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THE RAPID ALERT SYSTEM FOR FOOD AND FEED (RASFF). THE PLACE IN SCIENTIFIC RESEARCH, LIMITATIONS AND POSSIBILITIES OF DATA USE

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Purpose: The goal of the study was to qualitatively and quantitatively evaluation of the data available in the Rapid Alert System for Food and Feed (RASFF) and to identify opportunities for further research concerning notifications reported in this system.
Design/methodology/approach: The research involved reviewing and critically assessing the data collected in the RASFF, conducting a two-way joining cluster analysis (in Statistica 13.3) on product categories and hazard categories, and building a map of links (in VOSviewer 1.6.20) between the keywords identified by the authors of the scientific papers.
Findings: The paper identifies the limitations of the RASFF, such as the lack of access to historical data, mistakes in the data, the exclusion of the United Kingdom from the system and the lack of information on operators involved in the food chain. It also indicates possible areas for further research of notifications reported in the RASFF, considering mainly product categories and hazard categories, as well as other types of data.
Originality/value: The article assesses the quality of RASFF data in a cross-cutting and comprehensive manner and identifies further opportunities for its analysis. The results of the research are intended for food safety researchers, food chain participants and food surveillance bodies.
Keywords: RASFF, food safety, European Union, cluster analysis, VOSviewer.
Category of the paper: research paper, general review.

1. Introduction

Table 1 shows examples of institutions and food safety databases in open access. These institutions' websites provide data or databases on food safety hazards. The range and type of data provided in these databases varies considerably (Allende et al., 2022; Bucchini et al., 2016; Cheftel, 2011; Fusco et al., 2015; Manning, Soon, 2019; Manning et al., 2022; Marvin et al., 2017; Talari et al., 2022). Until recently, the data collected in the Rapid Alert

System for Food and Feed (RASFF) covered a period of several decades, which made in-depth studies possible.

Table 1.
Examples of institutions and food safety databases in open access

Institution / Database and Website	Scope of data or activities
Canadian Food Inspection Agency (CFIA) https://recalls-rappels.canada.ca/en	Recalls, advisories and safety alerts
European Union / Rapid Alert System for Food and Feed (RASFF) https://webgate.ec.europa.eu/rasff-window/screen/search	Risks from the food chain
Food and Agriculture Organization of the United Nations, World Health Organization / International Food Safety Authorities Network (INFOSAN) https://www.fao.org/food-safety/emergencies/infosan/en/	Food safety incidents and emergencies
Food and Drug Administration (FDA) https://www.fda.gov/safety/recalls-market-withdrawals-safety-alerts	Recalls, market withdrawals and safety alerts
Food Standards Australia New Zealand (FSANZ) https://www.foodstandards.gov.au/food-recalls/alerts	Australian food recall alerts
Foodborne Diseases Active Surveillance Network (FoodNet) https://www.cdc.gov/foodnet/index.html	Infections transmitted commonly through food
Hong Kong Centre for Food Safety https://www.cfs.gov.hk/english/index.html	Ensuring that food is safe and fit for consumption
World Health Organization / Global Environment Monitoring System - Food Contamination Monitoring and Assessment Programme (GEMS/Food) https://extranet.who.int/gemsfood/	Food contaminants (biological and chemical)

Source: own research.

The RASFF was established in 1979, but its legal basis is now Regulation (EC) 178/2002, also known as the General Food Law. The purpose of this system is to ensure the exchange of information between member countries in order to support a rapid response by food safety authorities if a risk to public health arises in the food chain. The members of the RASFF are the 27 countries of the European Union (EU), countries of the European Free Trade Association (EFTA), the European Commission – DG Health and Food Safety, the European Food Safety Authority (EFSA) and the EFTA Surveillance Authority (European Commission, 2024a).

In Figure 1 presented the number of notifications in the RASFF in 1979-2023. In the initial period (up to and including 1996), the number of these notifications was a maximum of around 30 per year, therefore it has been omitted.

The number of notifications in the RASFF shows an upward trend with a peak in 2021 (over 6000) and a significant decrease in 2022 and 2023 (to about 4500). This was due to significantly fewer notifications for pesticide residues, pathogenic micro-organisms, composition, as well as food additives and flavourings and allergens. In turn, the year before (i.e. between 2000 and 2021), there was a significant increase in the number of pesticide notifications (around 800). The reason for the stopping in the fast-moving growth trend may have been the Covid-19 pandemic and the associated decline in trade (including imports), but beyond that, also the changes made in the RASFF, because some hazards were excluded from it and moved to other systems, to which there is no longer open access.

