

Microbiological quality of street foods in Belo Horizonte, Minas Gerais

Qualidade microbiológica da comida de rua de Belo Horizonte, Minas Gerais

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Abstract

This study aimed to analyze the microbiological quality of foods sold by street vendors in Belo Horizonte, MG. The sample was statistically defined and comprised 51 street vendors: 48 individuals agreed to respond to the socioeconomic questionnaire and checklist; 50, to the foods temperature measurement; and 5, to microbiological analysis (foods, utensils and vendor's hands). Mean age was 41 years (SD \pm 15); 21% of leftovers were reused; 43.8% of the vendors did not wear a protection hair cap or net; 87.5% handled money while handling the foods. Only 18.7% of hot foods exhibited temperatures in conformity with the adopted standard. Nonconformities were found for Viable Aerobic Mesophilic Bacteria (100%), Coliforms at 35°C (60%), *Staphylococcus aureus* (60%), *Bacillus cereus* (20%) and *Salmonella* spp. (60%). All utensil samples indicated poor hygiene, and coliforms at 35°C were present in all hands of the street vendors analyzed. The conditions of infrastructure, equipment and utensils and personal hygiene of the respondents were unsatisfactory. It is necessary to intervene and train street vendors in order to assure food safety for consumers. In addition, it is necessary to develop a specific sanitation legislation for this kind of business.

Keywords: Street Food. Safety of Street. Health Surveillance.

Resumo

O objetivo deste estudo foi analisar a qualidade microbiológica dos alimentos comercializados pelos ambulantes de Belo Horizonte, MG. A amostra foi definida estatisticamente e composta por 51 ambulantes de alimentos: 48 concordaram em responder ao questionário socioeconômico e a lista de verificação; 50, a aferição da temperatura do alimento; e 5, a análise microbiológica (alimento, utensílio e mão do ambulante). A média de idade foi de 41 anos (DP \pm 15), 21% das sobras eram reaproveitadas, 43,8% dos ambulantes não mantinham os cabelos protegidos por touca ou rede, 87,5% manuseavam dinheiro antes de manipular alimentos. Apenas 18,7% dos alimentos quentes apresentaram temperaturas adequadas conforme o padrão adotado. Foram encontradas inadequações para Aeróbios Mesófilos Viáveis (100%), Coliformes a 35° C (60%), *Staphylococcus aureus* (60%), *Bacillus cereus* (20%) e *Salmonella* spp. (60%). Todas as amostras de utensílios foram consideradas com má higienização, e coliformes a 35° C estiveram presentes em todas as mãos dos ambulantes analisadas. As condições de infraestrutura, higienização dos equipamentos e utensílios e higiene pessoal dos entrevistados estavam deficientes. Faz-se necessário intervir e capacitar os ambulantes para que a comercialização dos alimentos ocorra de forma segura para o consumidor. Além disso, é preciso elaborar uma legislação sanitária específica para este tipo de comércio.

Palavras-chave: Comida de Rua. Segurança dos Alimentos. Vigilância Sanitária.

Introduction

Informal jobs keep rising worldwide year after year, especially in developing countries, as a result of high unemployment rates, low purchasing power of the population and limited access to education and formal labor market.^{1,2} In this context, there has been an increasing number of street vendors in the cities, selling or preparing foods.¹ The expansion of this sector is not only due to the possibility of jobs for the population but also the access to a large diversity of low-cost foods by low income families.³

According to data from the Household Budget Survey (POF 2008-2009),⁴ it is estimated that in large Brazilian centers about 30% of the meals are eaten out of the home and that population spends on average 33.1% of the food budget share in this kind of meal. Studies developed in several countries have shown that microbial contamination of these products is unquestionable, based on the assumption that foods hygiene and handling conditions may be unsatisfactory due to the lack of resources at the points of sale.^{3,5-12}

