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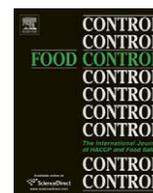
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Food safety practices in a Portuguese canteen

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ABSTRACT

The objective of this study was to verify procedures and practices related to the pre-requisites of the Hazard Analysis and Critical Control Point (HACCP) at university foodservice canteen. A checklist based on the Portuguese and European legislation was developed and applied. The global score of the checklist in this canteen was 62% which is acceptable. The topics that had the worse classifications concerned: food handlers, preparation, distribution, cleaning areas and quality control. This checklist may help the quality control of food production in catering establishments and improve the hygiene and sanitary quality of the meals served.

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1. Introduction

Cases of foodborne illness occur daily in all countries, from the most to the least developed. As most of these cases are not reported, the true dimension of the problem is unknown (WHO, 2007). Millions of people become ill and many die as a result of eating unsafe food. Up to one third of the population of developed countries are affected by foodborne illness each year (FAO & WHO, 2002). In Portugal, *Salmonella* was responsible for the majority of the hospitalizations in 1999 and in 2000, with most cases being reported in restaurants and hotels (WHO, 2002).

Foodborne disease has emerged as an important and growing public health and economic problem in many countries during the last two decades (Rocourt, Moy, Vierk, & Schlundt, 2003). Finally, the data from Europe and the United States shows that the largest benefits in reducing foodborne illness levels have come from implementing controls in farm-to-retail processing (Adak, Meakins, Yip, Lopman & O'Brien, 2005).

The legislation introduces a “farm to fork” approach to food safety, by including primary production in food hygiene legislation. The European Union (EU) legislation on food hygiene focuses on controls needed for public health protection and clarifies responsibility of food business operators to produce food safely (Bolton & Maunsell, 2004). The general food law regulation contains all seven principles of HACCP (Reg. No. 852/2004). Catering businesses will need to have a food safety management system based on the principles of HACCP (Taylor, 2001, 2008; Taylor & Kane, 2005). They are

already required to produce food that is safe to eat, but the recent regulations additionally require that catering businesses must be able to show what they do to ensure food safety (Gibson, Rose, Haas, Gerba, & Rusin, 2002; Reg. No. 178/2002; Reg. No. 852/2004).

A common understanding of the expectations and limitations of HACCP systems for foodservice between regulatory authorities and foodservice operations will help to ensure broad, effective implementation of food safety controls. A flexible HACCP system is more suitable for foodservice operations, which due to the complexity of their recipes, menus, food varieties, and amounts involved in the operation, varies for different types of foodservice operations (Seward, 2000).

A combined statistics result from USA, UK and the Netherlands indicated that up to 70% of foodborne illness was associated with catering or foodservice functions (Griffith, Worsfold, & Mitchell, 1998), which shows the importance of food safety in the foodservice areas. Data shows that the places where incriminated food was consumed in Europe, from 1999 to 2000, increased 30% in restaurants, hotels and bars; 7% in schools; 8% in canteens; 53% in catering areas and 36% in private homes, comparatively to the period from 1993 to 1998 (EU-RAIN, 2005). The importance of catering in Europe is confirmed by an annual turnover of 22 billion euros and provides 600,000 jobs and more than one in four meals eaten outside the home (FERCO, 2006).

Hygienic food preparation and the education of those involved in preparation, processing and service of meals are crucial lines of defence in the prevention of most types of foodborne illness (Gibson et al., 2002) the infection agent may be transferred to food directly or by cross-contamination (Martinez-Tome, Vera, & Murcia, 2000). Checklists may present a useful tool to control

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procedures. The continued auditing and verification of an HACCP system demands the same attention as the initial development of a HACCP plan (Sperber, 1998). The manager in foodservice needs to verify periodically good hygiene practices (GHP) and procedures, and the checklist can be useful.

The Food Safety and Economics Agency (ASAE) developed one of the official Portuguese checklists for assessment of sanitary and hygiene practices (ASAE, 2006). This is a comprehensive checklist, made up of 30 pages, used in the official inspections of the restaurant sector. Another official checklist was developed by the National Health Institute Dr. Ricardo Jorge (INSA), and it was designed for use in foodservice. This document includes references to the current legislation for each parameter, and it has 50 topics grouped in five main categories (Amorim, 2006).

