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IMPLEMENTATION AND FUNCTIONING OF HACCP PRINCIPLES IN THE MACEDONIAN WINERIES: A MULTIPLE CASE STUDY

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Abstract

Wine is considered as a food and must be produced under conditions that will ensure the safety of the product for human consumption. The HACCP system is the internationally recognized as a food safety tool, and must be applied during the entire food production process. The implementation of a food safety management system based on the principles of HACCP in the wineries should minimise the number and extent of exposures to hazards and improve overall safety of the wine.

In this study, an exploratory multiple case study approach was adopted in order to provide better understanding of the process of implementation and functioning of the HACCP system in the Macedonian wineries. Twelve Macedonian wineries (cases) of varying size and annual production participated in the study. Two methods for collecting empirical data have been applied: survey by applying a questionnaire sent via e-mail and face-to-face interview.

Using survey data, the key factors affecting the functioning of the HACCP system in the Macedonian wine industry were analysed. The findings provide evidence that the most common motives for the implementation of HACCP system in the wineries are: enhanced compliance with regulation, improved communication and control, and implemented traceability system. Also, the results showed that the main factors that hinder the implementation and functioning of HACCP system are: excessive documentation, lack of time, and lack of knowledge relevant to food safety (especially among micro sized wineries).

Key words: *food safety management systems, wine*

INTRODUCTION

Wine holds a profound significance within the rich history and cultural heritage of the Macedonian people. In present times, it has emerged as a crucial agricultural asset for the country. Specifically, as outlined in the 2014-2020 National Strategy for Agriculture and Rural Development, viticulture and wine production contribute approximately 17% to 20% of the agricultural Gross Domestic Product (GDP). Demonstrating its economic influence, in 2021, the Republic of North Macedonia earned the 29th spot among global wine exporters based on financial impact. (http://www.worldstopexports.com/wine-exports-country/).

In the journey from vineyard to consumer, the winery serves as a vital link in the wine production process. As a producer in the food industry, the winery assumes responsibility for overseeing the entire food chain. Considering the extensive nature of this chain, which encompasses the grape as the raw material, each stage involved in obtaining wine, including maturation, product storage, bottling, and often distribution and sale to the end consumer, it becomes evident that a comprehensive and meticulous analysis is necessary. This entails conducting risk assessments, identifying critical points, and exercising control throughout the

entire production process to ensure the quality, safety, and traceability of the final product (Marcotrigiano et al., 2020).

Given our country's strategic objective of attaining full membership in the European Union, R.N. Macedonia harmonises its national legislation, including legal frameworks pertaining to food safety in wine production, with European regulatory standards. Wine producers, as well as other food business operators, are obliged to introduce, implement and maintain a permanent procedure or procedures based on Hazard Analysis Critical Control Point (HACCP) principles, together with the application of good hygiene practices, i.e., good production practices (Law on Food Safety of RNM) in order to minimise the number and extent of exposures to hazards and improve overall safety of the wine. The HACCP system is the backbone of any Food Safety System and its application in the winery should provide a systematic preventive approach to food safety from biological, chemical, and physical hazards in production processes that can cause the wine to be unsafe, and designs measurements to reduce these risks to a safe level (Culler & Conklin, 2015).

Given that Macedonian wine has the potential to be the most significant export brand of the country's agricultural and food sector and bearing in mind that the quality and safety of wine directly affect the competitiveness of the product, our research was aimed at understanding the current situation, as well as analysis of the weaknesses, challenges and benefits of establishing quality and food safety systems in the wine sector in the Republic of North Macedonia. This paper showcases the results related to the process of implementation and functioning of the HACCP system in the Macedonian wineries.

MATERIAL AND METHODS

Qualitative research strategy - Case study

In this study, an exploratory multiple case study approach was adopted in order to provide better understanding of the process of implementation and functioning of the HACCP system in the Macedonian wineries. A case study is a research strategy that involves an empirical investigation of a specific contemporary phenomenon, conducted within its real-life context (Yin, 2009). This approach involves leveraging multiple sources of evidence and is considered appropriate for investigating organizations and companies. It is particularly useful when exploring subjects such as best practices, policy implementation and evaluation, industrial relations, management and organizational issues, organizational cultures, and processes of change and adaptation (Robson, 2016).