Food street vendors sell their products in locations where there is a large number of people and vehicles and that usually do not meet all food safety requirements.⁷ The site conditions, as well as lack of refrigeration equipment, sources of drinking water, handlers' personal hygiene, and public sanitary facilities not only increase the risks for contamination but also favor bacterial growth.⁶ In addition, foods that are improperly prepared and stored can be carriers of microorganisms like *Salmonella* spp, *Vibrio cholerae*, *Staphylococcus aureus*, and coliforms,^{2,13} and this contamination can be reduced if Good Practices for Foods Production/Handling are applied throughout the production chain.¹⁴

Given the above, this study aimed to evaluate the microbiological quality of foods sold by street vendors in Belo Horizonte, MG.

Methods

The study was carried out in the Central-Southern region of Belo Horizonte, Minas Gerais, in 2013, from February to September, comprising two stages. For this investigation, public spaces with high flows of people and a large number of food street vendors were chosen.

The evaluation was carried out using a socioeconomic questionnaire and a checklist comprised of objective questions and questions observed by the interviewer. The checklist, which was developed based on Amson's method,¹⁵ consisted of topics grouped into four blocks: environmental conditions (characteristics of the location, site of installation, pests control, wastes, lighting, electrical installation and drinking water sources); foods handling (identification of raw materials, ingredients and processed products; food turnover and storage); the vendors' personal hygiene (clothing, hygiene habits, health condition and training programs for food handlers and supervision); and utensils, equipment and carts (food handling utensils, equipment, cleanliness of utensils, equipment, carts, and the place where carts are kept and sanitized).

For the sample calculation of the Central-Southern neighborhoods, the statistical software program *Sample Size Calculate*¹⁶ was used, with 95% confidence level and margin of error of 20%. Thus, the sample was composed of 11 randomly-chosen neighborhoods in the Central-Southern region. In these neighborhoods, 51 food street vendors were invited to participate in the study, but only 48 agreed to answer the socioeconomic questionnaire and checklist.

The street vendors who answered the socioeconomic questionnaire and the checklist were predominantly female (52.1%, n=25), mean age 41 years (minimum: 17 years; maximum: 76 years; SD \pm 15 years), educational level (35.4%, n=17) corresponding to incomplete elementary school, and the most frequent worktime consisted of two shifts, day and night shifts.

After the interviews, the temperature of the ready-for-use foods sold by the street vendors was measured (50 street vendors participated in this stage). A digital infrared thermometer with

temperature ranging from 50° C negative to 350° C positive was used. In order to verify adequacy of the temperatures measured, we followed the current legislation, which recommends that hot foods must be kept at 60° C or over for six hours maximum, while cold foods must not exceed the temperature of 10° C during four hours of exposure.

In the second stage, five vendors that participated in the first stage were randomly selected for collection and microbiological analysis of a sample of the food marketed, as described in Table 1, handler's hands and one utensil (stainless steel catch tongs). The criterion used to select the street vendors was the sale of some of the foods included in this study. At the time of the food sample collection, the food temperature was also measured to determine nonconformity, if any.

Table 1. Microbiological evaluation of foods, utensils and handlers' hand of street vendors in the Central-Southern region of Horizonte/MG, 2013.

	Sample	Parameter					<i>Salmonella</i> spp
		VMB ¹	<i>S. aureus</i>	<i>B. cereus</i>	Colif.* 45°C	Colif.* 35°C.	
	Grilled Noodles	5.14 ²	3.67 ²	2.52 ²	< 1.00 ²	4.30 ²	Absence ³
1	Utensil	4.03 ⁴	**	**	< 1.00 ⁴	2.02 ⁴	
	Hand	**	3.87 ⁵	**	< 1.00 ⁵	2.61 ⁵	
	Hamburger	4.94	3.97	2.75	< 1.00	1.78	Absence
2	Utensil	2.92	**	**	< 1.00	1.00	
	Hand	**	2.04	**	< 1.00	< 1.00	
	Hot dog	4.95	4.46	4.20	< 1.00	< 1.00	Presence
3	Utensil	2.68	**	**	< 1.00	3.14	
	Hand	**	1.30	**	< 1.00	< 1.00	
	Hamburger	5.18	>4.48	< 1.00	< 1.00	2.60	Presence
4	Utensil	3.43	**	**	< 1.00	2.00	
	Hand	**	< 1.00	**	< 1.00	< 1.00	
	Hamburger	4.90	4.66	2.10	0.70	4.15	Presence
5	Utensil	3.25	**	**	< 1.00	1.00	
	Hand	**	3.00	**	< 1.00	1.30	

