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## Food safety and hygiene knowledge of professional food handlers employed in university canteens: a questionnaire-based survey in Thessaloniki, Greece

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**ABSTRACT:** The burden of foodborne illnesses is an important public health issue even in modern societies with upgraded food safety systems. The role of food handlers in the safety of food at the time of consumption is critical, with elevated implications in the case of professionals in food service settings, for whom the lack of food safety knowledge has been recognised as a major barrier to following safe food-handling practices. This study assessed the self-reported food safety and hygiene knowledge of professional food handlers employed in university canteens operating in Thessaloniki, Greece, with the objective of providing novel insights into the level of corresponding awareness and knowledge gaps. In total, 26 food handlers employed in 15 university canteens voluntarily completed a self-administered, anonymous questionnaire containing 15 multiple-choice questions on topics relevant to food hygiene and foodborne pathogens. The obtained average knowledge score was 72.6%. Most respondents correctly replied to the general hygiene questions relevant to the presence of microorganisms on kitchen surfaces and utensils (69 – 100%) but only a marginal majority (54%) accurately recognised bleach sanitizer as a potential chemical hazard, for which a statistically significant correlation ( $P$ -value = 0.033) with previous food hygiene training was detected. Regarding the temperature-related hygiene questions, less than two-thirds of the respondents were aware of the maximum allowed operating temperature of refrigerators in terms of food safety and the actual effect of freezing on harmful bacteria in food. With the exception of *Salmonella* (92%), only around one third of food handlers (27 – 35%) accurately recognised the most common food vehicles of foodborne bacterial pathogens of high public health relevance, such as *Campylobacter*, *Listeria monocytogenes*, and *Staphylococcus aureus*. The results of this study provide insights into the level of food safety and hygiene awareness among Greek professional food handlers in university canteens and highlight relevant knowledge gaps, which call for targeted training initiatives tailored to actual needs.

**Keyword:** Food safety knowledge; Food handlers; Questionnaire-based survey; Canteens

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## INTRODUCTION

Despite modern regulatory and legislative regimes for food safety and hygiene, foodborne illnesses remain a significant public health burden in the European Union (EU) and worldwide. In recent years, strong-evidence foodborne outbreaks attributed to contaminated food prepared and served in facilities in the EU food services sector have been increasing (EFSA and ECDC, 2023, 2024). This fact highlights the critical role of food handlers in food safety at the time of consumption or the *plate* stage of the food chain continuum (Levy et al., 2022; Smigic et al., 2016; Soares et al., 2013). Improper time/temperature control during thermal treatment or refrigeration storage and cross-contamination have been reported as implicated food-handling malpractices in foodborne outbreaks due to inadequately eliminating or even introducing foodborne pathogens, such as *Campylobacter*, *Salmonella*, *Listeria monocytogenes*, and *Staphylococcus aureus*, in foods at the consumption point of the food chain (Bolocan et al., 2015; EFSA and ECDC, 2023, 2024; Tang et al., 2011; Todd et al., 2007).

According to legislative requirements pertinent to food safety and hygiene, food business operators (FBOs) in the EU should adhere to the HACCP principles and good hygiene practices (GHP) and ensure awareness of food safety hazards and of the importance of food safety and hygiene by all employees mostly via appropriate training commensurate with their work activity and ongoing supervision (EC, 2004). Compliance with any national law requirements concerning training programmes for people employed in certain food sectors is also foreseen among EU member states (EC, 2004). For example, in Greece, the ministerial order No. 14708/2007 defines the terms and conditions for the preparation and approval of compulsory training programmes for the staff of food businesses, under the responsibility of the Hellenic Food Authority. Within this framework, all professional food handlers undergo officially approved HACCP-based training, commonly before or at the beginning of commencing their first work position in the Greek catering industry.