The research used non random sampling technique. Twelve Macedonian wineries (cases) of varying size and annual production were selected to participate in the study. To facilitate a comprehensive analysis, the selection criteria for the chosen cases encompassed both wineries that had implemented a voluntary food safety standard, as well as those that had not. Furthermore, to ensure heterogeneity and enhance the richness of the database for analysis, the selection process considered the year of establishment of the wineries and their export activities. Care was taken to include representatives from both older wineries that were formerly state-owned, before the dissolution of the Yugoslav federation in 1991, as well as relatively new wineries established within the last two decades. The selection also included wineries with a strong focus on export markets, alongside cases that exclusively target the domestic market.

Data collection

Two methods for collecting empirical data have been applied: survey by applying a questionnaire sent via e-mail and face-to-face interview. The survey questionnaire contained open-ended and closed-ended questions. For the majority of questions, extra space was provided for additional comments by the respondents, which in term made it possible to avoid limitations on answers, and the respondents had the opportunity to provide a broader overview of the questions of interest for the research. The interviews were semi-structured, mostly with open-ended questions. All the chosen wineries, which had been contacted and agreed to take part in the study, completed the survey questionnaire. Subsequently, to delve deeper into the subject

of our research and gain a more comprehensive understanding of the voluntary food safety and quality systems in Macedonian wineries, interviews were conducted in five wineries. Each interview involved two company representatives. A representative from the management and a person responsible for managing quality and food safety systems in the winery were interviewed, as persons who are directly involved in the decision-making process and implementation of quality and food safety systems. The names of the interviewees were protected, and they were identified by their job positions. The interviews were prearranged and conducted in person, that is, face to face between the researcher (interviewer) and the surveyed (interviewed) person. During the interview, spontaneous questions that lead one to the next were also asked. The results of the survey questionnaire and the interview were used to produce a case study for each winery and as such were prepared for analysis.

In addition to the primary data provided through the survey questionnaire and interviews, the research also used secondary data like reports from relevant organizations, winery websites, as well as other published materials in order to obtain a more diverse information basis for analysis. The implementation of a multi-source data collection strategy was intended to facilitate the utilization of triangulation during data analysis. This scientific research approach, implemented throughout various stages of our investigation, aimed to uphold the credibility of the qualitative research.

Data analysis

Using survey data, the key factors affecting the functioning of the HACCP system in the Macedonian wine industry were analysed. In the process of analysis and conclusion in the research, the inductive-deductive process was applied, as an appropriate methodological approach in case studies (Perry, 1998). The analysis of the data from our qualitative research was conducted in three phases: (i) In the first phase of the analysis, the qualitative data obtained from the survey questionnaire and the interviews were recorded and summarized. To ensure anonymity, as well as to organize the data in further analysis, each winery was assigned a code consisting of one letter and one number. The letters refer to the size of the company, and the classification was made according to the number of employees. In accordance with the recommendations of the European Commission (96/280/EC), regarding the definition of the size of enterprises, in our research, when coding, an enterprise with less than 10 employees is ranked in the Micro group; with more than 10, but less than 50 employees is ranked in the Small group and with more than 50 and less than 250 employees – Medium enterprise (winery). Hence, we have "C" for medium, "M" for small and "Ми" for micro-wineries. The number next to the corresponding letter in the code represents the average annual production level of the winery in the last 5 years, and the lowest number (1) refers to the lowest average annual production. The results of the survey questionnaire, interviews, and data from other sources were categorized with codes, recorded, and compiled. This process allowed for condensing the data into relevant information for the research and generating twelve case studies based on it. (ii) In the second stage of the analysis, in order to identify the similarities or differences between the cases, the obtained data were further selected and organized in tables according to the research questions. (iii) In the third stage, building upon the previous analysis, the data underwent further examination, incorporating insights from the reviewed existing literature on the topic, which in turn lead to the deriving and confirming research conclusions.

RESULTS AND DISCUSSION

Sample characteristics

Based on the applied coding criteria, five micro-wineries (Ми1, Ми2, Ми3, Ми4 and Ми5), three small wineries (M1, M2 and M3) and four medium-sized wineries (C1, C2, C3 and C4) were included in our research. Five of the wineries (M2, M3, C2, C3 and C4) have an average annual production of more than 1,000,000 litres of wine, while the remaining seven wineries are characterized by an average annual wine production of less than 1,000,000 litres. The characteristics of the selected wineries on bases on the main criteria are presented in the Table 1.

