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Journal of Veterinary Medicine and Research

Research Article

Efficiency of Operational Procedures Used At an Institutional Foodservice Unit from Southern Brazil

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Submitted: 23 August 2016

Accepted: 10 November 2016

Published: 11 November 2016

ISSN: 2378-931X

Keywords
- Cleaning vegetables
- Hot foods transportation
- Coli form counts
- *Salmonella spp*

Abstract

This study aimed to available the efficiency of procedures in use at an institutional foodservice unit for hygienization of vegetables that are served raw in salads and for the transport of bulk quantities of hot food preparations. The temperatures of the hot food preparations transported, as well as their holding time, were kept within the safety limits prescribed by Brazilian legislation from the end of the cooking process up to the end of the service period. However, high coli form counts of some vegetable samples after hygienization suggest that these procedures need to be adjusted.

ABBREVIATIONS

FDB: Foodborne disease; MPN: Most Probable Number

INTRODUCTION

Outbreaks of foodborne disease (FBD) can occur when factors such as contamination, multiplication, and survival of microorganisms in raw and processed foods are not controlled. The most common errors in preparation of foods leading to episodes of FBD include insufficient cooking or reheating, preparation of food several hours before use, storage at temperatures that favor the multiplication of bacteria and/or formation of toxins, cross contamination, and poor hygienic handling [1].

The control of hazards potentially associated with prepared foods ready to serve requires the application of strict control procedures. This is especially true for foods that are eaten raw, like fruits and vegetables, where the concern about product contamination is greatly increased because the washing, sanitization and cutting procedures at small foodservice units are usually done manually. An additional point of concern is that fresh-cut vegetables release fluids rich in nutrients that become available to microorganisms, allowing them to multiply, increasing the initial microbial load [2]. Similarly, it is essential that hot food items that are prepared in a central foodservice unit and served in a satellite unit, be transported in proper insulated containers with strict monitoring of holding time and temperature to prevent microbial growth and to ensure that the food transported is safe to eat.

In these circumstances, to available the efficiency of procedures in use to control health hazards associated with serving raw vegetables and hot foods prepared in advance is very important to avoid FBD in foodservice units. The Codex Alimentarius [3] recommends the obtaining evidence that a control procedure, or a combination of procedures, is able to control a specific hazard in a food item. It also states that the focus of validation should be the collection and evaluation of scientific, technical and observational data, to confirm that the procedure or procedures effectively control the hazard.

The aim of this study was available the efficiency of procedures in use for hygienization of raw vegetables served in salads, and for transport of pre-prepared hot foods at an institutional foodservice unit in Soutahern Brazil.

MATERIALS AND METHODS

Food transport procedure

The efficiency of the procedure for transport of two types of hot food preparations, beans and meats, was verified through checking the food temperatures and time elapsed from the end of the cooking process to the end of service, twice a week over a period of four weeks. The preparations were produced at Unit 1 and stored shortly after the cooking process in insulated containers for transportation to Unit 2, located 15 km away, where they were served for lunch. Time was recorded with a digital timer and temperature was checked with a digital probe

thermometer at the end of cooking at Unit 1 and just after arrival at Unit 2, and at the midway point and end of service.

Vegetable hygienization procedure

To verify the efficiency of the procedure for vegetable hygienization, samples of two types of vegetables served raw in salads at Unit 2 were collected for bacteriological analysis two days per week for a period of eight weeks. The samples included 200g of lettuce (n = 32) and tomatoes (n = 32) that were collected before and after the cleaning and sanitization procedures (after salad assemblage). They were transported under refrigeration to the laboratory where the bacteriological analysis described below was performed according to the methods recommended in the Bacteriological Analytical Manual [4]. Figure (1) shows the flow chart for the preparation of raw salads at Unit 1.

Coliform count

A 25g sample was weighed and mixed in 225ml of peptone water (Merck Laboratories, Darmstadt, Germany). From this initial dilution, further decimal dilutions were prepared for coliform counts by the Most Probable Number (MPN - 3 tubes) method. One mL of each dilution was then transferred to tubes containing 10mL of sodium lauryl sulfate broth (Merck) and fermentation tubes, and incubated at 35°C for 48 hours. A loopful of material from each positive tube (gas formation) was transferred to tubes containing 10 mL of *Escherichia coli* broth (EC, Merck) and fermentation tubes, and incubated at 45°C for 48 hours. Results of positive EC tubes were used to estimate coliform counts at 45°C with the aid of the MPN table.

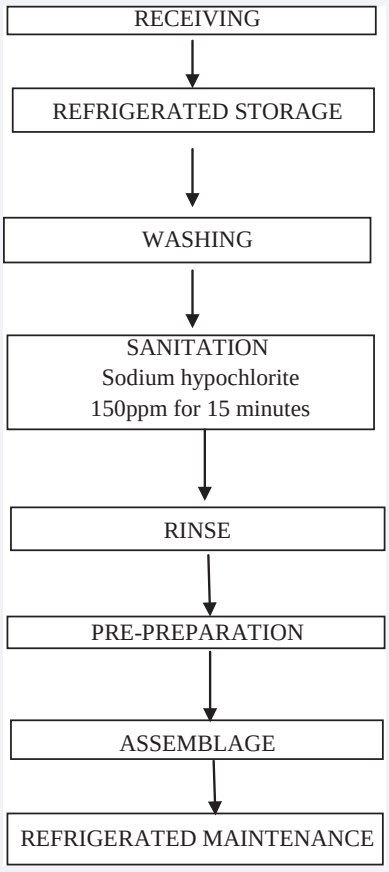

Figure 1 Flowchart for preparation of raw salads in a foodservice from Southern Brazil.

