importance in street food; i.e., the equipment used in preparation and storage of foods should prevent contamination and proliferation of microorganisms. In a similar study in the Municipality of Presidente Prudente–Brazil, the equipment and utensils were dirty and in poor health condition in 11% of the snack trailers. In 20% of these trailers, the foods were stored in inadequate compartments (Fattori *et al.*, 2005).

The limitations of this study include the following factors. We excluded mobile vendors due to the difficulty in locating them and impracticality of assessing their hygienic-sanitary conditions. Another limitation refers to the study area; sampling was limited to the area near the University Center. So, the food items sold only in that region were studied. In this regard, future researchers can investigate other types of foods in other parts of the city or different cities in their countries. We hope that our findings can inform the scientific community and the public about the hygiene conditions of the food sold in Centro Universitário de Maceió, Brazil. As a result, health professionals and authorities can design educational plans for the public and vendors to ensure safe food.

Conclusion

According to the findings, 100% of the street food selling places were at an unsatisfactory level of Good Manufacturing Practices. Investigations showed that 13 (62%) food samples were not appropriate for consumption. Therefore, health surveillance intervention is required to train the vendors about the importance of Good Manufacturing Practices to prevent future health problems caused by food contamination.

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Authors' contributions

All authors contributed to this work. Authors' contributions João Paulo dos Santos was in the designation and supervision of the study. Lucas Pedrosa Souto Maior and Isaura Cariolando Santos da Silva responsible for the study design and data collection. Karwhory Wallas Lins da Silva and Morgana Cristhyne Tenorio Sampaio participated in the writing of the manuscript. Nathalia Rose da Silva Gomes, Ilda Manuelly da Silva Santos, Thiago José Matos Rocha and Eliane Costa Souza they critically reviewed the manuscript and approved the final version sent for publication.

Conflict of interest

All authors declare no conflict of interests.

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