



## Food hygiene practices in different food establishments



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### ABSTRACT

The aim of this study was to investigate three dimensions of food hygiene in three European cities - Belgrade, Thessaloniki and Porto. The first dimension of the survey was to evaluate the level of hygiene in different food establishments supplying food direct to consumers. A total of 91 food businesses were included in the survey with 30 food businesses from Belgrade and Porto, and 31 from Thessaloniki. In parallel with scoring the premises, the second dimension of the study was to examine the opinion of managers of these food establishments regarding food hygiene rating. Finally, in order to justify the importance of food hygiene, the research covered consumers' perception regarding food safety and hygiene practices in the three European cities. A total of 600 respondents were interviewed in the survey, 200 respondents per city.

This study confirmed that HACCP as a concept is important and major differences in the level of food hygiene in food establishments are based on HACCP status rather than type and size of food establishment. The analysis revealed hygiene and food preparation as the predominant in low ranking of food hygiene and safety procedures, followed by inadequate layout as predominant factor in evaluating structural requirements. Also, the obtained results indicated greater level of hygiene in food establishments in Thessaloniki and Porto, than in Belgrade. Managers' opinion confirms their belief that a transparent food hygiene rating of all food establishments could lead to improved business. Finally, respondents in all cities confirmed their awareness of the importance of food hygiene and indicated kitchen related statements as the most influential.

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## 1. Introduction

When eating outside, consumers expect to obtain quality food with an acceptable food hygiene level, which reduces the risk for food-borne illness. Also, the consumers often rely on local authorities and inspection services to regulate and inspect restaurants in order to assure that hygiene requirements are met. Delivering safe food to consumers is the responsibility of operators at all levels of the food production chain (EU, 2004). According to Regulation (EC) No. 852/2004 (EU, 2004), all food business operators have to implement a written food safety system based on hazard analysis and critical control point (HACCP) principles. Benefits and constraints, as well as identifying needs for tailoring a HACCP system to suit the needs of small and less developed businesses like

restaurants and eating places has been analyzed and discussed in several articles (Dzwolak, 2014; Fielding, Ellis, Clayton, & Peters, 2011; Pichler, Ziegler, Aldrian, & Allerberger, 2014; Taylor, 2001, 2008; Taylor & Kane, 2005; Walker, Pritchard, & Forsythe, 2003; Yapp & Fairman, 2006).

Despite the legal requirements for the implementation of good hygiene practice and HACCP, cross-contamination remains an important causative factor in outbreaks that occurred in restaurants, take-away and fast food places (Bisbini, Leoni, & Nanetti, 2000; Gaibani et al., 2011; Giraudon et al., 2009; Insulander, de Jong, & Svenungsson, 2008; Meldrum et al., 2009; Severi et al., 2012) and highlights the continuing importance of good hygiene practices with adequate training of food handlers. Along with the legal requirements, the restaurant cleanliness and overall hygiene seems to be one of key factors in customers' restaurant quality evaluations (Aksoydan, 2007).

In order to improve the awareness of management of the eating out of home places on one side and consumers on the other side, food hygiene rating system was introduced in several

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countries, namely Denmark, the United Kingdom, United States, parts of Canada, New Zealand and Singapore (Jin & Leslie, 2003; Simon et al., 2005). In these countries, the health authorities conduct regular inspections of restaurants, bars, fast food and other food establishments selling foods and drink to the public and make the inspection results expressed as hygiene rating score available at the business premises and/or via the Internet for public viewing.

The Danish government launched a so called “Smiley scheme” in 2001 in order to enhance the protection of consumers’ interest (Nielsen, 2006). Regarding this scheme, all inspections results are summarized in the form of a symbol (a Smiley face ranging from big smile to sad face) and food establishments are obliged to publish this symbol at the entrance door to the eating place. By doing this, customers are provided a simple and convenient way of identifying the hygiene conditions of specific food establishment. According to the Danish Veterinary and Food Administration, a market survey conducted in November 2007 showed that 97% of consumers supported the Smiley scheme and this way of presenting the hygiene conditions in restaurants and food outlets (Denmark, 2011). A Similar system was introduced in the United Kingdom in 2004, when the Food Standards Agency of United Kingdom launched a pilot scheme – “Scores on the doors” (SOTD) to make hygiene inspection information of food establishments available at the business premises and online via the Internet for public viewing. These schemes are intended to measure and numerically express food businesses against legal compliance in three areas namely, hygiene compliance, confidence in management/control systems and structural hygiene, with the lower score reflecting a higher standard. According to the results of Wright et al. (2008), “Scores on the doors” schemes encouraged food businesses to improve their hygiene standards and might have led to measurable improvements in hygiene inspection scores.