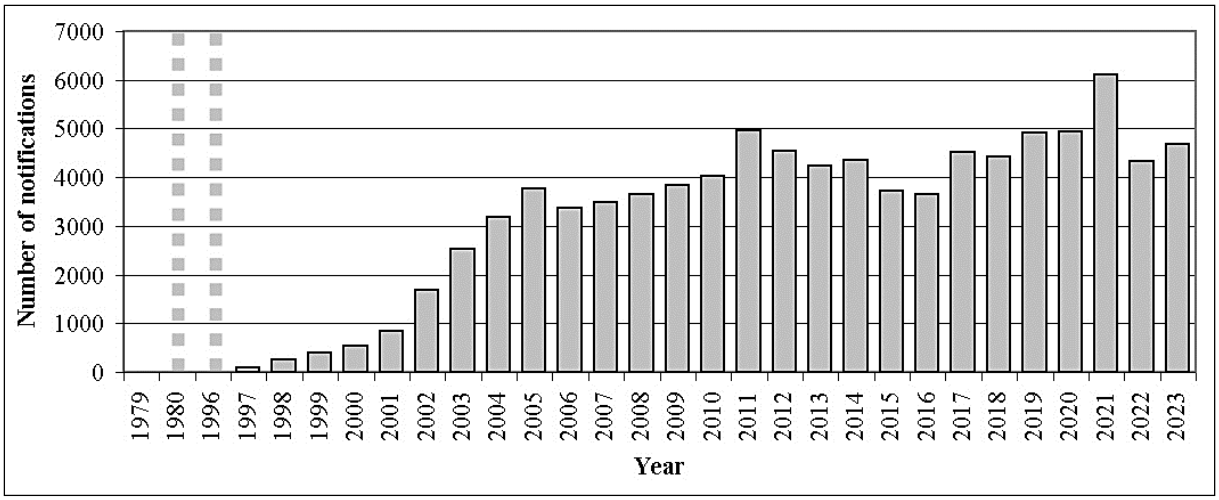

Figure 1. The number of notifications in the RASFF.

Source: own research.

Indeed, on the basis of Regulation 2019/1715 (European Commission, 2019), in 2021 the Alert and Cooperation Network (ACN) has been established, comprising the RASFF (non-compliances with possible health risks), the Administrative Assistance and Cooperation Network – AAC (non-compliances without health risks) and the Agri-Food Fraud Network – FFN (suspicions of fraud) (European Commission, 2024c). The AAC was made available for European countries from 2015 and the FFN was set up already in 2013. These systems work on voluntary basis and only for cross-border non compliances. In turn, in the case of the RASFF, its members are obliged to report information. The FFN is a network that links EU member states and Europol (Popping et al., 2022). All these systems operate now together to maintain the food safety in the European Union (Kowalska et al., 2019). However, it is worth mentioning that following the changes made in the RASFF, the MedISys-Food Fraud (MedISys-FF) has become the only publicly accessible system collecting data on food fraud (Marvin et al., 2022), but access to this data requires a login.

The RASFF has been modified in various ways over the years of its operation. However, there are rarely published works that critically evaluate these changes, as well as the available data. It should also be noted that various authors have used the data available in the RASFF, but have not indicated possible directions for further research. Therefore, the goal of the study was to qualitatively and quantitatively evaluation of the data available in the RASFF and to identify opportunities for further research concerning notifications reported in this system.

2. Methods

Data was obtained from two databases: the restored (archived) one for 1979-2021 (European Commission, 2023) and the official one for 2022-2023 (European Commission, 2024b) as xls files and then merged covering a total of 89,098 notifications. This data was processed in the programs: Microsoft Excel 365 (Microsoft Corporation, Redmond, DC, USA) and LibreOffice Calc 7.6.5.2 (The Document Foundation, Berlin, Germany), using the following functions: vertical search, pivot tables, filtering, sorting and transposition. The different types of data have been critically assessed including shortcomings, mistakes and possible difficulties that may arise in their processing.

The data was further converted into percentages of notifications of products in hazard categories and hazard categories in products and placed in source tables. To investigate similarities between products and hazard categories, a two-way joining cluster analysis in Statistica 13.3 (TIBCO Software Inc., Santa Clara, CA, USA) was conducted. This method is used when values contained in both columns and rows of the source table can be expected to simultaneously contribute to the discovery of meaningful patterns of clusters (it is therefore a two-dimensional analysis). The structure of the obtained clusters is not homogeneous by nature, but it is recognised that this method can be a powerful exploratory tool for data analysis (TIBCO, 2024). The findings of the cluster analysis were presented in contour/discrete charts using coloured squares, starting from white (smallest clusters or no clusters) through green, yellow, orange, red to brown (largest cluster). The adoption of the white colour was due to the need to fade out the dark green colour, which would have taken up most of the charts rendering them difficult to read.

