

## BARRIERS TO THE IMPLEMENTATION AND MAINTENANCE OF THE HACCP SYSTEM IN THE CATERING SECTOR

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### Abstract

The proactive food safety system HACCP is recognized as a leading public health instrument that ensures high standards of hygiene and safety in the entire food chain, however, its application and maintenance by food business operators (FBOs) often encounter difficulties and barriers to its successful functioning in practice. This study aimed to determine the limitations and barriers to the effective implementation and maintenance of the food safety system - HACCP in the catering sector in the area of the city of Sarajevo.

The research was conducted as a descriptive-analytical, cross-sectional study that included 33 FBOs/ "restaurants" with and without the HACCP system, 197 food handlers and 33 managers in the selected FBOs. The "snowball sampling method" was used as a method to select FBOs. Anonymous survey questionnaires and a checklist were used as research instruments. Descriptive and analytical statistical methods were used with the application of statistical significance tests: Chi-squared test, Mann-Whitney U test, and Fisher's exact test. The value  $\alpha < 0.05$  was used for the limit of statistical significance.

Food handlers employed in FBOs operating according to HACCP principles had statistically significantly better knowledge ( $Z = -7.797$ ;  $p = 0.0001$ ) compared to food handlers employed in FBOs without HACCP. Managers' non-affirmative attitudes towards HACCP have been identified as one of the barriers to successful risk management. As many as 57.3% of food handlers and 40% of managers of FBOs without an implemented HACCP system consider the HACCP system exclusively as an administrative-technical measure of inspection bodies. The sanitary-technical and hygienic conditions of FBOs without HACCP were evaluated as very poor.

As many as 80% of FBOs without a HACCP system had non-compliant prerequisite programs.

The specifics of the catering sector require strict fulfilment of prerequisite programs, motivation and devotion of employees as well as management commitment and investment in human resources.

**Key words:** HACCP, Food safety, Restaurants, Barriers.

### 1. Introduction

Food is any substance or product, processed, partially processed, or unprocessed, that is intended for consumption or expected to be consumed by humans [1]. Food safety involves ensuring that food prepared and consumed in the correct manner will not harm human health and well-being [2]. However, ensuring an adequate supply of safe and high-quality food in a highly globalized world presents increasingly difficult and often underappreciated challenges for governments, commercial organizations, and individuals [3]. Food safety is receiving increasing attention due to current natural and social phenomena that are changing both the nature and frequency of food safety risks [4]. Foodborne illnesses represent a growing public health problem, resulting from the ingestion of food contaminated with microbiological, chemical, physical agents, allergens, and are considered an important cause of morbidity and mortality worldwide [5, 6].

Risks associated with food safety are closely linked to human behavior patterns. Urban lifestyles, preoccupation with work activities, and lack of time have resulted in a trend of increased consumption of

food outside of households. These behavioral changes have contributed to the growing role of food service establishments in social life, models of people's dietary habits, and certainly to a higher prevalence of diseases associated with the consumption of unsafe food [7]. According to a report from the USA Centers for Disease Control and Prevention (CDC), in 2017, there were 841 reported cases of foodborne illnesses in the United States, with food prepared in food service establishments being the cause of individual outbreaks in 64% of the cases. Furthermore, 48% of the outbreak cases were associated with restaurants [8]. The hospitality sector, especially restaurants, raises public health concerns as foodborne outbreaks and sporadic cases of illnesses are most commonly linked to them [9]. Food service establishments are a crucial endpoint in the "farm to table" chain since various types of food are directly prepared and served for almost all population groups, among which individuals belonging to vulnerable population groups are particularly significant in terms of disease risk [10]. Problems related to the occurrence of diseases caused by the consumption of contaminated food are mostly identified only after they occur, and the public health sector often deals with the consequences rather than taking proactive action to identify and prevent the root causes of the problem.

In order to reduce the risk of food contamination and prevent the occurrence of foodborne illnesses, a regulatory framework has been established at the international level based on the principles of precaution and proactive action - the Hazard Analysis Critical Control Point (HACCP) system [11]. HACCP, as a food safety system, has become a key component of international and national government policies and international strategies aimed at ensuring safe food handling by Food Business Operators (FBOs) [12]. Practical experiences and reviews of professional and scientific literature on food safety and hygiene confirm that the effectiveness of the implementation process, and more importantly, the maintenance of the HACCP food safety system, is directly dependent on a complex combination of organizational, administrative-technical, and managerial components [13]. There is a wide range of risk factors closely associated with the hospitality sector, which are recognized as key barriers and challenges to the successful implementation and maintenance of the HACCP system in practice.