The aim of this study was to investigate three dimensions of food hygiene in three European cities namely Belgrade, Thessaloniki and Porto. The first dimension of the survey was to evaluate the level of hygiene in different food establishments supplying food direct to consumers such as restaurants, take-away and cafe/pubs and other places where people eat food prepared outside of the home, given as Food Hygiene Rating – FHR (scores from 0 to 5). In parallel with scoring the premises, the second dimension of the study was to examine the opinion of managers of these food establishments regarding food hygiene rating. Finally, in order to justify the importance of food hygiene, the research covered consumers’ perception regarding food safety and hygiene practices in food establishments supplying food direct to consumers in the three European cities.

## 2. Material and methods

### 2.1. Food establishments characterization

The data used in this study were collected by undisguised observations after obtaining the permission of the owners of the food establishments to investigate and observe the practices of food safety and food hygiene in their premises. A total of 91 food establishments were included in the survey with 30 from Belgrade (Serbia) and Porto (Portugal), and 31 food establishment from Thessaloniki (Greece), from different parts of the cities. The survey was conducted from May 2012 until December 2012. The breakdown of establishments’ type that participated in this survey is shown in Table 1.

The food establishments included restaurants, take-away places and pub/cafes. Restaurants’ main activity is to serve all three meals,

**Table 1**  
Structure of food establishments by businesses type and number of employees.

City	Food businesses type	Number of businesses $n^a$ (%)	Number of employees		
			<10	10–25	>25
			$n$ (%)	$n$ (%)	$n$ (%)
Belgrade	Restaurant	15 (50.0%)	1 (6.7%)	6 (40.0%)	8 (53.3%)
	Take-away	9 (30.0%)	8 (88.9%)	1 (11.1%)	0 (0.0%)
	Pub/cafe	6 (20.0%)	4 (66.7%)	1 (16.7%)	1 (16.7%)
Thessaloniki	Restaurant	16 (51.6%)	9 (56.3%)	4 (25%)	3 (18.8%)
	Take-away	12 (38.7%)	10 (83.3%)	2 (16.7%)	0 (0.0%)
	Pub/cafe	3 (9.7%)	2 (66.7%)	1 (33.3%)	0 (0.0%)
Porto	Restaurant	16 (53.3%)	11 (68.8%)	5 (31.3%)	0 (0.0%)
	Take-away	5 (16.7%)	4 (80.0%)	1 (20.0%)	0 (0.0%)
	Pub/cafe	9 (30.0%)	8 (88.9%)	1 (11.1%)	0 (0.0%)
Total			57 (62.6%)	22 (24.2%)	12 (13.2%)

<sup>a</sup>  $n$  represents the number of establishments, (%) represents their share in the sample.

breakfast, lunch and dinner with variety of meat, fish and vegetarian dishes, while take-away places’ main activity is to serve fast food, pastry, soft drinks and/or juices. The investigation included also pub/cafe where the hot and cold drinks are served as a main activity, and serving branches, starters and sandwiches is also available.

### 2.2. Food hygiene in food establishments

Food Hygiene Rating – FHR was conducted using a checklist prepared for the purpose of “Scores on the doors” scheme. For rating the hygiene conditions in the different food establishments visited, the three main area were investigated, namely the level of current compliance with food hygiene and safety procedure, level of current compliance with structure and cleaning practices and confidence in management/control procedures. Within the group of requirements covering compliance with food hygiene and safety procedures and basic food handling practices, six prerequisite programs (PRPs) have been identified and analyzed (CAC, 1993; FSA, 2012): temperature control (TC), cross-contamination (CC); personal hygiene (PH), food preparation (FP), overall hygiene (OH) and water control (WC). Group of requirements covering compliance with structural requirements covered the following PRPs: layout of food establishment (LA), waste procedure (WP), pest control (PE), maintenance (MA) as well as status of licenses and permits (PL) of the food establishments. Finally confidence in management and control procedures covered managing HACCP in relation to HACCP documentation (DO), records keeping (RE), staff awareness (SA), incoming (IC) and external control (EC).

Each element is numerically scored against the relevant criteria given in guidance from poor “30” to good “0”. Numerical scores obtained for each element were then combined in order to give a final food hygiene rating which can range from “0” at the bottom requiring urgent improvements to “5” at the top showing very good hygiene practice. The final rating depends on the overall level of compliance, but also reflects the level of compliance for each of the individual areas by taking into account the highest of the three scores – the additional scoring factor (FSA, 2012).