Subsequently, in order to tentatively identify possible directions for further research on notifications reported in the RASFF for the ten most frequently reported product categories (or subgroups thereof) and the ten most frequently reported hazard categories, the number of works published in this area up to and including 2023 was examined. For this purpose, the databases of the following publishers were reviewed: Elsevier (Elsevier, 2024), Springer (Springer, 2024), Taylor & Francis (Taylor & Francis, 2024), Wiley (Wiley, 2024) and the Multidisciplinary Digital Publishing Institute (Multidisciplinary Digital Publishing Institute, 2024).

A map of links between the keyword “RASFF” and other words indicated was also built. First, papers with the mentioned keyword “RASFF”, published up to and including 2023 (176 articles), were searched on the Web of Science website and the data relating to them were exported in a text file (Web of Science, 2024). This file was then used to create a map in the VOSviewer 1.6.20 (Centre for Science and Technology Studies, Leiden University, The Netherlands) based on the bibliographic data. The following options were used: type of analysis (co-occurrence), unit of analysis (author keywords), counting method (full counting) and threshold, i.e. minimum number of occurrence of a keyword: 2.

3. Results

3.1. Types of data reported. Mistakes, shortcomings and difficulties with interpretation

In Table 2 presented data available in restored (archived) and official RASFF databases. Next to the individual data types, their original names are given in brackets if they were different.

Table 2.
Data available in restored (archived) and official RASFF databases

Detail	Restored (archived) database	Official database	
Data [a]	**Data available in both databases**		
	Notification number (Reference) [b] Date [b] Product category Product type (Type) Notification type (Type2) Notifying country (Notifying) Country of origin (Origin) Subject	Notification number (Reference) [b] Date [b] Product category (Category) Product type (Type) Notification type (Classification) Notifying country Country of origin (Origin) Subject	
	Other data		
	Risk decision [c] Product Hazard category Hazard (Substance/finding) Full hazard [d] Result and Unit [e] Notification basis (Control type) [e] Distribution status [e] Action taken [e]	Risk decision Product (Product name/ Name) [f] Hazard category [f] Hazards [g] Hazards with specificity Result (Analytical results and Unit) [f]	Notification basis [f] Distribution status [f] Action taken (Measures taken) [f] Distribution [h] ForAttention [i] ForFollowUp [h] Operator [h] Status
Period	1979 – 2021	2020 – until now	
File format	two xls files (for 1979-2020 and 2021) [j]	xls or csv file [k]	
Website	https://data.europa.eu/data/datasets/restored_rasff?locale=en	https://webgate.ec.europa.eu/rasff-window/screen/search	

Note [a] The individual data types are given in a standardised form so that they can be clearly named and compared with each other (whereas the original names of the individual data types, if they were different, are given in brackets). [b] Data including year of notification. [c] For 2021 only. [d] Detailed name of hazard. [e] Some data missing, especially for earlier years of the functioning of the system. [f] Data available when viewing notification details. [g] One or more hazards. [h] Country or countries. [i] INFOSAN and/or country and/or countries. [j] The files are available directly on the website indicated. [k] The file is available after selecting search criteria and then exporting data from the database. It can contain a maximum of 5000 rows.

Source: own research.

Only the first eight data types are available directly in the xls files from both databases and these are: notification number, date, product category, product type, notification type, notifying country, country of origin and subject. Other types of data are only available in one of the two databases or, in the case of the official database, only when viewing the notification in question. In the obtaining of this data, its processing or analysing, mistakes, shortcomings may be noted, possible difficulties related to its interpretation may also be pointing out (Table 3).

The main impediment for the researcher is the lack of data on notifications prior to 2000 in the officially available RASFF database. In order to include the notifications before that year in the research, it is necessary to retrieve them from the restored database or from data already retrieved, saved and retained. However, this data will be structured differently, so it is necessary to pre-process it before combining. Another difficulty is the redirection of data on certain hazard categories from the RASFF to other networks (i.e. already mentioned above AAC and FFN), which are only accessible to the supervisory authorities of the particular system members. This data should be made available in open access, through the RASFF or other extended system.

