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THE RELATIONSHIP BETWEEN FOOD SAFETY KNOWLEDGE AND SUCCESSFUL IMPLEMENTATION FOOD SAFETY MANAGEMENT SYSTEM

Abstract: *Training of personel who are engaged in food safety management system implementation and personel who handle with food is very important for efficiency of food safety management system. Companeis very offten has a problem with assessing food safety knowledge because in standards are not defined methodlogy for this assessment.*

In this research we try to explore level of knowledge obout food safety amnog HACCP team members and food handlers in Bosnia and Herzegovina. A structural food safety knowledge questeionarie was developed for assessing knowledge separate for HACCP team members ad food handlers. Data were collected from 80 HACCP team members and 740 food handlers.

A majoriti of HACCP team members (70,0%) has food safety training in previous three years Also, food handlers in most cases has apropriate food safety training in previous three years (80,1%). The overall test result were 83,63 % of correct answers for food handlers and 72,33% for HACCP team members. It is also sigificant that the HACCP team members has a better result in companies who are certify according one of GFSI approved certification sheme.

It is recommended to companies, associations of companies, scientific institutions, consulting organisations to develop specific food safety training on higher level for HACCP team members and methodology for official assessment of food safety knowledge.

Keywords: *Food safety, Knowledge, HACCP, Implementation*

1. Introduction

HACCP (Hazard Analysis and Critical Control Point) system is worldwide accepted system in assurance safety of food products (Grujic et. al., 2010). HACCP system is based od seven HACCP principles and prerequisite programs (WHO, 2003).

In past few years HACCP system has a increasing application in food business in Bosnia and Herzegovina and certification of established systems according to different standards.

Many companies has a numerous difficulties with applying of this system.

In a survey conducted on the example of

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companies in the United Kingdom, it is evident that the successful implementation of the HACCP system in small companies has several barriers that can be divided into managerial, organizational and technical ones (Taylor, 2001).

Since the requirement of all standards relating to the application of the HACCP system is also and one of the basic steps in applying the HACCP system according to the Codex Alimentarius guidelines, that is, the formation of a multidisciplinary HACCP team. Multidisciplinarity does not necessarily mean a higher level of knowledge of the HACCP system, and this problem was explored by Wallace et al., (2012). They came to the conclusion that the total knowledge of HACCP team members is less than the individual knowledge of individual members of the HACCP team.

Researching the impact of knowledge on the HACCP System of food handlers in the Region of Istanbul, Ulusoy and Çolakoğlu (2014) found that the knowledge of food handlers regarding the HACCP system is growing with time spent in the food industry, age and level of education. Similar research was conducted in Bosnia and Herzegovina by Grujic et. al., (2012) with food handlers in restaurants. They found that urgent measures are needed to increase the level of knowledge of employees in restaurants about food safety.

Researching the knowledge of staff involved in preparing food at the University Restaurant in Jordan, regarding the HACCP system and food safety, Osaili et. al., (2012) found it is very important to establish a staff training system. According to their research, the overall assessment of the knowledge of food safety staff was at a low level (69,4%), and the highest grade was obtained for the personal hygiene segment (79,9%) and the lowest for the segment of safe storage, dissolution, cooking and heating of food (52,4%).

According to data obtained by researching the knowledge of owners and managers of fish processing companies in Mauritius, Ramnauth et al., (2008) concluded that there is a very low level of knowledge in the surveyed population regarding the identification of hazards and risks that can be realistically expected in companies dealing with fish processing. There is an unequivocal need to increase new knowledge at managerial level in fish processing.

One of the key factors influencing the successful implementation of the HACCP system is the lack of staff training, in addition to the commitment of the management for the implementation of the HACCP system and the implementation costs, found out Milios et al. (2017) in the research carried out in Greece. On the other hand, adequate training and experience that the members of the HACCP team have in the field of food safety ensure an effective implementation of the procedures of the HACCP system, reduce the number of product recalls and increase the reputation of the company according to this authors.