One person from each city has performed the observation in food establishments. In order to enable same level of consistency and severity and avoid misleading of ambiguous terms, authors developed an additional checklist highlighting what can be the main findings. Deployment of the checklist was generated using (CAC, 1993; FSA, 2012).

### 2.3. Managers' opinion on food hygiene

Additionally, face-to-face interviews were conducted by interviewing managers/owners in the food establishments visited in each European city. The interviews used in this study aimed to examine the concern and awareness of the interviewees toward food hygiene rating scheme. The interviews took place within the premises and each interview lasted approximately 10–15 min. The first section of the questionnaire included general information about the food establishment such as the number of employees, the HACCP system implementation status and the number of inspection visits and their findings related to food safety. Due to the fact that rating these establishments is not a legal requirement in the three countries, as no such method exists, the second section explored statements covering opinion of managers/owners on food hygiene rating scoring system, legislation, the possibility of FHR to improve food safety, consumer's confidence and business. All statements gave the respondents the opportunity to rate their degree of agreement with their perception on specific statement according to a five-point Likert scale from 1 "strongly disagree", 2 "disagree", 3 "no opinion", 4 "agree" to 5 "strongly agree". Finally, the managers had the possibility to give their opinion on possible frequency of FHR, period of follow-up visits and attitude towards (non)announced visits.

Findings were analysed using an independent sample *t*-test, one-way ANOVA with post hoc Tukey test (SPSS Statistics 16.0). Values with a  $p < 0.05$  were considered statistically significant.

### 2.4. Consumers' perception regarding food safety and hygiene

The survey on consumers' perception of food hygiene and safety was conducted from May 2012 until December 2012. A total of 600 respondents were interviewed in the survey, including 200 respondents per city. The respondents were chosen to represent the population that visits food establishments supplying food direct to consumers. The authors recognize that this method does not provide a truly random sample, but instead, represents a "convenience sample" for further statistical analysis.

A structured questionnaire was developed considering similar research realized in the US comparing perception in Asian and Mexican restaurants (Lee, Niode, Simonne, & Bruhn, 2012). This questionnaire consists of two sections; first section included general demographic information about respondents' gender and age (Table 6), while the second section explored statements covering perception on food safety and hygiene. It consisted of 10 statements: Em – Employees; In – Inspection; Hy – Hygiene; Co – Cooking; Qu – Quality, Ap – Approval; St – Storage; Te – Temperature; Se – Serving; Da – Days (Table 7). All statements gave the respondents the opportunity to rate their degree of agreement with their perception on service quality according to a five-point Likert scale from 1 "strongly disagree", 2 "disagree", 3 "no opinion", 4 "agree" to 5 "strongly agree".

The data obtained were grouped into a matrix with the respondents as rows and the statements as columns. The matrix of calculated data, with 600 rows and 10 columns, was analyzed by the principal component analysis method (PCA) using correlation matrix with no rotation method (SPSS Statistics 16.0). Bartlett's test of sphericity was significant ( $p < 0.000$ ) and also Kaiser-Meyer-Olkin measure of sampling adequacy was satisfactory (0.853). The first two extracted principal components (PC) were taken into consideration in further analysis as they present over 50% of total variance and scree plot of the eigenvalues (not shown) suggested the same two components.

## 3. Results

### 3.1. Food establishments

A total of 91 food establishments were covered in this study with 30 food establishments from Belgrade, 30 from Porto, and 31 from Thessaloniki. The majority of food establishments involved in this study were restaurants, followed by take-away and cafe/pubs. Regarding the size of food establishments, the survey covered mainly small size companies in three cities (less than 10 and between 10 and 25 employees), except for Belgrade where 53.3% of investigated restaurants employed more than 25 employees (Table 1).

More than 70% of food establishments in Thessaloniki and Porto were those with HACCP system implemented, while in Belgrade an opposite situation was found, as only 23.3% of investigated food establishments had implemented a HACCP based food safety system (Table 2). In total, 57.1% of all food establishments had HACCP systems in place, and 42.9% had no HACCP system implemented.

In Thessaloniki, all food establishments had food safety inspection within the past year, and during these inspection visits, in 24 places (77.4%), inspectors had some comments regarding food safety. Similarly in Belgrade, only 2 food establishments were not visited by relevant food inspectors, and in 16 places (57.1%) the food safety comments were given. The lower number of inspections was reported for establishments in Porto, with approx. 50% of places being visited within the past year, out of which 84.6% were places with food safety issues reported (Table 2).

