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Food Safety in the Domestic Environment: Kitchen Hygiene

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Abstract: Foodborne diseases are widely accepted as one of the major public health concerns for all countries. According to the results of various studies, the domestic sector needs to be a key element in the reduction of foodborne illness as a significant proportion of these diseasescases arises from poor food handling and hygiene practices in the domestic environment. The objective of this preliminary study was to obtain an indication of the level of hygiene of Portuguese kitchens. 10 domestic kitchens were characterized based on the presence of Escherichia coli, Staphylococcus aureus and Enterobacteriaceae in 16 different sampling points and of *Listeria* sp. in refrigerators and on the administration of a small questionnaire to the person responsible for the house cleaning and cooking about food safety and hygiene practices. Although based on a small number of homes, this study demonstrated that various points in the kitchen harbourharbor pathogenic organisms, thus being a possible source of food poisoning, for example through cross-contamination.

Key words: Food safety, domestic environment, kitchen hygiene, cross-contamination, consumer education

INTRODUCTION

Foodborne diseases are widely accepted as one of the major public health concerns for all countries and The rreducingtion in the incidence of food-borne diseases is an objective of various national and international programmes. The domestic sector needs to be a key element in their strategy as various studies indicate that a significant proportion of food-borne illness arises from poor food handling and hygiene practices in the home[1,2]. In Portugal, according to the 8th report of WHO Surveillance Programme for Control of Foodborne Disease during the period 1990-2000, 30% of the outbreaks were linked with consumption of foods in private homes[3]. This value represents a high percentage but is probably an under-estimate as outbreaks normally reported are those involving a great number of persons; these normally generally occur in commercial catering establishments such as canteens and restaurants.

This preliminary study was undertaken to characterize the level of hygiene in 10 Portuguese domestic kitchens based on the presence of *Escherichia coli*, *Staphylococcus aureus* and *Enterobactereaceae Enterobacteriaceae* in 16 different sampling points points and the presence of *Listeria* sp. in the refrigerators. A small questionnaire was answered by the person responsible for the house cleaning and cooking. Although the number of sampled kitchens had beenwas limited, the results are,, in our opinion, representative of the situation in many Portuguese houseshomes and reinforce the conclusions taken by Azevedo[4] who pointed out the need for consumer education on basic food safety and hygiene rules. There have been very few studies into domestic food safety and hygiene practices in Portugal, (Azevedo) although similar studies have been conducted in other countries[5]. This study may contribute to the development of specific education strategies as some behaviors that compromise food safety were identified and need to be avoided.

MATERIALS AND METHODS

Microbiological sampling: During the period October 2002-May 2003, various surfaces and equipments (16 sampling points) located at in 10 private homes in the North of Portugal (around Porto) were sampled for the presence of *Staphylococus S. aureus*, *Escherichia E. coli*, *Enterobactereiaceae* and, in the case of refrigerators, *Listeria* sp. Samples were always taken after the normal daily cleaning of the kitchen.

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Sample preparation

Towels and wiping cloths: Each sample was divided in littlesmall pieces, soaked for 15 min in 225 mL of sterile Buffered Peptone Water (BPW) and homogenised for 2 min in a Stomachker.

Sponge: Each sponge was soaked for 15 min in 100 mL of BPW and then homogenised for 2 min in a Stomachker.

Surface: Surface samples were collected by swabbing the selected locations with sterile cotton swabs, previously immersed in sterile Ringer's solution. The swabs were transferred to 10 mL of Ringer's Solution or, for the detection of *Enterobacteriaceae,* to 10 mL of BPW.

Detection of *Enterobacteriaceae*

Towels, wiping cloths and sponges: Ten milliliter of the homogenate were incubated at 37°C for 20 h. One milliliter of this enrichment was then transferred to 10 mL of EE broth. After incubatedion at 37°C for 24 h a loopful of this broth was streaked on Violet Red Bile Glucose Agar (VRBGA). After growth at 37°C for 24 h characteristic colonies were confirmed by the oxidase test and glucose fermentation.

Surfaces: Each swab suspension was incubated at 37°C for 20 h and the subsequent methodology was the same as described above for towels and sponges.

Detection of *S. aureus*

Towels, Wiping cloths and sponges: Ten milliliter of each homogenate was transferred to 10 mL of double strength Chapman broth. After incubation at 37°C for 24 and 48 h, a loopful was streaked on Baird-Parker Agar (BPA) plates. After incubation at 37°C for 48 h, black and grey colonies with or without a white halo on BPA plates, were confirmed for the presence of the enzyme coagulase with Rabbit plasma.