Table 1. Winery characteristics.

Winery code	Year of establishment	Employees	Average annual production (L)	Export orientation (% of the total amount of wine sold annually)
Ми1	2008	4	10 000 (60% bulk, 40% bottled)	70%
Ми2	2010	2	12 500 (60% bulk, 40% bottled)	0%
Ми3	2006	3	50 000 (50% bulk, 50% bottled)	10%
Ми4	1997	8	160 000 (70% bulk, 30% bottled)	0%
Ми5	2003	9	203 000 (100% bottled)	70%
M1	2006	40	56 231 (5% bulk, 95% bottled)	2%
M2	1928 (last change of ownership-2016)	35	2 214 500 (>99% bulk)	91%
M3	2008	44	3 000 000 (80% bulk, 20% bottled)	75%
C1	1998	54	412 225 (100% bottled)	45%
C2	2002	100	3 690 440 (10% bulk, 90% bottled)	80%
C3	1979 (last change of ownership-2019)	92	7 800 000 (80% bulk, 20% bottled)	85%
C4	1883 (last change of ownership-2004)	195	14 000 000 (100% bottled)	50%

Of the five micro wineries covered in our research, three (Ми1, Ми2, Ми4) are focused more on the production of bulk wine, one winery (Ми3) produces an equal amount of bottled wine and bulk wine, and the Ми5 winery produces solely bottled wine. In small and medium-sized wineries, with the exception of wineries M2 and C3, bottled wine is the dominant product. Considering that both wineries that are an exception (M2, C3) were going through a transitional period in the research period - changes in ownership and financial challenges, it is plausible that these factors contributed to the witnessed state of affairs. From the analysis of data, it was determined that bottled wine convincingly dominates the export of wine, and with the exception of wineries (Ми1, C3) all other wineries exporting wine to foreign markets, almost exclusively market bottled wine.

Table 2 presents the situation concerning the implementation of the HACCP system in wineries. From the data shown, it is clear that all 12 selected wineries as of 2020 have implemented and operate according to the HACCP principles. But when conducting the questionnaire and initial data processing, at the beginning of 2018, two micro wineries (Ми2, Ми4) had not implemented the HACCP system. The Ми2 winery was not ready to introduce it, while in the Ми4 winery the implementation was underway, and the system was implemented in November 2018.

Table 2. presents the situation concerning the implementation of the HACCP system in wineries.

Winery	Implementation of the HACCP system		Engagement of External Expertise in Implementation
	2018	*2020*	
Ми1	+	+	yes
Ми2	-	+	yes
Ми3	+	+	without external expertise
Ми4	on-going	+	yes
Ми5	+	+	yes
М1	+	+	yes
М2	+	+	yes
М3	+	+	yes
С1	+	+	yes
С2	+	+	yes
С3	+	+	yes
С4	+	+	without external expertise

(+) implemented HACCP system

In Table 2 it can also be seen that the implementation of the HACCP system in 10 wineries (82%) was carried out with the help of an external expert, and 2 wineries (18%) independently implemented the system (С4, Ми3). It is interesting to comment that the two wineries that have independently implemented the system belong to different groups of wineries according to the criteria we adopted in the research. Namely, winery С4 is a medium-sized winery with 195 employees, including an employee in the position of Food Safety and Quality Control Manager, while the other, Ми3, is a micro winery with only three employees, among which there is no expert with knowledge relevant to food safety. The winery Ми3 stated that it was more convenient for them to invest in their own education and learning for the implementation of the system, than to pay an external expert. Unlike these two wineries, most of the surveyed managers and employees in the quality and safety sector in the other wineries stated that it is much better to hire an external expert because they have too many other obligations. The results of our study confirm the position of Mensah & Julien (2011), who consider that enterprise size has no significant effect in terms of motivation, benefits and challenges to compliance with food safety regulation. In accordance with the results obtained in our research, it seems that although Macedonian wineries most often decide to seek external expert assistance for the implementation of the system, the subsequent stages of the application of the system and the management of all activities are conducted independently.

Critical Control Points (CCPs) determination when conducting wine safety risk analysis is essential in the HACCP system. CCPs are the steps in the process where a control measure is applied and is essential to prevent, eliminate or reduce to an acceptable level the identified food safety hazard(s). Table 3 shows the number of CCPs determined per winery. The obtained data showed that winery Ми1 has the most (6) CCPs, and winery С1 has the least (1).