*Coliforms; **NA: not analyzed.

¹Viable aerobic mesophilic bacteria; ²log CFU/g; ³absence/presence in 25 g; ⁴log CFU/UT; ⁵log CFU/HAND.

All food samples collected were transferred to sterile plastic bags, identified, sealed and transported in expanded polyethylene boxes containing ice to the Laboratory of Food Microbiology, Department of Food/Pampulha campus, Pharmacy Faculty, Federal University of Minas Gerais. The time elapsed from the material collection to the microbiological analysis did not exceed 24 hours. Samples from the vendor's hand and utensils were collected using a swab.¹⁷

For analysis of the food samples we used the Viable Aerobic Mesophilic Bacteria (VMB) parameters, Coliforms at 35° C and 45° C, *Salmonella ssp.*, *Staphylococcus aureus* and *Bacillus cereus*; for the hands, counts of coliforms at 35° C and 45° C and *Staphylococcus aureus*; and for the utensils, the VMB parameters and coliforms at 35° C and 45° C.¹⁸

To determine the samples adequacy, the parameter used was the sample indicative tolerance, according to the Brazilian legislation.^{19,20} For coliform counts in foods at 35° C, the limit values considered were 2.0 log CFU/g, and for Coliforms at 45° C, *Staphylococcus aureus*, *Bacillus cereus* and *Salmonella spp.*,^{17,21} the maximum values were 2.0 log CFU/g, 3.0 log CFU/g, 3.0 log CFU/g, respectively, except for *Salmonella spp.*, the absence of which in 25 g of the food was desirable.^{19,20}

In the determination of the results obtained in the checklist, numeric values were used for the investigated items, according to the method proposed by Valente & Passos.²² The descriptive analysis included calculation of the frequencies, means and percent distributions with the aid of the Statistical Package for the Social Sciences (SPSS) software, version 19.0.

This study was approved by the Ethics Committee of the Federal University of Minas Gerais, process number 0225.0.203.000-10.

Results

Evaluation of the environmental conditions

With respect to the environmental conditions, it was found that 87.5% (n=42) of the sale sites were near storm drains, and 93.8% (n=45) were in high traffic areas, most of them with apparent dust. The pavement was not in proper maintenance conditions in 93.8% (n=45), and in 91.7% (n=44) there were discarded or extraneous objects to the environment and accumulated trash and/or stagnant water.

As appropriate containers to collect trash it was considered those that can be easily cleaned and transported, with automatic, not manual lid and appropriate trash bags. Of the participants, only 19.6% (n=9) met the cited required conditions, and 34% (n=16) said that they frequently removed the trash. The presence of pests such as flies was observed in 58.3% (n=28) of the street vendors.

The water used by 50% (n=22) of the sampled street vendors comes from commercial establishments, from their own house (36.4%, n=16) and other locations (13.6%, n=6), since 100% of the water was stored in plastic bottles.

Evaluation of foods handling

The most popular foods sold by the street vendors were popcorn and *praliné* (33.8%, n=18), followed by hot dog (20.3%, n=9) and sandwiches (13.5%, n=6).

With respect to food handling practices, 20.8% (n=10) of leftovers were reused; 2.20% (n=1) used homemade mayonnaise, and 14.60% (n=7) dressings and spices in squeezers. The packages used to serve foods were disposable (100%; n=48), but only 52.10% (n=25) of the vendors stored them in appropriate places.