In the ASAE checklist, the assessments are recorded as “yes”, “no” and “not applicable”, however, in the INSA version the responses are simply “yes” and “no”. There is no quantitative or qualitative classification or categorization of the answers in either of them. Classification and categorization can help in the analysis and decision making on the important changes required in the unit, to identify the procedures required to move towards continuous quality improvement.

In this context, a new checklist was developed and applied. The major aim of this research was to evaluate the principles of the HACCP system implementation and test the checklist developed for the university foodservice canteen. The principal objective of this study was to analyse and diagnose the main principles, good practices and the implementation of the HACCP based system in a university canteen.

2. Materials and methods

The study was carried out in five phases, namely, the technical visit to analyse the location, the construction of the hygienic-sanitary checklist, the pilot test to evaluate and improve the checklist, the application of the checklist and the data treatment. The schematic methodology outline can be seen in Fig. 1.

2.1. Technical visit to analyse the location

The visit to the establishment took place on the scheduled date. During this visit we verified the premises from a physical and environmental perspective, checked out the types of services carried out by the unit and their labour organizational system, as well as the production flow. The data obtained were important for the construction of the checklist, so that all the items specified in the legislation could be included, besides adjusting them to the specificities of this canteen.

2.2. Construction of the hygienic-sanitary checklist

This phase began with the identification and ordering, as well as gathering of information about European and Portuguese legisla-

tion related to food production in foodservice. The checklist was based on a previous one developed, tested and approved by specialized technicians and teachers from a Nutrition College, to be used by the Sanitary Inspection, the official inspection agency in a region in southern Brazil (Bramorski, Deschamps, Freygang, & Tommasi, 2003). From the original Brazilian checklist we adopted the structure, the items, the weight and score of the modules and we added new items and sub items according to the Portuguese and European Legislation.

The initial analysis involved the European Union Regulations CE No. 178/2002, No. 852/2004, No. 853/2004, No. 854/2004 and the Portuguese Government Decrees No. 560/99, No. 132/2000, No. 179/2004, No. 195/2005, No. 113/2006 as well the *Codex Alimentarius* – general principles of food hygiene (1993, 1999, 2003).

After verifying the items required by law, a list to be included in the checklist was created. The checklist was structured in six modules: physical facilities and environment; food handlers; equipments and materials; receiving and storage; preparation, distribution and cleaning areas and quality control. Each module contains the number of items considered necessary to investigate the theme in detail. The proposed checklist has 50 items and 300 sub items divided by the six modules and tries to offer a thorough diagnostic analysis of the canteen being assessed (Veiros et al., 2007). The score and nominal classification of each module were structured to facilitate the visualization of the stages in relation to the legal requirements. The general classification was organized in a qualitative and quantitative order, to provide an indicator which was easy to understand and allowed immediate application in the establishment.

The classification used in the checklist was based on the scale adopted by the Northern Public Health Centre in Portugal (Nogueira, 2004), which had later been applied and tested in a checklist developed for the hygienic-sanitary assessment of restaurants before and during the European Soccer Championships Euro 2004 in the city of Porto, in Portugal (Santos, 2005).

2.3. Pilot test

The checklist was tested in a pilot study, carried out in the same cafeteria for which it was being developed. The application date was chosen randomly, with the consent of the local supervisor. The objective of the pilot test was to evaluate the tool and verify the degree of ease in its application, the adequacy of the terms and organizational structure, as well as to facilitate comprehension by the evaluator on the items and sub items that were to be analysed and confirm if they corresponded to the proposed analysis. Following the pilot test, the terms were revised and discussed with other researchers, this resulted in some changes being made on how the items were grouped and four items and 11 sub items were excluded due to repetitions. These changes were based on the legal requirements for the foodservice area and the balance of the sub items of the various items. The final version was used to evaluate the canteen being studied. In this phase the most important issue was the adequacy of the tool, not the assessment of the location.

2.4. Application of the checklist

The checklist was applied, in person, by one of the researchers at a Portuguese University canteen, through direct observation, backed up by photographic records for future analysis and confirmation or revision of the observations.

A Casio Exilim EX-S500 5 mega pixels digital camera was used, and 130 photographic records were obtained. A printed version of the checklist was used and later the data was inserted in the computerized version.