Research into the effects of the food safety management system in the meat industry in Serbia has shown that problems related to the knowledge of the staff involved in the implementation and the application of the food safety management system play a very important role. According to Radovanovic et. al., (2013) costs related to training and re-training of staff, as well as the availability of staff to devote themselves to the implementation of food safety management systems in addition to their everyday tasks pose a very significant obstacle in the application of the food safety system in the meat industry in Serbia.

In the research of Pilling et. al. (2008) it was stated that food handlers in restaurant show higher compliance with regard to a few specific behaviours relating food safety, when they had received mandatory training.

Small companies specifically has internal barriers to implement HACCP system

related to insufficient knowledge or that barriers can be external in case of inadequate support from government institution. This barriers must be considered during initial stages of HACCP implementation acknowledge Kafetzopoulos and Gotzamani in their research (2014).

2. Materials and methods

This survey was conducted in period of July to December 2018 and in survey was included 38 companies in Bosnia and Herzegovina. All companies who are in this survey are certified by third party certification body, according to HACCP Codex Alimentarius or other standard (ISO22000, ISO9001, IFS Food, FSSC22000).

Table 1. Share in specific certificates in researched companies

HACCP Codex	ISO 9001	ISO 22000	IFS Food	FSSC 22000
84,21%	84,21%	13,16%	21,05%	2,63%

There is two group of participants on this survey: one group are food handlers who has a job related from food handling and other group was HACCP team members with different job descriptions like it is obligatory to has multidisciplinary HACCP team. Total number of food handlers who were interviewed was 740 and total number of HACCP team members was 80.

On the beginning we develop structured questionnaire separate for each category of participants in research. For HACCP team members questionnaire consist of 20 questions with four offered answers. The main group of questions are related to HACCP principles, microbiology, sanitation, legislation and auditing of quality and food safety management system. For food handlers questionnaire consist of 11 questions with four offered answers. The questions are related to hygiene, allergens and conditions for safe storage of food.

Company characteristics are often considered as important factor in developing and applying requirements of food safety and quality standards. Authors, Zu, Zhou, Zhu, & Yao (2011) and Trienekens and Zuurbier (2008) aim that company size, type of applied processess and technology, type of industry and infrstructural facilities has very significant factors in implementation food safety management systems.

If we consider the size of companies most of the participants are from middle size comapnies (50 %) regarding to number of employees, Official Gazette of Republic of Srpska (2013).

Table 2. Number of companies who participate in research according to size

Number of small enterprises	Number of middle size enterprises	Number of big enterprises
12	19	7

In the start of research, the following research null hypothesis (Ho) are formulated:

- H1: Knowledge of female workers who work in food processing companies are not statistically significantly different then male workers,
- H2: Knowledge of workers who work in companies who are certify according to GFSI (Global Food Safety Initiative) standards are not statistically significantly different then workers who work in companies who are not GFS certified,
- H3: Knowledge of workers who has training relating food safety every year are not statistically significantly different then workers who don't have food safety training in previous one year,
- H4: Knowledge of workers who work in animal food processing

companies are not statistically significantly different then workers who work in other food processing companies,

- H5: Knowledge of workers who work in food processing companies who export their product are not statistically significantly different then workers who work in food processing companies who not export their products.

Alternative hypothesis (Ha) are formulated as a negation of null hypothesis.
For testing of significance of hypothesis was use Student t-test, for arithmetic means of two independent big sample. For this purpose of testing are calculated statistical parameters: size of sample, variance of the sample and arithmetic mean. Student t-test are calculated according to formula:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{SD_1^2}{n_1 - 1} + \frac{SD_2^2}{n_2 - 1}}}$$

Where is: $\bar{x}_1$ – arithmetical means of sample 1; $\bar{x}_2$ – arithmetical means of sample 2; SD^2_1 – variance of sample 1, SD^2_2 – variance of sample 2, n_1, n_2 – number of samples 1, 2.
Conclusion in case of this testing is made on the way:

- t-realized < t = 1,96, accept Ho and reject Ha, p> 0,05,
- t-realized ≥ t = 1,96, rejected Ho and accepts Ha, p <0,05,
- t-realized ≥ t = 2,58, Ho is rejected, accepts Ha and for p <0,01.

The analysis was done using Analysis Tool Pack in Microsoft Excel 2016.

