

Ensuring Safe Food Preparation among Slovenian Consumers

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Abstract

Introduction: According to EFSA, most foodborne diseases still develop at home. Consumers have insufficient knowledge of food safety and fail to transfer it properly into daily practice. The purpose of the research is to identify consumers' food safety knowledge and attitudes, their handling of selected foods and the hygiene in the kitchen. *Methods:* The mixed method approach was used. The knowledge of 380 consumers was examined with a survey questionnaire. In the second part of the study we observed 16 consumers during their preparation of specific foods, using an observation checklist. Eight consumers were older than 65, while eight were younger than 35 with small children. The hygiene conditions in the consumers' kitchens were examined using contact agar plates for determination of the number of different groups of microorganisms, while the cleaning adequacy was determined by measuring the ATP bioluminescence. *Results:* A lack of knowledge on certain topics regarding food safety was established; the consumers aged 36 to 55 and women demonstrated the highest level of knowledge. In some cases, the consumers who were being observed did not take proper action when preparing the food and therefore increased the risk of the cross-contamination of foods, food contact surfaces and kitchen utensils. Most consumers believe that they prepare foods according to food safety requirements. The increased number of total bacterial count, coliform bacteria and the *Escherichia coli* bacteria was detected in only 12.75% of consumers' kitchens observed. The results of ATP measurements showed that more than half of the samples of surfaces were not cleaned satisfactorily. *Discussion and conclusions:* Greatest emphasis has to be put on the cleaning of home kitchens. Even though consumers have some knowledge on food safety (e.g. preventing cross-contamination, storing leftovers, using separate kitchen towels), they often fail to put that knowledge into practice. Consumers should pay more attention to personal hygiene, especially to washing their hands more often and more thoroughly.

They should clean surfaces for food preparation, utensils, cutlery and dishes in their kitchens more thoroughly and promptly. They should pay more attention to preventing cross-contamination from surfaces that come into contact with food.

Keywords: Consumers, Food safety, Hygiene, Knowledge

Introduction

An integrated approach is essential for food safety, as it takes into account the fact that food supply is linked to the food supply chain from farm to fork. Consumers also play an important role in ensuring food safety, as they represent the final link in this food supply chain (Jevšnik et al., 2008). Among all reported cases of foodborne infections and poisonings in the European Union, the European Food Safety Authority (EFSA, 2018) in its annual report highlighted inadequate heat treatment of food as the main known cause of disease in households. The second most common cause was an inadequate food storage temperature. As an important cause of infections and food poisoning, they also pointed out food hygiene, which includes cleaning, washing and handling of food during its preparation.

Many consumers are unaware of the fact that also their home environment poses a risk of foodborne disease outbreaks (Byrd-Brebner et al., 2013). Research findings show that consumers most often associate foodborne disease with the catering industry or food establishments (Jevšnik et al., 2013). Most of the food is prepared by consumers at home (Byrd-Brebner et al., 2013), so knowledge about food preparation in their home kitchen is all the more important, as it reduces the likelihood of foodborne diseases (Meysenburg et al., 2014). Proper consumer behaviour in food preparation is, in addition to the knowledge of food hygiene, a key element in ensuring consumer safety (Ovca et al., 2014; Jevšnik et al., 2013; Kendall et al., 2013). The lack of knowledge and mishandling of food during preparation is more common in consumer groups of young adults (18 to 29 years), men, and people older than 60 years (Jevšnik et al., 2008; Leal et al., 2017). In studies that gathered data through questionnaires and by observing consumers during food preparation, it was observed that many consumers correctly answered questions about food safety and good hygiene practice. However, the results of observing consumers during food preparation show that they often act contrary to what they state in the questionnaires (Tomaszewska et al., 2017; Mazengia et al., 2015; Sampers et al., 2012; Clayton & Griffith, 2004), the chances of foodborne infections are thus much higher than shown in epidemiological data (Lange et al., 2016; Byrd-Brebner et al., 2013; Kendall et al., 2013). Irregularities in food handling at home are related to improper hand washing, improper separation of equipment and utensils, inadequate food storage, cross-contamination and insufficient heat treatment of food (Odeyemi et al., 2019; Gong et al., 2016; Burke et al., 2016; Bearth et al., 2014; Ergonul, 2013; Jevšnik et al., 2008). The purpose of our research was

to determine the knowledge of consumers about providing safe food, their behaviour during the preparation of selected foods and the hygienic conditions in home kitchens. Due to the scope of the research, the paper presents only the results of a questionnaire on consumer knowledge of food safety.