Table 3.
Mistakes, shortcomings in data and possible difficulties with interpretation of data from the RASFF

Detail	Characteristics
Mistakes and shortcomings in data	– Description of the notification (in the cell "subject") in a language other than English. – Different names of the same product, mistakes in the Latin name of the product. – Additional details in the product name - e.g. state or degree of processing, part of the product, colour; adding the name in the national language to the English name of the product (from the point of view of the researcher this is not necessary information); therefore, when preparing the data for analysis, it is necessary to standardise their names, which is very labour-intensive; the solution should be to place the basic product name in one cell and its extended description in another cell. – Frequent lack of information on quantity of substance reported as a hazard, lack of information on tested values and units. – Lack of information on notification basis, distribution status and action taken (especially in the earlier years of operation of the system) in the restored database, and no such information at all in the files exported from the official database (to obtain such information one has to browse through each notification separately). – Placement of a product in an inappropriate product category (in a restored database). – Frequent lack of country of origin in the official database (it is possible to obtain this information from the cell "subject", if the country of origin is indicated there). – Lack of a cell relating to product name in the file exported from the official database (this can be found in the cell "subject", which, however, requires analysis of each notification separately). – Exclusion of the United Kingdom as a country that can report notifications in the RASFF after its exit from the EU; this country was quite active and had reported 10.1% of all notifications to the end of 2020, so its exclusion from the system interrupted the continuity of reporting an important part of the notifications; the solution could be to remain this country as a member of the RASFF as other non-EU countries are (Switzerland, Norway, Iceland and Liechtenstein). – Duplication of data in the consumer portal (RASFF Consumer Portal), which may raise questions as to whether such a separate portal is needed.

Difficulties with data interpretation	– Lack of access to data prior to 2020 in the official RASFF database (this data is only available to the supervisory authorities of the member countries), so that in order to examine notifications over a longer period of time, it is necessary to combine data from two databases: the restored one and the official one, however, the data contained in the xls files from these databases have a different structure. – Moving some notifications to other networks: the Administrative Assistance and Cooperation Network (AAC) and the Agri-Food Fraud Network (FFN) and not having access to them (information on them is only available to the supervisory authorities of the member countries). – Listing of several countries of origin in a file exported from the official RASFF database without separating them into separate cells, which hinders analysis. – There is no information on the of hazard category in the file exported from the official RASFF database, which is due to the fact that one notification may concern two or more hazards in one or different categories (there were 18.7% such notifications in the whole history of the system). However, this information can be obtained indirectly by selecting the relevant criterion as a hazard category before exporting the data, and if the research would include several hazard categories, the data for each of them should be exported separately and then (if necessary) combined. – Adoption of the term "Food contact material" as one of the product types and "Food contact materials" as one of the product categories (such similar terms can be misleading); similarly, adoption of the terms "Food additives and flavourings" and "Feed additives" both as product categories and as hazard categories. – Changes of names of product categories and changes of names of hazard categories (e.g. "Heavy metals" to "Metals"). – Introduction of information on border rejections into the RASFF since 2008 only (border rejections can therefore not be investigated earlier); however, this should be considered as a development of food safety law in the European Union, and also the development of the RASFF. – Introduction of the division of information notifications into information for attention and information for follow-up from 2011 onwards. In order to examine these types of notifications throughout the pre-2011 period it is therefore necessary to revert to their initial name, i.e. information notifications, but this loses more detail about this type of notification; however, it should also be regarded as a development of food law and the RASFF.

Source: own research.

Finally, the open-access RASFF database should contain information on all notifications since 1979, and the data file exported to Excel should contain at least: reference (i.e. notification number), notification date, product type (e.g. food, feed, food contact material), product category, product, hazard category, hazard, subject (i.e. detailed description of the hazard), notifying country, country of origin, notification basis, action taken and distribution status. Other, more detailed information could be made available during the review of an individual notification. This would make it possible to analyse and track trends in reported hazards throughout the entire period of operation of the RASFF.

A significant inconvenience for the researcher is also the exclusion of the United Kingdom as a notifying country from the system, which, as indicated, entails the interruption of an important part of notifications in the RASFF, thus disrupting the ability to track trends over the long term. After its exclusion from the system, this country did not submit any more notifications between 2021 and 2023. Meanwhile, as pointed out, the United Kingdom could be treated similarly to other non-EU member countries of the system (e.g. Switzerland or Norway).

In addition, some data are either missing from the RASFF or incomplete, reported in national languages rather than English, or not standardised by name. This indicates the need for appropriate training for staff of the surveillance bodies in the member states, as well as the

relevant European Commission authorities verifying and making available these notifications in the RASFF. In turn, a significant deficiency in the RASFF database is the lack of information on trade names and the identity of individual companies. However, the European Commission argues that this is due to the need to balance openness with the protection of commercial information and does not affect consumer safety (European Commission, 2024b).

3.2. Products and hazards categories. Main reported problems

In Table 4 presented number of notifications and percentage (in descending order) of products notified in the RASFF by groups, product categories or subgroups. In some cases their names were shortened and/or also were ordered by subgroups. In turn, in Table 5 presented number of notifications and percentage (also in descending order) of hazards notified in the RASFF by groups and hazards categories. In some cases their names were also shortened. It is also worth noting that Table 4 (as well as Table 5) shows the number of records saved in the RASFF database rather than notifications due to the fact that a single notification may relate to several different hazards (as already mentioned in Table 3).