Effective implementation and maintenance of the HACCP system require the establishment of prerequisite programs (PRP), which involve ensuring adequate sanitary-technical and hygiene conditions within the premises, including the necessary infrastructure for food handling. In addition to material resources, human resources play a crucial

role, including the knowledge, practices, and attitudes of employees and facility managers regarding food safety, hygiene, and the importance of the HACCP system [14,15]. Negative attitudes of human resources and their perception of the HACCP system as a burden or obligation, implemented solely to meet the requirements of regulatory bodies in the field of food safety, result in limited chances for the system to become functional, and there is a high probability that it will be seen as a burden within the business system [16]. The constant turnover of the workforce, which characterizes the hospitality sector, as opposed to the food industry, is directly linked to the challenges of establishing a food safety system. Many employees in this sector are younger individuals, often lacking the necessary formal education and training in safe food handling and hygiene practices [17]. Many restaurant employees are poorly paid, lack health insurance, and taking time off work due to illness is often not possible. Therefore, one of the most challenging risks regarding food safety in the hospitality industry is the issue of employees handling food while being sick [18]. The low level of knowledge about food safety and hygiene, which consequently leads to improper implementation or complete absence of good hygiene and production practices by employees, directly affects the successful functioning of the HACCP system [14]. The specificity of restaurants, unlike other types of food establishments, lies in the offering of various types of simple and complex dishes prepared under different, often understaffed conditions, which increases the risk of contamination and the subsequent occurrence of illnesses. This also presents a challenging factor when it comes to the practical implementation of HACCP principles [19]. Although significant progress has been made in Bosnia and Herzegovina (BA) in terms of legislative reform in the field of food safety, particularly with the adoption of the Food Law in 2004 and the implementation of regulations from the "Hygiene Package" in 2012, especially provisions related to self-control programs, which unequivocally highlighted the need/obligation of FBOs including catering sector to establish, implement and maintain permanent procedures based on the principles of the HACCP system [20, 21], the implementation, maintenance, and effectiveness of the system still encounter problems and difficulties, particularly among Food Business Operators (FBOs) in the hospitality sector.

The aim of this study was to determine the key barriers and limiting factors for the establishment and maintenance of the HACCP system at FBOs from the catering sector in the area of the Sarajevo city by analyzing the compliance of PRP with the current regulations of the BA as well as by surveying human resources at the level of food handlers employees (FHE) and management at selected FBOs.

## 2. Materials and Methods

### 2.1 Questionnaire design and survey methods

The research was conducted as a descriptive analytical cross-sectional study on a sample of 33 FBOs from the category of foodservice establishments operating in the Sarajevo city area. The selection of FBOs was carried out using the stratified random sampling method. The „snowball sampling method“ was used in the selection of FBOs. The study included foodservice establishments from the restaurant group in accordance with the regulations on the categorization of foodservice establishments defined by the Rulebook on classification and minimum conditions for foodservice establishments in the groups “restaurants,” “bars,” and “simple service establishments” (Official Gazette of Federation of BA” No. 40/10, [22]).

In the mentioned number of FBOs, 197 food handlers employees were surveyed, as well as 33 individuals who were part of the managerial structures of the selected FBOs. The study included only FBOs from the restaurant group operating in the area of Sarajevo city that provide hospitality services in the preparation and serving of simple and/or complex, savory and/or sweet, hot and/or cold dishes that require simple and/or more complex preparation, serve various types of beverages. Respondents included individuals working in the process of receiving, storing, preparing, or serving food. The respondents who are part of the managerial structures, only decision-makers, and individuals aged 18 to 65 who have given voluntary consent to participate in the research.

Selection of FBOs was aimed at achieving uniformity in relation to the number of employees. FBOs were grouped into two categories: FBOs employing up to 10 FHE and FBOs employing more than 10 FHE. For FBOs employing up to 10 FHE, all FHE were included in the study, while for FBOs employing more than 10 FHE, respondents were selected using a random sampling method from all occupational categories in proportion to the number of FHE.

Three purpose-designed questionnaires were used as research instruments, developed as a result of literature review and existing similar questionnaires: 1. Questionnaire for assessing the knowledge, attitudes, and practices of food handlers regarding food safety and hygiene, developed as a result of literature review and existing similar questionnaires [13, 22 - 25]. 2. Questionnaire for assessing the knowledge, attitudes, and practices of facility managers regarding the importance of establishing and maintaining a food safety system-HACCP, developed as a result of literature review and existing similar questionnaires [13, 26-28]. 3. Questionnaire for evaluating the sanitary-technical

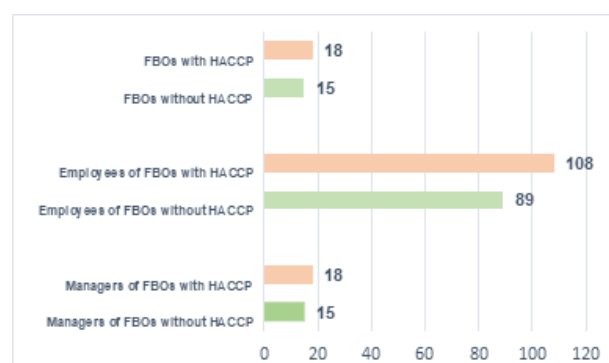
and hygiene conditions in food handling premises, prepared in accordance with the requirements of the relevant legislation - BA Rulebook on food hygiene [29], and recommendations provided in guidelines and manuals for implementing the HACCP system in the hospitality sector. Each response in all three questionnaires carried one point. Compliance of conditions in the facility as well as ranking of knowledge, attitudes and practices ranked according to percentage criteria (poor: < 50%, good: 50 - 75%, excellent: > 75%). The research was conducted within FBOs, and permission for free access to the premises was obtained, with each participant signing a voluntary consent form to participate in the study. Due to the extensive nature of the research, only significant results from the surveys are presented in tables and figures in this paper.