Methods

Consumer surveys on ensuring safe food preparation

To test consumers' knowledge of food safety, we used a validated questionnaire, mostly based on a questionnaire from the Food and Drug Administration (2010). Additional questions were added in order to compare the data with the previous Slovenian survey on consumer knowledge of food safety from 2008 (Jevšnik et al., 2008).

The questionnaire was entered into the 1KA online survey application and a web link to the survey questionnaire was sent to consumers via e-mail and social networks. A t-test for independent samples with the significance level of $p < 0,05$ was used for the statistical analysis of the obtained data.

Results

Due to the scope of the research, the paper presents only the results regarding consumer knowledge in the field of food safety. The online survey was started in November 2018 and completed in April 2019. Only relevant units that were fully ($n = 260$) or partially completed ($n = 80$), a total of 340 survey, were used for the analysis of the questionnaire. The largest number of respondents who completed the questionnaire was from the first age group ($n=171$, 50%), followed by respondents from the second age group ($n = 107$, 31 %) and from the third age group ($n=62$, 19 %) (Table 1).

Demographic data

Table 1 shows the demographic data of the surveyed consumers, i.e. age groups, level of education and gender.

Table 1. Demographic data of surveyed consumers ($n = 340$)

<i>Survey questionnaire</i>		
	<i>n</i>	<i>%</i>
<i>Age groups</i>		
1st age group (18 to 35 years)	171	50
2nd age group (36 to 55 years)	107	31
3rd age group (over 56 years)	62	19
<i>Level of education</i>		
Primary, secondary and higher education	185	55
University education, master's degree, doctorate	155	45
<i>Gender</i>		
Men	63	19
Women	277	81

Results of the questionnaire

Important results of the questionnaire are presented separately according to content areas.

We begin by establishing that more than half of the respondents (65 %) believe that foodborne diseases are rare in domestic households. 62 % of respondents believe that people more often get infected and/or poisoned by food consumed in restaurants.

Washing hands

The questionnaire found that 60 % of consumers always wash their hands before preparing food, while the rest almost always (31 %) or sometimes (9 %) wash their hands. Statistically significant differences in hand washing were found between the age groups of respondents, as half of consumers from the 1st age group and almost two thirds from the 2nd and 3rd age groups always wash their hands ($p = 0.024$, $r = -0.111$) (Figure 1).