In the files exported from the official RASFF database (i.e. for 2022-2023), data on product categories are available, but there is no data on hazard categories. Therefore, each hazard category was exported separately. However, the sum of the number of notifications (records) exported for particular hazard categories was around 2,300 less than the sum of all notifications during these two years. According to the response from the Directorate-General for Health and Food Safety, only hazards selected from the hazard catalogue are classified by hazard category. However, this can only take place if they are the result of sampling or analysis. If, in turn, a risk is indicated in the notification, but not based on a sample or the hazards are not selected for it after analysis, such a notification will not be included in the search results by hazard category. It added that Directorate-General is working to improve the data to avoid this problem in the future (Europe Direct Contact Centre, 2024).

Table 4.
Number of notifications and percentage of products notified in the RASFF

Group of products (Number; Percentage)	Product category / Subgroup of product category (Number; Percentage)
Food of plant origin (39,627; 44,5%)	Fruits and vegetables (14,376; 16.1%), Nuts and seeds (13,818; 15.5%), Herbs and spices (5,773; 6.5%), Cereals and bakery (3,938; 4.4%), Cocoa, coffee and tea (1,722; 1.9%)
Food of animal origin (26,083; 29,3%)	Fish (8,263; 9.3%), Poultry (5,045; 5.7%), Meat (4,431; 5.0%), Crustaceans (2,837; 3.2%), Molluscs (2,226; 2.5%), Milk (1,509; 1.7%), Cephalopods (617; 0.7%); Eggs (531; 0.6%), Honey (527; 0.6%), Gastropods (56; 0.1%), Animal by-products (41, below 0.1%)
Other food products (11,525; 12.9%)	Dietetic foods (5,123; 5.7%), Confectionery (1,526; 1.7%), Prepared dishes (1,163; 1.3%), Other food product (1,105; 1.2%), Soups, broths… (1,061; 1.2%), Fats and oils (935; 1.0%), Additives, flavourings (381; 0.4%), Ices and desserts (231; 0.3%)
Beverages, water and wine (1,246; 1.4%)	Beverages (982; 1.1%), Water (196; 0.2%), Wine (68; 0.1%)

Cont. table 4.

Food contact materials (5,022; 5.6%)	Food contact materials (5,022; 5.6%)
Feed and pet food (5,595; 6.3%)	Feed (4,216; 4.7%), Animal nutrition (451; 0.5%), Pet food (928; 1.0%)
All products	89,098; 100.0%

Source: own research.

Table 5.
Number of notifications and percentage of hazards notified in the RASFF

Group of hazards (Number; Percentage)	Hazard category (Number; Percentage)
Chemical (40,799; 45,8%)	Mycotoxins (14,718; 16.5%), Pesticide residues (11,879; 13.3%), Metals (4,090; 4.6%), Additives, flavourings (4,043; 4.5%), Allergens (2,832; 3.2%), Veterinary products (2,827; 3.2%), Industrial contaminants (345; 0.4%), Chemical contamination (65; 0.1%)
Biological (22,109; 24,8%)	Pathogenic micro-organisms (17,241 ; 19.4%), Microbial contaminants (2,716 ; 3.0%), Biological contaminants (1,137; 1.3%), Parasitic infestation (885; 1.0%), Non-pathogenic micro-organisms (101; 0.1%), Biotoxins (other) (29; below 0.1%)
Physical (3,496; 3,9%)	Foreign bodies (2,852; 3.2%), Radiation (644; 0.7%)
Other food hazards (22,694; 25,5%)	Composition (5,468; 6.1%), Migration (4,394; 4.9%), Adulteration / fraud (2,254; 2.5%), Poor or insufficient controls (1,904; 2.1%), Environmental pollutants (1,668; 1.9%), Novel food (1,307; 1.5%), Organoleptic aspects (1,163; 1.3%), Natural toxins (other) (962; 1.1%), Genetically modified (932; 1.0%), Not determined / other (696; 0.8%); Labelling (662; 0.7%), Packaging (521; 0.6%), Process contaminants (297; 0.3%), Feed additives (236; 0.3%), Encephalopathies (230; 0.3%)
All hazards	89,098; 100.0%

Source: own research.

In Figure 2 shown percentage share of products (subgroups or categories) in hazard categories and in Figure 3 presented percentage share of hazards categories in products reported in the RASFF. These figures were generated in Statistica using two-way joining cluster analysis.