Available data indicate that three key factors affect the occurrence of foodborne illnesses with respect to food handlers: knowledge, attitude, and practices (KAP) (Zanin et al., 2017). The KAP model suggests that knowledgeable food handlers are able to improve their food-handling practices voluntarily, and, thus, training is widely used to improve food

hygiene practices, though other factors such as age, education or work experience may also affect the level of food safety performance (Arendt et al., 2014; Medeiros, 2011; Osaili et al., 2018; Panchal et al., 2013; Pichler et al., 2014; Smigic et al., 2016). Recently published systematic reviews and meta-analyses have provided strong evidence for the effect of education interventions in improving food handlers' KAP and decreasing microbial proliferation in the food preparation environment. However, even food handlers demonstrating an awareness of food safety, generally fail to translate that knowledge into safe practices probably due to optimistic bias (de Sousa Carvalho Rossi et al., 2017; Levy et al., 2022; Soares et al., 2013; Young et al., 2019). During the last decade, studies assessing food safety and hygiene awareness among professional food handlers in various food service settings have highlighted knowledge gaps relevant to time and temperature control, hygiene practices, and microbial food contamination (Smigic et al., 2016; Jevšnik et al., 2023), with only a couple of these conducted in university canteens, none of which being located in a European country (Osaili et al., 2018; Siddiky et al., 2024; Webb & Morancie, 2015). However, deviations from GHP and improper food preparation, storage and handling in university canteens and restaurants entail a risk of causing foodborne outbreaks affecting a substantial number of consumers (students; teaching, administrative and technical staff) within a short period (Osaili et al., 2018).

Based on the above, this questionnaire-based study aimed to investigate the self-reported food safety and hygiene knowledge of professional food handlers employed in Greek university canteens to provide novel insights on the level of awareness and knowledge gaps on relevant topics, which could be utilised in the design of targeted future educational and training activities tailored to genuine needs.

## MATERIALS AND METHODS

### Study population

The questionnaire-based survey was conducted during the first quarter of 2024 in university canteens in Thessaloniki, Greece. At a preliminary phase, the objectives and type of the study (on-site collection of data relevant to food-safety/hygiene knowledge topics via an anonymous questionnaire for food handlers) with special emphasis on its voluntary basis were personally communicated to all corresponding FBOs ( $n = 18$ ) in order to provide their informed

consent, which was finally obtained by most of them ( $n = 15$ ) under the condition that the survey tool should be as brief as possible so as not to disrupt the normal flow of operations during working hours.

The target population of the questionnaire-based survey included any food handler employed in a university canteen in the region of Thessaloniki who was on duty during the on-site visit for the physical distribution of the questionnaires, and who volunteered to answer questions relevant to food safety and hygiene anonymously, and provided informed consent for the utilisation of the obtained responses for scientific purposes. The job description for participants included preparing and serving both cold- and hot-served ready-to-eat (RTE) fast foods (e.g., pie crusts, pizzas, sandwiches), coffee and beverages (e.g., fresh juices, tea), cleaning and sanitation tasks, and temperature control. Five (5) of the visited canteens (33%) were operated by a single employee, who, in all cases, volunteered to participate anonymously in the survey. All employees working in 11 out of the 15 visited canteens were available to voluntarily complete the questionnaire at the time of the corresponding visits whereas in the remaining four (4), one or two employees per canteen were unable to participate due to heavy customer service workload at the time of questionnaire distribution. Consequently, at least one completed questionnaire was obtained from each participating university canteen, resulting in a total of 26 being subjected to data analysis.

### Survey tool

A structured questionnaire with multiple-choice questions was developed to survey the self-reported knowledge on food safety and hygiene of professional food handlers employed in university canteens. Questions available from published and validated survey tools, relevant to food hygiene topics for which knowledge gaps have been previously reported, and awareness of priority foodborne pathogens in the EU (EFSA and ECDC, 2023, 2024) were utilized (Alkandari et al., 2019; Barjaktarović-Labović et al., 2018; Kennedy et al., 2005; Lazou et al., 2012; Panchal et al., 2013) to design a brief and comprehensible questionnaire with multiple-choice questions that participants could complete in less than 10 minutes. In the case of selected open-ended questions from literature, they were appropriately modified to a multiple-choice format.