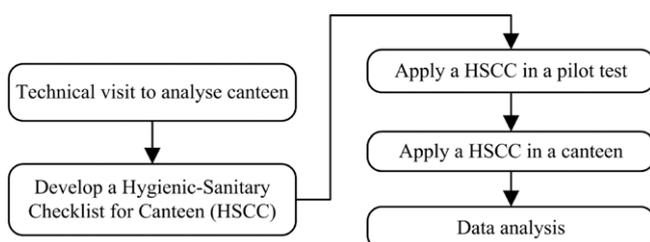


Fig. 1. Lay-out of study methodology.

2.5. Treatment of data

Following the application of the checklist, the data collected was inserted in an Excel[®] spreadsheet with the sub items being recorded as yes, no or not apply according to the predefined criteria. The formulas had been inserted into the Excel spreadsheets so the evaluation of the modules was calculated automatically, revealing the score obtained by each module, as well as the respective quantitative classification.

To calculate the Module Score (MS) of the checklist, the total numbers of Yes Scores (YS) and of Not Apply Scores (NAS) of each module were considered. The YS was multiplied by the Module Weight (MW), and the resulting score was attributed to each module. The checklist classification considers the following levels: Very Good if $\geq 90\%$; Good between $\geq 75\%$ and $< 90\%$; Acceptable between $\geq 50\%$ and $< 75\%$ and Not Acceptable if it is $< 50\%$.

3. Results and discussion

The application of the checklist at the university canteen resulted in a Catering Total Score (CTS) of 62% indicating an overall classification of acceptable ($> 50\%$). The modules and their respective scores and classifications can be verified in Table 1. The checklist, as an Excel[®] evaluation sheet, enables the evaluation of the foodservice unit, assessing it from both quantitative and qualitative parameters. The results were demonstrated and discussed by modules (sections).

3.1. Physical facilities and environment

This area obtained the best evaluation. Of the 72 sub items, 13 were not acceptable, corresponding to 81% adequacy. The items receiving the best evaluations were: conception and construction; installations; walls, ceilings and doors, in which all the sub items received an assessment of adequate. Sub items presenting some irregularities: the working space, as in some specific locations it does not always allow for adequate circulation and operations; sanitary facilities due to the absence of non manual handles; the changing rooms for having items outside the designated spaces; the floors due to inadequate overall drainage; the windows, as some were missing protective netting; the water supply due to the absence of waste reduction controls; and food residues, because some garbage cans were manual and there was no refrigerated garbage storage.

The least adequate item was the hand-washing stations, as they were missing in quite a few areas, and there was neither a hand-washing procedure nor liquid soap. The low adequacy of the hand-washing stations may compromise the quality and safety of

Table 1
Evaluation and classification of the checklist, university canteen, Portugal, November 2006.

Modules (sections)	MS	YS	MW	CM	NAS	%	Classification
RM1 Physical facilities and environment	8.1	56	10	72	3	81.2	Good
RM2 Food handler	3.6	7	15	29	0	24.1	Not acceptable
RM3 Equipment and materials	9.2	11	15	20	2	61.1	Acceptable
RM4 Receiving and storage	15.2	38	20	53	3	76.0	Good
RM5 Preparation, distribution and cleaning areas	14.8	45	20	69	8	73.8	Acceptable
RM6 Quality control	11.2	29	20	57	5	55.8	Acceptable

Mean = RM: Ranking Module; MS: Module Score; YS: Yes Score; MW: Module Weight; CM: Constant of Module; NAS: Not Apply Score.

the foods produced. It's common sense that effective hand-washing (including drying) is important in infection control. The ability of the various stages of hand-washing to decrease skin-surface microbial counts has been documented (Borges, Silva, & Gontijo Filho, 2007).

A study demonstrates that faucet handles were more likely to be contaminated and be in excess of benchmark values than paper-towel dispenser exits. However, the latter are likely to be the final surface touched during the hand-washing process and overall nearly 20% were above microbiologic benchmark values (Griffith, Malik, Cooper, Looker, & Michaels, 2003). Harrison, Griffith, Ayers, and Michaels (2003) studied the transfer and cross-contamination potential between hands, towels, and dispenser exits. The results indicate that zigzag transfer of bacteria between paper-towel dispensers and hands can take place if either one is contaminated. However, it is very difficult to expect foodservice workers to follow best practices if the establishment does not have the infrastructures to comply with them.