### 2.2 Statistical analysis

The collected data were statistically analyzed using IBM SPSS Statistics version 23.00 software and Microsoft Office Excel version 2020. Descriptive and analytical statistical methods were employed, along with the application of statistical significance tests including the hi-square test, Fisher’s exact test, and Mann-Whitney test. A significance level of  $\alpha < 0.05$  was used as the threshold for statistical significance. The reliability of the questionnaires was assessed by calculating the Cronbach’s coefficient of internal consistency, with results > 0.7 considered as an indicator of sufficient reliability.

## 3. Results and Discussion

The representation of the FBOs sample and the respondents included in the study is shown in Figure 1.



**Figure 1. Representation of the FBOs sample and respondents included in the research**

The “snowball sampling” methodology used for selecting FBOs was the most suitable due to the absence of a unified register of FBOs at the cantonal, entity, and state levels in Bosnian and Herzegovina that systematically classifies FBOs based on their registered activities. Consequently, there is no clear insight

into the number of FBOs registered as food service establishments, including those with and without implemented HACCP systems. Despite the decade-long requirement for all FBOs including the hospitality sector to align business with HACCP principles our research shows that business compliance in 45.5% of cases (15 FBOs) does not follow the provisions of the regulatory framework (Figure 1), which indicates the need establishment of a registry and more extensive research on this topic. The absence of such a register is a significant drawback in the field of food safety and poses a primary obstacle to the implementation of HACCP systems, transparency of FBOs, as well as official supervision and control over them. Countries in the region have followed the trend and recognized the need for comprehensive action in the field of food safety, including the development of unified registers of FBOs, as seen in the example of the Republic of Croatia [30]. Registering services with the competent authorities and obtaining operating permits should strictly and exclusively align with the facility's purpose, the complexity and scope of operations, and the number of employees to fulfil legal requirements primarily related to sanitary-technical and hygiene conditions that enable safe food handling.

### 3.1 Analysis of research related to prerequisite programs (PRP)

Businesses with food in facilities that are inadequate for a specific catering activity, with under-capacitated infrastructural equipment, represent a high risk for food safety, and business according to HACCP principles is almost impossible in such conditions. Neglected investment in infrastructure and work in facilities that do not meet sanitary-technical and hygiene standards often results in a much more significant financial burden compared to the initial investment, which arises as a result of official inspections and ordered measures aimed at eliminating infrastructural inconsistencies. Without adequate prerequisite programs and their effective application, the food safety system is dysfunctional and very expensive [31].

The results of our research related to the compliance of PRP in terms of sanitary-technical and hygiene requirements that must be met in facilities where food is handled indicate deficiencies in both groups of observed FBOs. Table 1 shows the compliance of FBOs regarding to the requirements by which good hygiene practices (GHP) related to the space and personal hygiene of FHE is realized.

**Table 1. Operations compliance of FBOs with and without the implemented HACCP system regarding GHP (N = 33)**

Requirements related to the principles of GHP	FBOs with HACCP (N = 18)		FBOs without HACCP (N = 15)		$\chi^2$	p
	*X <sub>1</sub>	*X <sub>2</sub>	*X <sub>1</sub>	*X <sub>2</sub>		
VARIABLES	%	%	%	%		
<b>There is a separate toilet for employees</b>	66.7	33.3	33.3	66.7	3.640	0.084
<b>There is a handwashing sink in the kitchen</b>	27.8	72.2	26.7	73.3	0.005	0.627
<b>Hot water is provided in the kitchen</b>	100.0	-	100.0	-	-	1
<b>Liquid hand sanitisers, disinfectants, paper towels or hand dryers are provided</b>	100.0	-	100.0	-	-	1
<b>Procedures and plans for cleaning and disinfecting of premises and equipment exist</b>	72.2	27.8	26.7	73.3	6.798	0.015
<b>Employees record the cleaning and disinfection of premises and equipment on a daily basis</b>	50.0	50.0	33.3	66.7	0.930	0.482
<b>There are prominently written procedures in the facility for maintaining the personal hygiene of employees</b>	61.1	38.9	20.0	80.0	5.661	0.033
<b>Employees wash their hands properly</b>	22.2	77.8	6.7	93.3	1.540	0.346
<b>Employees' nails are without polish, trimmed and neat</b>	83.3	16.7	60.0	40.0	2.246	0.239
<b>Employees do not wear jewelry during food preparation</b>	38.9	61.1	26.7	73.3	0.550	0.712
<b>Employees do not use mobile phones and other private things during food preparation</b>	27.8	72.2	6.7	93.3	2.451	0.186
<b>Employees do not eat/drink/consume cigarettes during food preparation</b>	61.1	38.9	-	100.0	13.750	0.0001
<b>Employees prevent cross-contamination by moving around</b>	44.4	55.6	-	100.0	8.80	0.004

Legend: \*X<sub>1</sub>: aligned; \*X<sub>2</sub>: not aligned.