### 3.2. Food hygiene rating in food establishments

There was a statistically significant difference in FHR scores among cities as determined by one-way ANOVA ( $F(2,27) = 9.517$ ,  $p = 0.000$ ), as shown in Table 3. A Tukey post-hoc test revealed that the obtained FHR were statistically higher in Thessaloniki ( $3.71 \pm 0.74$ ,  $p = 0.000$ ) and Porto ( $3.60 \pm 1.52$ ,  $p = 0.001$ ) compared to FHR obtained in food establishments in Belgrade ( $2.23 \pm 1.91$ ). However, no statistically significant differences were obtained in Thessaloniki and Porto ( $p = 0.954$ ).

The obtained results revealed that the size of food establishments had no effect on FHR ( $p > 0.05$ ). Although, the results of one-way ANOVA indicated a statistically significant difference in FHR scores between different type of food establishment ( $F(2,27) = 3.161$ ,  $p = 0.047$ ), a Tukey post-hoc test revealed no statistically significant difference ( $p > 0.05$ ) among restaurants, sandwich bars and cafe/pubs. FHR scores of food establishments with implemented HACCP system were significantly higher ( $3.715 \pm 1.160$ ) compared to FHR scores of food establishments that had not implemented HACCP system ( $2.487 \pm 1.833$ ),  $t(89) = 3.891$ ,  $p = 0.000$  (Table 3).

In order to deploy the research, authors analyzed non-conformities that influenced rating. Requirements with most frequent scores above "15" meaning poor performance are presented in Table 4. Analysis of food hygiene and safety procedures requirements revealed that restaurants have problems related to cross-contamination, hygiene and temperature control. Poorest rating was for cross-contamination and water control in take-away establishments while pubs and cafes showed bad practice in food preparation, temperature control and hygiene. Structural requirements mostly revealed problems in the layout of premises of all types of food establishments, followed by waste handling and maintenance. Finally managing HACCP showed on one side problems in documentation/record keeping, and on the other inadequate control (both incoming and external). These results indicate poor performance influenced by personnel, highlighting the

**Table 2**  
Structure of food establishments by implemented HACCP system.

City	Food businesses type	Number of business n (%) <sup>a</sup>					
		HACCP	No HACCP	Inspection <sup>b</sup>	No inspection	Food safety issues <sup>c</sup>	No food safety issues
Belgrade	Restaurant	5 (33.3%)	10 (66.7%)	13 (86.7%)	2 (13.3%)	7 (53.8%)	6 (46.2%)
	Take-away	1 (16.7%)	8 (83.3%)	9(100%)	0 (0%)	5 (55.6%)	4 (44.4%)
	Pub/cafe	1 (11.1%)	5 (88.9%)	6 (100%)	0 (0%)	4 (66.7%)	2 (33.3%)
	Total Belgrade	7 (23.3%)	23 (76.7%)	28 (93.3%)	2 (6.7%)	16 (57.1%)	12 (42.9%)
Thessaloniki	Restaurant	12 (75.0%)	4 (25.0%)	16 (100%)	0 (0%)	13 (81.3%)	3 (18.7%)
	Take-away	9 (75.0%)	3 (25.0%)	12 (100%)	0 (0%)	8 (66.7%)	4 (33.3%)
	Pub/cafe	3 (100.0%)	0 (0.0%)	3 (100%)	0 (0%)	3 (100%)	0 (0%)
	Total Thessal.	27 (77.4%)	7 (22.6%)	31 (100%)	0 (0%)	24 (77.4%)	7 (22.6%)
Porto	Restaurant	12 (75.0%)	4 (25.0%)	8 (60%)	6 (40%)	7 (87.5%)	1 (12.5%)
	Take-away	3 (60.0%)	2 (40.0%)	3 (60%)	2 (40%)	3 (100%)	0 (%)
	Pub/cafe	6 (66.7%)	3 (33.3%)	2 (22.2%)	7 (77.8%)	1 (50%)	1 (50%)
	Total Porto	21 (70.0%)	9 (30.0%)	13 (46.4%)	15 (53.6 %)	11 (84.6%)	2 (15.4%)
	Total	52 (57.1%)	39 (42.9%)	72 (80.9%)	17 (19.1%)	51 (70.8%)	21 (29.2%)

<sup>a</sup> n represents the number of establishments, (%) represents their share.

<sup>b</sup> Inspection within past 12 months.

<sup>c</sup> Food safety issues commented by inspectors during inspection in food establishments where the inspection occurred within past 12 months.

importance of adequate food handlers' training in order to ensure the safety of the foodstuff, as outlined by (Soares, García-Díez, Esteves, Oliveira, & Saraiva, 2013). Similar results obtained by a different methodology emphasized hygiene requirements such as inadequate hygiene habits, lack of protective clothing and bad hand washing in restaurants in Brasil, (Saccol et al., 2013).