The foods were not properly stored (in a clean, organized and well-preserved locations) in 58.30% (n=28) of the cases observed. In addition, in 75% (n=36) of the locations, the foods were not stored in appropriate containers (with identification, maintained in separate from other products) and under adequate temperature.

About 8.30% (n=4) of the respondents said that they did not have a permit from the city administration in Belo Horizonte (PBH) to sell street foods, and 72.90% (n=35) have never attended food-handling training.

Evaluation of the vendor personal hygiene

It was observed that 93.60% (n=44) of the vendors practiced actions that might contaminate the foods, such as not wearing a cap or net for hair protection (43.8%; n=21), handling money before handling the foods (87.5%; n=42), and talking over the food while handling it or smoking. Nearby commercial establishments were the places most often cited for their physiological needs (79.20%, n=38).

Concerning the health status, 85.10% (n=40) of the vendors did not have cutaneous infections and wounds, and 31.30% (n=15) reported that they usually work when they are sick (influenza, throat infections or diarrhea).

Evaluation of utensils, equipment and carts

In 23.40% (n=11) of the foods storage and transport carts, sanitation products were available, identified and stored in suitable places. About the hygiene conditions of the place where the carts

were kept, 40% (n=18) of the respondents stated that it was a clean area, free of unused objects, dust spots, accumulated trash and stagnant water. The most cited place where they leaved the cart is a covered parking lot (54.20%, n=26).

Foods temperature

Temperatures of the hot foods/meals sold by the street vendors were between 24.10° C and 87.0° C and were considered appropriate according to the adopted standard in 18.70% (n=9). The cold foods/meals evaluation, which consisted of two samples of coconut water, exhibited adequate temperatures, below 10° C.

Microbiological analysis

The results of the microbiological analysis of the food samples, utensils and vendors' hands in the Central-Southern region of Belo Horizonte, MG are shown in Table 1.

Discussion

In the present study, several inadequacies were found in all four blocks of the checklist (environmental conditions, foods handling, personal hygiene of the vendors and utensils, equipment and carts). The same inadequacy was found in the temperature and microbiological analysis of the food, hands and utensils used by the vendors.

Regarding environmental conditions, it was found inadequacy both in the physical structure of the food storage and transportation cart and in sale sites. Even in cases where the physical structure was in good condition, none of the sale sites met the minimum requirements set by current legislation.²¹

Since mobile sale and marketing of foods is a legalized activity, it is necessary to create specific regulations for the exercise of this kind of business, integrating good handling practices and physical and structural standards to the existing conditions.

Other problems observed include the accumulation of trash in uncovered containers and nonfrequent removal, proximity to the sewage main and to stagnant water. In a study with 158 points of sale of street food in Taubaté-SP, Franco & Ueno⁹ found pedal trash cans in 18.40% of the points studied, a value close to that found in the present study (19.60%). In turn, Mallon & Bortolozo¹⁰ did not find this kind of trash can, which is required by current legislation.²¹

These factors are conducive to installation and reproduction of urban pests and vectors that transmit diseases, such as enteroparasitosis, and infestation of pathogenic microorganisms, posing risks to consumer health by contamination of the food produced.^{21,23-25}

In other study with hot dogs sold in the streets of Cerqueira César-SP, the presence of pigeons was observed in 100% of the sites as well as insects in 52% of the points of sale due to uncovered trash cans.⁸ However, differently from these authors, the answer to this question was not in agreement with what had been seen by the interviewer but as reported by the respondents.

According to the obtained data, all street vendors use plastic bottles to store water. This result corroborates other study that found that street vendors who worked in parks and avenues used this same equipment.⁹ According to Siqueira et al.,²⁶ storing water in inappropriate containers is one of the steps where water can be contaminated.

