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Assistance Needed for Increasing Knowledge of HACCP Food Safety Principles for Organic Sector in Selected EU Countries

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Abstract: There are numerous food safety aspects that must be taken into consideration by organic food producers and processors to ensure the safety and quality of their products. The application of Hazard Analysis and Critical Control Point (HACCP) principles, together with the implementation of good hygiene practices (GHP), ensures that food safety and process hygiene criteria are met. This study was based on a survey conducted among 316 producers and processors representing the organic food sector in five European countries (Croatia, Estonia, Germany, Italy and Poland). The knowledge and experience of organic food operators with HACCP systems were evaluated. Moreover, their needs and expectations towards assistance (training, guidance materials) that could improve the level of knowledge and compliance with respective food safety rules and regulations were assessed. The need for support on a number of issues related to food safety and guidance documents on the application of HACCP principles were also identified. This study provides highlights of the application of HACCP principles, with particular focus on identifying priorities and needs for two types of food operators (food producers and food processors). Although most of the surveyed food operators were confirmed to have basic knowledge regarding the HACCP system, there was a lack of understanding of the system principles. The needs and expectations varied among the studied countries and types of organic operators. Recognition of the full potential of the HACCP system requires assistance, particularly in the preparation of documents and records. Further research is needed to understand the implications of these findings and to identify effective strategies to improve the HACCP knowledge of food operators.

Keywords: organic producers; organic processors; food safety; HACCP knowledge; Croatia; Estonia; Italy; Germany; Poland

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1. Introduction

Since the dawn of agriculture, food systems have been continuously evolving, with each change bringing new benefits and challenges, as well as increasing diversity and complexity [1]. Today's food systems are global, diverse, complex and large-scale, which increases the risk of a greater population being affected in case of any food safety outbreaks. According to the general requirements of food law, food shall not be placed on the market if it is unsafe [2]. Food is considered unsafe if it is injurious to health or unfit for human

consumption [2]. The Regulation on microbiological criteria of foodstuffs (No 2073/2005) states that food business operators at each stage of food production, processing and distribution, including retail, must take measures to ensure that food safety and process hygiene criteria are met as part of their procedures, based on Hazard Analysis and Critical Control Point (HACCP) principles, together with the implementation of good hygiene practices (GHP). The Regulation (EC) No 852/2004 of the European Parliament and of the Council of 29 April 2004 on the hygiene of foodstuffs requires all food business operators to implement a system based on the HACCP principles developed by the Codex Alimentarius Commission (Reg. 852/2004) [3]. It also provides a definition of hazard, stating that a "hazard" is a biological, chemical or physical substance in food or feed, or a condition of food or feed, that may cause an adverse health effect [4]. Codex Alimentarius states that people have the right to expect the food they eat to be safe and suitable for consumption [5]. It defines food safety as the assurance that food, when prepared and/or consumed as intended, will not cause adverse health effects to the consumer. This definition applies to both conventional and organic food production.

According to [6], organic production is defined as "an overall system of farm management and food production that combines best environmental and climate action practices, a high level of biodiversity, the preservation of natural resources and the application of high animal welfare standards and high production standards in line with the demand of a growing number of consumers for products produced using natural substances and processes". According to the EU's Action Plan [6], organic farming is crucial for the production of high-quality food with low environmental impact. The EU legislation [6] specifies, among others, that organic crops are cultivated without the use of synthetic chemical plant protection agents, easily soluble synthetic nitrogen, phosphorus and potassium fertilizers, and synthetic growth regulators. Specific rules and limitations have also been established for organic food processing [6]. There is a growing number of consumers searching for high quality foods produced with natural substances and processes [7], and thus the demand for organic products is dynamically increasing all over the world. The EU is one of the most important markets for organic foods globally [8], with organic retail sales amounting to EUR 46.7 billion in 2021. The largest market for organic products in the EU in 2020 was Germany, with retail sales of EUR 15.9 billion, followed by France (EUR 12.7 billion) and Italy (EUR 3.9 billion). The consolidated data for 2021 shows continued retail sales growth in most European countries [8]. According to the EU's Farm to Fork Strategy, at least 25% of agricultural land in the EU should be farmed organically by 2030 [9,10]. The total organic farmland in the EU has already increased by 6.1 million hectares from 2012 to 2021, reaching 15.6 million hectares in 2021, managed by almost 380,000 producers [6]. Among all EU Member States, France, Spain and Italy are identified as the top three countries with the largest organic agricultural area (with 2.8, 2.6 and 2.2 million hectares, respectively) [6]. At the same time Austria and Estonia have shown the highest shares of organic farmland in their total agricultural land (26.5% and 23.0%, respectively) [8].

Organically produced foods have previously been reported to show some beneficial quality characteristics as well as several positive food safety aspects [11–14]. This is due to the fact that organic food production and processing are subject to regulations setting strict limits on the substances, additives, methods and conditions that can be applied in agricultural production as well as the processing of food and feeds [6,12,15,16]. However, the restricted use of food additives, especially preservatives, may lead to the need for advanced awareness and knowledge of food operators on numerous food safety aspects that must be taken into consideration to assure high quality and safety standards of organic products [17], and to avoid/minimize the risk of food safety outbreaks [18].

Therefore, increased interest among food sector entrepreneurs in the food safety aspects related to the production of organic foods can be expected. Not only the legal requirements for organic food production, but also various aspects of food safety, including the effectiveness of self-control systems, need to be considered by organic producers and processors. There are many materials (publications, manuals, guides) available re-

ferring to food safety for conventional food products [19–25] and knowledge about food safety among conventional food producers and even consumers [26–28]. However, there is an extremely limited number of educational resources available for organic food safety teaching. This situation causes a gap in the availability of teaching materials for educators and organic stakeholders. There are no teaching materials on food safety in relation to organic food that would combine the subject of food safety with the legal, production and hygienic requirements for organic food. The currently available food safety teaching programs and materials do not include the organic production requirements and do not meet the specific conditions of organic producers. Moreover, there is very limited scientific research looking at the level of, and gaps in, food safety knowledge of European organic entrepreneurs and their expectations towards education in this subject area. Thus, the present study, conducted within the framework of the European project "Transnational Quality Education for Organic Food Safety" (SAFE-ORGfood), aimed to assess the knowledge of organic food business operators in selected EU member states about the HACCP system, plus the implementation of a self-control system based on the HACCP principles, as well as expectations towards assistance (training, educational materials) that could improve the level of knowledge and compliance with respective food safety rules and regulations. Specific objectives of this study were to check the knowledge of organic food producers and/or food processors about the HACCP concept/term, the existence of a functional HACCP-based self-control system in their enterprises, and finally the needs and expectations for training and guidance/educational materials addressing specific food safety areas and particular HACCP principles.

2. Materials and Methods

2.1. The Survey

This study was conducted in 2022 in five European countries: Croatia, Estonia, Germany, Italy and Poland. The survey was designed and conducted by researchers representing partner universities of the European SAFE-ORGfood project (http://safe-orgfood.eu,), including University of Zagreb (UNIZG, Zagreb, Croatia), Estonian University of Life Sciences (EMU, Tartu, Estonia), Münster University of Applied Sciences (MUAS, Münster, Germany), University of Tuscia (UNITUS, Viterbo, Italy), Warsaw University of Life Sciences (WULS, Warsaw, Poland). The SAFE-ORGfood project aimed to diagnose food safety training needs and knowledge gaps in the participating countries, in order to attune project activities and outcomes (teaching and training materials) towards the identified needs. Thus, the selection of countries for the survey reflected the composition of the SAFE-ORGfood project consortium. The participating countries are characterized by various developmental stages, sizes and dynamics of the organic sector, as well as various strategies and focuses of agricultural and food policies, which allows us to investigate interesting trends and differences among the countries in the area of the studied topic. The following analysis is based on responses to a questionnaire distributed electronically among farmers and companies representing the organic food sector (production and/or processing) in these five countries.

2.2. Description of the Questionnaire

The online questionnaire was composed of twelve closed-ended questions, divided into three sections (Table S1). It was designed in English, and then translated into the national languages of the five participating countries. The questionnaire was developed based on previous studies, the knowledge of participating researchers in the field of food safety including teaching and training, and in accordance with the requirements of European Union Regulation No 852/2004. The first section of the questionnaire included basic questions about the farm/company type, size, main products and organic certification. The second section was focused on knowledge of the HACCP system, implementation of a functional HACCP-based self-control system in the company/farm, and previous participation of the respondents in food safety training/courses. The last section consisted of five questions related to the respondents' needs and expectations concerning assistance, training

and advice on a range of food safety issues, and specifically on implementing the seven HACCP principles plus the expected and preferred forms of food safety materials/guidance documents and training.

2.3. Characteristics of the Surveyed Operators

The survey was distributed among over 2000 organic food operators. The inclusion criteria for participants were as follows: (1) producers and/or processors of organic food (owners/representatives of farms and food processing enterprises—one per farm/enterprise), (2) adults (≥18 years old), (3) residing in Croatia, Estonia, Germany, Italy or Poland, (4) interested in participating in the study, (5) having access to the Internet. Each person who agreed to participate in the survey was asked to complete the questionnaire according to the best of his/her knowledge. After excluding the results of 14 respondents who did not fully complete the questionnaire, data from 316 organic producers and/or processors were analyzed. The most common participating nationality was Italy (n = 97), followed by participants from Estonia (n = 75), Poland (n = 52), Croatia (n = 50) and Germany (n = 42).

Activity. To improve comparability among participants within each country, it was necessary to divide respondents into two broad categories. The first category included primary food producers (farmers), and the second category included food processors and those whose activity combined both food primary production and food processing. The distribution of respondents based on their activity/type is shown in Table 1. Across countries, the majority of respondents (68%, n = 215) were engaged in food processing (Group 2), while the remaining participants were exclusively organic producers (Group 1). In every country, the number of participants representing Group 2 was higher compared to Group 1. However, in Croatia and Italy, the difference in the size of these two groups was not statistically significant, while in Estonia 96% of respondents represented Group 2. This distribution resulted from the specificity of organic production in the countries participating in the study.

Organic certification. The percentage of certified organic farms among respondents representing each country is shown in Table 1. Of the total number of respondents (n = 316), more than 80% (n = 260) were certified as organic producers/processors. This result was consistent among all countries except for Poland, where only 56% respondents declared that they were certified as organic operators (producers and/or processors) by authorized certifying bodies.

