Food Control 29 (2013) 202–207

Contents lists available at SciVerse ScienceDirect

Food Control

journal homepage: www.elsevier.com/locate/foodcont

Prevention of travel-related foodborne diseases: Microbiological risk assessment of food handlers and ready-to-eat foods in northern Italy airport restaurants

Claudia Maria Balzaretti, Maria Ada Marzano*

Laboratory of Food Inspection, Department of Veterinary Sciences and Technologies for Food Safety, Faculty of Veterinary Medicine, University of Milan, Via Celoria 10, 20133 Milano, Italy

ARTICLE INFO

Article history:
Received 9 January 2012
Received in revised form
23 May 2012
Accepted 29 May 2012

Keywords:
Airport catering
Ready-to-eat food
Microbiological safety
Travel-related foodborne diseases
Food handlers
Food contact surfaces

ABSTRACT

The focus of this study was to assess the hygienic standards of 44 foodservice facilities located in three Italian International Airports (with an output ranging from 100 to 800 meals a day), by monitoring the microbiological quality and safety of foods ready for consumption ($n = 773$), food contact surfaces ($n = 302$), and food handlers ($n = 287$). The hygienic standard of surfaces was sufficiently high. Only 7.9% of surfaces did not conform with advisory standards in terms of total coliforms, and 2.6% were found to be contaminated with *Enterococcus* spp. at $\geq$1.0 $\log_{10}$ CFU/cm^2. The hygienic standard of washed and disinfected hands of food workers was not adequately high: the total bacterial count and coagulase positive *Staphylococci* exceeded the satisfactory limit in 8.4% and 3.5% of cases, respectively. The microbial analysis of foods examined showed an absence of *Listeria monocytogenes* and *Salmonella* spp. Food sample analyses highlighted a percentage of samples that did not conform to microbial reference standards: *Staphylococcus aureus* non-conforming percentages ranged from 2.3% for "fully cooked food" to 9.2% for "raw fruit and vegetables"; *Escherichia coli*, from 0.0% for "raw fruit and vegetables" to 6.1% for "cooked and uncooked foods"; total coliforms from 14.3% for "fully cooked food" to 79.8% for "cooked and uncooked food". In conclusion, the results suggest that more effort is needed in the application of HACCP principles. In order to prevent travel-related foodborne infections, various changes in the timing of food preparation and holding temperatures are needed, together with further training of food handlers.

1. Introduction

The catering business provides food and beverages to people and covers all sectors of society such as childcare, schools, hospitals, nursing homes, restaurants, bars, take-away and fast-food outlets (Garayoa, Vitas, Díez-Leturia, & García-Jalón, 2011). This industry has expanded greatly and undergone profound changes in recent years. Many factors have contributed to this, including lifestyle changes, increases in business and pleasure travel, and increases in purchasing power (Garayoa et al., 2011). With globalization, foodborne diseases (FBDs) have acquired a new dimension, as many food products are produced in one country to be imported and consumed in another (Martins & Germano, 2008). The increased international travel, as more affordable, has determined a FBDs globalization (Käferstein, Motarjemi, & Bettcher, 1997). Many infectious diseases, including a variety of gastrointestinal disorders, are contracted by individuals while travelling outside their country of residence (Evans, Sarvotham, Thomas, & Howard, 2006; Ravel, Nesbitt, Marshall, Sittler, & Pollari, 2011). The World Tourism Organization (WTO), a specialized agency of the United Nations (UN), estimates world tourist arrivals at 940 million in 2010 (UNWTO, 2011). In 2010, the 37 airports in Italy transited almost 140 million passengers (Assaeroporti, 2011). As a result, someone can be exposed to a foodborne illness in one country and expose others to the infection in a location thousand of miles away from the original source of infection (Käferstein et al., 1997; Ravel et al., 2011). The World Health Organization (WHO) reports that up to 30% of individuals in developed countries suffer from food and water related diseases annually (WHO, 2007). The European Union (EU) Summary Report on foodborne outbreaks in 2009 indicated a total of 5550 foodborne outbreaks, with 48,964 human cases, 4356 hospitalisations and 46 deaths. The EU's annual report also showed that up to 63.6% of FBDs were associated with foodservice catering (EFSA, 2011). In Italy, epidemiological data showed an increasing incidence of foodborne infectious diarrhoea from 1993 to 2006 (from 2.32 per population of 100,000 in 1993 to 5.01 per population of 100,000 in 2006) (De Giusti et al., 2011). Due to the

* Corresponding author. Tel.: +390250317855; fax: +390250317870.
E-mail addresses: mariaada.marzano@unimi.it, mariadamarzano@libero.it (M.A. Marzano).

0956-7135/$ – see front matter © 2012 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.foodcont.2012.05.077

number of people affected and the related economic losses, FBDs still continue to be a major public health concern in developed countries (Cates et al., 2009; Medeiros et al., 2004; Scharff, McDowell, & Medeiros, 2009).

In order to reduce the number of foodborne outbreaks, a new regulatory international framework for food production and food safety has been developed over the last few years. European Union legislation on food hygiene focuses on the controls needed for public health protection and clarifies the responsibility of food business operators to produce food safely (Bolton & Maunsell, 2004; Doménech, Amoros, Pérez-Gonzalvo, & Escriche, 2011). Catering businesses are required to apply a food safety management system based on the principles of hazard analysis and critical control points (HACCP) (Reg. EC 852/2004). In foodservice environments, various factors may be related to FBDs. USDHHS-FDA-CFSAN (2000) suggested that risk factors causing FBDs include food from unsafe sources, inadequate cooking, improper holding temperatures, contaminated equipment, and poor personal hygiene. Hygienic food preparation and the training of food handlers, processing and distribution of meals are crucial lines of defence in the prevention of most types of FBDs (Dharod et al., 2009; Gibson, Rose, Hass, Gerba, & Rusin, 2002). A flexible HACCP system is more suitable for foodservice operations, which, due to the complexity of their recipes, menus, food varieties, and amounts of food involved, varies for different types of foodservice operations (Veiros, Proença, Santos, Kent-Smith, & Rocha, 2009). For the efficient management of food safety in catering, the microbial risks of all the foodservice components need to be assessed.