Full compliance, regardless of the implementation of the HACCP system at FBOs, was recorded in terms of the provision of hot water, means and equipment for maintaining hand hygiene (100%). Procedures and plans for cleaning and disinfecting premises and equipment are statistically significantly more present in FBOs with HACCP compared to FBOs without HACCP (72.2% : 26.7%) ( $\chi^2 = 6.798$ ;  $p = 0.015$ ). The frequency of keeping records of cleaning and disinfection procedures performed was recorded in only half of FBOs with HACCP and one-third of FBOs without HACCP. Less than one-third of SPH, regardless of the implementation of HACCP, had provided handwashing inside the kitchen, which was significantly reflected in the high percentage of non-compliance regarding proper hand washing, although no statistically significant difference was recorded between the observed groups ( $\chi^2 = 1.540$ ;  $p = 0.346$ ). By observing the behaviour of the employees, a very important inconsistency that we noticed, in addition to the practice of washing hands in the sinks where food is prepared, is also the wiping of hands from the work uniform and rags, which was confirmed by the employees themselves (Table 8). Handling food with contaminated hands can lead to the spread of microorganisms both on food and on other surfaces with which one comes into contacts, such as work surfaces, equipment used to prepare and serve food, as well as door handles or refrigerators. The spread of microorganisms most often occurs due to inadequate hand washing, which leads to the faecal-

oral route of pathogen transmission [32]. Compliance in terms of neat, trimmed and unvarnished nails was recorded in 60% of FHE of FBOs without HACCP and 83.3% of FHE of FBOs operating according to HACCP principles. Untidiness, long nails, as well as wearing jewellery during food manipulation, in addition to microbiological ones, are also an important source of physical hazards that can contaminate food. Also, persons who handle food must not consume food or use private stoves during food preparation [33]. However, this is not the case in our research among FHE of FBOs without HACCP. By observing the behaviour, none of the FHE from this FBOs group followed the recommendations. With the majority of FHE of FBOs without HACCP (93.3%), it is noticeable that they use private things, especially mobile devices while preparing food.

The results of our research in Table 2 show that the compliance of SPH operations with regard to the proper handling of food follows a deviation from the requirements prescribed by the prerequisites.

Significantly better compliance in terms of ensuring the prescribed temperature regime in cooling devices ( $\chi^2 = 8.800$ ;  $p = 0.008$ ) as well as its monitoring ( $\chi^2 = 18.992$ ;  $p = 0.0001$ ) was recorded in FBOs with HACCP system compared to FBOs without HACCP. Although 94.4% of FBOs that operate according to HACCP principles had written records of temperature measurements

**Table 2. Operations compliance of FBOs with and without the implemented HACCP system regarding proper food handling (N = 33)**

Requirements related to proper food handling	FBOs with HACCP (N = 18)		FBOs without HACCP (N = 15)		$\chi^2$	p
	*X1	*X2	*X1	*X2		
Variables	%	%	%	%		
Stored food is free from secondary and tertiary packaging	83.3	16.7	53.3	46.7	3.487	0.126
The "FIFO" principle is followed	94.4	5.6	80.0	20.0	1.603	0.308
Ready-made dishes is protected and properly labeled	55.6	44.4	26.7	73.3	2.195	0.158
Ready-made dishes are stored above raw food. i.e. in separate cooling devices.	66.7	33.3	46.7	53.3	1.340	0.304
Cooling devices are equipped with a control thermometer to monitor the temperature	94.4	5.6	26.7	73.3	16.242	0.0001
The temperature in refrigerators does not exceed +5 °C	88.9	11.1	40.0	60.0	8.800	0.008
There are written records of temperature measurements in all refrigerators (min. 2X per day)	94.4	5.6	20.0	80.0	18.992	0.0001
All temperature records are properly and correctly filled out	55.6	44.4	13.3	86.7	6.303	0.027
There are records of the temperature of heat-treated food	44.4	55.6	-	100.0	8.800	0.004
There are written procedures on allergen management	33.3	66.7	-	100.0	6.111	0.021

Legend: \*X<sub>1</sub>: aligned; \*X<sub>2</sub>: not aligned.

in all cooling devices in which food is stored (min. 2X a day), however, in only 55.6% of FBOs with the HACCP system were confirmed compliance with a proper and correct filling of record lists. A statistically significant difference was recorded between FBOs in terms of checking and recording the temperature of heat-treated food ( $\chi^2 = 8.800$ ;  $p = 0.004$ ). In FBOs that operate according to HACCP principles, it was found that less than half of FBOs (44.4%) check and record the temperature of heat-treated food. In FBOs that do not have an implemented HACCP system, complete non-compliance was recorded in this variable. Not even one FBOs without an implemented HACCP system had written procedures for the proper management of allergens during food preparation. This is very important information given that allergic reactions are a growing public health problem, and restaurants are particularly risky due to their specific characteristics. Although a statistically significant difference was recorded between the analyzed FBOs regarding the existence of written procedures on allergen management ( $\chi^2 = 6.111$ ;  $p = 0.021$ ), poor compliance was also recorded in SPHs that have implemented the HACCP system (only 33.3% of cases). Excellent compliance of FBOs in both observed groups was recorded regarding compliance with the FIFO principle.

The storage of ready-made dishes in cooling devices at FBOs without an implemented HACCP system was poor, with less than 50% compliance, which represents one of the main food safety risks.

### 3.2. Analysis of research related to management

The key to the successful implementation and effective functioning of the HACCP system at any FBO is establishing and maintaining a positive food safety culture. Without management commitment, food safety principles often remain inconsistent. A particularly important element is the recognition of the benefits of the HACCP system by decision-makers at FBO, whose affirmative perceptions of the concept of safe food business positively reflect on the motivation and changes in employee behaviour [34].

Analyzing the answers of managers shown in Table 3 related to involvement in food safety policy within the facilities they manage, it could be said that a high percentage of managers follow the Codex changes from 2020 in terms of "food safety culture". However, their perception of commitment and employee motivation model indicate that the concept of "food safety culture" is still not fully recognized.

