



Vending machines: Food safety and quality assessment focused on food handlers and the variables involved in the industry



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ABSTRACT

The purpose of this paper was to analyse the quality and safety parameters of food products sold in vending machines. A hygienic-sanitary assessment was conducted on 338 vending machines located on the island of Gran Canaria. Hygiene Assessment System (HAS) surveys, food handler examinations and microbiological (processed food and water) and physicochemical (water) controls were applied, permitting evaluation through the identification of the main risks and/or hazards of the hygienic-sanitary quality of the products sold in vending machines.

Despite the positive results obtained from the HAS surveys applied to all the vending machines, achieving a total mean score of 87.6 ± 7.5 out of 100, the microbiological analysis showed that 5.7% of the 105 food samples were contaminated with *Listeria monocytogenes*, while *Salmonella* spp., *Escherichia coli* and *Staphylococcus aureus* were below the legally permitted limits. The lack of vehicles able to transport perishable food at correct temperatures (<8 °C) and the fact that some refrigerated vending machines were not at an ideal cooling temperature may have contributed to these values.

The assessment tools used in this study revealed hygienic deficiencies in the transportation and microbiological quality of the products, despite the favourable results obtained in the HAS surveys and food handler examinations, indicating that this relationship should be the subject of further study to improve its usefulness in the field of Hazard Analysis and Critical Control Points.

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1. Introduction

In recent decades there has been a significant increase in the development of the vending machine industry. Japan is the world leader and in the United States of America this sector has a value of 30 billion American Dollars per year (Lin, Yu, Hsu, & Weng, 2011), in the United Kingdom reaching approximately 1700 million British Pounds (Mintel, 2009).

Spain is a European power in the use of vending machines with a consolidated industry and highly integrated use. There are 560,000 vending machines across Spain, that is, one machine for

every 80 inhabitants, while Japan the industry leader, has 5.5 million vending machines, one for every 23 people (MTV, 2008).

With the rapid growth of this industry, there has been concern to ensure consumers about the safety of food sold in vending machines. In the late eighties and early nineties, some authors (Anonymous, 1987; ICMSFIUMS, 1988; Snyder, 1991) considered that the Hazard Analysis and Critical Control Points (HACCP) system was the most appropriate method to monitor vending machine operators to ensure consumer safety, offering a high level of food safety based on food risk prevention. A few years later, Hunter (1992) suggested that all vending machine companies should control the quality and safety of their operations, preferably using the same HACCP system.

Under the HACCP system, food business operators ensure that all stages of production, processing and distribution of food under

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their control satisfy the relevant hygiene requirements laid down in Regulation (EC) No. 852/2004. Successful implementation of the procedures based on HACCP principles requires the full cooperation and commitment of food business employees. To this end, employees should undergo training (Egan et al., 2007; Jevšnik, Hlebec, & Raspor, 2008). An important factor to take into consideration is that in the food business, the owner or manager is solely responsible for the management of human resources. Owners or managers who are trained in management, tend to give more value to training and actively encourage their employees to participate in further training development (Worsfold, 2005).

Several studies (Greig, Todd, Bartleson, & Michaels, 2007; Howes, McEwan, Griffiths, & Harris, 1996) have reported food mishandling as the main cause of foodborne disease and a factor strongly associated with outbreaks. Among the practices of food handlers which are often associated with foodborne outbreaks are: inadequate hand hygiene, inadequate hygiene of equipment and utensils, maintenance of ready-to-eat food at room temperature, preparation of meals in advance, insufficient cooking temperature and inadequate thawing (Chan & Chan, 2008; Food and Drug Administration, 2009; Greig et al., 2007). Therefore, these professionals may be responsible for up to 97% of foodborne disease outbreaks (Egan et al., 2007). Food handlers participate in the final stage of the prevention of foodborne diseases; they must take significant steps to reduce the number of pathogenic microorganisms to the minimum level (Medeiros et al., 2004). In line with this, McIntyre, Vallaster, Wilcott, Henderson, and Kosatsky (2013) pointed out that educating food handlers to prevent foodborne illness is an important objective for industries and governments.

Food safety is of vital importance to consumers, the food industry and the economy. According to Raspor (2004), the number of annual cases of salmonellosis and campylobacteriosis in Europe is likely to exceed five million; this means that the economic and human losses from foodborne diseases can no longer be ignored. Based on these premises, we must address the potential dangers, especially those of a microbiological nature which can affect different food types in the vending machines.