The final questionnaire consisted of three distinctive parts: i) introductory note (title, survey

objectives and anonymous and voluntary nature, a statement of consent to utilize the obtained data for the declared scientific purposes); ii) demographics (age, gender, level of education, current work position and the corresponding length of employment in years, past attendance to food hygiene and safety/FHS training); and iii) the main questionnaire (15 statement-type questions with multiple-choice possible answers). The instruction "*Choose only one response which you consider most appropriate among the provided options*" was available at the top of the page of the main questionnaire, and verbally communicated during the in-person distribution. Only one answer per question was correct, and the "*I don't know*" option was always available to minimize the possibility of randomly replying correctly. Though questions were presented as a single list in the questionnaire without evident thematic sections, their content was relevant to general food hygiene ( $n = 5$ ), temperature-related food hygiene ( $n = 6$ ), and food-borne pathogens ( $n = 4$ ). The in-person distribution of the questionnaires allowed for direct clarifications on the questions' wording. It served as a surrogate of a pilot study, which had to be omitted since it would exclude the responses of the respective participants (and the canteens with single-employee operation) from the analysis, thus, generating an even smaller study population than 26 people with subsequent implications on the statistical analysis.

### Statistical analysis

The responses to the food safety and hygiene questions were considered dependent variables. The knowledge score was calculated for each respondent by dividing the sum of obtained correct responses by the total number of questions surveyed (Smigic et al., 2016).

The IBM SPSS® version 23 software (IBM Corp., Armonk, NY, USA) was used for the statistical analyses. Primary data included the binary responses (correct or incorrect) separately for each of the 15 questions, a numerical variable derived from summing up the correct responses to the questions (total score), and the socio-demographic characteristics (age, gender, level of education, current work position, length of employment in years, past attendance to FHS training). Associations between attendance at FHS training and responses to each question were estimated using the Fisher's exact chi-squared test and Phi coefficient separately for each question. Analysis of variance was used to compare the mean number of correct responses across participants ac-

cording to their socio-demographic characteristics. The Mann-Whitney test was utilised to compare the mean number of correct answers between participants who attended or did not attend FHS training in the past. Statistical significance was set at the 0.05 level.

## RESULTS AND DISCUSSION

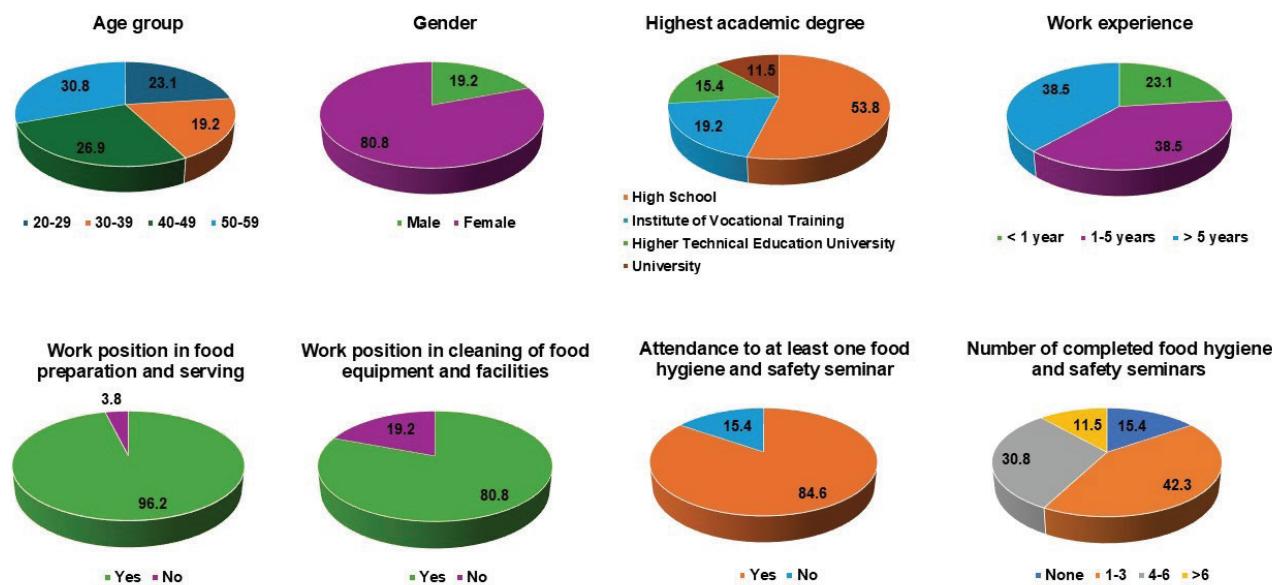
### Socio-demographic characteristics of food handlers

