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Evaluation of food temperatures during preparation and service in commercial restaurants in Belo Horizonte-MG, Brazil

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Abstract

Introduction: Due to lifestyle changes, people are increasingly eating outside the home. Commercial foodservices are important places in the daily lives of people, thus it is imperative to adopt food safety precautions. Time and temperature are parameters that need to be thoroughly controlled to avoid microbial growth. This study aimed to evaluate the temperatures after preparation and exposure of food in commercial restaurants. *Method:* Observational study conducted in ten descriptive commercial self-service restaurants in the south-central region of Belo Horizonte-MG. We analyzed the main course (two options), side dish (one option), complement (rice and beans) and salad (two options), using a digital probe thermometer ("EOF" trademark) with five measurements in one-hour intervals of during three alternate days. Statistical analysis was performed using SPSS version 16.0, using the median found in each preparation to evaluate the food holding temperature. Data were compared to RDC 216/2004 and Regulation CVS 6/1999. *Results:* Temperatures of the hot holding dishes ranged from 43ºC to 91ºC, and cold holding dishes, from 9ºC to 24ºC. Sixty percent of the restaurants showed nonconformities in food holding temperature, which suggests risk of microbiological contamination. *Conclusion:* It is essential to implement effective techniques for temperature control and proper training of the professionals involved.

Key words: Food. Quality Control. Temperature. Restaurants.

Introduction

The transformations experienced in modern life have cause significant changes in the eating habits of people, who are day after day reducing the number of meals eaten at home.[1] Such changes have been due to factors that include urbanization, industrialization, women's professionalization, improved living standards and education, more access of the population to leisure, less time for cooking and/or consuming foods, travels, among others.[1,2] Thus, improvements in the food services are vital, especially in commercial restaurants, requiring the implementation of methods of control of the quality of meals in their diverse dimensions, such as hygienic-sanitary, nutritional and sensorial.[1,3]

Food safety is associated with hygienic-sanitary quality, once foodborne pathogens are one of the main factors that lead to the high morbidity rates in Latin America and the Caribbean.[3] According to the Committee of the World Health Organization / Food and Agriculture Organization of the United Nations (WHO/FAO), diseases caused by contaminated foods are likely the greatest health problem in the contemporary world. So, with the increasing number of meals provided by foodservices, grows the concern with the quality of foods to protect and ensure the users' health.[1,4]

According to data of the *Associação Brasileira de Refeições Coletivas (ABERC)* (Brazilian Foodservices Association), the foodservices in Brazil served over 16.5 million meals/day in 2011, and in 2012, this number was up 8.7% compared to the previous year. The family average monthly expenditure with foods eaten outside the home is approximately R$ 172.78, in the southern region of the country, which corresponds to 37.2% of the household budget spent with food.[4,5]

Self-service restaurants, in the commercial category, are the foodservice most used by Brazilians. However, this kind of service is second in the ranking of establishments with the highest occurrence of foodborne diseases (FBD).[6]

To ensure the quality of meals, it is of vital importance to be careful in "time and temperature" control, a key factor in meal services. Exposure of foods to improper temperatures may cause the development of pathogens that lead to FBD outbreaks. In various restaurants, the preparations are kept on hot and cold serving equipment for a long time and many times not at proper temperature, with decisive influence on the growth of microbial activity.[7]

The aim of this study was to assess the temperatures during the preparation and serving of foods in commercial restaurants in the city of Belo Horizonte-MG.

Methodology

Observational descriptive study comprising ten self-service and "per kilo" commercial restaurants located in the center-south region of Belo Horizonte, Minas Gerais, chosen at random and having a similar type of menu.

The hot and cold preparations that were evaluated comprised main course (two options), side dish (one), complement (rice and beans), and salads (two kinds). Temperatures were measured with a digital probe thermometer inserted into the center of the bowl, in three alternate days, between January and February 2013, and recorded in a pre-designed form.