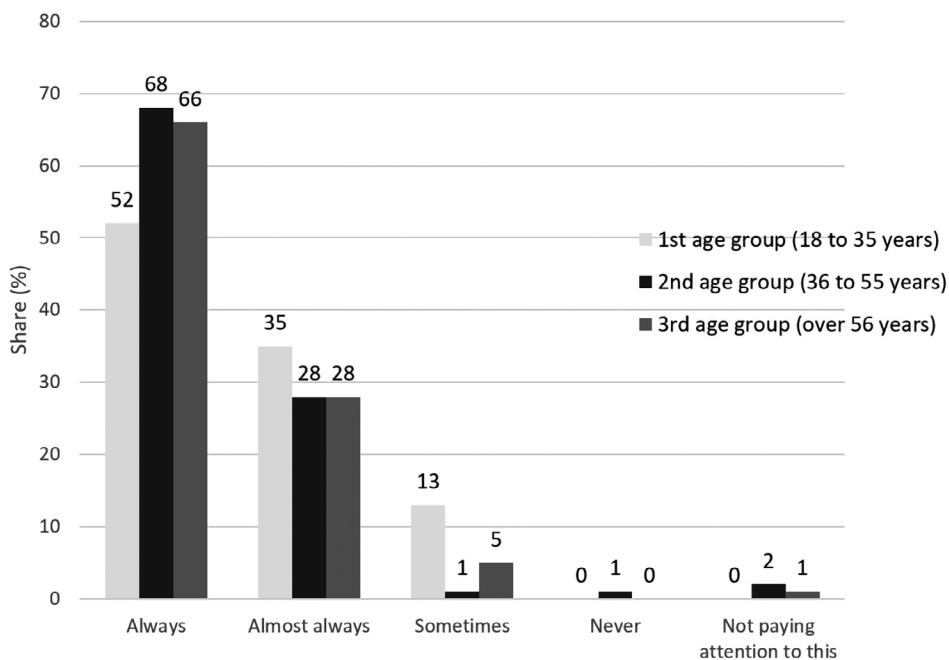


Figure 1: Shares (%) of respondents' answers regarding hand washing before food preparation by age groups ($n = 290$).

Among the 290 respondents, 26 % wash their hands for 10 seconds or less, 46 % for 11 to 20 seconds, 10 % for 20 seconds or more, while the others pay no attention to the washing time. Significantly, more men (43 %) than women (23 %) wash their hands for only 10 seconds or less, while a higher proportion of women (20 %) than men (6 %) do not pay attention to the time of wash-

ing hands. It is statistically proven that women wash their hands longer than men ($p = 0.008$).

After washing their hands, 37 % of the respondents use a kitchen towel to wipe their hands, followed by those who use paper towels (26 %) and those who use a kitchen towel that is also used to dry the dishes (22 %). Statistically significant differences were observed between age groups ($p = 0.042$, $r = 0.125$) and levels of education ($p = 0.006$, $r = 0.107$). Improper wiping of hands with a kitchen towel that is used for the dishes is the most common with consumers from the 1st age group (29%) and those with a university degree, master's degree or doctorate (27 %). Paper towels are most often used by consumers from the 3rd age group (34 %) and those with completed primary, secondary or higher education.

Washing food cutting board after use

Half of consumers in the 2nd age group (51 %) use a second vegetable cutting board after cutting red meat or poultry. A second cutting board is used by 44 % of respondents in the 1st age group and only 33 % of respondents in the 3rd age group of over 56 year olds ($p = 0.027$, $r = -0.103$). After use, 44 % of the respondents wash the board with detergent and warm water (38% of all women and 27% of men surveyed), and 17 % of respondents wash it only with water, more men (29 %) than women (11%) ($p < 0.001$, $r = -0.220$) and most of the consumers from the 3rd age group (23 %).

Knowledge of appropriate temperatures

About a third (30 %) of surveyed consumers have a thermometer in their home refrigerator to measure its temperature. 51 % of the respondents do not know the temperatures in their refrigerators. Among those who state that they have a thermometer, just over a half of them (54 %) know the temperatures. As many as 40 % of the respondents never check the temperature, or they only check it when the food is too warm or too cold to the touch (32 %), the rest check the temperature daily, once a month or weekly (28 %). The respondents were asked to indicate the temperature in their home refrigerator. The mean value of the temperatures reported was 5.4 °C, the highest 18°C and lowest -20°C. Most consumers (31 %) stated that the temperature was 5 °C. Respondents clean refrigerators as needed (68 %), every month (22 %) or once a week (9 %).

Knowledge of microorganisms found in home kitchens

The best knowledge of microorganisms was found in younger consumers from the 1st age group, and the least in respondents from the 3rd age group. The bacteria *Yersinia enterocolitica* (79 %), *Bacillus cereus* (75 %) and *Clostridium perfringens* (71 %), are the least known, while *Salmonella* (96 %), *Escherichia coli* O157 (56 %) and *Staphylococcus aureus* (40 %) are the best known. Consumers

with a university degree or more are best acquainted with the selected microorganisms.

Food thawing

Frozen meat is properly thawed by 52 % of respondents (34 % in the refrigerator, 11 % under running cold water and 7 % in the microwave oven). 42 % of respondents defrost meat on the kitchen counter, while 6 % of respondents never defrost frozen meat.