Size. The distribution of size among the 316 organic operators surveyed within the study is shown in Table 1. Overall, the vast majority of respondents (95%) represented operators with 1–50 employees. Approximately 55% (n = 175) of respondents represented small family farms (1–2 employees), 17% large family farms (3–5 employees), 12% micro farms (6–9 employees) and another 12% small farms (10–49 employees). Small family farms belonged to the most sizable group in this study, both in the individual countries and in the overall studied population. In Croatia, representatives of small family farms accounted for 80% of all respondents.

Products. Respondents were asked to indicate the types of products their farm/company produces, based on a list of eleven product categories (see Table 1). The most common product group reported was fruits (42%), while meat of small farm animals (rabbits, hares, rodents) and fish and fishery products were the least common (1% and 2%, respectively). In Croatia, almost 80% of respondents were fruits producers/processors, and 54% were vegetable producers/processors. Fruits and vegetables also dominated among the types of products produced and/or processed by the Polish respondents (60% and 44%, respectively). Among study participants from Estonia, fruits also represented the most common product (about 40%), followed by cereals (24%). Oil cultures and products were the most common category among Italian respondents (41%), followed by cereal grains (31%). Animal products, including especially meat of large farm animals (cattle, buffalo, horses, pigs, sheep, goats) (38%), poultry meat (24%) and milk and dairy products (31%) dominated among the types of foods produced and/or processed by German study participants. Other products such as cereals and fruits were also often indicated among foods produced by German respondents.

Table 1. Characteristics of the surveyed food business operators, represented by the frequency (*n*) and percentages (%) of answers, overall and within each country. Within each country, different lower-case letters indicate significant differences ($p < 0.05$) (vertically) for each question. Different upper-case letters indicate significant differences ($p < 0.05$) for the same answer among countries (horizontally).

		Number (*n*) and Percentage (%)					
Question	**Answers**	**Croatia (*n* = 50)**	**Estonia (*n* = 75)**	**Germany (*n* = 42)**	**Italy (*n* = 97)**	**Poland (*n* = 52)**	**Overall (*n* = 316)**
1. What type of farm do you represent?	1. Exclusive food producer	24aB (48)	3bC (4)	14bB (33)	42aA (43)	18bB (35)	101b (32)
	2. Exclusive food processor or food processor and producer	26aB (52)	72aA (96)	28aB (67)	55aA (57)	34aB (65)	215a (68)
2. What is the size of your farm?	1. Small family farm (only 1–2 employees)	40aA (80)	38aA (51)	22aB (52)	54aA (56)	21aB (40)	175a (55)
	2. Large family farm (3–5 employees)	4bB (8)	13bA (17)	10bAB (24)	11bAB (11)	16aA (31)	54b (17)
	3. Micro (6–9 employees)	4b (8)	8bc (11)	5c (12)	9bA (9)	11a (21)	37bc (12)
	4. Small (10–49 employees)	2bB (4)	12bA (16)	4cB (10)	13b (13)	3bB (6)	34c (11)
	5. Medium (50–249 employees)	0b (0)	4c (5)	1c (2)	8b (8)	0b (0)	13d (4)
	6. Large (>250 employees)	0b (0)	0c (0)	0 (0)	2 (2)	1b (2)	3e (1)
3. Are you a certified organic producer/processor?	1. Yes	43aB (86)	67aA (90)	37aB (88)	84aA (87)	29aB (56)	260a (82)
	2. No	3bB (6)	1bB (1)	2bB (5)	3bB (3)	13bA (25)	22b (7)
	3. Partly certified (certain products, certain production lines)	2b (4)	7b (9)	3b (7)	10b (10)	4c (8)	26b (8)
	4. Certifying process is ongoing	2b (4)	0b (0)	0b (0)	0b (0)	6bc (11)	8c (3)
4. What kind of products do you process?	1. Fruits, berries or/and products thereof	39aA (78)	29aAB (39)	13abC (31)	20abBC (21)	31aAB (60)	132a (42)
	2. Vegetables or/and products thereof	27aA (54)	12bBC (16)	6bcC (14)	13bcBC (13)	23aAB (44)	81b (26)
	3. Cereal grains or/and products thereof	5bC (10)	18abAB (24)	15abB (36)	30abA (31)	10bBC (19)	78b (25)
	4. Bakery products	0b (0)	6bc (8)	4bc (10)	8cd (8)	3c (6)	21d (7)
	5. Herbs and spices or/and products thereof	3bC (6)	14bA (19)	4bcBC (10)	11bcAB (11)	11bAB (21)	43c (14)
	6. Oil cultures and products thereof	10bB (20)	6bcBC (8)	2cC (5)	40aA (41)	1cC (2)	59bc (19)
	7. Meat of large farm animals (cattle, buffalo, pig, sheep, goat)	4b (8)	9bc (12)	16a (38)	10bc (10)	10b (19)	49c (16)
	8. Meat of small farm/livestock animals (rabbit, hare, rodent)	0b (0)	0c (0)	1c (2)	2c (2)	1c (2)	4e (1)
	9. Poultry meat (chicken, duck, turkey, quail)	0b (0)	4c (5)	10ab (24)	2c (2)	7bc (13)	23d (7)
	10. Milk and dairy products	3bB (6)	11bA (15)	13abA (31)	12bcA (12)	2cB (4)	41c (13)
	11. Fish and fishery products	0b (0)	2c (3)	1c (2)	4cd (4)	0c (0)	7e (2)

2.4. Statistical Analyses

Before the analysis, the internal consistency and reliability of the data were checked with the Cronbach's alpha test. The value of the alpha coefficient for all questions of the survey was 0.79, which confirmed satisfactory consistency of the data and thus qualified the data for further analysis.

The statistical analyses were performed using R Studio (version R-4.1.0). Data on the characteristics of respondents, their knowledge and experience in food safety, and their needs/expectations for guidance and assistance in dealing with problems related to organic food safety are expressed as number (n) and/or percentage (%) of respondents and summarized in tables or figures. Chi-square test (χ^2) was used to detect group differences using frequency (counts) data. In addition, χ^2 was used to assess the association or difference between categorical variables. Accordingly, differences within categories in each country, as well as in the overall sample, were tested using the Chi-square test with the chisq.test function of the stats package, followed by a pairwise comparison with the chisq.multcomp function of the RVAudeMemoire package [29] using the Bonferroni correction of the *p*-value.

In addition, multiple correspondence analysis (MCA) was used as a popular descriptive technique to examine relationships or patterns among multiple categorical variables. It was used to determine whether/how participants from different countries responded differently to each question. MCA was performed using the MCA function of the FactoMinerR package [30]. All statistical thresholds were set at a significance level of 0.05.

3. Results

3.1. Knowledge of the HACCP Concept

Figure 1 shows the percentage of participants who declared their knowledge of the HACCP concept, overall and within each country. Among respondents from all countries, only 15% stated that the HACCP concept was not known to them ($\chi^2 = 158.78$, $p < 0.001$). The highest percentage of organic entrepreneurs who knew the HACCP concept was found among Italian respondents (96%), followed by Estonians (89%). In Germany, Poland and Croatia the percentage of participants declaring to know the HACCP concept was significantly lower (74%, 75% and 80%, respectively).

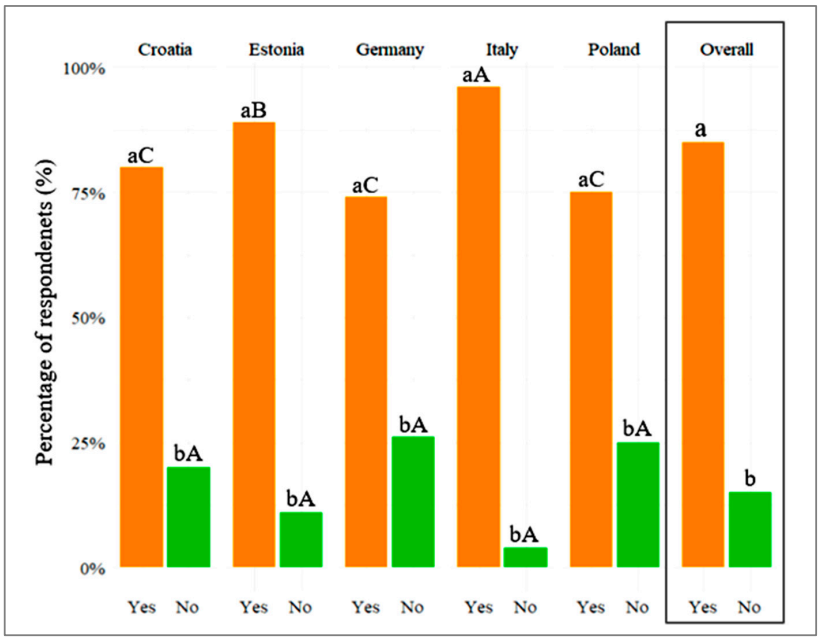

Figure 1. Percentage of participants who knew the HACCP concept, overall and in each country. Within each country, different lower-case letters indicate significant differences ($p < 0.05$). Different upper-case letters indicate significant differences ($p < 0.05$) for the same answer among countries.

3.2. The Application of a Functional Self-Control System Based on the HACCP Principles

The percentage of respondents who declared they have a functional self-control system based on HACCP principles in their enterprises/farms is shown in Figure 2. Although 85% of the respondents declared they know the HACCP concept, only 57% declared they have a functional self-control system in place based on the HACCP principles. About 30% of all participants reported that they did not have a functional self-control system in place based on the HACCP principles.