Temperatures were collected at four different times: when cooking was completed; when service began; one hour after the beginning of service; at the end of service. The collected data were analyzed by the SPSS software, version 16.0, based on the calculation of maximum, minimum and mean temperatures. To assess the temperatures during service, we used the mean temperature of each dish and considered the mean time of a three-hour serving time.

The Kruskal-Wallis test was also performed to analyze the service variable, so it was determined that the mean would be the best parameter of analysis to be used.

The resulting data were compared to Resolution RDC 216/2004[8] and Ordinance CVS 5/2013,[9] according to which hot preparations must be held at temperatures higher than 60ºC, for a maximum of 6-hour holding/serving time, and cold preparations must be held at temperatures below 10ºC.

Results

Table 1 describes the temperatures (minimum, mean, maximum) found in each preparation. It can be stated that there was a significant difference between the temperatures found in the foods, both in the hot and cold serving counters, and among the restaurants assessed ($p < 0.0001$). The temperatures of the hot dishes ranged from 43ºC to 91ºC, and of the cold dishes between 9ºC and 24ºC.

Table 1. Temperature of the cold and hot foods served in commercial restaurants in the center-south area of the city of Belo Horizonte-MG, 2013.

Foods	Temperature	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	p-value
Hot-serving counter	Minimum	74	67	83	69	65	76	68	48	84	49	
	Mean	75	74	86	73	69.5	81.5	72.5	55.5	86	54.5	< 0.0001
	Maximum	79	77	88	75	74	85	75	60	88	60	
Rice	Minimum	60	43	66	58	67	55	52	47	72	50	
	Mean	69	46	73.5	61.5	70.5	59	58.5	56	75	55	< 0.0001
	Maximum	75	48	78	65	76	62	65	62	79	61	
Beans	Minimum	60	48	80	77	65	77	76	65	81	62	
	Mean	71.5	51	86.5	78	71	85	82.5	69.5	86	68.5	< 0.0001
	Maximum	75	54	89	80	74	88	86	75	90	72	
Side dish	Minimum	50	50	55	56	56	49	49	48	67	57	
	Mean	60	54.5	63	59.5	60	55.5	61.5	55	71	59.5	< 0.0001
	Maximum	63	60	67	68	66	65	70	62	75	65	
Main dish 1	Minimum	68	68	86	77	75	75	51	68	86	68	
	Mean	74	74	87.5	79	78	78	67.5	74	89	75.5	< 0.0001
	Maximum	76	76	91	86	81	84	87	79	91	79	
Main dish 2	Minimum	59	59	66	65	55	64	51	57	60	51	
	Mean	61.5	61.5	70.5	68.5	62	71.5	63	62	64.5	57	< 0.0001
	Maximum	65	63	74	77	64	77	69	68	71	63	
Cold-serving counter	Minimum	6	6	6	4	6	7	11	3	2	6	
	Mean	7	7	8.5	6.5	7.5	9	12	4	3.5	8	< 0.0001
	Maximum	10	9	10	10	10	11	14	6	5	10	
Green salads	Minimum	16	11	13	15	9	14	16	10	12	16	
	Mean	17.5	13	14.5	17	12.5	16	18	12.5	16	18	< 0.0001
	Maximum	19	15	18	18	15	18	19	15	17	20	
Vegetables	Minimum	19	14	17	15	16	12	17	14	17	17	
	Mean	2	17.5	20	17	18.5	13	20	16.5	18	20	< 0.0001
	Maximum	22	21	22	20	21	20	23	19	22	24	

Tables 2 and 3 show that the temperatures of the hot and cold preparations did not vary significantly during the days and different times of measurement (p>0.05).

Table 2. Correlation of the daily temperature means of hot and cold dishes served in commercial restaurants in the center-south area of Belo Horizonte-MG, 2013.