The socio-demographic characteristics of the food handlers employed in the university canteens who voluntarily participated in the questionnaire-based survey are presented in Fig. 1. The average age of the food handlers was 40 years, with the youngest and oldest being 20 and 59 years old, respectively. Most of the respondents were women ( $\approx 81\%$ ), and reported high school (12 years in Greece) as their highest academic education ( $\approx 54\%$ ), previous attendance to at least one food safety and hygiene seminar ( $\approx 85\%$ ), and more than one year employment duration in both fields of food preparation/serving ( $\approx 96\%$ ) and cleaning of food equipment and facilities ( $\approx 81\%$ ). Similar figures regarding average age, educational status, and food safety training have been previously reported among food handlers working in restaurants, take-away, and catering establishments in a study conducted in three European countries, including Greece (Smigic et al., 2016). Such findings could be explained in the context of the EU legisla-

tive framework since GHP, HACCP, and food hygiene and safety training are legislative requirements (EC, 2004). Recent surveys among food handlers employed in institution-based foodservice establishments, including universities (Osaili et al., 2018; Siddiky et al., 2024), have reported, similarly, high school as the most common level of education, but lower percentages of food safety training ( $\leq 38\%$ ) compared to the present study.

### Overall knowledge score

The overall knowledge score of the food handlers who participated in the questionnaire-based survey was 72.6%. No statistically significant effects of the tested socio-demographic characteristics on the obtained knowledge score were determined. However, a 26-year-old food handler with vocational training education who had not yet attended any FHS seminar/training course scored the lowest knowledge score in this study. Similar findings have been previously reported among professionals in foodservice settings, including university canteens, as regards the youngest respondents achieving the lowest knowledge score and no observation of a significant impact of education level, length of employment, and previous participation in food safety training on knowledge score (Smigic et al., 2016; Webb & Morancie, 2015). Conversely, significant associations ( $P$ -value  $< 0.05$ ) have been observed between food safety knowledge scores obtained by food service profes-



**Figure 1.** Socio-demographic characteristics (% percentages) of food handlers ( $n = 26$ ) who participated in the questionnaire-based survey.

sionals and their socio-demographic characteristics such as age, gender, education, monthly salary, work position, experience, training, and/or establishment type and management (Al-Kandari, et al., 2015; Je-všnik et al., 2023; Osaili et al., 2018). The aforementioned discrepancies could be partly attributed to differences in study designs and population sizes across studies.

### General food hygiene knowledge

Most respondents correctly replied to the general food hygiene questions (Table 1). All of them (100%) were aware that kitchen cloths may carry germs, but almost 30% did not state the same for dish sponges ("Disagree" or "I don't know"). The common presence of residual detergent in the dish sponges was probably considered by some respondents to have a bactericidal effect. However, the survival and growth of bacteriota in dish sponges, including pathogens, has been previously reported (Møretrø et al., 2021a, b). In another study, the percentage of food handlers occupied in various food services (restaurants, bakeries, pastry shops) who reported that dishcloths can be a source of cross-contamination was approximately 22% prior to and 88% after a FHS training intervention (Barjaktarović-Labović et al., 2018). More than 92% of respondents were aware that

disposable gloves can become contaminated with microorganisms if they come into contact with food trays or door handles. The only two persons who disagreed had not received any FHS training in the past, and their disagreement could indicate a totally distorted impression that single-use gloves are and/or remain *germ-free* during the food service operations, thus increasing the risk of cross-contaminating RTE food. Likewise, more than 96% of respondents accurately acknowledged that kitchen sinks may harbour microbial pathogens, in line with available scientific data (Lim et al., 2017; Møretrø et al., 2021).