### 3.3. Managers' perception regarding FHR

Managers in the food establishments were asked about their opinion on FHR scores (Table 5). The results indicated that the highest rated was the statement that FHR can improve overall food safety and that FHR can improve consumers' confidence (mean scores 4.48). It is worth noting that managers believe that FHR should be obliged by legislation (4.34) and that this rating could improve their food business (4.32). The mean scores for the opinion regarding the equivalency of FHR scheme across the Europe and public presentation of obtained FHR were rated lower than other factors, being 4.13 and 3.98, respectively.

The managers of food establishments with an implemented HACCP system rated most statements significantly higher than those managers of non-HACCP implemented food establishments ( $p < 0.05$ ). In only two cases (FHR can improve food safety and FHR should be the same in the whole Europe), no significant difference was observed for mean rank scores ( $p > 0.05$ ).

Results regarding the opinion of managers on possible frequency of FHR show that most of the managers (over 40%) believe twice a year would be the most adequate frequency visit. However,

in Thessaloniki and Porto, managers rated frequency "once a year" as more preferable than in Belgrade, where managers prefer more frequent visits. Period of follow-up visits in order to improve FHR in Thessaloniki and Porto is 6 months (over 58% of respondents), while in Belgrade managers prefer visits every 3 months (over 80%). Finally, Belgrade managers believe that these visits should be unannounced (83.3%), in relation to Thessaloniki (35.5%) and Porto (6.7%). These data are not shown in tables.

### 3.4. Consumers' perception regarding food safety and hygiene in food establishments

Food safety statements show that respondents believe kitchen related statements influence mostly food safety (Table 7). In Belgrade it is the cleanliness of the kitchen, in Porto it is the storage temperature of food, while in Thessaloniki storage temperature, cooking and quality of food have the biggest influence on food safety. Gender analysis shows that both men and women believe cleanliness of the kitchen is the most influential statement. Younger population stated cleanliness of the kitchen while older population highlighted quality of food, storage temperature and cooking. These results are similar to research performed by (Lee et al., 2012).

Statements with the lowest ranking were two non-kitchen related statements - serving of food by waiters and belief that inspections should be more frequent. In Porto it is the inspection with the lowest ranking, in Belgrade it is the serving while in

**Table 3**  
Food hygiene rating (FHR) by city, food establishment type, number of employees and HACCP status.

		Food hygiene rating
City	Belgrade	2.23 ± 1.91 <sup>a</sup>
	Thessaloniki	3.71 ± 0.74 <sup>b</sup>
	Porto	3.60 ± 1.52 <sup>b</sup>
Type of food establishment	Restaurant	3.57 ± 1.33 <sup>a</sup>
	Take-away	2.88 ± 1.63 <sup>a</sup>
	Pub/cafe	2.61 ± 1.97 <sup>a</sup>
Number of employees	<10	3.02 ± 1.71 <sup>a</sup>
	10-25	3.54 ± 1.26 <sup>a</sup>
	>25	3.33 ± 1.56 <sup>a</sup>
HACCP	Yes	3.71 ± 1.16 <sup>a</sup>
	No	2.49 ± 1.83 <sup>b</sup>

Note: Items denoted with the same letter are not significantly different at the level of 5%.

**Table 4**  
Main requirements influencing poor scoring of FHR.

	Belgrade	Thessaloniki	Porto
Food hygiene and safety procedures	Restaurant PH, CC	OH	CC, TC
	Take-away CC	CC	WC
	Pub/cafe FP	OH	FP, TC
Structural requirements	Restaurant LA	MA	WP
	Take-away LA	MA	WP
	Pub/cafe LA, PE	MA	LA, WP
Managing HACCP	Restaurant DO, RE	–	EC
	Take-away DO	–	EC
	Pub/cafe DO, IC	–	EC

Legend: Food hygiene and safety procedures requirements: temperature control (TC), cross-contamination (CC); personal hygiene (PH), food preparation (FP), overall hygiene (OH) and water control (WC). Structural requirements: layout of food establishment (LA), waste procedure (WP), pest control (PE), maintenance (MA) status of licences and permits (PL). Management HACCP: documentation (DO), records keeping (RE), staff awareness (SA), incoming (IC) and external control (EC).