Table 3. Identified Critical Control Points (CCPs) in the wineries.

Winery	CCP1*	CCP2	CCP3	CCP4	CCP5	CCP6	Total CCPs
Ми1	x	x	x	x	x	x	6
Ми2		x	x			x	3
Ми3			x	x			2
Ми4	x	x					2
Ми5	x		x	x			3
M1		x		x		x	3
M2	x	x		x			3
M3	x		x				2
C1				x			1
C2			x	x		x	3
C3			x			x	2
C4	x			x	x	x	4
Total	6	5	7	8	2	6	

CCP1 - adding oenological agents CCP2 - grape receival
CCP3 - filtration CCP4 - bottling
CCP5 - stabilization CCP6 - storage

** the number in the CCP mark is not related to the order of occurrence of CCPs in the production process*

Literature sources do not provide a definitive stance on the exact number of Critical Control Points (CCPs) that wineries should identify. This determination is made by the hazard analysis team responsible for developing the HACCP plan. As a result, each winery independently establishes the number of CCPs based on their specific requirements. Kourtis & Arvanitoyannis (2001) consider seven critical control points in the wine-making process. It is also interesting to comment on the publication by the New Zealand Food Safety Agency, Code of Practice for grape wine WSMP (2011), which does not establish any CCPs in the wine-making process. The Agency believes that the control of hazards can be adequately achieved through the Code of Practice, that is, by observing good manufacturing or hygiene practice.

When comparing the findings of our research with the data presented in the publication "Macedonian Wine Industry Performance Survey 2009" (Velkov, 2010), it becomes evident that a great improvement has been achieved regarding the implementation of the mandatory HACCP system, as well as voluntary standards in the Macedonian wineries. In contrast to the situation determined in our research – implemented HACCP system in all 12 wineries in 2020, in the survey conducted in 2009 - out of 57 wineries included in the research, only 26 had implemented the HACCP system (less than half).

Cross case analysis

The analysis of the obtained data among wineries (Cross case analysis) made it possible to determine the motives and aggravating factors for implementation and functioning of the HACCP system in Macedonian wineries:

MOTIVES for the implementation of HACCP system in the wineries

- Enhanced compliance with regulation
- Improved communication
- Improved control (e.g. implemented traceability system)

HINDERING FACTORS for implementation and functioning of HACCP system

- Excessive documentation
- Lack of time
- Lack of knowledge relevant to food safety (especially among micro sized wineries).

The survey data obtained showed that wineries (Ми1, Ми2, Ми3, M2) feel that the implementation of the system is more help in terms of monitoring documentation and procedures but are not convinced that the implementation of the system is a guarantee of product safety. The larger wineries (M3, C1, C3, C4), which have implemented voluntary standards in wineries, believe that the

implementation and functioning of the system guarantees product safety and is an excellent basis for the implementation of voluntary standards (IFS, ISO 22000, ISO 9001, ISO 14001, etc.) and international trade. Fairman & Yapp (2004) point out that micro and small businesses typically show insufficient knowledge and skills regarding food safety, hence are not aware of the risks posed by business and are not motivated to improve the food safety system. Therefore, for the implementation of such systems in these companies, the role of state bodies (inspectorate) that would encourage them in the process of compliance with legal provisions is of particular importance.

Regarding the engagement of professional staff for food safety management, survey results showed that the lack of staff is more pronounced in smaller wineries. Namely, in most micro wineries (three out of five) and one small-sized winery (M1) there is no expert employee with formal knowledge relevant to food safety, but this is done by an employee who is assigned this task and performs it in parallel with other work tasks. In the other small and all medium-sized wineries, it was stated that the winery has an employee with formal knowledge relevant to food safety who takes care of the management of the HACCP system. Often these persons are also engaged in the production process (oenologists, technologists), and only wineries C3 and C4 stated that they have a person employed in the position of Food Safety and Quality Control Manager. In the comment on this situation, it was indicated that this is not required by law, or rather they say: *"...no one requires us legally to have a person employed in the position, so we manage in a way that is easier for us, we do not pay plus, and the work is done"*. The findings of Aggelogiannopoulos et al. (2007) align with the results obtained in this study. Their research examined the implementation of the voluntary quality management standard ISO 9001 and concluded that smaller companies within the wine sector face challenges in allocating a dedicated employee solely responsible for system management. Instead, these companies often distribute system-related tasks among existing employees, imposing additional responsibilities on them and thereby making implementation more challenging.