Enrolment in FHS training in the past was statistically significantly correlated ( $P$ -value = 0.033; Phi coefficient = 0.461) with accurately disagreeing ( $\approx$  54%) with the statement that the use of bleach for surface sanitation reduces the risk of food and food tray contamination. Residues of detergents and sanitizers on food-contact surfaces are common chemical hazards arising from poor cleaning and sanitation practices, a fact that is typically highlighted during FHS training courses. The bactericidal effect of bleach, which reduces microbial risk and is widely used in domestic settings, may have overshadowed its chemical hazard aspect, thus biased some parti-

**Table 1.** Responses (n = 26) to general food hygiene questions.

Questions	Multiple-choice responses *	Count	%
Kitchen cloths may carry microorganisms.	<b>Agree</b>	<b>26</b>	<b>100.0%</b>
	Disagree	0	0.0%
	I don't know	0	0.0%
Dish sponges do not carry microorganisms.	Agree	4	15.4%
	<b>Disagree</b>	<b>18</b>	<b>69.2%</b>
	I don't know	4	15.4%
Disposable gloves can be contaminated with microorganisms if I touch food trays or door handles.	<b>Agree</b>	<b>24</b>	<b>92.3%</b>
	Disagree	2	7.7%
	I don't know	0	0.0%
The use of bleach for surface sanitation reduces the risk of food and food trays contamination. †	Agree	9	34.6%
	<b>Disagree</b>	<b>14</b>	<b>53.8%</b>
	I don't know	3	11.5%
Kitchen sink surfaces may harbour microbial pathogens.	<b>Agree</b>	<b>25</b>	<b>96.2%</b>
	Disagree	0	0.0%
	I don't know	1	3.8%

\* Correct responses with corresponding counts and percentages appear in bold.

† Enrolment in FHS training in the past was statistically significantly correlated ( $P$ -value = 0.033) with providing the correct response.

pants to incorrectly respond to this survey question. In a relevant study by Barjaktarović-Labović et al. (2018), the vast majority of food handlers accurately agreed that improper cleaning and washing of devices increases the risk of chemical food contamination (91.4% and 97.5% prior- and post-FHS training intervention, respectively). Poor awareness of other chemical hazards originating from food contact surfaces has also been previously detected among 70.2% of foodservice workers at a university campus, who could not justify why food should not be stored in a galvanized container (Webb and Morancie, 2015).

#### Temperature-related food hygiene knowledge

As shown in Table 2, most food handlers correctly answered the temperature-related food hygiene questions. Though no statistically significant association was detected between the food handlers' characteristics and providing a correct response to

the temperature-related food hygiene questions in the present study, relevant training has been previously reported as an important factor in achieving better scores (Barjaktarović-Labović et al., 2018; Jevšnik et al., 2023).

All respondents (100%) were aware that defrosted food should not be refrozen. The vast majority ( $\approx$  96%) agreed that refrigerators' temperatures should be monitored daily. This high percentage of knowledgeable respondents could be explained by the fact that temperature settings and regular monitoring of refrigerators and freezers are common GHP implemented as a prerequisite program for the HACCP system within food safety management systems globally. Proper temperature monitoring practices have also been reported previously by 73.6% of food handlers in Kuwait, who stated to regularly check the temperature settings of chillers or freezers (Al-Kandari et al., 2015). However, fewer respondents than

**Table 2.** Responses (n = 26) to the temperature-related food hygiene questions.

Questions	Multiple-choice responses *	Count	%
Defrosted food should not be refrozen.	<b>Agree</b>	<b>26</b>	<b>100.0%</b>
	Disagree	0	0.0%
	I don't know	0	0.0%
The temperature of refrigerators should be monitored daily.	<b>Agree</b>	<b>25</b>	<b>96.2%</b>
	Disagree	0	0.0%
	I don't know	1	3.8%
	Agree	3	11.5%
Ice cubes don't contain microorganisms.	<b>Disagree</b>	<b>20</b>	<b>76.9%</b>
	I don't know	3	11.5%
	-18 °C	0	0.0%
	-4 °C	1	3.8%
Which is the maximum operating temperature of refrigerators regarding the safety of the stored food?	<b>4 °C</b>	<b>17</b>	<b>65.4%</b>
	7 °C	6	23.1%
	12 °C	0	0.0%
	I don't know	2	7.7%
	Agree	8	30.8%
Freezing eliminates harmful bacteria in food.	<b>Disagree</b>	<b>15</b>	<b>57.7%</b>
	I don't know	3	11.5%
	<b>Agree</b>	<b>20</b>	<b>76.9%</b>
Bacteria multiply quickly in food at temperatures from 5 °C to 60 °C.	Disagree	1	3.8%
	I don't know	5	19.2%