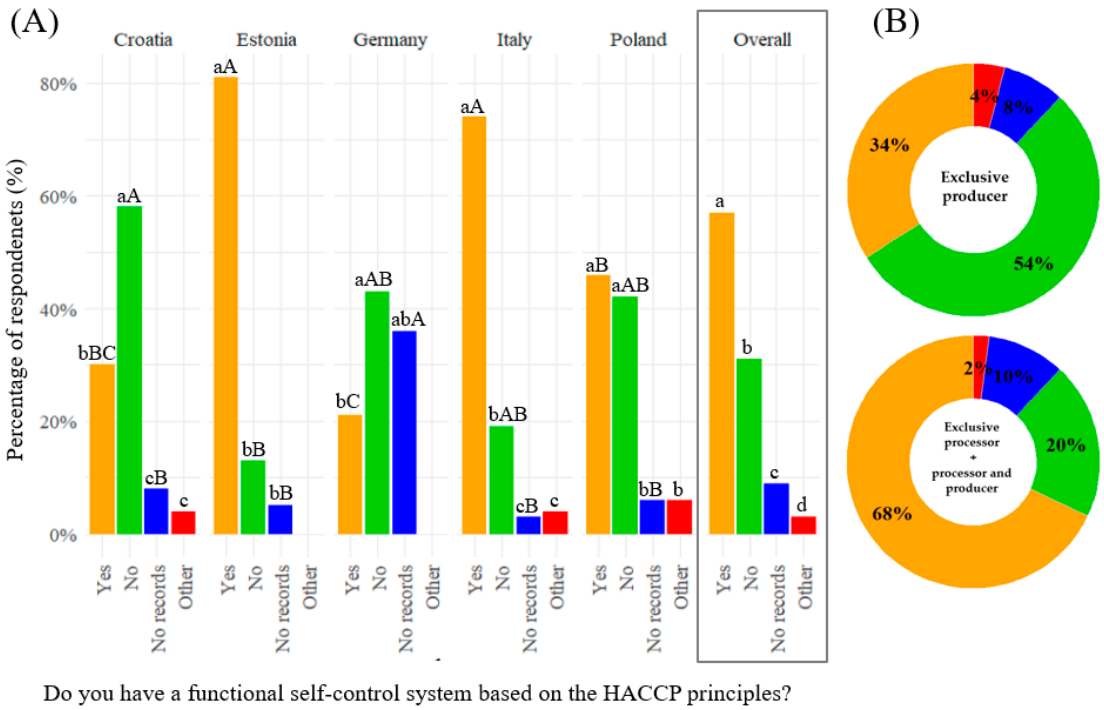

Figure 2. The percentage of operators with a functional self-control system based on HACCP principles, overall and in each country. (**A**). Within each country, different lower-case letters indicate significant differences ($p < 0.05$). Different upper-case letters indicate significant differences ($p < 0.05$) for the same answer among countries. Donut plots (**B**) show the differences between operator types (exclusive producer; exclusive processor + processor and producer) in terms of a functional self-control system in place.

In Estonia and Italy, 80% and 74% of participants, respectively, reported they have such a self-control system in place. On the other hand, the majority of participants in Croatia (58%) admitted that they did not have such a functional system (58%) in their farms/companies. In Germany, 44% of respondents indicated the lack of a functional self-control system, while 36% of respondents confirmed they have HACCP documentation but no records of its practical functionality. In Poland, 40% of respondents indicated they have a functional HACCP system in place, and a similar percentage reported the lack of such a system.

A significant relation ($\chi^2 = 43$, $p < 0.001$) was found between the type of operator (exclusive primary food producer or producer engaged in food processing) and the presence of a functional self-control system based on HACCP principles. About 54% of exclusive food producers reported not to have a self-control system in place, while only 20% of respondents representing the group of exclusive food processors or those who both produce and process foods in their enterprises reported the lack of such a functional system. The highest percentage of participants with a functional self-control HACCP-based system was identified among exclusive food processors.

3.3. Participation in Food Hygiene/Safety Training

Figure 3 summarizes information about food safety training attended by the study participants. Only 16% of all participants have not attended any food safety training in the past. Overall, around 45% of participants have attended only basic food hygiene training (one-day course) and 36% have attended several short courses. On the other hand, 27% of participants have attended advanced food safety training (three-day course). In Germany, 55% of participants have attended basic training (one-day course) and 38% have attended several short courses. Among Estonian respondents, about 60% have attended several short courses. The highest percentage of participants who attended advanced food safety training was recorded in Italy (45%) and Estonia (31%). The highest percentage of participants who had not attended any food safety training in the past was recorded in Croatia (36%) and Poland (27%).

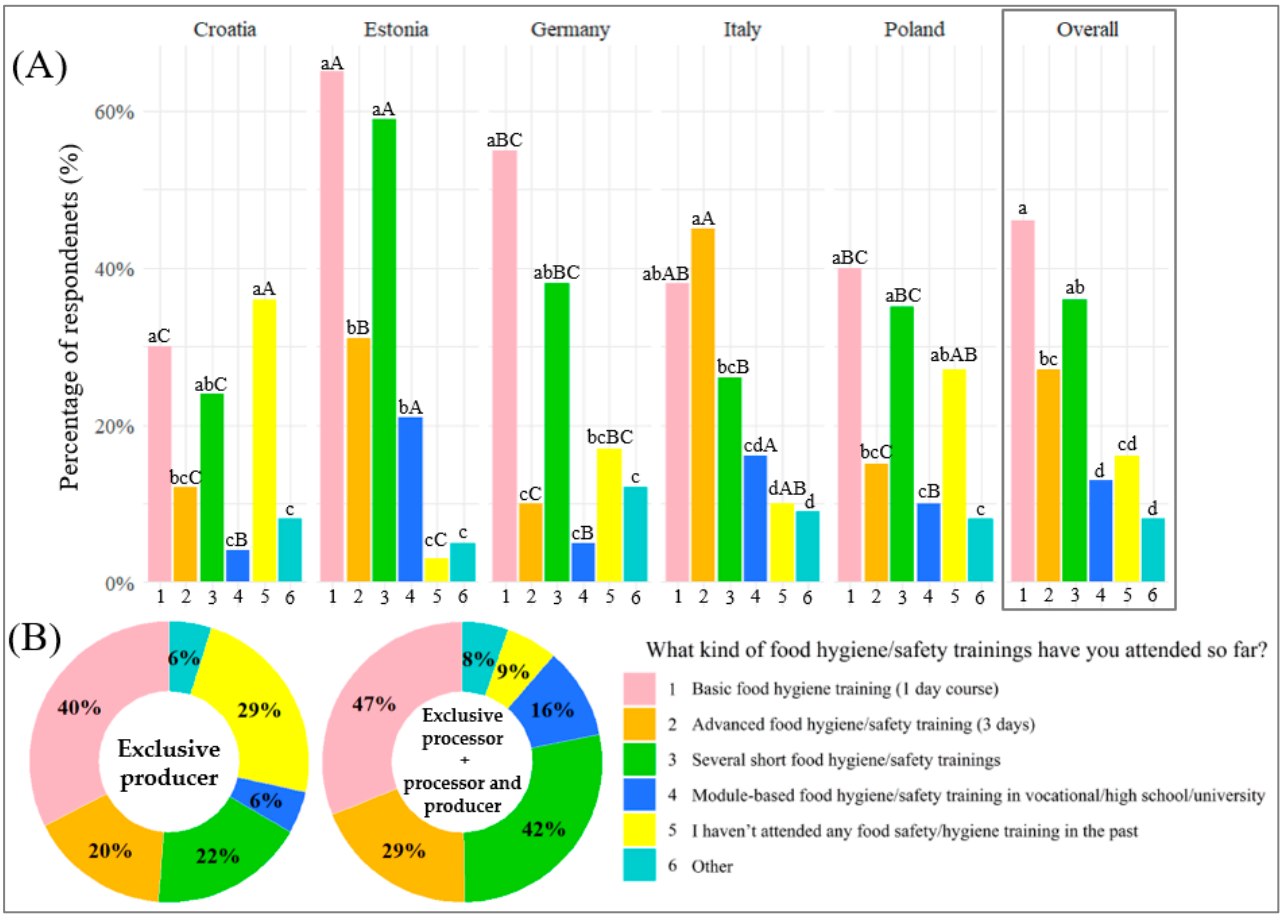

Figure 3. The percentage of participants who attended food safety training in the past, overall and in each country (**A**). Within each country, different lower-case letters indicate significant differences ($p < 0.05$). Different upper-case letters indicate significant differences ($p < 0.05$) for the same answer among countries. Donut plots (**B**) show the differences between operator types (exclusive producer; exclusive processor + processor and producer) in attending food hygiene/safety training in the past. The sum of the percentages for each training category exceeds 100%, as the participants could choose more than one category.

A significant relation ($\chi^2 = 32$, $p < 0.001$) was found between the type of organic operator (exclusive food producer or food producer engaged in food processing) and participation in food safety training. The majority of exclusive food producers (40%) have attended basic training (one-day course), while about 29% of representatives of the same group have not attended any food safety training in the past. In the group of exclusive

food processors or those who produce and process food, only 9% have not attended any food safety training. Among participants working in food processing, 47% have attended basic training (one-day course) and 42% have attended several short courses.

3.4. The Areas Where Organic Food Operators Need Assistance

Respondents from each country were asked to identify the food safety-related areas of knowledge where they require more support, in terms of training and guidance materials (Table 2). Overall, 40% of all respondents indicated that labelling and claims (nutritional, health) were a major problem, followed by food additives and other ingredients allowed in organic processing (30%). Only 8% and 9% mentioned drinking water quality and personnel-related issues such as health, personal hygiene, and training, as areas of particular interest. In each country, labelling and claims were identified as the main knowledge areas requiring assistance, ranging from 29% in Germany to 45% in Estonia.

Table 2. The areas of food safety knowledge for which respondents indicated the need for assistance (training, guidance), overall and in each country (presented as the number and percentage of responses). Different upper-case letters in the same row indicate significant differences ($p < 0.05$) for the same answer among countries.