Foods	Day 1	Day 2	Day 3	p-value
Hot-serving counter	73.0	74.0	75.0	0.872
Rice	59.0	62.0	61.5	0.681
Beans	73.0	76.0	76.0	0.397
Side dish	59.5	61.0	60.0	0.529
Main dish 1	78.5	78.0	77.0	0.643
Main dish 2	61.5	64.0	64.5	0.946
Cold-serving counter	8.5	7.0	7.0	0.958
Green salads	16.0	16.0	15.5	0.099
Vegetables	19.0	19.0	18.0	0.610

Table 3. Correlation of the means of the hot and cold holding temperatures at different service hours in commercial restaurants in the center-south area of Belo Horizonte-MG, 2013.

Foods	H*1	H2	H3	H4	Valor p
Hot-serving counter	72.0	74.5	75.0	74.5	0.598
Rice	60.0	61.5	62.0	62.0	0.647
Beans	75.5	76.0	76.0	75.0	0.931
Side dish	59.5	61.0	60.0	59.5	0.144
Main dish 1	78.5	78.0	77.0	78.0	0.555
Main dish 2	61.5	64.0	64.5	64.0	0.205
Cold-serving counter	8.5	7.0	7.0	7.5	0.235
Green salads	16.0	16.0	15.5	16.0	0.343
Vegetables	19.0	19.0	18.0	18.5	0.498

H1*= 11:00, H2*=12:00, H3*= 13:00, H4*=14:00

Figures 1 and 2 represent the means found in each hot and cold dish, respectively. Of the assessed restaurants, six (60%) had nonconformities regarding the temperature during the foods serving time. Of hot dishes, rice and pasta were the foods that indicated improper temperatures, and among the cold dishes, the vegetables. Temperatures at the hot and cold serving counters were also observed. Temperature of the hot-holding equipment was below 80ºC in seven restaurants (70%), and the cold-holding equipment was below 10ºC in all restaurants.

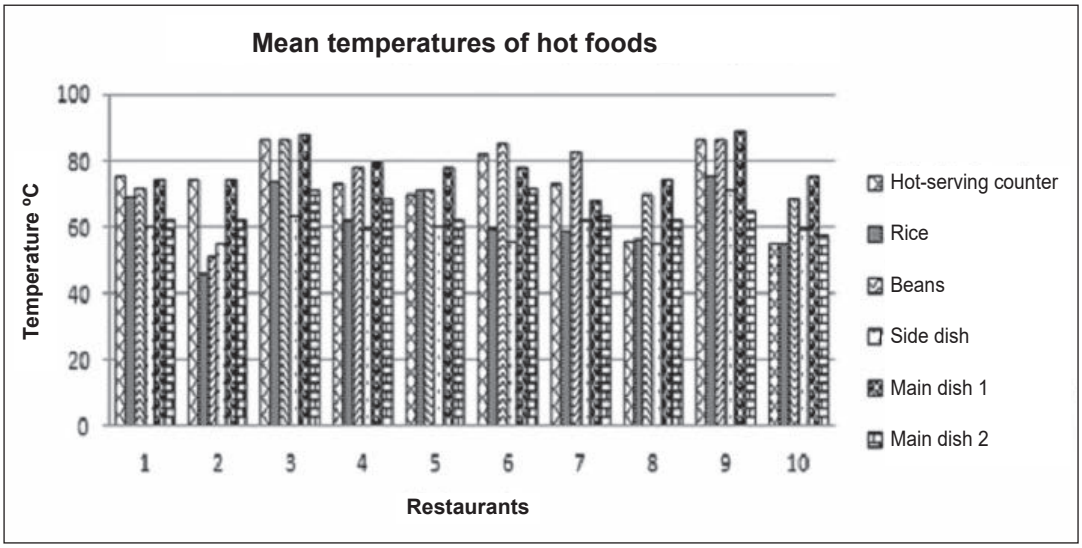

Figure 1. Mean temperatures of hot preparations served in commercial restaurants in the center-south area of Belo Horizonte-MG, 2013.