3. Results and discusion

In the beginning of evaluation questionaries' we was calculate results of each participant. Food handlers has average score of correct answers who is higher then HACCP team members (Table 1). The lowest score for food handlers was 36,36 % of correct answers (three food handlers has this score) and the highest score was 100 % (174 food handlers has this score).

Table 3. Overall results of testing

Tested population	Average percent of correct answers
HACCP team members	72,33 %
Food handlers	83,63 %

As a result of calculated scores, female food handlers (85,65±12,20%) have higher knowledge score then male food handlers (80,37±16,613%). This result was analyzed statistically by t-test and it is found that is statistically significant for the level 0,01 (t=4,63; p=0,000004<0,01). If we look on results for HACCP team members for female (75,81±13,35%) and male (67,25±15,32%) it is obvious that female HACCP team members have higher knowledge score. This is statistically significant on level 0,05 (t=2,55; p=0,0133<0,05) (Table 4).

Table 4. Results of testing by gender

Sample	Number of female	Number of male	$\bar{x}_{female}$ correct ans.	$\bar{x}_{male}$ correct ans.	Variance SD^2_{female}	Variance SD^2_{male}
Food handlers	457	238	85,65%	80,37%	1,49%	2,76%
HACCP team members	49	31	75,81%	67,25%	1,78%	2,34%

Requirements of standards approved by GFSI like IFS Food, BRA Global standard for food safety or FSSC22000 are more complex for implementation in food processing companies. So, it is expected that employees in companies that have been certified according standards approved by GFSI will have a higher level of knowledge in terms of food safety in order to successfully apply the requirements of these standards. Authors Spadoni and Lombardi (2014) in their research aim that BRC standard is basic standard for food supplier and a minimum standard for producer who work with European retailers.

In our research samples of food handlers who work in company who are certify by GFSI approved standards was 76,75%. The food handlers who work in companies who are certify according to GFSI approved standards have higher knowledge score (86,29±13,45%) regarding food safety then food handlers who work in companies who are not certify by GFSI approved standards (74,84±13,34%). This difference is statistically significant on the level 0,01 (t=9,83; $p=7,42x10^{-20}$ < 0,01). Similar situation is in results for HACCP team members because HACCP team members from companies who are GFSI certified has a higher knowledge score (77,83±12,32%) then HACCP team members who don't work in GFSI certified companies (69,30±15,10%). This difference is also statistically significant on the level 0,01 (t=2,74; t=0,0076<0,01) (Table 5).

Table 5. Results of testing regarding to GFSI certification

Sample	Number workers from GFSI certified companies (1)	Number of workers from non GFSI certified companies (2)	$\bar{x}_1$ correct answers	$\bar{x}_2$ correct answers	Variance SD^2_1	Variance SD^2_2
Food handlers	568	172	86,29%	74,84%	1,81%	1,79%
Haccp team members	30	50	77,83%	69,30%	1,52%	2,28%

Training of food handlers or HACCP team members is obligatory requirements of all food safety standards. Also, it is required by legislation relating to food in Bosnia and Herzegovina (Official Gazette Bosnia and Herzegovina, 2004). Roberts et. al., 2008, aim that training can have very significant impact on knowledge and behavior of food handlers. Seaman and Eves, 2008, aim that training of food handlers relating hygiene does not significant impact on behavior of food handlers but behavior depends of subjective norm every individual.

Our results show that food handlers who has regular yearly training have higher knowledge level relating food safety (87,26±13,34%) then food handlers who hasn't regular yearly training (79,61±14,21%). This difference is statistically significant on the level 0,01 (t=7,51; $p=1,71x10^{-13}$<0,01). Haccp team members who has yearly training relating to food safety have higher knowledge level (76,57±11,57%) then HACCP team member who has not regular yearly training (69,33±16,06%). This difference is statistically significant on the level 0,05

(t=2,33; p=0,02<0,05). (Table 6).