**Table 5**  
Managers' perception of FHR scores by city, HACCP status and type of food establishments.

Statement	Mean score <sup>a</sup>	City			HACCP status		Type of food establishment		
		Belgrade	Thessaloniki	Porto	Yes	No	Restaurant	Take-away	Cafe
FHR can improve food safety	4.48 ± 0.76a	4.40 ± 0.97	4.71 ± 0.53	4.33 ± 0.71	4.58 ± 0.64	4.36 ± 0.91	4.55 ± 0.65	4.38 ± 1.02	4.44 ± 0.61
FHR can improve consumers' confidence	4.48 ± 0.83a	4.27 ± 1.01	4.71 ± 0.58	4.47 ± 0.82	4.65 ± 0.68a	4.25 ± 0.97b	4.62 ± 0.57	4.34 ± 1.06	4.33 ± 1.03
FHR should be mandatory by legislation	4.34 ± 0.96ab	4.43 ± 0.90a	4.71 ± 0.53a	3.87 ± 1.17b	4.52 ± 0.75a	4.10 ± 1.14b	4.49 ± 0.77	4.23 ± 1.07	4.11 ± 1.18
FHR can improve my business	4.32 ± 0.94abcd	3.87 ± 1.13a	4.74 ± 0.44b	4.37 ± 0.93ab	4.54 ± 0.75a	4.05 ± 1.09b	4.40 ± 0.82	4.23 ± 1.14	4.28 ± 0.96
FHR is necessary for all food establishments	4.23 ± 0.82bcd	4.17 ± 0.79a	4.71 ± 0.58b	3.80 ± 0.80a	4.40 ± 0.75a	4.00 ± 0.85b	4.36 ± 0.67	4.11 ± 0.99	4.06 ± 0.87
FHR should be the same in the whole Europe	4.13 ± 1.14cd	4.30 ± 0.74b	4.61 ± 0.61b	3.47 ± 1.50a	4.08 ± 1.29	4.20 ± 0.89	4.23 ± 1.14	4.19 ± 0.98	3.78 ± 1.31
FHR should be presented public	3.98 ± 1.14d	3.90 ± 1.18	4.22 ± 0.95	3.83 ± 1.26	4.23 ± 1.08a	3.67 ± 1.15a	4.06 ± 1.13	4.00 ± 1.16	3.78 ± 1.16

<sup>a</sup> Scores were on 5 point Likert scale with: 5 – strongly agree and 1 – strongly disagree. Note: Items denoted with the same letter are not significantly different at the level of 5%.

Thessaloniki both had very similar scores. Male population stated inspection while female respondents encircled serving as the statement with lowest ranking. Younger population recognized serving as the statement least important while older population doesn't believe that inspections should be more frequent.

PCA outputs for the data matrix are shown in Fig. 1. Dimension reduction by PCA separated the observed factors into two distinct directions: kitchen related and non-kitchen related statements. PC1 (kitchen related component) has high positive loadings (>0.5) on hygiene, cooking, quality, approval, storage and temperature with no negative loadings. PC2 (non-kitchen related component) has high positive loadings (>0.5) on employees, inspections and negative loading on serving of food.

#### 4. Discussion

The food hygiene procedures and practices in different food establishments should be improved in order to reduce food borne illness related to poor hygiene practices. This study examined one possible way of evaluation of hygiene practices of food establishments including restaurants, sandwich bar and cafe/pubs in three different cities. This study confirmed that HACCP as a concept is important and major differences in food establishments are based on HACCP status rather than type and size of food establishment. Also, the obtained results indicated greater level of hygiene given as FHR values in food establishments in Thessaloniki and Porto, than in Belgrade. The possible explanation for difference in FHR scores can be found in the fact that both Thessaloniki and Porto are part of EU for years. On its route to the EU, the Republic of Serbia changed and improved its food safety legislation and introduced HACCP as a mandatory requirement in year 2005, at that time only for animal origin food (Serbia, 2010). Later in 2009, HACCP became a requirement for all food establishments (Serbia, 2009).

Results show that the upgrading of obtained scores in all three cities is more than preferable. This can be obtained through improvements of practices during food preparation, storage, cleaning practices, but also by education and training of food handlers directly involved in preparation, processing and service of meals in restaurants are crucial in the prevention of most types of foodborne illness (Gibson, Rose, Haas, Gerba, & Rusin, 2002). Also there is a need for more regular inspection of food establishments by the local authorities in order to check the compliance with the food hygiene and food safety requirements at every stage of food preparation to prevent possible food contamination. Evidence from countries which used rating system such as USA, parts of Canada, Denmark, New Zealand and Singapore suggests that food hygiene schemes lead to improved standards of food safety, and better sales

as well as being welcomed by customers (Boehnke & Graham, 2000; Moriss, 2005; Thompson, de Burger, & Kadri, 2005). Managers' opinion confirms their belief that a transparent FHR could lead to improved business. Several reports also indicated that the introduction of restaurant hygiene grade resulted in significant decrease of foodborne diseases hospitalization (Jin & Leslie, 2003; Simon et al., 2005). Additionally, the scoring system allowed the consumer to choose food establishments with better hygiene score. The consumer recognizes the importance of these scores and awareness regarding hygiene.