In addition to the environmental conditions, handler hygiene, foods storage, cleanliness of the workplace, and the foods preparation and storage stages are essential items for the production of good quality foods/meals.²⁷

In the present study, it was observed that the respondents did not meet the requirements related to uniform, nails and hands, adornments and hair protection, as recommended, as well as actions that could prevent foods contamination. Rodrigues et al.²⁸ observed in their work that 55% of street vendors wore adornments and 75% exhibited clean, trimmed nails, optimistic results when compared to the present study.

Another unhygienic attitude observed during the interview was the habit of talking over the food, a source of food contamination (saliva). This behavior was also described in the study by Lundgren et al.,²⁹ who assessed the hygiene-sanitation quality of meat sold in street fairs and public markets in João Pessoa-PB. The concomitant action of handling money and food without washing the hands between these actions was often observed and corroborates the study conducted by Rodrigues et al.,¹¹ which reported that 87.50% of the street vendors exhibited such wrong behavior.

Other data of concern was the prevalence of interviewees who stated that they usually work when sick. Foods handling is one of the factors that require greater control in order to assure foods safety. Studies indicate that when the food handler looks sick or is an asymptomatic carrier, he/she is responsible for up to 26% of Foodborne Illness (FBI).³⁰ This fact emphasizes the importance of handlers' training on Good Fabrication Practices, since poor food production practices were found in more than 70% of the respondents. Therefore, it is suggested to provide on-the-job training to street vendors, since their usual daily workload prevents them to attend external courses.

Same inadequate practices were found by Rodrigues et al.¹¹ regarding sanitation and cleanliness of utensils and equipment. Failure in equipment and utensils cleaning procedures allows that

the residues that adhere to the equipment and surfaces become a potential source of cross-contamination and the onset of foodborne illnesses.^{10,30}

The temperature evaluation also indicated noncompliance with Ordinance CVS 05/2013²¹ and Regulation RDC 216/2004,³¹ considering that adequacy was only found in 22% of the samples, and with a higher value than that found in two studies conducted in Taubaté-SP and Paraíso-TO.^{11,32} It is known that temperatures out of the recommended values favor the growth of pathogenic microorganisms, causing damages to the consumer health.

The microbiological analyses of the foods, utensils and the vendors' hands also showed nonconformities to the current legislation.

Presence of coliforms were found in 60% of the food samples and in 40% of the utensils and vendors' hands. Coliforms, when present, may indicate hygiene failure during the production process. Moreover, if appropriate storage and processing practices are not applied, intestinal pathogens associated with this group can reach infectious dose, causing FBIs.¹⁵ If we observe the percentage of samples that were positive for *Salmonella* spp (40%) and correlates it with the data obtained from the questionnaire about the inadequacy of the parameters "poor hands hygiene", "vendor handles money and food at the same time" and inappropriate foods storage", it can be inferred that there is a great risk of occurrence of salmonellosis when consuming these foods.

The foods most susceptible to *Salmonella* poisoning are those which contain high contents of moisture, protein and carbohydrates, such as beef, pork, poultry, eggs, milk and dairy products, seafood and stuffed desserts.^{2,10,15,28,32}

The counts of *S. aureus* in this study was higher than the limit set by the Brazilian standards in 80% of the samples (foods and vendor's hand), representing the highest prevalence of poisoning among the pathogens. This value is not surprising because humans are the main sources of this microorganism.^{2,10,13,15} It is worth noting that poor hands hygiene and non-use of hair caps accounted for the high inadequacy level of more than 90% of the street vendors. These data suggest that the contact of hands with the food may have been one of the causes of poisoning and confirm the importance of proper hands hygiene as a key step to prevent foods poisoning.^{28,32}

Of the samples analyzed for coliforms at 35° C, 60% exceeded the limit of 2.0 log CFU/g. This group is used as an indicator of water drinkability and general hygiene-sanitation conditions of the foods processing environment.³³