**Table 3. Percentage of correct answers towards knowledge and practice about food safety and HACCP among FBOs managers (N = 33)**

Variables	FBOs with HACCP (N = 18)	FBOs without HACCP (N = 15)	$\chi^2$	p
	Correct	Correct		
	%	%		
<b>As a part of the management, are you involved in the work of the food safety team?</b> <i>YES, completely</i>	77.8	80.0	0.888	0.609
<b>Have you completed training related to principles of HACCP system principles?</b> <i>YES</i>	88.9	6.7	22.146	0.0001
<b>Do you consult the competent authorities if you have any doubts about food safety and hygiene in the system of your business?</b> <i>YES, always</i>	11.1	33.3	4.407	0.130
<b>Is the implementation of the HACCP system binding according to the current legislation of BA?</b> <i>YES, for all SPH operating on the territory of BA, regardless of the number of employees</i>	77.8	13.3	16.338	0.001
<b>Who is responsible for ensuring food safety?</b> <i>Food safety is ensured by the joint efforts of all employees and company management</i>	94.4	46.7	9.472	0.003
<b>Continuous education in the field of food safety based on the HACCP principles is:</b> <i>Mandatory for all all food handling employees</i>	88.9	13.3	19.004	0.0001
<b>Have you provided education in the field of health education/sanitary minimum for all food-handlers employees?</b> <i>YES, for all employees</i>	61.1	46.7	3.982	0.316
<b>Have you provided education based on HACCP principles for all food-handlers employees?</b> <i>YES, for all employees</i>	31.1	-	29.471	0.0001

In our research, significant barriers to the implementation and maintenance of the HACCP system related to managers are closely linked to their perception of the HACCP system as a legal obligation, as well as a non-affirmative perception of the importance of ensuring continuous education for employees. Although a statistically significant difference was recorded between the examined groups in terms of ensuring education in the field of food safety and hygiene based on HACCP principles ( $\chi^2 = 29.471$ ;  $p = 0.0001$ ) still less than one-third of SPH managers with HACCP (31.1 %) provided the mentioned education for all its employees even though the HACCP system was implemented in the facilities. Less than half of the

managers of FBOs without HACCP (46.7%) declared that they provided mandatory education for all their FHE in the field of health education - sanitary minimum. The fact that slightly more than one-third of FBOs managers with HACCP also did not ensure the sanitary minimum for all their employees is also worrying. Casolani and Del Signore [35], in their research conducted among 420 managers of hotels, restaurants, and cafes in Italy regarding their views on the factors that influence the implementation of the HACCP system, highlighted the importance of education and training and the need for training to be at the centre of all national and international food safety policies. Managers considered that improving

**Table 4. Attitudes of FBOs managers towards the HACCP system (N = 33)**

Variables	FBOs with HACCP (N = 18)					FBOs without HACCP (N = 15)					$\chi^2$	p
	*X <sub>1</sub>	*X <sub>2</sub>	*X <sub>3</sub>	*X <sub>4</sub>	*X <sub>5</sub>	*X <sub>1</sub>	*X <sub>2</sub>	*X <sub>3</sub>	*X <sub>4</sub>	*X <sub>5</sub>		
	%	%	%	%	%	%	%	%	%	%		
HACCP system reduces costs	-	5.6	38.9	55.6	-	6.7	26.7	33.3	33.3	-	4.565	0.207
HACCP system costs too much	11.1	61.1	-	27.8	-	40.0	26.7	26.7	6.6	-	11.758	0.008
HACCP system improves consumer confidence	61.1	33.3	5.6	-	-	26.7	46.7	13.3	13.3	-	5.661	0.142
HACCP system reduces the risk of foodborne diseases	44.4	44.4	11.1	-	-	13.3	33.3	26.7	26.7	-	8.759	0.033
HACCP system is exclusively an administrative and technical measure of inspection bodies	11.1	22.2	-	66.7	-	20.0	20.0	6.7	53.3	-	1.886	0.596
HACCP system has too much documentation that reduces the effectiveness of employees' work	27.8	55.6	5.6	11.1	-	13.3	40.0	33.3	13.3	-	4.719	0.194
Proper implementation and maintenance of the HACCP system require establishing adequate prerequisite programs	72.2	27.8	-	-	-	33.3	66.7	-	-	-	4.991	0.029
HACCP system is difficult to establish due to the constant fluctuation of the workforce	16.7	61.1	11.1	11.1	-	40.0	46.7	6.7	6.7	-	2.302	0.512
The HACCP system is difficult to establish due to weak employee motivation for changes in the work environment	16.7	66.7	5.6	11.1	-	26.7	66.7	-	6.7	-	1.397	0.706
The HACCP system is difficult to establish due to the lack of support from the leading authorities	66.7	22.2	5.6	5.6	-	33.3	46.7	13.3	6.7	-	3.792	0.285
A pay cut is the best measure to improve and change the behavior of food handlers.	50.0	16.7	-	33.3	-	20.0	26.7	-	53.3	-	3.204	0.204

Legend: \*X<sub>1</sub>: completely agree; \*X<sub>2</sub>: agree; \*X<sub>3</sub>: not sure; \*X<sub>4</sub>: disagree; \*X<sub>5</sub>: completely disagree.

their knowledge in the catering sector is extremely important and that training activities should be planned based on feedback from employees and their experiences with HACCP.