Although the transparency and public availability of scores given by legislators can be seen as a positive initiative and can provide an incentive for food business operators to comply with given hygiene legislation, opinion of the managers in this study indicated that this was the lowest rated statement. It is possible that this opinion is mainly raised by the fear of procedures which they are not familiar with and the question how difficult is to reach a good score in this system.

The most common scenarios which lead to the outbreaks in the restaurants, fast food and take-away is the combination of heat treatments practices with subsequent time-temperature abuse, cross-contamination of raw and cooked ingredients and defects in food preparation and hygiene. Results confirmed these requirements as the predominant in low ranking of food hygiene and safety procedures. Also important to note that often smaller restaurants, fast food and take-away places, but also the regular restaurants had to deal with inadequate work space for the circulation of workers in some areas, which may impair production processes to follow the hygienic standards and increase the risk of accidents.

Possible benefits of FHR scores could be the improved consumer access to information regarding the food safety performance of specific food establishment. Additionally this system could put more pressure on food establishments to comply and be consistent with regulatory requirements. Certainly the improved food hygiene

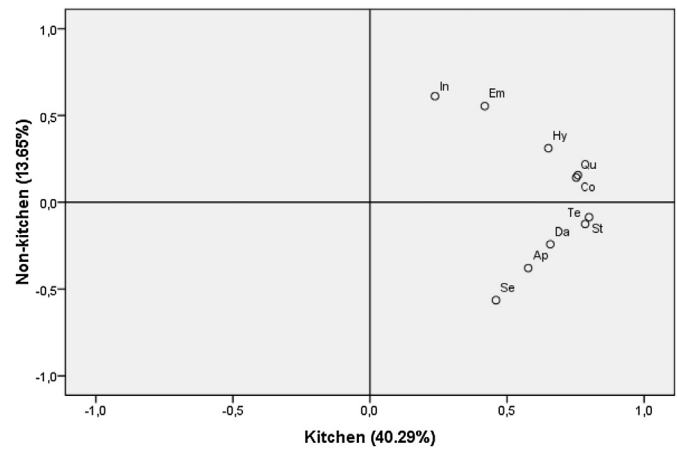
**Table 6**  
Demographic characteristics of respondents.

Characteristic	Belgrade	Thessaloniki	Porto	Total
<i>Gender</i>				
Male	86 (43.0%)	100 (50.0%)	103 (51.5%)	289 (48.17%)
Female	114 (57.0%)	100 (50.0%)	97 (48.5%)	311 (51.83%)
<i>Age</i>				
24 or younger	44 (22.0%)	40 (20.0%)	18 (9%)	102 (17.00%)
25 - 34	50 (25.0%)	40 (20.0%)	75 (37.5%)	165 (27.50%)
35-44	50 (25.0%)	40 (20.0%)	57 (28.5%)	147 (24.50%)
45-54	32 (16.0%)	40 (20.0%)	25 (12.5%)	97 (16.17%)
55 or older	24 (12.0%)	40 (20.0%)	25 (12.5%)	89 (14.83%)