It is important to take into consideration that food and drink present in machines are commonly found pre-packaged and must not be in contact with any surface of the machine. The microbiota of the food and drinks should be the same as in the food served by traditional methods. However, vending machines, once loaded, are left unattended for long periods of time, which can mean an increased microbiological risk.

Taking the example of drink vending machines, they are refilled, cleaned and maintained by the operating companies. The frequency of cleaning varies depending on the machine type, frequency of use, and location. Inside the machine there are a number of areas where it is possible to accumulate moistened dust which needs to be cleaned to prevent the possibility of microbial growth and the occurrence of dust clumps in beverages (Hall, Short, Saltmarsh, Fielding, & Peters, 2007).

Regarding the Spanish legislation on vending machines, it is important to say that until March 2010 it was required that the machines featured an authorization or approval by the Autonomous Community in which they were located and activated. However, now it is only necessary that they satisfy the applicable technical regulations. This was established by Law 1/2010 of March 1, amending the Law 7/1996 of 15 January on retail trade, in line with the provisions of Directive 2006/123/EC, standard community developed under the auspices of the Establishing Treaty of the European Community.

Since studies on the hygienic and sanitary conditions, including microbiological analysis, about the food and drink sold in vending machines are very scarce (Hall, Griffiths, Saltmarsh, Peters, &

Fielding, 2012; Hunter, 1992; Hunter & Barrell, 1999; Hunter & Burge, 1986), the aim of this paper was to assess the quality and the hygienic conditions of the products sold in vending machines, through physicochemical and microbiological water analysis, microbiological food analysis, a hygienic-sanitary survey and a food handler knowledge examination, applying the results of these relationships to the management of HACCP in the vending industry.

2. Materials and methods

2.1. Vending machines

For this work we have considered the island of Gran Canaria in a comprehensive manner, with particular emphasis on the University of Las Palmas de Gran Canaria (ULPGC) campuses located on this island. The ULPGC has 23,931 students enrolled on various degree programmes distributed across 4 campuses on Gran Canaria (ULPGC, 2013).

The study was carried out on 338 vending machines (111 hot drink vending machines; 82 cold drink vending machines; 74 snack vending machines and 71 refrigerated vending machines dispensing solid food products) located in the town of Las Palmas de Gran Canaria, Spain, including 100% of the machines in ULPGC buildings, i.e. 70 units.

2.2. Assessment of the adequacy of the vending machines

The adequacy of the vending machines was obtained employing information from different procedures. The first source was two Hygiene Assessment System (HAS) surveys, one applied to vending machines and another to the food replenishment route. The second source was the hygiene knowledge of the route managers, employing a written test, and the third was the analysis of the quality of the food by microbiological counts, physicochemical evaluation and temperature measurements.

2.2.1. HAS surveys

In order to assess the state of adequacy of the vending machines and the food distribution route to those machines in terms of the hygienic and sanitary requirements of the legislation in force at the time of baseline (Regulation (EC) 853/2004), two HAS surveys were developed, taking into consideration previous studies where this kind of survey was applied (Carrascosa, 2010; García Pinillos & Jukes, 2008; Millán & Sanjuán, 2005; Pérez, 2012; Raposo et al., 2013). Each question in the survey was given a score according to the degree of compliance of the machines and the operations of the food replacement route using a predetermined scale.

The score given to each category of the health inspection rating was based on current regulations, the current scientific knowledge of hygiene and food technology and professional experience during visits to machines while monitoring the operator responsible for the replenishment of food in the machines, giving higher scores to operations posing greater risk. The surveys designed were based not only on the basis of hygienic-sanitary conditions, but also took into account the operation state of the machines and whether the products expended retained their best organoleptic properties and quality; for example, if a soft drink was dispensed at an acceptably cool temperature or whether biscuits were expended with a crunchy texture, rather than a mushy one.

For these two surveys, we considered a value of 75 out of 100 as the excluding minimum, below which the implementation of a HACCP system for serious deficiency in any of the areas represented by the headings in the survey cannot be carried out, and it would be essential to take immediate measures to reduce the risk to public health, in addition to the weak points obtained by the surveys.

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