The manager’s perception that responsibility for food safety belongs exclusively to FHE is another barrier to the successful implementation and functioning of HACCP in practice. The results of our research indicate poor communication between SPH and competent authorities, where less than one-third of SPH managers, regardless of the implementation of the HACCP system, consult the competent authorities in case of ambiguities related to food safety and hygiene in the system of their business. Risk communication and information exchange between FBOs and competent inspection bodies is considered extremely important and is a basic element in the risk analysis process, which according to the Food and Agriculture Organization of the United Nations (FAO) is an important interactive process. Considering the important role of restaurants as FBOs in the food chain from the aspect of the emergence and spread of infectious diseases among consumers, openness to cooperation with competent institutions and the acceptance of the HACCP system as an important public health instrument is extremely important for reducing risks and removing barriers in the work process [36].

The attitudes of managers shown in Table 4 regarding the purpose of the HACCP system are dominantly non-affirmative, which is recognized as a significant complicating factor.

As many as 40% of FBOs managers without an implemented HACCP system believe that HACCP is exclusively an administrative-technical measure of inspection bodies. It is worrying that more than one-third of FBOs managers who operate according to HACCP principles have the same attitudes.

Mandal *et al.*, [37], in a study conducted in 40 restaurants in the city of Allahabad found that more than 50% of managers did not link HACCP and food

safety and did not recognize the benefits of HACCP and in 90% of cases considered it expensive. The results of our study are similar to the results of the mentioned research, considering that 72.2% of FBOs managers with HACCP and 66.7% of FBOs managers without HACCP consider that the HACCP system costs too much. The justification of the attitudes that the HACCP system costs too much can be linked to the financial challenges and barriers faced by small and medium-sized FBOs from the hospitality sector, and the establishment of a safe food business is often viewed exclusively through visible parameters that comply with the legal requirements. These visible parameters include certificates of implemented DDD measures by an authorized contractor, sanitary booklets for FHE, microbiological reports of food samples and swabs, food labels and confirmation that food of animal origin has passed veterinary control. More than 80% of managers in both groups of managers in our research consider that the HACCP system is difficult to establish due to insufficient support from leading authorities. Khalid [38], investigated the issue of the implementation of the HACCP system in Afghanistan and mapped the financial burdens and insufficient involvement of competent authorities as barriers to the establishment of the HACCP system. An interesting, but devastating fact that we got in our research is that more than half of the managers of FBOs that operate according to HACCP principles believe that a salary reduction is the best measure for improving and changing the behaviour of FHE, which is in complete contradiction to the principles of the food safety culture.

### 3.3. Analysis of research related to employees

Table 5 shows the responses of FHE regarding education in the field of food safety.

It is very important information that more than 50% of FHE in FBOs without HACCP and 20.4% of FHE of FBOs with HACCP have not completed education in the field of health education-sanitary minimum is very important. The sanitary minimum course is

**Table 5. Completed education in the field of food safety among FHE in FBOs with and without an implemented HACCP system (N = 197)**

Variable	FBOs with HACCP (N = 108)			FBOs without HACCP (N = 89)			$\chi^2$	p
	*X <sub>1</sub>	*X <sub>2</sub>	*X <sub>3</sub>	*X <sub>1</sub>	*X <sub>2</sub>	*X <sub>3</sub>		
	%	%	%	%	%	%		
<b>Do you have a valid certificate in the field of health education/ sanitary minimum?</b>	79.6	17.6	2.8	40.4	56.2	3.4	13.893	0.001
<b>Have you completed education and training on safe food handling based on HACCP principles?</b>	81.5	17.6	0.9	6.7	93.3	-	11.987	0.001

Legend: \*X1: yes; \*X2: no; \*X3: don't know/not sure.



a mandatory education program according to the current legislation of Bosnia and Herzegovina for all FHE regardless of the implementation of the HACCP system [39]. According to the Rulebook on Food Hygiene of Bosnia and Herzegovina [29], education based on HACCP principles is also mandatory. The data of our research show that even in FBOs operating according to HACCP, 17.6% of employees did not complete this education and only 6.7% of employees in FBOs without HACCP. Considering that managers from this group of facilities confirmed that they did not provide training based on HACCP principles for any of their employees (Table 3), we can assume that

the employees completed this training at other SPH or it was the result of a self-initiated decision. According to the legislation of Bosnia and Herzegovina, the sanitary minimum course is valid for four years, which is a long period if additional education is not carried out. It is recommended that FHE complete education and training based on HACCP principles at least once a year [40], which in many cases is not implemented in practice, given that the Bosnia and Herzegovina Rulebook on Food Hygiene does not specify the frequency of education. Not conducting continuous and customized education is a significant barrier to the success of safe food handling.