Food handling after heat treatment

50 % of respondents leave the prepared dish at room temperature for less than two hours to cool down, 28 % of them for more than two hours and 21 % pay no attention to it. The majority of consumers surveyed (88 %) handle roasted meat correctly, as after heat treatment they do not put it in the container in which the raw meat was stored.

Discussion

The aim of the research was to determine the knowledge of consumers about ensuring food safety. It was assumed that consumers with a higher level of education would have more knowledge in the field of food safety, but this cannot be fully confirmed, as it was found that there are only certain areas where consumers with a higher level of education (university education and more) show better knowledge than those with a lower level of education (primary, secondary or higher school). These areas are: knowledge of microorganisms that can cause food contamination, wiping hands after washing, and food defrosting procedures. The Food Safety Survey by the Food and Drug Administration (2010) found that food is handled the least safely by the youngest American consumers, by the oldest and by those with the highest level of education.

Proper hand washing before and during food preparation is done more consistently by female consumers than by male ones, as 62 % of women and 51 % of men always wash their hands before preparing food. If we compare the results with a previous study among Slovenian consumers conducted by Jevšnik and co-workers (2008), we see that the majority of consumers (86 %) always wash their hands before preparing food. Our present research came to poorer results, as only 60 % of all respondents always wash their hands before preparing food. In the study by Jevšnik et al. (2008), it was found that more than half of consumers wash their hands for less than 10 seconds, which is almost half more than in this recent study, where about a quarter report hand washing time of less than 10 seconds. 67 % of respondents wash their hands with soap and warm water after handling raw red meat, chicken or fish, which is more than in the study by Jevšnik et al., where that share was 57 %.

In our recent study, it was found that 30 % of the respondents have a thermometer in their home refrigerator to check the temperature. Better results are

shown in a survey of American consumers, where 42 % of respondents have a thermometer in the refrigerator, with an average temperature of 3.6 °C (Food and Drug Administration, 2010). The average temperature stated by the surveyed consumers in our study is slightly higher and amounts to 5.4 °C. Half of the respondents stated that they are not familiar with the temperatures in home refrigerators. 40 % of the respondents never check the temperature, followed by those who check the temperature when the food is too hot or too cold to the touch.

The questionnaire results show that slightly less than half of the respondents defrost food at room temperature, while the rest carry out the procedure correctly, in the refrigerator, under running cold water or in the microwave oven. Lower results were reported by Sterniša et al. (2018) and Jevšnik et al. (2008), where almost three quarters (73 %) or half (50 %) of respondents thawed frozen meat at room temperature. Studies from abroad found that meat is thawed at room temperature by 44 % of Nigerian consumers (Adebowale et al., 2017), 47 % of African and Asian consumers (Odeyemi et al., 2019) and 73 % of consulted Belgian consumers (Stratev et al., 2017), as well as more than half of Turkish consumers (Ergonul, 2013).

The best knowledge of microorganisms that can cause foodborne diseases is shown in consumers younger than 35 years, which can be attributed to the fact that they have greater access to information than older consumers. In general, the knowledge of pathogenic microorganisms is poor. More than half of the surveyed consumers know only two types of bacteria, namely *Salmonella* and *Escherichia coli* O157, which is more than noted by Gong et al. (2016), as more than half of Chinese consumers have never heard of these bacteria.

Conclusion

The study provided insight into consumer knowledge about how to ensure food safety when working with food at home. Deficiencies were found in the consumers' knowledge regarding food defrosting procedures, food hygiene, knowledge about pathogenic microorganisms in food, the use of thermometers in refrigerators and checking the core temperature of food during heat treatment. The highest level of knowledge was shown by consumers aged 36 to 55, in particular female showed better performance. Respondents are largely convinced that foodborne infections occur primarily in restaurants, not at home. Statistics by the European Food Safety Authority show just the opposite. The largest share of infections occur at the end of the chain, on the consumers' side. It is therefore necessary to raise the awareness in all age groups of consumers and provide systemic education of children and adolescents about ensuring food safety during the purchase and in handling food at home.

Only in this way will young consumers become responsible and aware of the fact that they are the last link in the food safety chain, obliged to handle food safely and in accordance with producers' requirements.

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