Table 6. Results of testing regarding training

Sample	Number of workers who has regular yearly training (1)	Number of workers who hasn't regular yearly training (2)	$\bar{x}_1$ correct answers	$\bar{x}_2$ correct answers	Variance SD^2_1	Variance SD^2_2
Food handlers	389	351	87,26%	79,61%	1,78%	2,02%
Haccp team members	35	45	76,57%	69,33%	1,34%	2,58%

When starting with apply of HACCP concept in Bosnia and Herzegovina, by the legislation first facilities who must apply HACCP concept was the food processing companies who process food animal origin (meat, milk, eggs, etc.). This obligation was stated in Decision about requirements for the facilities who process food animal origin (Official Gazette Bosnia and Herzegovina, 2005). Radovanovic et.. al, (2013) aim in their research for meat industry in Serbia that is necessary additional training of employee during HACCP implementation. So it is expected that food handlers who work in animal processing food industry has higher level of knowledge relating to the food safety. Our result shows different, the level of knowledge score for food handlers in animal processing industry (80,78±11,31%) was lower then food handlers who work in non-animal processing industry (84,71±15,10%). This difference is statistically significant with level 0,01 (t=3,81; p=0,0001<0,01). Similar is with knowledge score of HACCP team members where HACCP team members from animal processing companies have lower knowledge score (67,94±16,76%) then HACCP team members from non-animal processing companies (73,73±13,92%). But this difference are not statistically significant (t=1,30; p=0,2045>0,05) (Table 7).

Table 7. Results of testing regarding type of processing

Sample	Number of workers who work in animal food processing (1)	Number of workers who work in non-animal food processing (2)	$\bar{x}_1$ correct answers	$\bar{x}_2$ correct answers	Variance SD^2_1	Variance SD^2_2
Food handlers	203	537	80,78%	84,71%	1,28%	2,28%
Haccp team members	17	63	67,94%	73,73%	2,81%	1,94%

Food safety regulations has a big impact on international trade of food. Jongwanich (2009) aim that food safety standards imposed by developed countries could impede processed food exports from developing countries. Companies from developing countries must have enough resources to gain food safety standards of

developed countries. This include special human resources with enough knowledge.

Results from our research show that food handlers who work in exporting companies have higher level of knowledge score (84,16±14,31%) then food handlers who does not work in exporting companies (77,85±12,37%). This difference is statistically significant on the level 0,01 (t=3,78; p=0,0003<0,01). HACCP team members from the exporting companies have higher knowledge score (77,26±10,24%) then HACCP team members who work in non-exporting companies (67,23±16,97%). This difference is statistically significant on the level 0,01 (t=3,15; p=0,002<0,01).

Table 8. Results of testing regarding export orientation of companies

Sample	Number of workers who work in exporting companies (1)	Number of workers who work in non-exporting companies (2)	$\bar{x}_1$ correct answers	$\bar{x}_2$ correct answers	Variance SD^2_1	Variance SD^2_2
Food handlers	678	62	84,16%	77,85%	2,05%	1,53%
Haccp team members	42	38	77,26%	67,23%	1,05%	2,88%

4. Conclusion

Based on this questionerie survey we receive the data about knowledge regarding food safety on food handlers and HACCP team members. The overall results for konwledge level of HACCP team members are low (72,33%). This can be reason for concern, but cause of this situation can be that HACCP team are multidisciplinar and all member of HACCP team are not very familiar with food safety. On the other hand it is neceserry to develop specific traning for HACCP team members to improve their knowledge. It is also obviuos that HACCP team member who has regular training regarding food safety has a better result during examination (76,57%). Employees who work in companies who applying more strict standards (GFSI approved) in their business processess has better results on examination in case of HACCP team members (77,83%) and food handlers (86,29%). So companies should strive to adopt GFSI approved standards in their bussiness process which can be a way to get more competetive on the market and increase knowledge level regarding food safety of their workers.

It is also obvius that companies who sell their product to export market, who is more sophisticated and demanding for food safety requirements has a employee with higher knowledge score relating to food safety.

If we look at the wider situation in Bosnia and Herzegovina, large migrations of the working-age population are in progress, which certainly puts food industry ahead of great challenges. There is a great deal of fluctuation of labor in all branches, and so in the food industry, so that the conception and implementation of specific training programs related to food safety is urgently needed in all companies.

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