Question	Answers	Number (*n*) and Percentage (%)					
		Croatia	Estonia	Germany	Italy	Poland	Overall
Please select the areas where you need more assistance	1. General food hygiene and safety principles	8(16) B	9(12) B	15(36) B	28(29) A	17(33) AB	77(24)
	2. Prerequisite programs (PRP) specific for organic food production/processing	19(38) A	22(29) A	15(36) A	5(5) B	13(25) AB	74(23)
	3. Food fraud	3(6) B	16(21) A	5(12) B	21(22) A	14(27) A	59(19)
	4. Process contaminants (e.g., acrylamide, PAHs) and residues (e.g., pesticides, medicinal)	4(8) D	12(16) BC	6(14) CD	31(32) A	15(29) B	68(22)
	5. Food additives and other ingredients allowed in organic processing	7(14) C	44(59) A	8(19) C	19(20) B	18(35) B	96(30)
	6. Prevention of cross-contamination and cross contact including food allergen management	3(6) B	10(13) AB	8(19) AB	14(14) A	12(23) A	47(15)
	7. Temperature control and assurance of the cold chain	3(6)	7(9)	9(21)	7(7)	5(10)	31(10)
	8. Drinking water quality	2(4) B	9(12) A	2(5) B	12(12) A	0(0) B	25(8)
	9. Wrapping, packaging; requirements of Food Contact Materials (FCM)	11(22) B	20(27) AB	19(45) AB	26(27) A	14(27) AB	90(28)
	10. Transport and vehicles	1(2) B	6(8) AB	8(19) A	12(12) A	6(12) AB	33(10)
	11. Waste management	4(8) B	8(11) AB	3(7) B	14(14) A	12(23) A	41(13)
	12. Pest control	7(14)	9(12)	7(17)	16(16)	5(10)	44(14)
	13. Cleaning and disinfection	4(8)	9(12)	11(26)	16(16)	7(13)	47(15)
	14. Staff: health, personal hygiene, training	1(2) B	4(5) B	6(14) AB	13(13) A	4(8) B	28(9)
	15. Food safety culture	4(8) C	9(12) BC	4(10) C	20(21) A	12(23) AB	49(16)
	16. Food ingredients including raw materials, allergens, quality requirements	6(12)	19(25)	11(26)	10(10)	9(17)	55(17)
	17. Determination of shelf-life of food	9(18)	22(29)	20(48)	17(18)	21(40)	89(28)
	18. Laboratory testing (production surfaces, raw materials, final products)	10(20) B	26(35) A	9(21) B	24(25) A	11(21) B	80(25)
	19. Labelling and claims (nutritional, health)	21(42) BC	34(45) AB	12(29) C	42(43) A	18(35) C	127(40)
	20. Traceability, recall, withdrawal of food from the market	2(4) B	6(8) AB	9(21) A	13(13) A	14(27) A	44(14)
	21. Other	3(6)	3(4)	5(12)	7(7)	1(2)	19(6)

The need for assistance/training on pre-requisite programs was also declared by a significant number of respondents (more than 25%) in most of the countries, except for Italy. The need for assistance in the area related to the determination of food shelf-life was most frequently indicated in Germany (48%) and Poland (40%). A high percentage (about 60%) of

Estonian respondents reported the need for training/support in the topics of food additives and other ingredients allowed in organic processing. Wrapping, packaging and requirements regarding Food Contact Materials were considered as an important area of support needed only by respondents in Germany (45%). The subject of process contaminants and residues appeared to be of interest only in the case of Italian respondents (32%).

3.5. The Need for Assistance concerning HACCP Principles

Respondents from each country were asked to select the HACCP principle(s) for which they need more support/assistance in terms of training and guidance (Figure 4). For about 45% of all respondents, Principle 7 was a major concern, followed by Principle 1 (33%). Principle 7 was also selected by a significant number of respondents representing each country (ranging from 30% in Italy to 69% in Poland). Principle 1 was a major concern in Germany (48%), Poland (44%), Croatia (34%) and Italy (28%). Moreover, about 43% and 45% of participants in Germany have chosen Principles 2 and 4, respectively. Principle 2 was also an issue in Poland (40%).

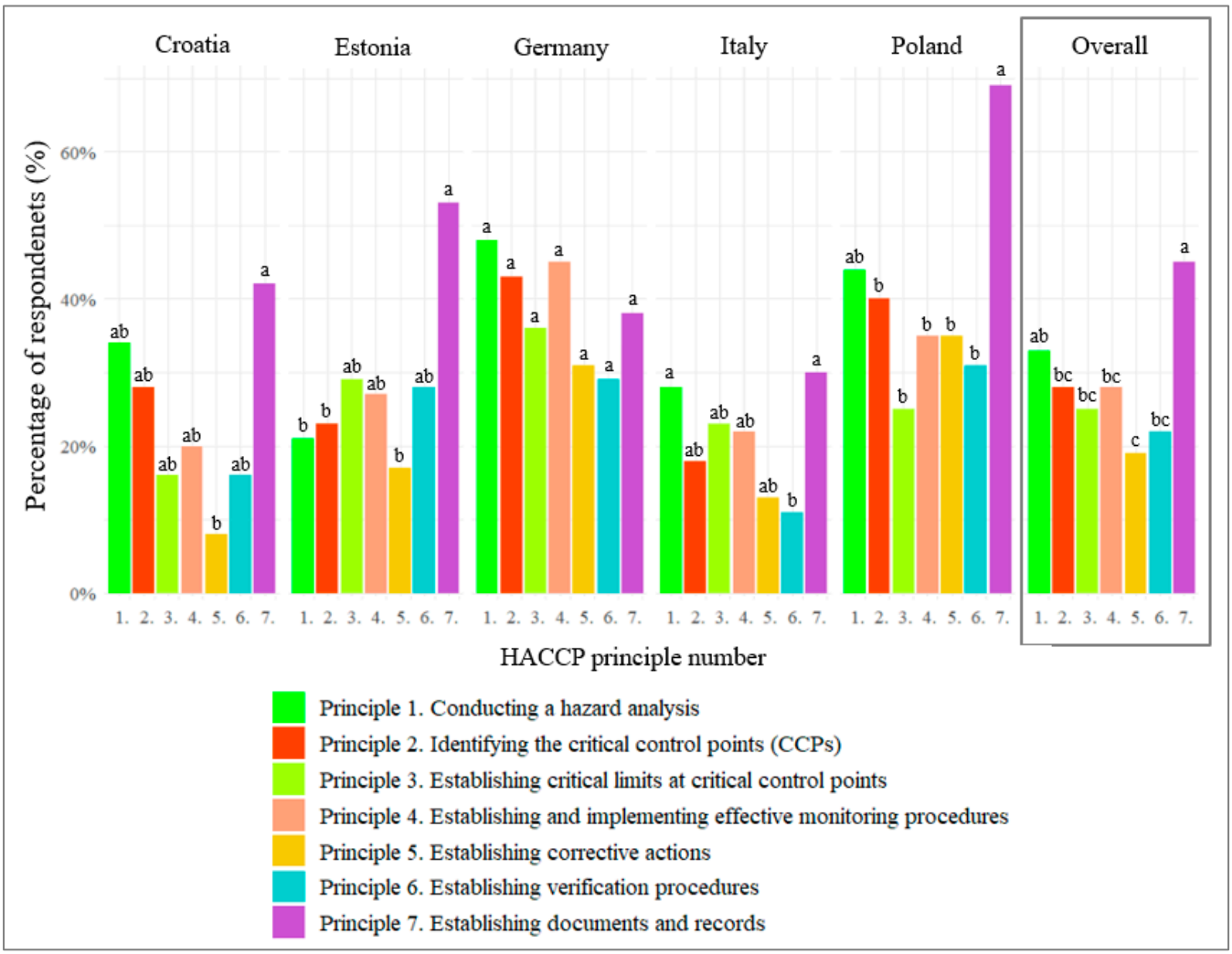

Figure 4. The percentage of responses indicating the need for assistance (training, guidance) concerning particular HACCP principles, overall and in each country. Within each country, different lower-case letters indicate significant differences ($p < 0.05$).

Figures 5 and 6 show the percentages of responses regarding the forms of training, and the forms of training materials, preferred by the study participants. As for the forms of food safety training, a high percentage (40%) of participants from Estonia preferred

passive offline training via the Internet (e.g., via homepage, Moodle—where they could download materials and study them according to their time availability), while in Italy 63% of participants preferred active online training via the Internet (e.g., Zoom, MS Teams). More than 50% of respondents in each country, and overall, selected online training via the Internet (e.g., Zoom, MS Teams) as the most preferred option. In addition, more than 50% of participants (in Germany over 70%) chose hands-on, on-site training in a well-functioning organic enterprise as the most preferred training option. Overall, training in classroom as well as offline training via the Internet were the least preferred training forms. Regarding the forms of food safety training materials, the collection of sample HACCP procedures with practical solutions was one of the most preferred options internationally (50%). However, 64% of participants in Germany preferred short guides (>4 pages), while 65% of participants in Poland preferred videos. Among the participants in each of the countries, the lowest interest was observed in the case of leaflets (1–4 pages).

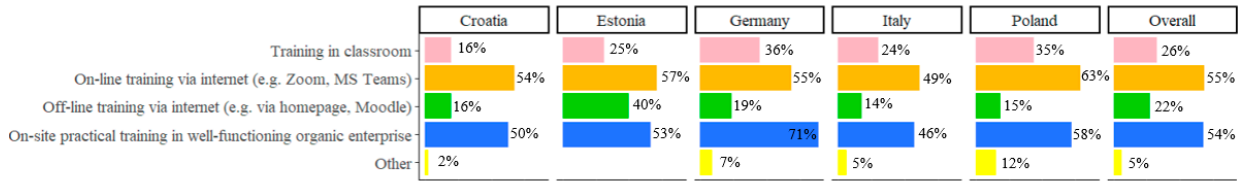

Figure 5. The percentages of responses regarding the forms of food safety training preferred by the study participants, overall and in each country.

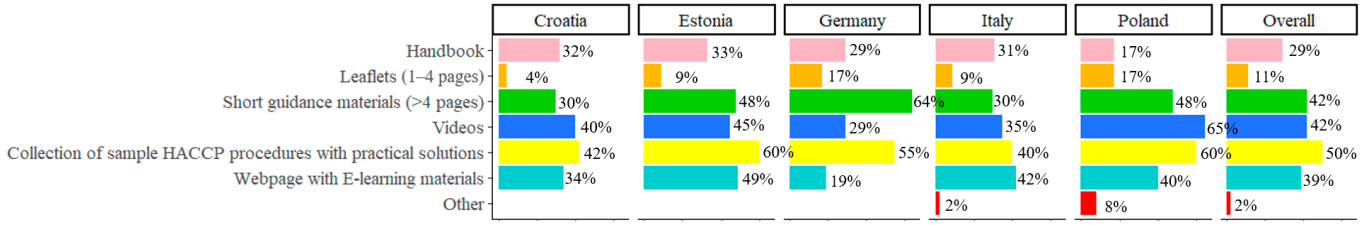

Figure 6. The percentages of responses regarding the forms of food safety training materials preferred by the study participants, overall and in each country.