\* Correct responses with corresponding counts and percentages appear in bold.

the vast majority in this study were aware of the exact hazardous temperature range that enhances a rapid bacterial proliferation in foods ( $\approx 77\%$ ), and an even lower percentage accurately recognized the maximum allowed refrigeration temperature for food safety ( $\approx 65\%$ ). Deficiencies in understanding critical temperature ranges and safe storage practices have also been detected in previous studies. In particular, poorer knowledge compared to this study has been previously reported among domestic food handlers (71.6%) (Moreb et al., 2017) and foodservice staff of European catering businesses (Jevšnik et al., 2023; Pichler et al., 2014) regarding the optimal cooling (37.8%) and storing (63%) temperatures for foods as well as the minimum (7%) and maximum (12%) temperatures at which pathogenic microorganisms can multiply in food. Regarding foodservice workers at universities, only 21.1% correctly recognised the range of the temperature danger zone in terms of food safety in Trinidad and Tobago (Webb & Morancie, 2015), only 32.5% were knowledgeable of the proper refrigerator operating temperature in Jordan (Osaili et al., 2018), and 65.2% were unaware of the importance of basic temperature control requirements in controlling microbial growth in food in restaurants in Saudi Arabia (Al-Shabib et al., 2016).

Approximately 77% of the respondents in this study were aware that ice cubes may contain microorganisms, but a much lower percentage ( $\approx 58\%$ ) correctly reported that freezing cannot eliminate harmful bacteria in food, indicating a discrepancy in recognizing different aspects of the effect of freezing on microbes. Previously published findings suggested that knowledge scores relevant to the impact of food freezing vary among different studies. Prior to receiving FHS training, only 15.6% of food handlers in Montenegro (Barjaktarović-Labović et al., 2018) reported that food freezing eliminates the potential microbial hazards. Likewise, only 53.7% of food handlers from Greece, Serbia, and Portugal (Smigic et al., 2016), correctly acknowledged that microbial growth is ceased at freezing temperatures ( $< -18^{\circ}\text{C}$ ), but bacteria remain viable with the potential to grow after defrosting in favourable conditions whereas 21% of respondents in small food businesses in United Kingdom (Walker & Jones 2002) alleged that freezing can kill all bacteria. Regarding the responses to the microbiological status of ice in this study, similar knowledge scores (75.3%) have been reported by Zanin et al. (2015) for seafood handlers who disagreed with the statement that “*water can be a vehicle for disease transmission, but the*

*risk of disease is reduced when it turns into ice*”. These varying levels of food safety knowledge and practices related to temperature control among food handlers across different regions emphasise the importance of tailored interventions and continuous training with verified efficacy to enhance adherence to proper food safety standards and practices (Barjaktarović-Labović et al., 2018).

### Foodborne pathogens knowledge

The responses to the foodborne pathogens-related questions in this study are presented in Table 3. More than 92% of food handlers successfully recognised raw chicken meat as the most common food vehicle of *Salmonella* among the provided options. Recent studies conducted in various countries, including Greece, have reported lower average levels of knowledge among food service professionals concerning the frequent detection of *Salmonella* in raw chicken meat (85.7%) and its implication in foodborne illness cases (53.7%) (Al-Kandari, et al., 2015; Smigic et al., 2016). Among foodservice staff in universities, only 42.1% could acknowledge *Salmonella* as a foodborne pathogen and specify one of its common sources in a study conducted in Jordan (Osaili et al., 2018), and 50.9% could recognise *Salmonella* as the most common foodborne bacterium in Trinidad and Tobago among the provided options (Webb & Morancie, 2015).