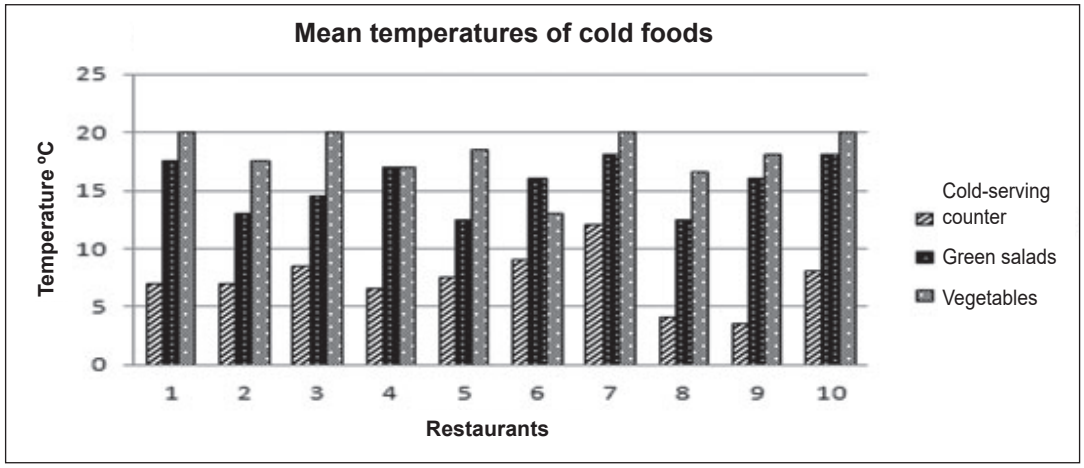

Figure 2. Mean temperatures of the cold dishes served in commercial restaurants in the center-south area of Belo Horizonte-MG, 2013.

Discussion

In the analysis of the results obtained, it was found that in only four restaurants the hot foods temperature was appropriate (Figure 1), when compared to the temperatures described on RDC 216/2004.[9] According to this resolution, the foods, after being cooked, must be maintained in such conditions of time and temperature as to prevent microbial multiplication and ensure the foods quality and safety. Thus, it is recommended that the foods be kept at a temperature of 60ºC or higher for a maximum of six-hour holding time. Regarding the cold preparations, it was observed that all of them were kept a temperatures higher than 10ºC, a nonconformity with the resolution, which recommends that cold foods be kept under a temperature of 10ºC or colder.

Both Ordinance CVS5/2013[9] and Resolution RDC 216/2004[9] recommend the same temperature standards for hot and cold foods, but the Ordinance CVS5/2013 states that a temperature of cold dishes between 10ºC and 21ºC can be considered appropriate as long as the holding or serving time does not exceed two hours. Given this, the cold foods that were examined proved to be unsuitable for consumption because they were exposed to temperatures higher than 10ºC for a period of approximately four hours, once they were not kept properly after preparation – in most of the restaurants, the foods were maintained at room temperature.

Alves et al.[3] and Momesso et al.[10] found similar results: 22% and 20%, respectively, of the hot dishes examined indicated an adequate temperature, according to RDC 216/2004. However, it the present work higher temperatures were found (40%).

Ricardo et al.,[6] in a study carried out in Goiânia-GO, found a mean temperature of 25ºC in the cold dishes. According to CVS5/2013, the foods held for more than two hours at a temperature of 21ºC or higher must be discarded. In this study, unsuitable temperatures were also found (mean temperature of 15.5ºC for greens and 18ºC for vegetables). Improper cooling after preparation was the main cause of these nonconformities. The cooling time after cooking is not enough to maintain the foods at a temperature of 10ºC and lower – most of the restaurants under study do not have pass-through openings or refrigeration equipment, and, when available, are not sufficient to store all foods properly.

Alves et al.[3] suggest that failure in foods cooling after cooking as well as poor training and awareness of handlers are the main factors that interfere negatively on the control of temperature of cold foods. In addition, Domene et al.[11] claim that low water content in foods prevents keeping adequate temperatures. They observed that rice, pasta and beefsteak were the foods with the poorest temperature controls. They also claim that starchy foods usually are not held under optimal temperatures once high heat alters the texture and affects the sensorial characteristics of foods and, consequently, may diminish acceptability.