Surfaces: One milliliter of each swab suspension was transferred to 10 mL of single strength Chapman broth. The subsequent methodology was the same as described above for towels and sponges.

Detection of *E. coli*

Towels, wiping cloths and sponges: Ten milliliter of each homogenate was transferred to 10 mL of double strength Lactose broth and incubated at 30°C for 48 h . From each tube in which gas production was observed (Durham tube) 1 mL was transferred into 9 mL of Brilliant green bile 2% broth and into 10mL of Tryptone Water. Each broth was incubated in a water bath at 44.5°C for 48 h. Positive results were growth in Brilliant green bile broth and production of indole in tryptone broth (confirmed with Kovaks reagent).

Surfaces: One milliliter of each swab suspension was transferred to 10 mL of single strength Lactose broth. The subsequent methodology was the same as that described for towels and sponges.

Detection of *Listeria* sp. in refrigerators: From each refrigerator 3 surface samples were collected (one from locations where vegetables were stored and the other 2 from locations where cheese or meats were stored), by swabbing at various points of the selected location with sterile cotton swabs, previously immersed in sterile Ringer's solution. The swabs were transferred to 10 mL of half-Fraser broth and incubated at 30°C for 48 h. Aliquots (1 mL) of these primary enrichments were transferred to 10 mL of secondary enrichment Fraser broth and incubated at 30°C for 48 h. A loopful of each primary enrichment culture and of the secondary enrichments after 24 and 48 h of incubation, were streaked separately onto PALCAM and Oxford agar plates. After incubation at 37°C for 48 h, five typical colonies per plate (when possible) were transferred onto Plate Count Agar and incubated at 37°C for 48 h. Pure cultures were tested for the Gram reaction, catalase, oxidase, fermentation of the sugars mannitol (0.5% w/v), rhamnose (1% w/v) and xylose (0.5% w/v) and CAMP with *Staphylococcus aureus* NCTC 1621 and *Rhodococcus equi* NCTC 25923.

Questionnaire on hygienic practices: In each household the person responsible for the house cleaning and cooking was asked to answer a simple questionnaire, including the following:

- How often do you clean kitchen equipment?
  a) every week; b) every two weeks; c) every month.
- How do you clean your kitchen equipment and surfaces?
  a) sponge/towel and hot water; b) sponge/towel, hot water and detergent/disinfectant; c) wet sponge/towel.
- When did you last disinfect your sink drain, disposal and connecting pipe?
  a) last night; b) last week; c) never.
- How do you wash and dry your dishes?
  a) washing machine; b) with hot water and detergent and air-dried; c) with hot water and detergent and dried with a towel.

- In the kitchen, when do you wash your hands?
  a) before preparing foods; b) after preparing raw foods; c) after preparing one food item and before changing to another one; d) after using the WC.

RESULTS AND DISCUSSION

Although *Listeria* species are often found in refrigerators[4,6,7], in this study, probably because of the low number of refrigerators sampled, *Listeria* sp. was not detected in any of the samples. In relation to the other microbiological indicators investigated, the situation was of concern. For *Enterobacteriaceae*, considered useful indicators of hygiene, positive samples were obtained from various sampling points. In 6 kitchens (60%), 50% or more of the sample points were contaminated and in one kitchen all the sampling points were positive. As shown in Table 1, these organisms were observed more frequently in towels, wiping cloths and sponges, in the sink drain and on the knob of the drawers.