**Table 6. Comparison of mean values of employees' general knowledge of food safety and hygiene in relation to the implementation of the HACCP system (N = 197)**

FBOs with HACCP (N = 108)		FBOs without HACCP (N = 89)		Z	p
Mean	SD	Mean	SD		
32.12	6.08	25.10	4.78	-7.797	0.0001
Good		Good			

**Table 7. Knowledge of employees about food safety and hygiene (N = 197)**

Variables	FBOs with HACCP (N = 108)			FBOs without HACCP (N = 89)			$\chi^2$	p
	*X <sub>1</sub>	*X <sub>2</sub>	*X <sub>3</sub>	*X <sub>1</sub>	*X <sub>2</sub>	*X <sub>3</sub>		
Knowledge of FHE about the influence of temperature on food safety	%	%	%	%	%	%		
Microorganisms multiply the fastest at the +37 °C	43.5	44.4	12.0	43.8	43.8	12.4	0.009	0.995
At the temperature of the refrigerator, microorganisms grow very slowly	35.2	62.0	2.8	34.8	62.9	2.2	0.062	0.969
Cooking/frying are processes that destroy most microorganisms	44.4	54.6	0.9	33.7	65.2	1.1	2.352	0.307
The minimum heat treatment temperature that destroys most microorganisms is +70 °C measured in the center of the food	28.7	63.9	7.4	15.7	80.9	3.4	6.991	0.028
Thermal processing of food does not destroy food allergens.	19.4	60.2	20.4	23.6	55.1	21.3	0.639	0.727
Warm meals should be kept at a temperature above +65 °C and cold dishes below +8 °C	37.0	59.3	3.7	22.5	70.8	6.7	5.291	0.068
Food can be stored at room temperature after being thermally processed for a maximum of 2 hours before being stored in a refrigerator	35.2	64.8	-	27.0	73.0	-	1.528	0.140
<b>Knowledge of FHE about personal hygiene</b>								
Proper hand washing before handling food reduces the risk of food contamination and disease transmission	100.0	-	-	100.0	-	-	-	1
Proper wearing of gloves when food handling reduces the risk of transmitting infections.	99.1	-	0.9	98.9	-	1.1	0.19	0.701
Wearing jewellery (rings) poses a high risk of food contamination	98.1	1.9	-	89.9	5.6	4.5	7.154	0.028
People who have visibly infected wounds on the skin, diarrhoea, vomiting, fever, and sore throat should not work with food	99.1	0.9	-	98.9	1.1	-	0.19	0.701
Eating and drinking while food handling increases the risk of food contamination and illness related to food	61.1	26.9	12.0	29.2	60.7	10.1	24.040	0.0001

Legend: \*X<sub>1</sub>: correct; \*X<sub>2</sub>: incorrect; \*X<sub>3</sub>: don't know.

Although the FHE’s knowledge of food safety and hygiene in both examined groups was evaluated as good (Table 6), the FHE of FBOs operating according to the principles of the HACCP system gave statistically significantly more correct answers ( $Z = -7.797$ ;  $p = 0.0001$ ).

However, in certain questions, employees of both investigated groups showed a poor level of knowledge. The analysis of the variables that examined the knowledge about the influence of temperature on food safety confirmed the poor level of knowledge in both groups of employees (Table 7), which is similar to the results of the research on a sample of 50 restaurants in Beirut, including 80 FHE conducted by Faour-Klingbeil *et al.*, [41]. The authors noted a poor level of knowledge among the respondents. Only 48% of employees knew that the temperature of the refrigerator slows down the growth of bacteria, that cooking destroys bacteria (55%), and 11% of FHE knew that that thermal processing of food should be done in the range of 63 - 70 °C. A significantly large percentage of employees in both FBOs groups showed an excellent level of knowledge when it comes to the importance of maintaining proper hand hygiene,

wearing gloves properly during food manipulation, not wearing jewellery, and food manipulation in case of health problems. Although these recommendations are well known because they are the dominant topics of the education program, however, by analyzing the self-assessment of practices and observing the behavior of employees, it is noticeable that they are not fully applied in practice and that they do not positive correlate with the knowledge of employees.

A high percentage of FHE (more than 90%) in both groups of FBOs believe that constant and proper record keeping of the temperature of cooling devices and food undergoing heat treatment is essential for food safety, however their practice does not confirm this, as shown in Table 8.

Only 20.4% of FHE in FBOs with HACCP and 3.4% of FHE in FBOs without HACCP check and record the temperature of cooling devices on a daily basis. Checking and recording the temperature of thermally processed food is a constant practice for only 13.9% of FHE who work according to HACCP principles and 2.2% of FHE in FBOs without HACCP. The evaluation of the sanitary-technical and hygienic conditions in the

**Table 8. Practices of employees regarding food safety and hygiene (N = 197)**

Variables	FBOs with HACCP (N = 108)					FBOs without HACCP (N = 89)					$\chi^2$	p
	*X <sub>1</sub>	*X <sub>2</sub>	*X <sub>3</sub>	*X <sub>4</sub>	*X <sub>5</sub>	*X <sub>1</sub>	*X <sub>2</sub>	*X <sub>3</sub>	*X <sub>4</sub>	*X <sub>5</sub>		
	%	%	%	%	%	%	%	%	%	%		
<b>Do you check and record the temperature of all cooling devices every day?</b>	3.7	11.1	17.6	47.2	20.4	50.6	23.6	14.6	7.9	3.4	26.660	0.0001
<b>Do you check and record the temperature of the food that requires heat treatment?</b>	14.8	27.8	23.1	20.4	13.9	70.8	9.0	16.9	1.1	2.2	27.143	0.0001
<b>When receiving food, do you check the temperature of food that requires an appropriate temperature regime?</b>	16.7	21.3	41.7	11.1	9.3	39.3	22.5	22.5	11.2	4.5	16.350	0.003
<b>Do you accept perishable food whose temperature is above +5 °C</b>	4.6	3.7	32.4	57.4	1.9	2.5	5.6	41.6	44.9	5.6	5.704	0.222
<b>Do you wash your hands in the kitchen sink?</b>	13.9	13.9	24.1	28.7	19.1	12.4	6.7	15.7	28.1	37.1	9.639	0.047
<b>After washing your hands, do you wipe your hands with a work uniform or rag?</b>	21.9	16.7	16.7	13.9	0.9	27.0	21.3	22.5	28.1	1.1	13.723	0.008
<b>Do you remove jewellery (rings, watches, earrings) before starting work?</b>	9.3	7.4	11.1	27.8	44.4	12.4	18.0	5.6	10.1	53.9	15.213	0.004
<b>Are you wearing a head covering and a clean work uniform?</b>	0.9	0.9	-	13.0	85.2	3.4	2.2	1.1	24.7	68.5	8.640	0.071
<b>Do you come to work with a cold or diarrhea?</b>	15.7	43.5	35.2	4.6	0.9	13.5	14.6	49.4	22.5	-	29.005	0.0001