Record keeping in compliance with standard requirements was highlighted as a challenging aspect of implementing and operating the HACCP system in the majority of wineries. This was attributed to the time-consuming nature of documentation tasks and the need for trained staff to carry them out. In this context, it is interesting to bear in mind that barriers, such as time and finance, can conceal deeper and more complex attitudes in enterprises, including distrust of food safety legislation, lack of motivation in dealing with requirements regarding food safety legislation, and lack of knowledge and education (Yapp & Fairman, 2006).

The results of our analysis showed that all wineries have the full support of the management to create an environment conducive to improving the quality and safety of the product. Regarding the support of the HACCP system by the other employees in the wineries, it can be concluded that employees support the system once it is established and begins to function, but at the beginning of the implementation most wineries encounter resistance from the employees, who found it harder to get used to the new way of operating and keeping records. The wineries applied different strategies to overcome the problem: training, regrouping of working groups, additional education, and, if necessary, sanctions. After the conducted trainings and years of operation, today in the wineries the system is accepted, and the procedures are perceived as a common integral part of the overall process.

CONCLUDING REMARKS

The requirements that ensure quality during the entire winemaking process and safeguard against relevant hazards have become important to consumers and mandatory for protecting human health. When it comes to wine, the risks associated with quality typically involve sensory aspects such as taste, colour, clarity, aroma, and the presence of specific components that make it an appealing and desirable product for consumers. Conversely, safety hazards can be categorized into physical risks (e.g., metal or glass fragments),

chemical hazards (such as pesticide residues, sulphur dioxide, heavy metals, or urea), and microbiological threats (e.g., the presence of pathogenic organisms), all of which pose potential health risks to consumers. The risk associated with microbial contamination is generally considered to be relatively low in the final product, given that the presence of alcohol and polyphenols, as well as the pH value of wine make the product an unsuitable environment for the existence of pathogenic microorganisms, but nevertheless, identification of all potential hazards and retrieval of appropriate preventive and corrective actions is of primary importance to minimize the outbreaks of incidents in the wine sector that are hazardous for human health (Kourtis & Arvanitoyannis, 2001). Considering that wine is a strategic product in the agri-food sector of the country, the improvements of the food quality and safety management systems in the Macedonian wineries will contribute to increasing the competitiveness of Macedonian wine through increased consumer confidence and improved product image, and this will also provide an economic benefit to both the company and the state.

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ИМПЛЕМЕНТАЦИЈА И ФУНКЦИОНИРАЊЕ НА НАССР ПРИНЦИПИТЕ ВО МАКЕДОНСКИТЕ ВИНАРИИ: СТУДИЈА НА ПОВЕЌЕ СЛУЧАИ

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Резиме

Виното како прехранбена намирница мора да се произведува во услови кои ќе обезбедат безбедност на производот за човечка употреба. HACCP (Hazard Analysis Critical Control Point) системот е меѓународно признат систем за безбедност на храна, кој задолжително се применува во текот на целиот процес на производство. Имплементацијата на систем за управување со безбедноста на храната заснована на принципите на HACCP во винариите треба да го минимизира бројот и степенот на изложеност на опасности и да ја подобри севкупната безбедност на виното.

Во ова истражување беше примената студија на повеќе случаи (multiple case study), како методолошки пристап со цел да се обезбеди подобро разбирање на процесот на имплементација и функционирање на HACCP системот во македонските винарии. Во истражувањето учествуваа 12 македонски винарии (случаи) со различна големина и годишно производство. Применети се две методи за собирање емпириски податоци: анкета со примена на прашалник испратен преку е-пошта и интервју лице в лице.

Анализата на добиените податоци овозможи да се извлечат заклучоци во однос на факторите кои влијаат на функционирањето на HACCP системот во македонската винска индустрија. Наодите даваат доказ дека најчестите мотиви за имплементација на HACCP системот во винариите се: усогласеност со законската регулатива, подобрена комуникација и контрола и имплементиран систем за следливост. Исто така, анализата покажа дека главни фактори кои ги попречуваат имплементацијата и функционирањето на HACCP системот се: обемната документација, недостаток на време и недостаток на знаење релевантно за безбедноста на храната (особено кај винариите со микро големина).

Клучни зборови: *системи за управување со безбедноста на храната, вино.*