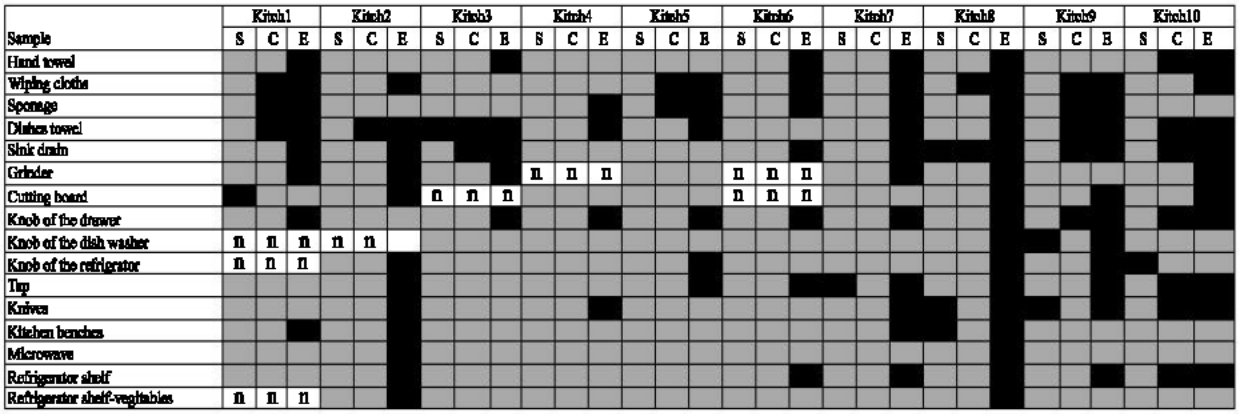
The high incidence of bacteria on towels and wiping cloths is certainly due to the frequency that cloths were used to wipe up raw food juices or to dry hands. Contaminated towels and wiping cloths will spread bacteria when used to clean equipment and surfaces and probably results in the high incidence of contamination in most of the kitchens. In fact, Speirs *et al.*[1] have already demonstrated that bacteria were transferred from dishes onto food more frequently when the dish had been towel dried instead of air-dried. The high number of contaminated sink drains was not a surprise as food particles get trapped in the drain and disposal and along with the moisture, create an ideal environment for bacterial growth.

E. coli and *S. aureus* were also found but in a lower number of kitchens and in less fewer sampling points. *E. coli* is an indicator of faecal contamination and might be introduced into the kitchen by raw foods, mainly of animal origin, people, pets and insects. For example, according to Table 2, some of the respondents do not wash their hands after using the toilet or after handling raw foods.

S. aureus is an indicator of poor personal hygiene practices such as poor hand washing technique or wipinges the nose, touching hair, mouth and smoking with no hand washing before preparing foods or cleanings the kitchen.

Interestingly, when the microbiological results were analyzed in comparison with the answers to the questionnaire, no correlation was apparent (it is important to point out that this correlation was only based on inspection of results and no statistical treatments were applied). As an example, none one of the bacteria investigated was detected in the sink drains of kitchens N°4 and N°5 although the answer to question 4, when did you disinfect your sink drain for the last time?, the answer was never. Another example refers to kitchen 8. It apparently presents the lowest hygienic level although

Table 1: Presence of *S. Aureus*, *E. Coli* and *Enterobacteriaceae* on various sufaces and equipment in 10 domestic portuguese kitchens



S, *S. aureus*; C, *E. coli*; E, *Enterobacteriaceae*, n, not tested, black squares, positive samples, Gray square, negative samples

Table 2: Hygiene practices of consumers in domestic kitchens

Question number	Answers given by the person responsible for the housecleaning to the questionnaire administrated									
	Kitch1	Kitch2	Kitch3	Kitch4	Kitch5	Kitch6	Kitch7	Kitch8	Kitch9	Kitch10
1	a	a	b	b	a	b	c	a	a	b
2	b	b	b	b	b	c	b	b	b	b
3	b	a	b	c	c	b	c	b	c	c
4	a/c	a	a	a	a	a	b	a	a	b
5	a/b/c/d	a/c	a/c/d	c/d	b/d	a	a/b/c/d	a/b/c/d	a/b/c/d	a/b/c/d

the answers to the questionnaire were the most appropriate with respect to hygienic practices. In previous studies, it was demonstrated that there was considerable variation between the stated and the actual hygiene practices[8] and Redmond and Griffith[9] had already demonstrated that information obtained in observational studies is the most reliable concerning actual consumer's food safety knowledge and behaviour.

Although based on a small number of homes, this study demonstrated that various points in the kitchen harbor pathogenic organisms, thus being a possible source of food poisoning, for example through cross-contamination. It is important to point out that these kitchens were randomly selected. Workers from ESB (students, teachers and other workers) were informed about this research and offered their kitchens for sampleing. They were asked to maintain their usual cleaning procedures in the days before sampling.

The results from this study give rise to some concern and are in agreement with some other studies with more representative sample numbers[10,11]. Other authors also indicates that the reduction in the percentage of food-borne diseases will not be possible without consumer education about safe practices in food handling[refs5].

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