Only three restaurants showed adequate temperatures in the hot serving counter, according to CVS5/2013,[9] between 80ºC and 90ºC. Foods exposed to improper temperatures are more susceptible to microorganism proliferation.[8]

The foods with the worst temperature control were rice, pasta and beefsteak. The characteristics of these preparations are conducive to the growth of bacteria *Bacillus cereus* and coliforms at 45ºC, respectively, according to the RDC-12/2001, which establishes sanitary microbiological standards for foods.[12]

Bacillus cereus is a rod-shaped mesophilic bacterium that, in an environment containing oxygen, forms spores. The minimum temperature of growth is 4ºC to 5ºC and maximum is 48ºC to 50ºC. The risk of contamination by *Bacillus cereus* is associated with the production of toxins (poison) produced by the bacterium. According to Paiva et al.,[13] poisonings are due to improper storage of foodstuffs and failure in the control of time and temperature. This bacterium can cause two kinds of FBD – diarrheal and emetic. In rice and pasta, the most common is the emetic FBD. [14]

Chang et al.[15] conducted study with preparations based on cold rice, in eight restaurants, to determine the prevalence of *Bacillus cereus* in such dishes. One of the specific objectives of the study was to examine the time and temperature correlation during the food production and consumption. They observed that the foods were ready for consumption at a temperature of 66.1ºC when freshly prepared to order, and 59.8ºC when they were pre-cooked or ready for being re-heated. There was infection by *Bacillus cereus* in 37.5% of the samples. The authors concluded that the use of processing methods in which it is possible to control time and temperature resulted in a smaller count of *B. cereus*. The restaurants investigated in the present study had mean temperatures of rice in the range of 46°C to 75°C, which clearly shows failure in temperature control.

The temperature of pasta in all restaurants under study was improper, but remained above 50ºC, which inhibits the growth of *B. cereus*. Regarding rice, only one restaurant presented mean temperature below 50ºC (46ºC), indicating risk for microbiological growth and food contamination.

Passos et al.[16] carried out an analysis of roast beef because of an outbreak of infection in the employees of a contractor company in São Paulo and found a high coliform count, based on the guidelines of RDC 12/2001.[12] According to the authors, the presence of coliforms indicates that the food is improper for consumption due to risk of food poisoning. This shows that there is risk for FBD when the holding time for service and temperature of the foods served in restaurants are not monitored.

In this work, although the beefsteak temperature was improper in one restaurant, we can say that this food did not offer risk for growth of mesophilic bacteria and coliforms, as the lowest mean was around 57ºC.[17]

Fortuna[17] analyzed 22 samples of beef before and after cooking and found that proper cooking supplanted the risk of contamination. Vieira et al.[18] analyzed the microbiological quality of raw meat and meat-based cooked dishes served in Poços de Caldas-MG and found that when properly cooked there was a considerable reduction of aerobic mesophylls. In addition, the authors underlined the importance of controlling the temperature of cooking and serving.

Chesca et al.[19] state that the bacteria present in meat are partially or totally destroyed when exposed to adequate cooking temperatures, but heat has no residual effect, i.e., at the end of its action re-contamination and/or proliferation may occur. For this reason, foods subjected to heat must be consumed right away or kept at proper temperatures.

Conclusion

The results of analysis of the mean temperatures found in the restaurants of this study showed that most of them did not control or monitor properly the existing relation between the foods holding time and temperature. Lack of trained personnel, equipment and physical space are the main reasons for the failures in time-temperature control. Consequently, there is a high risk for microbiological contamination and possible risk of outbreaks of foodborne diseases.

To diminish the likelihood of occurrence of FBD in restaurants, suggestion is the implementation of more effective techniques for temperature control and adequate training of the staff involved in this action.

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