**Table 7**  
Consumers' perception of food safety in restaurants in three European cities.

Statements	City			Gender		Age				
	Belgrade	Porto	Thessaloniki	Male	Female	≤24	25–34	35–44	45–54	≥55
	Sample size: 200	200	200	289	311	102	165	147	97	89
All restaurant employees should go through food safety training before begin allowed to open (Em)	4.63 ± 0.55	4.39 ± 0.87	4.65 ± 0.48	4.53 ± 0.68	4.58 ± 0.65	4.59 ± 0.57	4.62 ± 0.61	4.48 ± 0.69	4.47 ± 0.78	4.61 ± 0.68
Inspections should be more frequent (In)	4.42 ± 0.80	3.78 ± 1.07	4.22 ± 0.67	4.01 ± 0.97	4.26 ± 0.81	4.04 ± 1.03	4.35 ± 0.85	4.08 ± 0.78	3.92 ± 0.95	4.18 ± 0.89
The cleanliness of the kitchen has a big impact on food safety (Hy)	4.75 ± 0.60	4.40 ± 0.85	4.94 ± 0.25	4.74 ± 0.67	4.65 ± 0.64	4.77 ± 0.56	4.68 ± 0.71	4.73 ± 0.58	4.59 ± 0.75	4.67 ± 0.65
Cooking and preparing of food has a big impact on food safety (Co)	4.62 ± 0.58	4.36 ± 0.76	4.97 ± 0.17	4.68 ± 0.61	4.62 ± 0.62	4.58 ± 0.59	4.65 ± 0.68	4.71 ± 0.55	4.57 ± 0.66	4.71 ± 0.57
Quality of food (freshness, ingredients, etc.) has a big impact on food safety (Qu)	4.64 ± 0.62	4.39 ± 0.79	4.98 ± 0.14	4.71 ± 0.58	4.65 ± 0.67	4.54 ± 0.61	4.68 ± 0.72	4.79 ± 0.51	4.63 ± 0.68	4.70 ± 0.55
State approval/inspection has a big impact on food safety (Ap)	4.00 ± 1.08	4.22 ± 0.87	4.61 ± 0.61	4.27 ± 0.88	4.28 ± 0.93	4.19 ± 0.84	4.24 ± 0.94	4.23 ± 1.01	4.30 ± 0.87	4.49 ± 0.77
Storage of food has a big impact on food safety (St)	4.59 ± 0.62	4.39 ± 0.71	4.91 ± 0.29	4.67 ± 0.57	4.59 ± 0.64	4.42 ± 0.57	4.61 ± 0.72	4.73 ± 0.49	4.70 ± 0.54	4.64 ± 0.63
Temperature of storage areas of food has a big impact on food safety (Te)	4.55 ± 0.69	4.41 ± 0.69	4.97 ± 0.19	4.68 ± 0.60	4.63 ± 0.63	4.57 ± 0.61	4.62 ± 0.71	4.76 ± 0.51	4.66 ± 0.59	4.63 ± 0.61
Serving of food has a big impact on food safety (Se)	3.62 ± 1.06	4.30 ± 0.82	4.21 ± 0.95	4.05 ± 1.05	4.04 ± 0.94	3.76 ± 1.23	4.10 ± 0.99	3.98 ± 0.95	4.06 ± 0.88	4.34 ± 0.84
The days between the purchase and preparation of the food has a big impact on food safety (Da)	4.43 ± 0.77	4.40 ± 0.81	4.93 ± 0.26	4.59 ± 0.73	4.59 ± 0.68	4.51 ± 0.71	4.52 ± 0.76	4.67 ± 0.67	4.57 ± 0.71	4.69 ± 0.61

The calculated values present the mean value ± standard deviation (five-point Likert scale: 1 = "strongly disagree", 3 = "no opinion", 5 = "strongly agree").



**Fig. 1.** Principal component analysis loadings plot for ten parameters influencing perception of food safety in restaurants in three European cities. No Rotation method. The two extracted components explain > 50% of total variance. All restaurant employees should go through food safety training before begin allowed to open (Em); Inspections should be more frequent (In); The cleanliness of the kitchen has a big impact on food safety (Hy); Cooking and preparing of food has a big impact on food safety (Co); Quality of food (freshness, ingredients, etc.) has a big impact on food safety (Qu); State approval/inspection has a big impact on food safety (Ap); Storage of food has a big impact on food safety (St); Temperature of storage areas of food has a big impact on food safety (Te); Serving of food has a big impact on food safety (Se); The days between the purchase and preparation of the food has a big impact on food safety (Da).

compliance of food establishment with subsequent reduction in risk factors that might lead to the foodborne diseases is more than desirable.

The results also show high level of awareness on food safety by consumers confirming previous studies that highlighted foodservice hygiene as one of the top considerations when consumers select a dining place (Barber, Goodman, & Goh, 2011; Ungku Fatimah, Boo, Sambasivan, & Salleh, 2011).

## 5. Conclusion

The hygiene rating system could encourage food businesses to improve the level of awareness of food handlers on food safety and hygiene and to fully implement a documented HACCP based food safety system. This system should improve consumer confidence, but also consumers should have easily assessable information about hygiene inspection. Nevertheless, this rating system will be fully successful only after public is aware of them and the same criteria should be used in all countries.

Limitations of the research stem from the use of a convenience sample. People interpret numbers and scales differently, but for data analysis, it was assumed that respondents have the same understanding of numbers and scales as the researchers. Since the data were collected in three cities, the current result should not be generalized. Given the great cultural and other differences within the three cities, more research is necessary to determine if similar results would be derived across various other continental and Mediterranean European cities. This study did not attempt to specify hypothesis regarding food hygiene profile of an average European food establishment.

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