Taking into account the products and hazards with the highest number of notifications (Table 4 and Table 5) and as well as the percentages (Figure 2 and Figure 3), it can be noticed that the most important problems were: mycotoxins in nuts and seeds, pesticide residues in fruits and vegetables, cocoa, coffee and tea, metals in fish, pathogenic micro-organisms in poultry, meat and milk (as well as feed), composition of dietetic foods and migration from food contact materials. It is also worth noting that in three cases the notifications within hazard categories were strongly related to products, and these are: mycotoxins in nuts and seeds, pesticide residues in fruits and vegetables and also hazards linked to migration from food contact materials. Indeed, significant clusters occurred here both when considering the percentages regarding products in relation to hazards and hazards in relation to products.

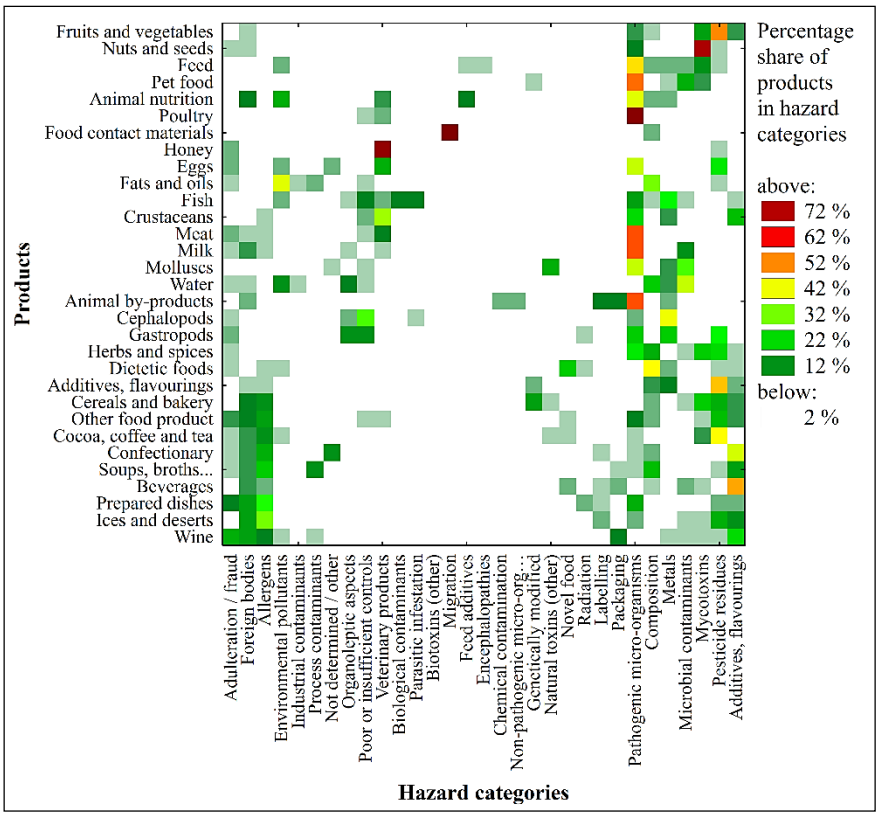

Figure 2. Percentage share of products in hazard categories reported in the RASFF.

Source: own research.