In recent years, several studies (Almualla et al., 2010; Chapman, Eversley, Fillion, MacLaurin, & Powell, 2010; Garayoa et al., 2011; Gillespie, Little, & Mitchell, 2000; Legnani, Leoni, Berveglieri, Mirolo, & Alvaro, 2004; Marzano & Balzaretti, 2011; Martinez-Tomè, Vera, & Murcia, 2000; Rodríguez, Valero, Carrasco et al., 2011; Rodríguez, Valero, Posada-Izquierdo, Carrasco, & Zurera, 2011; Santana, Almeida, Ferreira, & Almeida, 2009; Tessi et al., 2002; Veiros et al., 2009; Yoon et al., 2008) have been conducted aiming to evaluate the microbiological quality and safety of ready-to-eat foods prepared and served by catering business in many sectors of society (schools, hospitals, supermarkets, hotels, long-term care facilities, canteens for workers, mass catering establishments); however, to our knowledge, no studies were developed about the potential foodborne microbial risks in airport catering establishments.

The main objective of this study was to assess the hygienic standard of 44 foodservice facilities located in three Italian international airports. This involved monitoring the following: the microbiological quality and safety of foods ready for consumption, food contact surfaces, and hands of workers. Two other goals were firstly to assess the potential risk of travel-related foodborne illnesses through the prevalence evaluation of pathogenic and potential-pathogenic microorganisms in ready-to-eat foods (RTEs). Secondly, the study aimed to suggest potential corrective measures to improve the control of microbial contamination and a higher level of protection of human health and consumer interest in relation to food (Regulation EC No. 178/2002).

2. Materials and methods

2.1. Catering facilities

This investigation was conducted from April 2010 to November 2011, involving 44 catering facilities (restaurants, cafeterias, self-service restaurants, fast food and take away outlets) located in three Italian international airports, with a production potential ranging from 100 to 800 meals a day.

2.2. Sample collection

2.2.1. Ready-to-eat food

Ready-to-eat food samples ($n = 773$) were collected every six months from 44 establishments. Food samples were collected in the morning between 10:00 a.m. to 13:00 p.m. on each sampling day, approximately 250 g of each food type was placed in a sterilized plastic bag. All samples were transported to the laboratory in containers with ice, and were analyzed the same day. For this study, RTE foods were divided into four groups according to their preparation methods (Table 1). Food temperature was recorded with a portable thermometer (Checktemp 1, Hanna Instruments, Italy) at the time of sampling. The thermometer probe was inserted into foods so that the sensing point was near to the geometric center of the food. Prior to this, the probe was immersed in a 1% quaternary ammonium chloride solution (Suma D10, Johnson & Diversey, USA), rinsed and wiped dry with paper tissue.

2.2.2. Food contact surfaces

Samples ($n = 302$), from the surfaces in contact with foods – counter tops, knives, ladles, cutter blades, cutting boards, ceramic plates and cups – were randomly selected for evaluation. The hygienic control of surfaces was performed after regular cleaning procedures had been completed, according to HACCP foodservice plans. Surfaces were examined by flexible hygienic test slides "Contact Slide" (International PBI S.p.A., 2010). The contact-slides were transported in an ice container and analyzed immediately on arrival at the laboratory (ISO 18593, 2004; International PBI S.p.A., 2010).

2.2.3. Food handlers

Samples ($n = 287$) were collected from the washed hands of workers by the flexible hygienic test Contact-Slide (International PBI S.p.A., Italy). A single hand wash was the method used by food personnel, according to HACCP foodservice plans.

2.3. Microbiological analyses

The microbiological analysis focused on pathogenic and potential-pathogenic microorganism markers (*Listeria monocytogenes*, *Salmonella* spp., *Escherichia coli*, *Staphylococcus aureus*). It also included spoilage-microorganisms and hygienic markers: aerobic plate counts, total coliforms and intestinal Enterococci.

For the food samples, an analytical unit (10 g) was aseptically taken from each unit, added to 90 ml of sterile diluent solution (0.85% NaCl and 0.1% peptone), and homogenized in a stomacher 400 (Colworth, UK) for 1 min at room temperature and then serial 10-fold dilutions were made in a sterile saline solution.

Table 1
Ready-to-eat foods groups, according to their preparation methods.

Ready-to-eat foods groups	Number of samples	Description
Group A	266	Fully cooked food for immediate sale or consumption (e.g. pasta, pizza, burgers, vegetables, ready meals after regeneration)
Group B	229	Fully cooked food with minimum further handling prior to sale or consumption (e.g. whole pies, sausage rolls, quiches, roast meats, chicken portions)
Group C	213	Multi-ingredients preparations, consisting of cooked and uncooked foods ready for consumption (e.g. seafood sauces, roast beef with raw rocket, mixed salads)
Group D	65	Raw fruit and vegetables ready for consumption (e.g. julien carrots, sliced fennel, chopped lettuce, radicchio, pre-prepared fruit salads)