3.6. Multiple Correspondence Analysis (MCA)

Figure 7 presents the first two dimensions of MCA, which accounted for about 28% of the total variation between countries, and the characteristics of surveyed organic operators, including variables such as operator type and size. The results show that exclusive food producers tended to represent mainly small enterprises (only 1–2 employees). In contrast, participants engaged in food processing tended to represent enterprises of a larger size (3–9 employees and 10–49 employees).

Figure 8 shows the first two dimensions of the MCA, accounting for about 27% of the total variation between countries, organic operators' knowledge about the HACCP concept, presence of a functional self-control system, and previous participation in food safety training, respectively. All these variables were included in the second section of the survey. The analysis revealed that organic food business operators who declared not to know the HACCP concept and who had not attended any food safety/hygiene training in the past, tended not to have a functional self-control system in place based on the HACCP principles. Moreover, participants who declared to have known the HACCP and had a HACCP-based self-control system in place, had typically attended either several short food safety courses, advanced food hygiene/safety training (three-day course), and/or module-based food hygiene/safety training in vocational/high school/university.

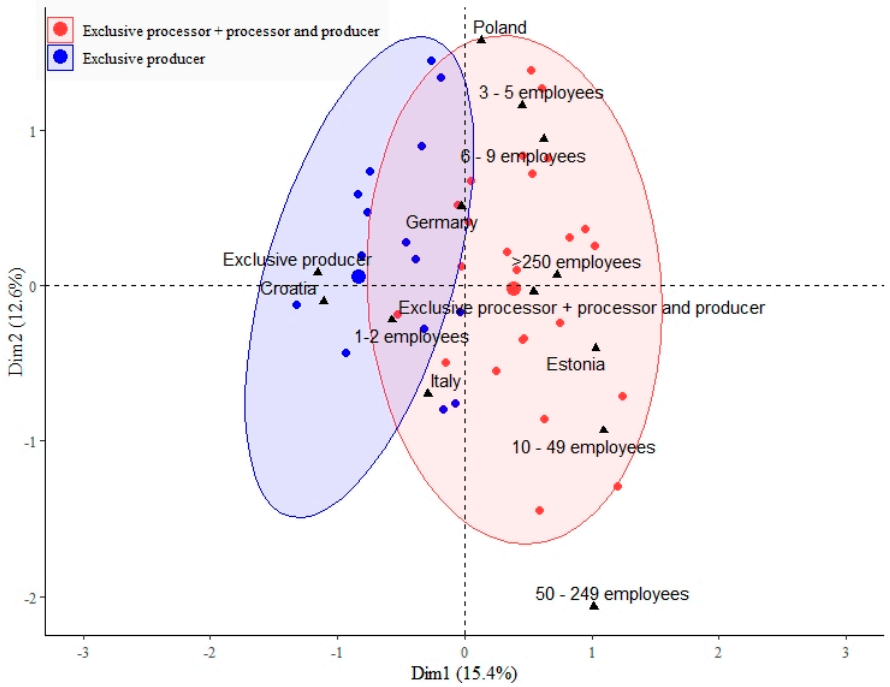

Figure 7. The Multiple Correspondence Analysis (MCA) illustrating the first two dimensions (Dim1 and Dim2), created with the following variables: country, organic food business operator type, organic food business operator size.

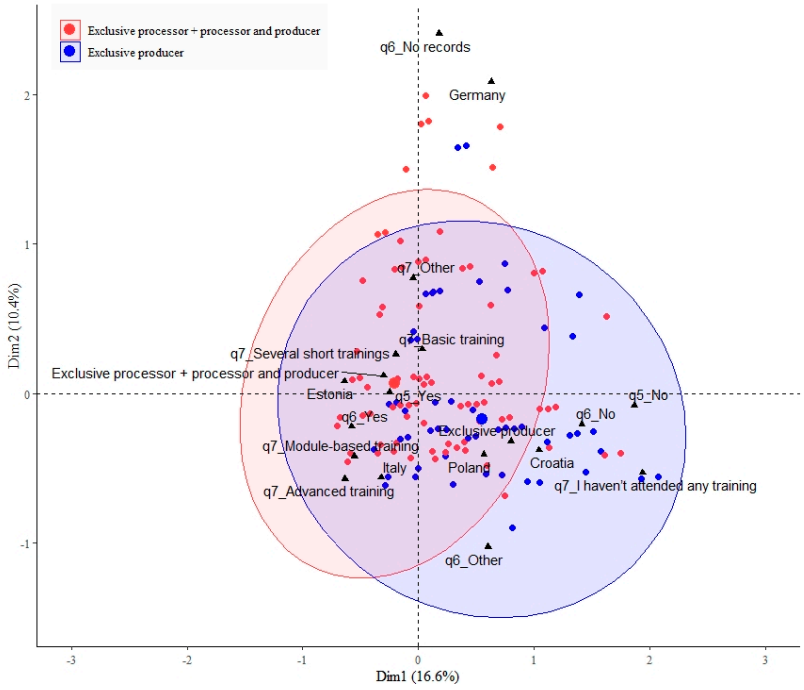

Figure 8. The Multiple Correspondence Analysis (MCA) illustrating the first two dimensions (Dim1 and Dim2), created with the following variables: organic food business operator type, knowledge of the HACCP concept (q5), presence of a functional self-control system in the enterprise (q6), types of food hygiene/safety training attended to date (q7).

Figure 9 shows the first two dimensions of the MCA, accounting for about 11% of the total variation between countries, as well as the organic food business operators' needs for assistance on a range of food safety issues. No strong associations were detected, as the two dimensions of the MCA analysis explained only a limited percentage of the total

variation. However, on the positive side of Dimension 1, it could be seen that exclusive food producers tended to have problems related to (1) general principles of food safety, while participants who process food tended to show more interest in the topics related to (5) food additives and other ingredients allowed in organic processing, (6) cross-contamination and cross contact prevention including food allergen management, (16) food ingredients including raw materials, allergens, quality requirements, (17) determination of shelf-life of food, and (18) laboratory testing (production surfaces, raw materials, final products). It can also be noted that issues related to (10) transportation and vehicles, (11) waste management, (12) pest control, (13) cleaning and disinfection (14) personnel (health, personal hygiene, training), and (15) food safety culture, are among the common problems for both types of food business operators.

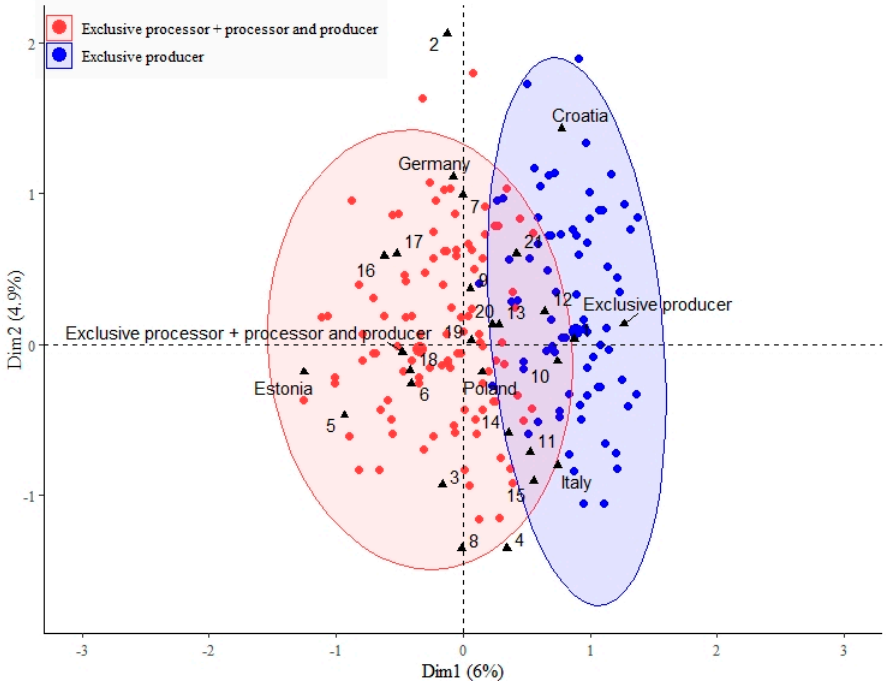

Figure 9. The Multiple Correspondence Analysis (MCA) illustrating the first two dimensions (Dim1 and Dim2), created with the following variables: organic food business operator type, food safety knowledge areas requiring assistance/support. The meaning of the numbers (1 to 21) can be found in Table S1 as the answers to q8. "Please select the areas where you need more assistance".

Figure 10 shows the first two dimensions of the MCA, accounting for about 23% of the total variation between countries, and the respondents' needs for assistance regarding food safety issues related to the seven HACCP principles. It appears that the participants classified as exclusive food producers indicated their need for support in the areas of Principles 1, 2 and 4. In contrast, food processors reported the need for assistance in the areas of all seven HACCP principles. The need for assistance within the areas of Principles 3, 6 and 7 appears to be specific to participants working in food processing.

Figure 11 shows the first two dimensions of the MCA, accounting for about 14% of the total variation between countries, and the kinds of guidance materials indicated as needed by the study participants. It appears that participants classified as exclusive food producers are interested in acquiring information on (9) traceability and (11) allergen labelling and management. On the other hand, participants classified as food processors indicated the need for guidance on all subjects except for (9) traceability and (11) allergen labelling and management. No common needs were identified between the two types of food business operators.