Salmonella research

For the isolation of *Salmonella* spp., an initial enrichment of the sample was performed by adding 225 ml of Buffered Peptone Water (BPW, Merck) to 25g of sample, followed by an incubation period of 24 hours at 37°C. Next, a selective enrichment was performed by inoculating 0.1 mL of BPW into 10 mL of Rappaport-Vassiliadis broth (Merck) and 1 mL into 10 mL of tetrathionate brilliant green broth (Merck) and incubating at 42°C for 24 hours. A loopful of each selective broth was then plated onto brilliant green phenol red agar (Merck) and Hektoen enteric agar (Merck) plates and incubated at 37°C for 24 hours. Colonies showing growth characteristics of salmonellae were confirmed by biochemical and serological tests.

Statistical analysis

SPSS software (SPSS Inc, Chicago, version 17.0, 2008) was used to construct a database for variance analysis. The Wilcoxon test for unpaired data was used to compare the results of bacterial determinations before and after the hygienization of vegetables.

RESULTS AND DISCUSSION

Food transport procedure

Table (1) shows the mean average temperatures and holding times of hot food preparations produced at Unit 1 and transported to Unit 2 for service. The results showed that both average and lowest temperatures of beans were above 60°C at all monitored time points. On the other hand, meat preparations had an average temperature below 60°C at the end of the service period and although average temperatures stayed above 60°C at the other two monitored time points at Unit 2, the lowest temperatures were below the safety limit.

Hot food preparations must be served on hot counters at a temperature and for an exposure time that guarantees safe consumption. Brazilian legislation stipulates that the temperature of serving counters for hot food preparations must be set to 60°C or above to prevent microbial growth and that food should be exposed no longer than six hours, otherwise a significant loss of organoleptic properties occurs [5]. Other guidelines used in Brazil do allow hot food preparations to remain on display for up to three hours at temperatures below 60°C [6]. None of the food preparations we studied remained for three hours or more at temperatures below the safety limit of 60°C.

Temperature maintenance of the hot food preparations transported was affected by its physical structure and the extent of food surface exchanging heat. The liquid consistency and large volume of bean preparations favored temperature maintenance during transport and throughout the service period, whereas in the meat preparations, which were mostly made up of small pieces, the temperature dropped more rapidly and was often below 60°C. However, even when temperatures were below the safety limit, the exposure time of the preparations did not exceed two hours.

Table 1: Temperatures and holding times of hot food preparations transported between institutional foodservice units from Southern Brazil, 2016.

Procedure step	Checking time	Average Temperature (°C)*	Temperature Variation (°C)	Standard Deviation (SD)
Beans End of cooking**	10:40	90.7	89.4-91.9	2.97
Arrival at Unit 2	11:20	78.0	76.2-79.8	4.25
Mid-service***	11:45	75.5	73.0-77.9	5.89
End of service***	13:00	64.2	61.4-66.7	6.60
Meats				
End of cooking**	10:50	87.1	75.0-95.5	5.06
Arrival at Unit 2	11:20	77.2	43.0-92.4	13.93
Mid-service***	11:45	72.5	43.1-87.1	11.60
End of service***	13:00	58.5	50.0-68.0	6.29

*Mean of eight observations **Unit 1 ***Unit 2

Table 2: Coliform counts before and after hygienization of lettuce and tomatoes from an institutional food service unit in Southern Brazil, 2016.

Food	Samples (n)	Coliforms at 45°C (MPN/g)	p-value*
Lettuce Non-hygienized (n=16)	1	9.2	> 0,05
	2	23	
	13	<3	
Hygienized (n=16)	1	1.2×10^2	
	1	2.4×10^2	
	1	23	
	13	<3	
Tomatoes Non-hygienized (n=16)	1	9.2	> 0,05
	15	<3	
Hygienized (n=16)	1	9.2	
	1	1.1×10^3	
	1	$> 1.1 \times 10^3$	
	1	2.4×10^3	
	12	<3	

*Wilcoxon test

Vegetable hygienization procedure

Results of coliform counts in samples of lettuce and tomatoes before and after the hygienization procedure are shown in Table (2). The initial sanitary quality of the vegetables used at the foodservice unit was very good. Brazilian legislation stipulates that the sanitary standard for vegetables consumed raw may be up to 10^2 coliforms/gram (count at 45°C) and the absence of *Salmonella* in 25g of food [7]. The sanitary quality of both lettuce and tomatoes before hygienization was in conformity with these standards. However, after the hygienization procedure two samples of lettuce (12.5%) and three samples of tomatoes (18.7%) yielded coliform counts above the standard. These results suggest that a failure may be occurring in the procedure, although the coliform counts of the vegetables before hygienization were not statistically different ($p > 0.05$) from those after hygienization. Considering the good initial sanitary quality of the vegetables in use, probably the failure is not in the hygienization procedure itself but in a step that comes after, such as pre-preparation or assemblage of salads, and may be due to improper food handling or contaminated surfaces or utensils.

CONCLUSION

The procedure for transport of hot food preparations demonstrated to be efficient as their holding temperatures were either above the safety limit of 60°C or below the three-hour safety limit for exposure.

The procedure for hygienization of vegetables to be consumed raw demonstrated not to be efficient, since the finding of high coli form counts in samples of vegetables after salad assemblage suggest a failure in this procedure, or in other safety practices such as hand washing or cleaning of surfaces or utensils.

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Cite this article

Rodrigues KL, Demoliner F, Guimarães Aleixo JA, Silva JA (2016) Efficiency of Operational Procedures Used At an Institutional Foodservice Unit from Southern Brazil. J Vet Med Res 3(5): 1064.