Another observation had to do with the work space which was inadequate for the circulation of workers in some areas, which may lead to production processes not following the hygienic standards and increase the risk of accidents. Studies have demonstrated that the conditions of the work environment can interfere directly in the quality of the services provided as well as having a close influence on the health of the workers, possibly favouring the appearance or worsening of disease. Others have demonstrated the connection between physical stress and the risk of accidents, as well as the negative impact on the health and nutritional status (Foley, 1995; Matos & Proenca, 2003). So the foodservice manager must bear in mind the direct and indirect implications of the installations and work environment.

3.2. Food handlers

This module is among the three with the largest numbers of non-conformities. Of the 29 sub items, 22 were non-conforming, and only 24% were adequate. The best rated sub items was uniforms/shoes, even though they were not always ergonomic. The other adequate items were the apparent good health of workers and the basic training of some of them.

None of the other sub items was conforming, particularly with regards to jewellery, nail varnish, nails and skin lesions; periodic training and the correct performance of duties; use of personal protection equipment (EPI); frequency, need, duration and the adequate hand-washing product; finalizing with the safe procedures for food manipulation and the correct use of disposable gloves.

With regards to hand-washing, Pragle, Harding, and Mack (2007), confirmed that teaching and training foodservice workers is considered the most frequently identified factor in influencing them to wash their hands, an important aspect as hand-contact surfaces were more often contaminated than food-contact surfaces (DeVita, Wadhera, Theis, & Ingham, 2007).

In their research, Wongworawat and Jones (2007), state that the choice of sanitizer was fundamental for the reduction of the bacterial count on the hands of the food handlers they studied and that using hand jewellery may contribute to an increased bacterial count. In this context, there are studies demonstrating that following training, there is a reduction in the use of jewellery and in the number of colonies on the hands of foodservice workers, confirming the importance of periodic training (Acikel et al., 2007).

As previously mentioned, in the canteen being researched, there is no periodic training, which may contribute and/or lead to unsafe procedures in food handling and in the use of disposable gloves. Lynch, Phillips, Elledge, Hanumanthaiah, and Boatright (2005) describe a tendency of the foodservice workers to use the same pair of gloves for long periods of time, which provides a false idea that

gloves reduce or prevent bacterial contamination. In addition, the study by Grassos, Petraki, Petineli, Daoussi, and Sagana (2005), indicated that the scrubbing time has a strong link with bacterial growth and that microbial flora grows rapidly between 0 and 90 min following scrubbing, even under surgical gloves. The inadequacies may directly affect the safety and quality of foods produced in the canteen, given the link between the lack of training and hand sanitizing, even though it is not the only causing factor.

Foodservice workers are very often people from a low social and cultural level, and studies have shown the association between educational level and personal hygiene (Sangole, Lanjewar, & Zodepey, 2002). Food handlers have a major role in the prevention of food poisoning during food production and distribution (Lues & Van Tonder, 2007). In spite of training offered to food handlers, they do not always put it in practice, as demonstrated by a study in which of the food handlers who received food hygiene training, 63% admitted to sometimes not carrying out food safety behaviours (Clayton, Griffith, Price, & Peters, 2002). There is a need to develop training methods that are proven to change behaviour as well as imparting knowledge (Egan et al., 2007; Mortimore, 2001).

3.3. Equipment and materials (EM)

In this area, from 20 sub items, we observed 11 adequate sub items, seven inadequate and two not apply, the equivalent to 61% adequacy. Equipments were the best item in this area, followed by the surfaces. However, not all equipments have automatic control mechanisms or temperature monitoring. During the evaluation, the food-contact surfaces were not being sanitized. Utensils and containers were not identified by work area. Regarding procedures, frequent sanitizing was not a standard occurrence during the observed work shift.

Another item evaluated was the surface of the food handling areas, where materials and their upkeep were adequate. The sanitizing stage is very important to avoid cross-contamination in the kitchen. A study carried out to analyze the general knowledge and practices of food handlers in Portugal, showed that in relation to instruments and working identified 93% of food handlers identifies disinfectants as the best process of killing bacteria, however, 24% did not know that after the use of disinfectant on instruments and surfaces both must be cleaned with potable water (Gomes-Neves, Araujo, Ramos, & Cardoso, 2007).