Apart from *Salmonella*, the remaining foodborne pathogen-related questions in the present study exhibited the lowest percentage of correct answers (Table 3), but without, however, detecting any statistically significant impact of the food handlers' demographic characteristics on the provided replies. More specifically, only 27% of respondents knew that raw chicken is most likely associated with *Campylobacter*, and around 35% correctly identified the most common food vehicles for *Listeria* and *S. aureus*. Campylobacteriosis is the most commonly reported zoonosis and the most frequently reported foodborne illness in the EU, foodborne listeriosis causes the highest number of hospitalisations and fatal cases in the EU, and staphylococcal foodborne intoxication is commonly attributed to prepared dishes contaminated by food handlers themselves and then stored at sub-optimal temperatures (EFSA and ECDC, 2023, 2024; Erdogan & Pamuk, 2019). These findings were rather disappointing, as they indicated that almost two-thirds of the professional food handlers in this study were unaware of the most common food vehicles for high-priority food-

**Table 3.** Responses (n = 26) to the foodborne pathogens-related questions.

Questions	Multiple-choice responses *	Count	%
Where are <i>Staphylococcus aureus</i> bacteria that cause food poisoning most likely found?	Contaminated water	5	19.2%
	<b>Contaminated food left at room temperature</b>	<b>9</b>	<b>34.6%</b>
	Undercooked pork	1	3.8%
	Raw eggs	1	3.8%
	I don't know	10	38.5%
	Canned food	3	11.5%
	Raw pork	1	3.8%
With which food are <i>Campylobacter</i> bacteria most likely associated?	<b>Raw chicken meat</b>	<b>7</b>	<b>26.9%</b>
	Raw beef	1	3.8%
	Sliced cheese or sausages	0	0.0%
	I don't know	14	53.8%
	Raw pork	0	0.0%
	Fresh vegetables	0	0.0%
	Raw beef	0	0.0%
Touching which food may most likely contaminate your hands with <i>Salmonella</i> bacteria?	<b>Raw chicken meat</b>	<b>25</b>	<b>92.3%</b>
	Sliced cheese or sausages	0	0.0%
	I don't know	1	3.8%
	Home-made canned food	1	3.8%
	Raw beef	1	3.8%
	Raw chicken meat	0	0.0%
Which food is most likely associated with <i>Listeria monocytogenes</i> ?	<b>Sliced cheese or sausages</b>	<b>9</b>	<b>34.6%</b>
	Raw eggs	0	0.0%
	I don't know	15	57.7%

\* Correct responses with corresponding counts and percentages appear in bold.

borne bacterial pathogens in the EU and worldwide. Even lower levels of awareness of these foodborne pathogens and their common food sources have been previously reported by food service professionals at universities in Jordan (4.2 – 9.2%) (Osaili et al., 2018), and by Greek university students engaged in domestic food handling (5.9 – 30.9%) (Lazou et al., 2012). Though the actual impact of such knowledge gaps in the epidemiology and public health burden of high priority foodborne illnesses cannot easily be quantified (Levy et al., 2022; Smigic et al., 2016), the undoubtable key role of food handlers, both domestic and professional, in the safety of food at the consumption stage of the food chain calls for a high level of awareness of foodborne pathogens and commonly implicated foods through proper and continuous training.

Lastly, the present study exhibits certain acknowl-

edged limitations. First, the total number of existing canteens in the public universities of Thessaloniki is relatively low; thus, the obtained results cannot be extrapolated to other university canteens and the corresponding foodservice staff working in Greece. Moreover, the responses to the survey questions should be evaluated within the used wording and questionnaire design (multiple-choice questions with only one correct answer), which should be further optimised in similar future surveys to eliminate any potential biased shifts towards providing incorrect responses, to allow more robust control of confounding, and to obtain data on explanatory variables and potential statistically significant correlations. For example, the bleach-related question was the only one relevant to potential chemical hazards, and the absence of any reference to chemical contamination or chemical hazard aspects in its wording may have

biased a shift towards incorrect responses. Therefore, an acknowledged limitation of this study is that respondents' overall knowledge of chemical hazards could not be objectively evaluated.

## CONCLUSIONS

In conclusion, the findings of the present study provide novel insights into the level of food safety and hygiene knowledge among professional food handlers employed in Greek university canteens, relevant knowledge gaps, and comparisons with previous similar studies. These results could collectively be utilized as a foundation for targeted food safety training and hygiene practice interventions based on tangible needs. Topics of priority, as indicated by their associated lowest level of knowledge obtained in both the present and previous studies, are the effect of various temperature/time combinations on microbial populations in foods, the source attribution of the most common and potentially fatal foodborne

illnesses, and the potential role of commonly used detergents and sanitizers as chemical food safety hazards.

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## CONFLICT OF INTEREST

The author declares no conflict of interest.

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