Rodrigues et al.²⁸ observed that 53% of the studied establishments exhibited unsatisfactory results for this parameter in hot dog samples. Alves and Ueno³² analyzed coliforms at 35° C in foods and identified 76.6% of poisoning by these microorganisms. With respect to coliforms at 45° C or coliforms of fecal origin,¹⁹ in most of the samples no detectable values were found, and the presence of these microorganisms in foods is considered a sanitation indicator.³⁴ This result

was different from other studies, where the counts of fecal coliforms were higher than those set by the Brazilian legislation.^{35,36}

Based on the counts of *Staphylococcus aureus*, two samples were outside the tolerance limit for indicative samples, while the others exhibited a higher value of CFU/g per food than this limit. *S. aureus* has a thermostable toxin and can be in contact with foods through infected handlers, especially in foods that require a high degree of handling. It is responsible for causing poisoning by consuming foods with preformed toxins, thus serving as an indicator of after-process poisoning or sanitary conditions of the surfaces that are in contact with foods.^{29,37}

Another kind of food poisoning is the one caused by *Bacillus cereus*, a pathogen capable of forming spores, which multiply considerably when there is time-temperature misuse.³⁰ However, there was only one sample that did not conform to standards, a fact that contradicts the results obtained by Bezerra et al.,³⁵ who found acceptable levels, based on the Brazilian legislation, when they assessed this microorganism in samples.

Salmonella spp., another pathogen that causes foodborne illness, differently from others, must be absent in foods, as defined by Regulation RDC 12/2001,¹⁹ as well as in Forsythe.³⁸ Such compliance was not observed in the present study, which indicated three out of five samples contaminated with this microorganism. It should be noted that, in general, studies show that the presence of this microorganism occurs in few samples or is inexistent.^{35,39} Outbreaks of *Salmonella* spp. infections are more commonly caused by the intake of chicken, meat, eggs or dairy products contaminated by fecal matter or when stored under inadequate temperatures.^{39,40} These factors can explain the presence of this bacterium in the samples analyzed.

Not only in the products samples microbiological contamination was observed. Based on the standards defined by the Foods and Drugs Administration – FDA and the American Public Health Association – APHA,¹⁷ all samples from the utensils indicated poor sanitation.

In the analysis of the vendors' hands, coliforms counts were found at 35° C and *S. aureus*, corroborating other studies.^{35,41-43} According to Grandó et al.,⁴⁴ inappropriate practices during the foods preparation is the cause of contamination with *S. aureus*. Moreover, deficient hands hygiene may lead to these contaminations.³⁰ Therefore, we can state that vendors' poor hands hygiene, which was found in this study, can be the source of transmission of pathogens to the foods.

Cases of FBI occur worldwide every day. Considering that about 30% of the meals are made outside the home in the large Brazilian centers, improper preparation and sale of foods by street vendors has become a public health problem. Untrained handlers on foods safety has been directly associated with foods poisoning due to diseases, poor hygiene habits and inadequate production practices.^{24,30}

However, occurrence of FBIs in Brazil does not require compulsory notification, which prevents an actual evaluation of the problem.⁸ Training, in this context, is all-important and should be considered a strong factor for the quality assurance of commercial foods.^{10,45}

Conclusion

The findings of this study allow to conclude that poor conditions of infrastructure, cleanliness of equipment and utensils and personal hygiene of the respondents were conducive to foods poisoning, which was apparent in the microbiological analysis of the foods/meals sold and temperatures measured. In order to assure foods safety for consumers, it is necessary to intervene and train the workers who sell foods/meals in the streets, so that, through the acquired knowledge, they will be able to perform their activities minimizing critical points of contamination of the products for sale.

Collaborators

Monteiro MAM, Dutra DB, Torres FA and Oliveira RBP participated in the analysis and interpretation of data, in writing the manuscript, in the critical review of the intellectual content and approval of the final version to be published. Ribeiro RC and Garcia MAVT contributed to the interpretation of data, in writing the paper, critical review of the intellectual content and approval of the final version to be published.

Conflict of interests: the authors declare that there is no conflict of interests whatsoever.

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