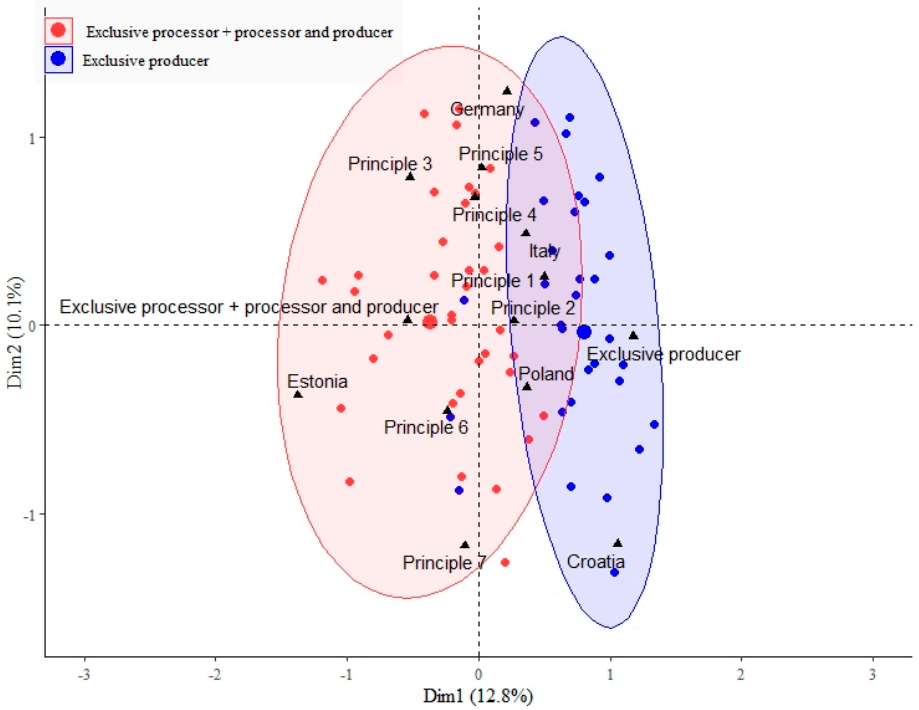

Figure 10. The Multiple Correspondence Analysis (MCA) illustrating the first two dimensions (Dim1 and Dim2), created with the following variables: organic food business operator type, needs for assistance in the area of particular HACCP principles.

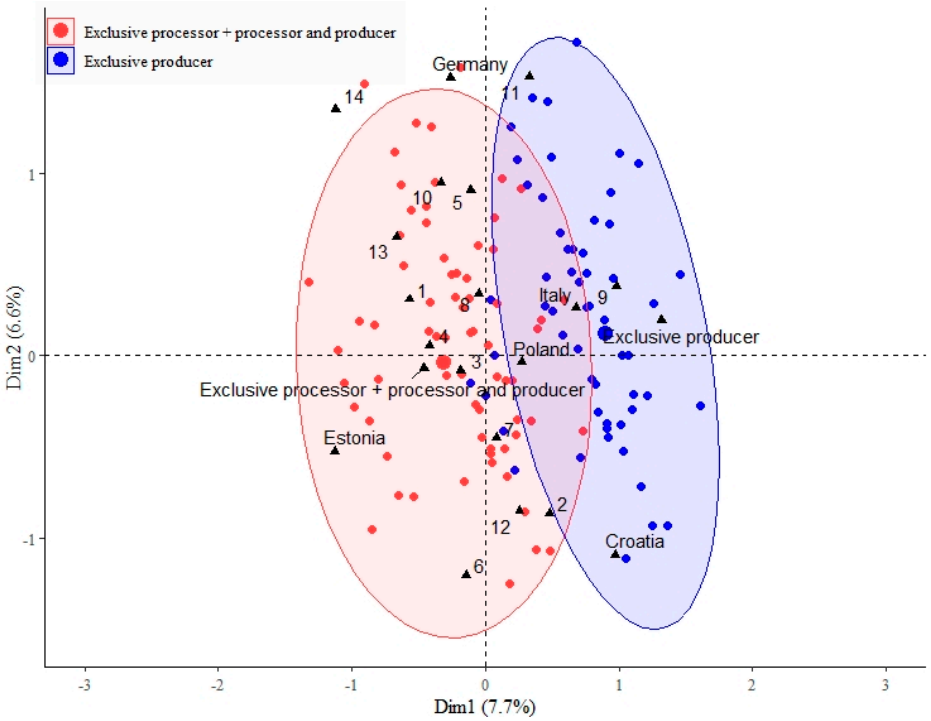

Figure 11. The Multiple Correspondence Analysis (MCA) illustrating the first two dimensions (Dim1 and Dim2), created with the following variables: organic food business operator type, kind of guidance materials needed. The meaning of the numbers (1 to 14) can be found in Table S1 as the answers to q12. "What kind of guidance materials would you need?"

4. Discussion

Food safety remains a critical issue in the food chain, and the production of safe food is a priority for both conventional and organic producers and processors. Consumer aware-

ness of the importance of high quality and safe food as part of a healthy lifestyle [8] has also been systematically increasing in the last decades, pushing food system operators even more strongly towards investing significant efforts to comply with the expected standards.

The present study allowed us to assess and to compare the food safety knowledge of organic food business operators in five EU countries, as well as their expectations and needs towards assistance (training, guidance materials) that could contribute to improving the level of knowledge and compliance with respective food safety rules and regulations, including successful implementation of a functional self-control system based on the HACCP principles. The results of the present survey fill a gap in the existing literature on organic food safety. A number of studies on the difficulties in implementing HACCP food safety knowledge, attitudes, and practices were carried out among conventional food producers [19,31–35]. With the growing trend of organic food consumption, similar studies need to be performed for the organic food sector. Knowledge of the needs and capabilities of organic food producers in the area of food safety will help to provide specific support, and thus facilitate the development and management of successful organic food operators.

The present study has shown significant differences in the knowledge of the HACCP system among the surveyed producers and/or processors from different countries. A high percentage of food system operators who knew the HACCP concept was found among respondents in Italy and Estonia—countries with a significant share of organic products on the market [8]. In Poland, where organic food is still a niche market, organic producers and/or processors have previously reported a number of significant barriers to running organic businesses, such as difficulties in the adaptation of European requirements, high production costs, and finally lack of adequate guidance [36], which is most likely the reason for the lack of knowledge about the HACCP concept and the lack of functional HACCP-based self-control procedures in many of the organic food business operators surveyed within the presented study. A similar trend can be observed in Croatia. Even though the number of organic farms and the area under organic management in this country have both increased significantly in the last decade, the majority of operators in this sector are focused on primary production, and organic food processing is still at an early stage of development [37]. Among 6024 organic operators in Croatia in 2021, only 378 were processors [38]. In Germany, many small food enterprises use the possibility of a simplified control and record-keeping procedure, as described in Annex III of the European Commission Notice on the Implementation of Food Safety Management Systems [39]. Even though these procedures are also based on the principles of the HACCP system, representatives of many small businesses do not seem to be aware of this, which may explain the relatively low percentage of affirmative answers to the question about a self-controlled HACCP system and the high percentage of those who stated that they do not keep appropriate records.

The largest need for support (in terms of training and guidance materials) in the surveyed countries indicated by the organic processors was related to the first and the last of the seven HACCP principles, i.e., hazard analysis and HACCP documentation. Similar problems were reported when analyzing the implementation of HACCP principles in the conventional sector in Poland and Germany, and in several small-sized Polish food companies [23,39]. Hazard analysis and HACCP documentation for organic food production facilities should take into account hazards and procedures specific to the organic sector, to ensure food safety. The need for support for the first HACCP principle is related to the lack of knowledge about the risks and their occurrence, which has already been demonstrated by many authors [23,40,41]. This may be due to the lower importance being given to these topics in the available training programs, or due to the lack of available training materials/content covering this specific knowledge. The positive impacts of training on food safety in the conventional sector have been demonstrated by many researchers [42–44]. It is expected that the knowledge and practices of organic sector operators would also improve significantly after participating in appropriate training programs. Regarding food safety requirements, organic stakeholders in Poland were

previously reported to complain about the high level of bureaucracy [36]. Knowledge about the needs and expectations of organic food producers is important to ensure organic food safety, and guidance and training materials intended to help organic producers cannot be based exclusively on conventional documentation templates. Examples of documentation for organic operators, in the form of comprehensive, ready-to-implement manuals in the field of HACCP principles, have been developed as a part of the SAFE-ORGfood (http://safe-orgfood.eu/intelectual-outputs/ready-to-implement/).

A few studies focused on the frequency of undergoing food safety training by representatives of conventional food sector entities were previously reported [45]. Moreover, several reports comparing the knowledge and awareness of conventional food operators before and after specific food safety training can be found in the scientific literature [41,44,46]. For example, Taha et al. [45] investigated food safety knowledge among over 6000 food handlers in nearly 100 food service establishments in United Arab Emirates. Food safety knowledge of food handlers was evaluated as good, with half of the respondents being familiar with, for example, correct procedures for cleaning and sanitizing food contact surfaces. The study found a significant association between food safety knowledge and food handlers' education, age and experience in food safety training. The authors underlined the need for enhancing the efficiency and effectiveness of food safety training and training materials [45]. Huq et al. [41] analyzed hygiene practices and safety measures in a number of small and medium-sized bakeries in Tangail Region, Bangladesh and identified a massive need for education as well as for the development and implementation of a proper monitoring system and control procedures for hygiene practices in all the studied objects. Trafiałek et al. [44] analyzed the effectiveness of food safety training provided to employees of a Polish catering company with an implemented food safety management system based on ISO 22000:2018 standard. The study allowed the verification of the level of employees' knowledge prior to and after the training. It proved that staff training played a significant role in the upskilling of the catering employees and in minimizing the risk of mistakes related to food safety made by the employees when fulfilling their duties [44]. At the same time, to date, no studies have investigated the attendance of organic food operators at various types of food safety-related training sessions.

Our results suggest that there is a need for different approaches to food safety training depending on the country. For several years, Estonia has been implementing the long-term knowledge transfer programs "Food Safety and Food" and "Organic Farming", with the aim to raise awareness about food and food safety among stakeholders involved in primary food production and food processing. Under this program, information days and additional training sessions are held every year, food safety conferences are organized, and manuals and informational materials are provided. Practical materials for organic processors about cereals, fruits, vegetables, dairy and meat products have been published. This is probably one of the reasons behind the strong knowledge of the HACCP-based food safety systems and the declared participation in advanced food safety training among the Estonian participants of the present study. Beyond the described initiative, there is no specialized organic advisory system functional in Estonia [47]. Examples of guidance documents produced within the above mentioned program in Estonia are "Determination of shelf-life of food" [48], "Essential foodborne pathogens" [49], "Chemical hazards in food" [50], "Biofilms in food production environment" [51], "Root cause analyses of a pathogen contamination" [52]. The production of these materials was supported by the European Agricultural Fund for Rural Development (EAFRD). The positive impact of these guides is probably the reason for the high level of awareness among Estonian processors, which is reflected in the survey results from Estonia.