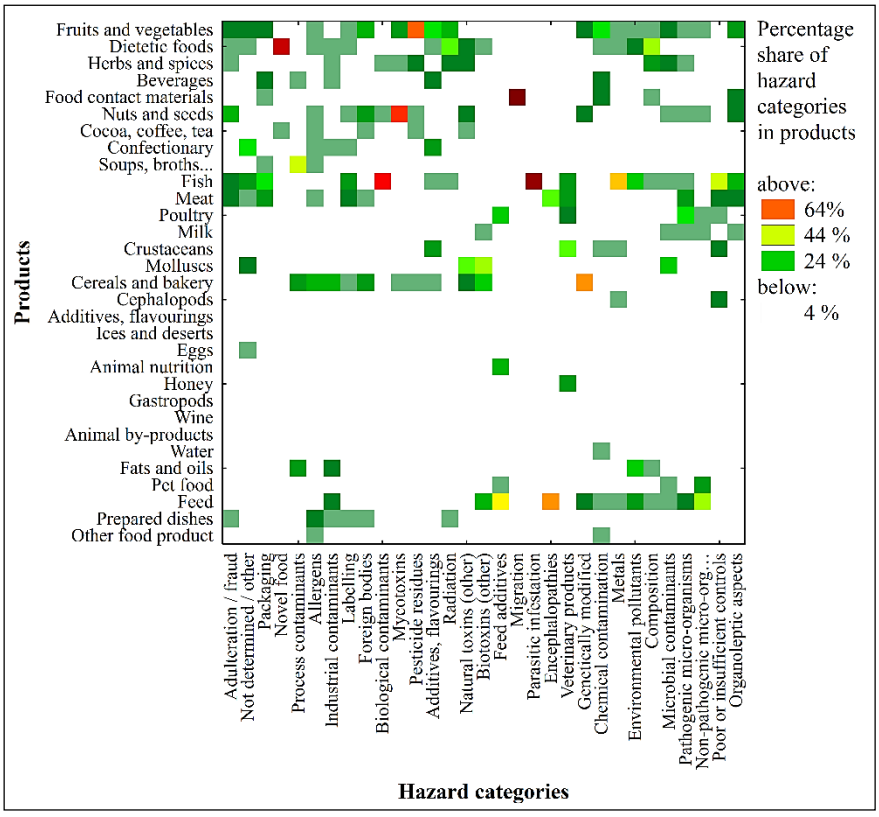

Figure 3. Percentage share of hazard categories in products reported in the RASFF.

Source: own research.

It is moreover notable that if only the percentages (and not the numbers) are considered, it is also possible to identify problems reported for products with a much lower number of notifications and these are e.g.: hazards associated with novel food in the context of dietetic foods and genetic modifications of cereals and bakery, biological contaminants and parasitic infestation in fish, veterinary products in honey, additives and flavourings in beverages, and also feed additives and encephalopathies in feed.

When comparing the colours (and shades) in the Figures 2 and Figure 3 with their legends, it can be seen that their coverage is not accurate, which can make it difficult to interpret the results. This is undoubtedly a drawback of two-way joining cluster analysis, however, these charts are automatically generated and optimising the settings is quite limited. Therefore, attention was mainly paid to the largest clusters, i.e. those marked in brown or red. It is also worth noting that most of the chart areas are marked in white, indicating that clusters are very small or do not exist.

4. Discussion

4.1. Scientific works relating to the RASFF

Table 6 shows the number of works on the ten most frequently notified product categories (or subgroups thereof) and hazard categories reported in the RASFF up to and including 2023 (Elsevier, 2024; Springer, 2024; Multidisciplinary Digital Publishing Institute, 2024; Taylor & Francis, 2024; Wiley, 2024). There are presented in the descending order. The indicated product categories together account for approximately 80% of all notifications in the RASFF (and similarly the hazard categories too). In the case of category "Additives, flavourings", the results are not conclusive, as they can be both as products, but can also be reported as hazards.

Table 6.
The number of works on the ten most frequently notified product categories (or subgroups) and hazard categories reported in the RASFF up to and including 2023

Searched keyword (Number of notifications in the RASFF)		Publisher (Number of works)				
		Elsevier	Springer	Taylor & Francis	Wiley	MDPI
RASFF		1,026	429	220	578	21
RASFF and Product category/ Subgroup of product category	Fruits and vegetables (14,376)	272	138	64	259	5
	Nuts and seeds (13,818)	149	59	30	130	0
	Fish (8,263)	416	180	114	337	4
	Herbs and spices (5,773)	143	54	34	131	4
	Dietetic foods (5,123)	44	21	99	303	1
	Poultry (5,045)	258	101	59	125	1
	Food contact materials (5,022)	120	39	33	74	2
	Meat (excluding Poultry) (4,431)	251	102	60	125	1
	Feed (4,216)	920	422	201	529	18
	Cereals and bakery (3,938)	98	44	20	79	1

Cont. table 6.

RASFF and Hazard category	Pathogenic micro-organisms (17,241)	52	20	19	93	4
	Mycotoxins (14,718)	334	114	69	180	2
	Pesticide residues (11,879)	280	128	123	246	3
	Composition (5,468)	455	167	148	408	1
	Migration (4,394)	147	83	56	130	2
	Metals (4,090)	332	112	62	182	5
	Additives, flavourings (4,043)	99	53	69	219	0
	Foreign bodies (2,852)	133	90	23	79	1
	Allergens (2,832)	154	68	20	107	4
	Veterinary products (2,827)	340	157	74	331	1

Note. MDPI – Multidisciplinary Digital Publishing Institute.

Source: own research.

If one compares the total number of works with the keyword "RASFF" only with the number of works containing this word and the name of the product category or hazard category, it can be seen that most works only mention this system. On the other hand, however, it may also be noted that some works must have referred to several product categories and/or hazard categories together. Another finding that can be drawn from comparing the number of works and the number of notifications is that there is no correlation between them. Thus, some problems are examined frequently and others rarely or not at all.