Utensils and containers in the canteen were made of adequate materials and were in good condition, although some were not appropriately cleaned. Comparisons indicate that this is not a particular characteristic of this unit, as in a study of 30 restaurants in the city of Porto – Portugal, 87% of the locations had bad evaluations on surface control and 67% on equipment control (Santos, 2005). A study carried out in Texas found 41% of the surfaces analysed contaminated with 27 different types of bacteria. The most commonly contaminated areas were the dishwashing sink, the hand-washing sink faucet handles, the handle of the garbage can lid and cutting boards (Staskel, Briley, Field, & Barth, 2007). There are serious pathogens able to survive in a range of environments, under various conditions. Results of a study showed that *Escherichia coli* O157 was able to survive for over 28 days at both refrigeration and room temperatures on stainless steel (Wilks, Michels, & Keevil, 2005).

The equipment and materials were specific by area and/or tasks although they were not clearly identified (by colour for example) and were not sanitized following contact with raw foods during the work shift. This in spite of the study by Gomes-Neves et al. (2007), which indicates that 73% of surveyed Portuguese food handlers recognize the need of washing or changing knives when manipulating raw food from different origins. The established operational procedures need to be complied with throughout the phases

and steps in a foodservice facility. Staff members need to be aware of the importance and reasons why procedures need to be followed, so that they can follow them precisely, in spite of lack of time or other complicating factors which might hinder compliance.

3.4. Reception and storage

In this sector, of the 53 sub items assessed, 38 were adequate, 12 inadequate and 3 do not apply, so an average of 76% adequacy. The best scored items, where almost all sub items were adequate are as follows: storage at room temperature, where only the distance from the wall of the food products was not fully adequate. All the cold storage equipment (refrigerators, freezer, and blast chillers) had adequate items. However, receiving, cold storage and defrosting presented non-conformities. In receiving, there was no verification of quantity, temperature, integrity of containers and expiry date for any foods, and no records kept for control and tracking. In cold storage, the problems had to do with the actual storage of foods, visible labelling and lack of an alert system for the temperatures in the refrigerators. During defrosting, there was an issue with the drainage of liquids and with packages weighing more than 2.5 kg.

These initial stages are determinant in order to assure food safety and quality of meal during the next stages of producing (Sun & Ockerman, 2005). Receiving is a stage where a detailed verification of the foods' characteristics is required, however, not all aspects are carefully checked, as demonstrated by a study on the evaluation of the self control system in 30 Portuguese restaurants, where the control on what was received was considered bad in 73% of the establishments (Santos, 2005). The existence of sufficient and adequate equipment does not in itself ensure that foods will be stored correctly and taking into account the delivery time. The study by Gomes-Neves et al. (2007), on the level of knowledge of Portuguese food handlers about food storage, indicated that only 37% knew how to store cooked and raw food correctly in the different shelves of a refrigerator.

The adequate selection of suppliers and the close supervision of receiving are crucial to ensure that the criteria defined by the unit are verified and respected. So as was concluded in the study by Mitchell, Fraser, and Bearon (2007), we need to visualize the food handlers as partners in the prevention of foodborne illness in food-service establishments.

3.5. Preparation, distribution and cleaning areas

Of the 69 sub items evaluated in this area, 45 were adequate, 16 inadequate and 8 do not apply, so 73.8% of the applicable sub items were adequate. The best evaluated items were related with the procedures and quality of deep frying, refrigeration and maintenance of frozen foods, cleaning and storage areas and dishwashing. The items where inadequacies matched or overcame adequacies were: raw foods, cooking, dining room, pot washing and sanitization. With regard to raw foods, the non-conformities were related to separation from pre-cooked, disinfection of fruits and vegetables and temperature monitoring. During cooking, the problems were ensuring a temperature higher than 75 °C in the geometrical centre of the food and the safe handling of under cooked meats. In the dining room, the non-conformities were related to the refilling containers and temperature controls. In the pot washing area there were problems with the cleanliness and the overall circuit, drainage and drying. In finalizing this module, regarding sanitization, there was a lack of signage and proximity of chemicals and foods. The reality encountered in the evaluation of this module is actually better than in a previously cited study, where deficiencies of 70% and 83% were found for the procedure controls and final product respectively (Santos, 2005).

It is important to detect non-conformities in fundamental stages to eliminate risk. A deep analysis is required to clarify the motives interfering with the compliance of good practices in the canteen. In the meantime, the reduced number of foodservice workers and the time constraints in the unit, may be some of the contributing factors to the existing non-conformities, along with others, such as the absence of initial and on-going training of food handlers. [Mitchell et al. \(2007\)](#) maintain that the initial working instructions, together with food safety training, appropriate equipment and space, food safety procedure manuals and work space are enabling factors to aid safe food handling behaviour.