In Croatia, all food processors and handlers are required to attend the "Minimum Hygienic Course" before starting their work with food, and then every five years, to acquire necessary knowledge about food safety and personal hygiene. The course, conducted as part of the basic and extended programs, is not mandatory for primary producers. The extended program is designed for people who work with food in complex preparation

processes and provides detailed knowledge on HACCP principles, in contrast to the basic program, where HACCP is presented only at the concept level [53]. It can be assumed that the majority of Croatian producers who responded to our survey have completed the basic program, and thus need more support in the area of the HACCP-based food safety system.

The survey revealed that 54% of food producers, who do not process food, do not have a functional self-control HACCP-based system in place. About 45% of all respondents indicated Principle 7 as an important concern, followed by Principle 1 (33%). A high percentage of respondents within each country also indicated Principle 7 (ranging from 30% in Italy to 69% in Poland). Principle 1 was a major concern in Germany (48%), Poland (44%), Croatia (34%) and Italy (28%). Moreover, about 43% and 45% of participants in Germany selected Principles 2 and 4, respectively. Principle 2 was also a concern in Poland (40%). It should be noted though that primary food producers, who do not process food, are not required to implement a HACCP-based food safety system on their farms.

Even though some benefits of the implementation of the HACCP concept in primary production have previously been suggested, as it might create a direct link with the HACCP systems in place in the food processing businesses [54], there have also been reports showing that the HACCP system is not fully applicable at the primary production level, and that food safety can be obtained through the careful implementation of good hygiene practice (GHP) at the farm [55]. In the case of primary producers, the major concern is when good practices and other pre-requisite programs are not fully understood and/or implemented, as suggested by the results of this study. Thus, for this stakeholders' group the development of training programs to strengthen good practices could be considered as a priority. However, HACCP training programs could also be recommended for all operators (including non-processors), taking into consideration that primary producers may use this knowledge, should they decide to venture into the food processing realm. The present study had several limitations. Firstly, the performed survey was limited to only five European countries participating in the SAFE-ORGfood project, characterized by a different level of development, geography, historical background, etc. These countries are also in various stages of the development of the organic sector, including organic food processing. Therefore, the study outcomes may not be applicable to other countries, with other geographic and political circumstances, and that are currently in other stages of the organic food sector development, even those in Europe. Another limitation concerns the low response rate to the survey, resulting in a low representation of the sector in particular countries participating in the study. This limits the possibilities to further investigate several interesting potential moderators/drivers of the study outcomes, which would be allowed with a greater sample size.

In response to the needs identified within this study, the SAFE-ORGfood project consortium developed useful educational materials for teachers, trainers and organic producers and/or processors. However, the study results, showing significant differences in the knowledge and needs of organic stakeholders among the surveyed countries, indicate that further projects and initiatives are needed to support organic operators, in order to ensure safety of organic food products. In addition, further international cooperation and exchange of experience is of great importance to support European organic stakeholders in the field of food safety. Such integrated actions can increase the share of high quality and safe organic products, especially in countries where organic food is still a niche market. On the other hand, future research should focus on consumer awareness and expectations regarding organic products in individual countries. Such a comprehensive approach would allow the production of safe organic foods that meet consumer expectations.

It might also be of interest and be fascinating to further investigate the background of the differences identified amongst the studied countries participating in the SAFE-ORGfood project, in relation to their history and other conditions. This could help to overcome country-specific limitations and to attune strategies, including policies and other interventions, towards improved food safety.

5. Conclusions

In this study, the developed questionnaire allowed us to assess the food safety knowledge as well as the needs and expectations of organic stakeholders in selected EU countries, i.e., Italy, Estonia, Croatia, Germany and Poland, in terms of the content and forms of food safety training and guidance materials. It could be applied in other countries to identify the respective training needs and expectations of organic food business operators, in order to develop effective strategies that are well-attuned to the actual country-specific conditions.

This study identified a number of food safety aspects/areas in which organic food producers and processors from Poland, Estonia, Italy, Germany and Croatia need more assistance and support. The largest need for support was related to knowledge about how to conduct hazard analysis and how to prepare documents and records in relation to the HACCP principles. Labelling and claims (nutritional, health) were also indicated as main concerns in all participating countries, but there were also significant differences among countries in food safety-related topics in which assistance was needed. This study has also identified significant differences between the needs and expectations of primary producers and processors regarding training programs, which helps to better attune the training forms and content towards the actual needs of the specific target groups.

The outcomes of this study, but also the identified study limitations, clearly pave a way forward for future follow-up studies and for the development of training programs which could significantly help to assure a high level of food safety in the organic food production and processing sector.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su15086605/s1; Table S1: Questions included in the SAFE-ORGfood organic food business operators survey.

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References

1. Hueston, W.; McLeod, A. Overview of the global food system: Changes over time/space and lessons for future food safety. In *Improving Food Safety through a One Health Approach: Workshop Summary*; National Academies Press: Washington, DC, USA, 2012; p. 189.
2. European Parliament and Council. Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 Laying Down the General Principles and Requirements of Food Law, Establishing the European Food Safety Authority and Laying Down Procedures in Matters of Food Safety. Available online: https://webarchive.nationalarchives.gov.uk/eu-exit/https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02002R0178-20190 (accessed on 31 March 2022).
3. European Parliament and Council. Regulation (EC) No 852/2004 of the European Parliament and of the Council of 29 April 2004. On the Hygiene of Foodstuffs. Available online: https://eur-lex.europa.eu/eli/reg/2004/852/oj (accessed on 31 March 2022).
4. European Parliament and Council. Regulation (EC) No 2073/2005 on Microbiological Criteria for Foodstuffs. UNEP Law and Environment Assistance Platform. Available online: https://leap.unep.org/countries/eu/national-legislation/commission-regulation-ec-no-20732005-microbiological-criteria (accessed on 31 March 2022).
5. Food and Agriculture Organization of the United Nations; World Health Organization. Codex Alimentarius. General Principles of Food Hygiene. CXC 1-1969. Adopted in 1969. Amended in 1999. Revised in 1997, 2003, 2020. Editorial Corrections in 2011. 1969. Available online: https://www.fao.org/fao-who-codexalimentarius/sh-proxy/en/?lnk=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252FStandards%252FCXC%2B1-1969%252FCXC_001e.pdf (accessed on 1 April 2022).
6. European Parliament and Council. Regulation (EC) No 2018/848 of the European parliament and of the Council of 30 May 2018 on organic production and labelling of organic products and repealing Council Regulation (EC) No 834/2007. *Off. J. Eur. Union L* **2018**, *150*, 1–92.
7. Soroka, A.; Mazurek-Kusiak, A.K.; Trafialek, J. Organic food in the diet of residents of the visegrad group (V4) countries—Reasons for and barriers to its purchasing. *Nutrients* **2021**, *13*, 4351. [CrossRef]
8. Willer, H.; Schlatter, B.; Trávníček, J. Organic Farming and Market Development in Europe and the European Union. In *The World of Organic Agriculture. Statistics and Emerging Trends 2023*; Research Institute of Organic Agriculture FiBL and IFOAM-Organics International, Frick and Bonn; Available online: https://www.fibl.org/en/shop-en/1254-organic-world-2023 (accessed on 20 February 2023).
9. European Commission (EC). *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. A Farm to Fork Strategy for a Fair, Healthy and Environmentally-Friendly Food System*; COM/2020/381 Final; European Commission: Brussels, Belgium, 2020.
10. Rudnicki, R.; Biczkowski, M.; Wiśniewski, Ł.; Wiśniewski, P.; Bielski, S.; Marks-Bielska, R. Towards Green Agriculture and Sustainable Development: Pro-Environmental Activity of Farms under the Common Agricultural Policy. *Energies* **2023**, *16*, 1770. [CrossRef]
11. Barański, M.; Volakakis, N.; Seal, C.; Sanderson, R.; Stewart, G.B.; Benbrook, C.; Biavati, B.; Markellou, E.; Giotis, C.; Gromadzka-Ostrowska, J.; et al. Higher antioxidant and lower cadmium concentrations and lower incidence of pesticide residues in organically grown crops: A systematic literature review and meta-analyses. *Br. J. Nutr.* **2014**, *112*, 794–811. [CrossRef] [PubMed]
12. Rempelos, L.; Wang, J.; Barański, M.; Watson, A.; Volakakis, N.; Hoppe, H.W.; Kühn-Velten, W.N.; Hadall, C.; Hasanaliyeva, G.; Chatzidimitriou, E.; et al. Diet and food type affect urinary pesticide residue excretion profiles in healthy individuals: Results of a randomized controlled dietary intervention trial. *Am. J. Clin. Nutr.* **2022**, *115*, 364–377. [CrossRef]
13. Średnicka-Tober, D.; Barański, M.; Seal, C.; Sanderson, R.; Benbrook, C.; Steinshamn, H.; Gromadzka-Ostrowska, J.; Rembiałkowska, E.; Skwarło-Sońta, K.; Eyre, M.; et al. Composition differences between organic and conventional meat: A systematic literature review and meta-analysis. *Br. J. Nutr.* **2016**, *115*, 994–1011. [CrossRef]
14. Średnicka-Tober, D.; Barański, M.; Seal, C.J.; Sanderson, R.; Benbrook, C.; Steinshamn, H.; Gromadzka-Ostrowska, J.; Rembiałkowska, E.; Skwarło-Sońta, K.; Eyre, M.; et al. Higher PUFA and n-3 PUFA, conjugated linoleic acid, α-tocopherol and iron, but lower iodine and selenium concentrations in organic milk: A systematic literature review and meta- and redundancy analyses. *Br. J. Nutr.* **2016**, *115*, 1043–1060. [CrossRef]
15. Migliorini, P.; Wezel, A. Converging and diverging principles and practices of organic agriculture regulations and agroecology. A review. *Agron. Sustain. Dev.* **2017**, *37*, 63. [CrossRef]
16. Costantini, E.; La Torre, A. Regulatory framework in the European Union governing the use of basic substances in conventional and organic production. *J. Plant Dis. Prot.* **2022**, *129*, 715–743. [CrossRef]
17. Raudsepp, P.; Koskar, J.; Anton, D.; Meremäe, K.; Kapp, K.; Laurson, P.; Bleive, U.; Kaldmäe, H.; Roasto, M.; Püssa, T. Antibacterial and antioxidative properties of different parts of garden rhubarb, blackcurrant, chokeberry and blue honeysuckle. *J. Sci. Food Agric.* **2019**, *99*, 2311–2320. [CrossRef] [PubMed]
18. Harvey, R.R.; Zakhour, C.M.; Gould, L.H. Foodborne Disease Outbreaks Associated with Organic Foods in the United States. *J. Food Prot.* **2016**, *79*, 1953–1958. [CrossRef] [PubMed]
19. Trafialek, J.; Kolozyn-Krajewska, D. Implementation of safety assurance system in food production in Poland. *Polish J. Food Nutr. Sci.* **2011**, *61*, 115–124. [CrossRef]
20. Kotsanopoulos, K.V.; Arvanitoyannis, I.S. Audit results of UK meat companies—Critical analysis. *Br. Food J.* **2017**, *119*, 2684–2697. [CrossRef]