Legend: \*X<sub>1</sub>: never; \*X<sub>2</sub>: rarely; \*X<sub>3</sub>: sometimes; \*X<sub>4</sub>: often; \*X<sub>5</sub>: always.

facility showed that there are records of temperature at FBOs with HACCP, however, in less than half of SPH with HACCP (44.4%) they are properly filled, while this inconsistency is significantly greater in FBOs without HACCP (86.7%) (Table 2).

During the research, by observing the behaviour of the workers, we noticed that in a large number of cases, employees fill in the records retroactively. Data that indicate poor knowledge of the temperature conditions of food storage, as well as heat treatment and the absence of record keeping, should be worrisome considering that temperature as a physical, measurable parameter in terms of food storage represents a control point, and for food that undergoes heat treatment, a critical control point by which the dangers of microbiological the origins are controlled or reduced to an acceptable level. In the research conducted by Lee *et al.*, [42], as well as in the research conducted by Smigic *et al.*, [43], the importance of regularly checking and recording the temperature conditions of food storage and measuring the temperature of thermal processing of food was highlighted. Research by these authors also indicates that omissions and the absence of temperature checks by employees represent a high risk for food safety. Bas *et al.*, [28], in their research, confirmed that as many as 67.8% of respondents never keep records of the temperature of cooling devices, 16.5% of employees check and keep records of the temperature of thermally processed food, and only 10.4% of respondents check the temperature when receiving food. The stated results are similar to the results of our research, given that less than 10% of employees in both examined groups check the temperature of food that requires a temperature regime when receiving it. The obtained data represent a significant risk for the health safety of food prepared within FBOs, which should be paid special attention to.

Less than half of SPH employees with HACCP (44.4%) confirmed that they always remove rings and watches when working with food. We did not get a completely correct answer from any group of employees when it comes to wearing a clean and neat work uniform and head covering. Despite the excellent level of knowledge about health problems that can lead to the transmission of microbial agents (Table 7) and consequently lead to food contamination, still 35.2% of employees working at FBOs with HACCP and 49.4% of employees working at FBOs without HACCP stated that they sometimes come to work with symptoms of diarrhoea and colds. It is a worrying fact that coming to work and working with food is a constant practice of 22.5% of FHE from FBOs without HACCP. These data represent a serious risk, considering that acute diarrhea is the most common symptom of foodborne diseases [44].

#### 4. Conclusions

- The results obtained in our research indicate a wide spectrum of determined barriers and imitating factors that affect the success of the HACCP system in practice.
- Key shortcomings are related to work in inadequate and under-capacitated facilities where there are no objective conditions for the implementation of preconditioning programs in practice, which forms the basis for the successful implementation or effective functioning of HACCP.
- Mentioned shortcomings also contribute to the fictitious existence of the HACCP system, which is also visible through documentation that partially exists or does not exist, and which is incorrectly filled out in order to satisfy the form in case of inspection monitoring. Non-affirmative attitudes of managers (HACCP costs too much, does not reduce costs, lack of support from leading authorities, poor communication or complete lack of communication with inspection bodies, etc.), failure to recognize the benefits of the system and considering HACCP as an administrative-technical measure aimed to the immediate satisfaction of legal requirements obligation is a significant limiting factor. The managers of the selected FBOs in our research do not invest in educational programs or consider them essential for behavioural changes and employee motivation for changes. In this way, they contribute to a bad food safety culture. Managers should rationalize the benefits of the HACCP system, be more open to changes, and understand that the HACCP system is a legal obligation and that their operations must meet high hygiene criteria in order to reduce the risks of contamination and consequently the occurrence of diseases. Managers should invest more in material and human resources, be more devoted to employees, provide adequate working conditions and stimulate them to work conscientiously and responsibly with food. Limiting factors related to employees are partially justified in inadequate working conditions and unmotivating relationships of managers.
- Also, observed deficiencies related to the poor level of knowledge among FHE about food safety and hygiene followed by poor hygiene practices require quality and continuous employee education in order to point out the importance of the role of employees in the business system with the aim of reducing the risk of food contamination. It is crucial that all links in the chain are aware of their role and that HACCP is not viewed as a burden but as an integral part of the business that develops through the joint action of managers and employees for the purpose of mutual satisfaction and safe food business. The absence of a register of FBOs in Bosnia and Herzegovina is a significant aggravating circumstance for monitoring and better control over food business systems. The creation of a single register by competent authorities in the field of food safety would greatly contribute to

better transparency of the HACCP system as well as better functionality in practice.

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