The implementation of good practices and HACCP principles could reduce the number of inadequacies or non-conformities in the preparation stage. However, this direct and immediate effect does not always occur, as is shown by the study of [Legnani, Leoni, Berveglieri, Mirolo, and Alvaro \(2004\)](#), in Italy, undertaking a total of 236 inspections on 27 catering establishments after a HACCP system implementation. The surveillance system had brought to light various shortcomings regarding the equipment (36 corrective actions) and incorrect procedures (47 corrective actions). The tool and work surfaces showed an unacceptable contamination in 10% of samples ([Legnani et al., 2004](#)). Therefore, the difficulties encountered in this context in the canteen being studied, are not isolated, as when we compare our findings with those reported by local and European studies, similar problems are found.

3.6. Quality control

In this field, of the 57 sub items evaluated, 28 were adequate, the equivalent to 49%. The items that were totally or almost totally adequate relate to the records and microbiological analysis, as well as the samples and sanitizing plan. For the samples, the non-conformities were due to the timing of collection, and for the sanitizing plan there was no definition of those responsible for procedures and areas. The items on documentation and records, implementation of procedures and systems as well as tracking, presented the largest problems. For example, good practices codes and procedures exist but are not implemented. The inexistence of the pre-requisites of the HACCP system which are required by law was verified during the evaluation. Other sub items such as visitors were classified as do not apply, because they were not observed during the application of the checklist; or because they fell under the direct responsibility of the central management not the canteen manager, as for example, pre-requisites and qualifications of suppliers and tenders.

Compared to dozens of Portuguese restaurants, this item was inadequate in 77% of evaluated establishments ([Santos, 2005](#)). For the item documentation and records out of 10 sub items evaluated, 5 were adequate (50%). Comparing with the same study by Santos, this item of documentation and records was inadequate in 73% of the restaurants in Porto, Portugal ([Santos, 2005](#)).

The implementation of good practices and HACCP principles requires not only the theoretical existence of documents, standards and control files, but also their effective use and implementation in the canteen routine operation, in order to make them a part of the daily activities under the responsibility of qualified staff. However, it is very difficult to implement certain tasks, as was demonstrated by the study of [Hielm, Tuominen, Aarnisalo, Raaska, and Majjala \(2006\)](#), who questioned 870 employees, workers and managers of 30 food manufacturing companies on difficulties in the planning of HACCP. The most common were the choice of critical points, gaining the commitment of the entire workforce and organizing the documentation of monitoring results.

Another study with 444 food handlers, in 104 small food businesses about their knowledge of food hygiene, demonstrated that the basic lack of hygiene such as cleaning of work surfaces and

not able to link temperature values with the role of cooking and low temperature storage, for the control of microbiological hazards, prove to be a major barrier to the effective implementation of HACCP in these establishments ([Walker, Pritchard, & Forsythe, 2003](#)).

We observed that quality control requires tasks interlinked to the various sectors of the canteen and that the lack of specific training of food handlers can compromise some stages and consequently the desired quality. The control items that were inspected were those required by the legislation of the foodservice sector, so, even if not all items are contemplated, it is important for the unit to know which programs it still needs to implement and the ranking in terms of priority and benefits.

4. Conclusion

The checklist applied in this study permitted a rapid evaluation of the foodservice unit assessed, specifying the non-conformities according to the stages of the food production process, as well as the evaluation of the physical structure, equipments and human resources. The tool was developed for the canteen being studied; however, it can be applied to other units with similar characteristics. It allows a quantitative evaluation, which provides less subjective assessments and diagnostic nominal classifications. The percentage scores and classification facilitate an objective evaluation, which provides information about stages and categories needing improvements in order to accomplish legal requirements. Furthermore, the periodic application of the checklist provides monitoring of the service and location, helping the foodservice manager on regular inspections.

The investment in the university canteen should be directed towards the compliance of safe procedures by food handlers, through a continuous training plan that covers theory as well as on the job training. With these measures, it would be possible to significantly reduce the identified problems, overcoming safety hazards.

The checklist may help the quality control of food production in catering establishment and improve the hygiene and sanitary quality of the meal served. The application of this checklist in other canteens is essential aiming to characterized food safety practices in the Portuguese context.

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