21. Putri, N.T.; Rhamadani, A.; Wisnel, W. Designing food safety standards in beef jerky pro-duction process with the application of hazard analysis critical control point (HACCP). *Nutr. Food Sci.* **2020**, *50*, 333–347. [CrossRef]
22. Jakubowska-Gawlik, K.; Kolanowski, W.; Trafialek, J. Evaluating suppliers of spices, casings and packaging to a meat processing plant using food safety audits data gathered during a 13-year period. *Food Control* **2021**, *127*, 108138. [CrossRef]
23. Trafiałek, J.; Lehrke, M.; Lücke, F.-K.; Kołożyn-Krajewska, D.; Janssen, J. HACCP-based procedures in Germany and Poland. *Food Control* **2015**, *55*, 66–74. [CrossRef]
24. Al-Akash, H.; Arrah, A.A.; Bhatti, F.; Maabreh, R.; Arrah, R.A. The effect of food safety training program on food safety knowledge and practices in hotels' and hospitals' food services. *Ital. J. Food Saf.* **2022**, *11*, 9914. [CrossRef]
25. Trafialek, J.; Drosinos, E.H.; Laskowski, W.; Jakubowska-Gawlik, K.; Tzamalis, P.; Leksawasdi, N.; Surawang, S.; Kolanowski, W. Street food vendors' hygienic practices in some Asian and EU countries—A survey. *Food Control* **2018**, *85*, 212–222. [CrossRef]
26. López-Santiago, J.; García, A.I.G.; Gómez-Villarino, M.T. An Evaluation of Food Safety Performance in Wineries. *Foods* **2022**, *11*, 1249. [CrossRef]
27. Atambayeva, Z.; Nurgazezova, A.; Rebezov, M.; Kazhibayeva, G.; Kassymov, S.; Sviderskaya, D.; Toleubekova, S.; Assirzhanova, Z.; Ashakayeva, R.; Apsalikova, Z. A Risk and Hazard Analysis Model for the Production Process of a New Meat Product Blended With Germinated Green Buckwheat and Food Safety Awareness. *Front. Nutr.* **2022**, *9*, 902760. [CrossRef] [PubMed]
28. Kolanowski, W.; Trafialek, J.; Drosinos, E.H.; Tzamalis, P. Polish and Greek young adults' experience of low quality meals when eating out. *Food Control* **2020**, *109*, 106901. [CrossRef]
29. Hervé, M. Testing and Plotting Procedures for Biostatistics. In *Package 'RVAideMemoire'*; R Foundation for Statistical Computing: Vienna, Austria, 2018; Available online: https://cran.rproject.org/web/packages/RVAideMemoire/index.html (accessed on 14 February 2023).
30. Lê, S.; Josse, J.; Rennes, A.; Husson, F. FactoMineR: An R Package for Multivariate Analysis. *JSS J. Stat. Softw.* **2008**, *25*, 1–18.
31. Herath, D.; Henson, S. Barriers to HACCP implementation: Evidence from the food processing sector in Ontario, Canada. *Agribusiness* **2010**, *26*, 265–279. [CrossRef]
32. Karaman, A.D.; Cobanoglu, F.; Tunalioglu, R.; Ova, G. Barriers and benefits of the implementation of food safety management systems among the Turkish dairy industry: A case study. *Food Control* **2012**, *25*, 732–739. [CrossRef]
33. Garayoa, R.; Díez-Leturia, M.; Bes-Rastrollo, M.; García-Jalón, I.; Vitas, A.I. Catering services and HACCP: Temperature assessment and surface hygiene control before and after audits and a specific training session. *Food Control* **2014**, *43*, 193–198. [CrossRef]
34. Cusato, S.; Gameiro, A.H.; Sant'Ana, A.S.; Corassin, C.H.; Cruz, A.G.; de Oliveira, C.A.F. Assessing the costs involved in the implementation of GMP and HACCP in a small dairy factory. *Qual. Assur. Saf. Crops Foods* **2014**, *6*, 135–139. [CrossRef]
35. Al-Shabib, N.A.; Mosilhey, S.H.; Husain, F.M. Cross-sectional study on food safety knowledge, attitude and practices of male food handlers employed in restaurants of King Saud University, Saudi Arabia. *Food Control* **2016**, *59*, 212–217. [CrossRef]
36. Mazurek-Kusiak, A.; Sawicki, B.; Kobyłka, A. Contemporary Challenges to the Organic Farming: A Polish and Hungarian Case Study. *Sustainability* **2021**, *13*, 8005. [CrossRef]
37. Ramov, N.; Slavuj, L. Ekološka poljoprivreda u Hrvatskoj—Analiza razvoja i stavovi mladih o ekološkim poljoprivrednim proizvodima. *Geogr. Horiz.* **2021**, *67*, 23–36.
38. Ministarstvo Poljoprivrede—Statistika. Available online: https://poljoprivreda.gov.hr/statistika-360/360 (accessed on 22 February 2023).
39. European Commission (EC). Commission Notice on the implementation of food safety management systems covering prerequisite programs (PRPs) and procedures based on the HACCP principles, including the facilitation/flexibility of the implementation in certain food businesses. *Off. J. Eur. Union L* **2016**, *278*, 1–32.
40. Assessment of HACCP plans in standardized food safety management systems—The case of small-sized Polish food businesses. *Food Control* **2019**, *106*, 106716. [CrossRef]
41. Huq, A.O.; Uddin, M.J.; Haque, K.F.; Roy, P.; Hossain, M.B. Health, hygiene practices and safety measures of selected baking factories in Tangail region, Bangladesh. *Int. J. Curr. Microbiol. Appl. Sci.* **2013**, *2*, 68–75.
42. Jubayer, M.F.; Kayshar, M.S.; Hossain, M.S.; Uddin, M.N.; Al-Emran, M.; Akter, S.S. Evaluation of food safety knowledge, attitude, and self-reported practices of trained and newly recruited untrained workers of two baking industries in Dhaka, Bangladesh. *Heliyon* **2020**, *6*, e05021. [CrossRef] [PubMed]
43. McIntyre, L.; Vallaster, L.; Wilcott, L.; Henderson, S.B.; Kosatsky, T. Evaluation of food safety knowledge, attitudes and self-reported hand washing practices in FOODSAFE trained and untrained food handlers in British Columbia, Canada. *Food Control* **2013**, *30*, 150–156. [CrossRef]
44. Trafiałek, J.; Pawłowska, J. Effect of Analysis of training provided to employess in catering company with implemented food safety management system pursuant to ISO standard of 2200 series. *Food Sci. Technol. Qual.* **2013**, *1*, 217–229.
45. Taha, S.; Osaili, T.M.; Saddal, N.K.; Al-Nabulsi, A.A.; Ayyash, M.M.; Obaid, R.S. Food safety knowledge among food handlers in food service establishments in United Arab Emirates. *Food Control* **2020**, *110*, 106968. [CrossRef]
46. Al-Kandari, D.; Al-abdeen, J.; Sidhu, J. Food safety knowledge, attitudes and practices of food handlers in restaurants in Kuwait. *Food Control* **2019**, *103*, 103–110. [CrossRef]
47. Vetemaa, A.; Mikk, M.; Peetsmann, E. Mahepõllumajandus Eestis 2021. In *Organic Farming in Estonia in 2021*; The Estonian University of Life Sciences: Tartu, Estonia, 2022; p. 53.

48. Roasto, M.; Laikoja, K. *Toidu Säilimisaja Määramine (Determination of the Shelf Life of Food)*; Estonian University of Life Sciences: Tartu, Estonia, 2019; p. 44. ISBN 978-9949-698-73-8.
49. Roasto, M. *Olulised Toidupatogeenid (Essential Foodborne Pathogens)*; Estonian University of Life Sciences, Vali Press OÜ: Tartu, Estonia, 2019; p. 23; ISBN 978-9949-629-96-1.
50. Püssa, T. *Toidu Keemilised Ohud (Chemical Hazards in Food)*; Estonian University of Life Sciences: Tartu, Estonia, 2020; p. 24; ISBN 978-9949-698-37-0.
51. Roasto, M. *Biokirmed Toidutootmise Keskkonnas (Biofilms in Food Production Environment)*; Estonian University of Life Sciences: Tartu, Estonia, 2021; p. 21; ISBN 978-9916-669-14-3.
52. Mäesaar, M.; Roasto, M. *Patogeeni(de) Algallikate Väljaselgitamine Toidukäitlemise Ettevõttes (Root Cause Analyses of a Pathogen Contamination)*; Estonian University of Life Sciences: Tartu, Estonia, 2022; p. 28; ISBN 978-9916-669-85-3.
53. Croatian Institute of Public Health, Hygiene Minimum. 2022. Available online: https://www.hzjz.hr/sluzba-zdravstvena-ekologija/higijenski-minimum/ (accessed on 1 February 2023).
54. Stanley, R.; Knight, C.; Bodnar, F. Experiences and challenges in the development of an organic HACCP system. *NJAS—Wagening. J. Life Sci.* **2011**, *58*, 117–121. [CrossRef]
55. Cerf, O.; Donnat, E. Application of hazard analysis—Critical control point (HACCP) principles to primary production: What is feasible and desirable? *Food Control* **2011**, *22*, 1839–1843. [CrossRef]