In terms of product categories, both Elsevier and Springer published a high number of works on feed, followed by food itself, with the most common being: fish, fruits and vegetables, poultry and meat. Authors of works issued by these publishers most often referred to hazards related to: composition, additives and flavourings, veterinary products, mycotoxins, pesticide residues and metals. In Taylor & Francis and Wiley publications, the search results are similar, but there are far more works published on a product category such as dietetic foods. It is also worth noting that Wiley publishes two journals related to one of the RASFF members (the EFSA), and they are: EFSA Journal and EFSA Supporting publication. In turn, the Multidisciplinary Digital Publishing Institute published only single works on issues reported in the RASFF, although, as with the aforementioned publishers, most works referred to feed.

Authors of papers on the RASFF mostly only refer to this system or carry out an analysis of the reported notifications. Much less often do they make critical comments on the data collected in the RASFF database. Among them are D'Amico et al. (2018), who, analysing notifications on seafood, pointed out that the data sent to the RASFF portal may depend on a number of factors: periodic changes in the attention of member countries due to different problems, subjective perceptions of those who report notifications (in terms of risk decisions), reporting of multiple notifications or non-reporting (resulting in too many or too few notifications), types or frequency of checks at border posts. D'Amico et al. (2014), examining notifications of fishery products from China, also noted that they are reported in the RASFF under different trade or scientific names (as also indicated in Table 3), due to linguistic difficulties or translation mistakes.

Petrović (2013), referring to notifications on viruses in the RASFF, drew attention that they are not representative and are not based on common criteria therefore should be interpreted with care. Banach et al. (2016) noted that data collected in the RASFF do not always identify pathogenic microbial species or the severity of chemical agents (e.g. genotoxic, carcinogenic, mutagenic). Notifications of food poisoning are very limited and mainly concern biological hazards. Data gathered in the RASFF is not always consistent in terms of relevant information on identified hazards. In many cases there are editing mistakes (e.g. products and hazards are misspelled), categories are misrepresented (e.g. non-pathogenic organisms in the pathogenic micro-organisms category) or information relevant for early identification may be inadvertently omitted (if, for example, they do not pose a hazard to a member country). In addition, some organisms, agents and commodities are rarely examined. Consequently, under-reporting may occur. On the other hand, overlapping hazards may result in over-reporting. Similar observations were made by Soon et al. (2020), who analysed outbreaks and recalls and stated that it is possible that the RASFF double counts some incidents, but this cannot be conclusively determined without checking line by line.

In turn, Lawrence et al. (2022) recalled that the United Kingdom, Spain, Germany, Italy and Belgium accounted for the largest number of notifications relating to seafood, meaning that the share of the total data set in the RASFF on this kind of products is shaped by institutions from mentioned countries. A similar observation was expressed by Kowalska and Manning (2021). They drew attention to the significant variation among EU member states in their participation in the RASFF. They also highlighted that trends in RASFF data should be interpreted with caution due to changes in the law and purposive sampling.

Manning et al. (2022), reviewing notifications reported in the RASFF and relating to dietetic foods, dietary supplements and fortified foods, noted that in the early 2000s, European legislation in this area was changed, which contributed to an increase in the frequency of actions carried out by food control authorities. There had also been a dynamic market development and increased competition between producers and distributors of dietetic foods, which may have contributed to the adulteration of products for economic gain. It is also worth noting that in May 2004, the number of RASFF member countries increased significantly due to the enlargement of the EU, which could also have had an influence on the number of notifications in this system. This aspect was indicated by studying the notifications concerning cereals and bakery products originating from Poland (Kowalska et al., 2018).

Whereas, Dabbenne et al. (2014) noted that the number of notifications of food recalls reported in the RASFF increased in 2011, which could be due to the introduction of new legal regulations and food safety standards, the development of new detection methods, as well as increasing imports from less developed countries, where food safety requirements are usually at a lower level. Meanwhile, in examining notifications relating to fruits and vegetables reported in the RASFF, it was also noted that although a country may be mentioned as the country of

origin of a product, this does not necessarily indicate that the hazard comes from this country (European Commission, 2024b; Johannessen, Cudjoe, 2009).

In turn, Popping et al. (2022) noted that many notifications in the RASFF relate to contaminants resulting from non-compliance with regulatory requirements, but not necessarily related to health concerns (for example, in the case of pesticides, veterinary drug residues or mycotoxins). They also add that although the RASFF database is a valuable resource, it lacks detailed information (for example, mislabelling of allergens can be classified as a food fraud, while the presence of melamine is classified as a food safety incident even when it is also a food fraud).

4.2. Map of links

Figure 4 (generated in VOSviewer) shows map of links between the keyword "RASFF" and other keywords specified by the authors. It consists of 22 items, 6 clusters (marked with different colours) and 61 links. It should be reminded that in creating the map, those keywords that occurred at least twice were taken into account.

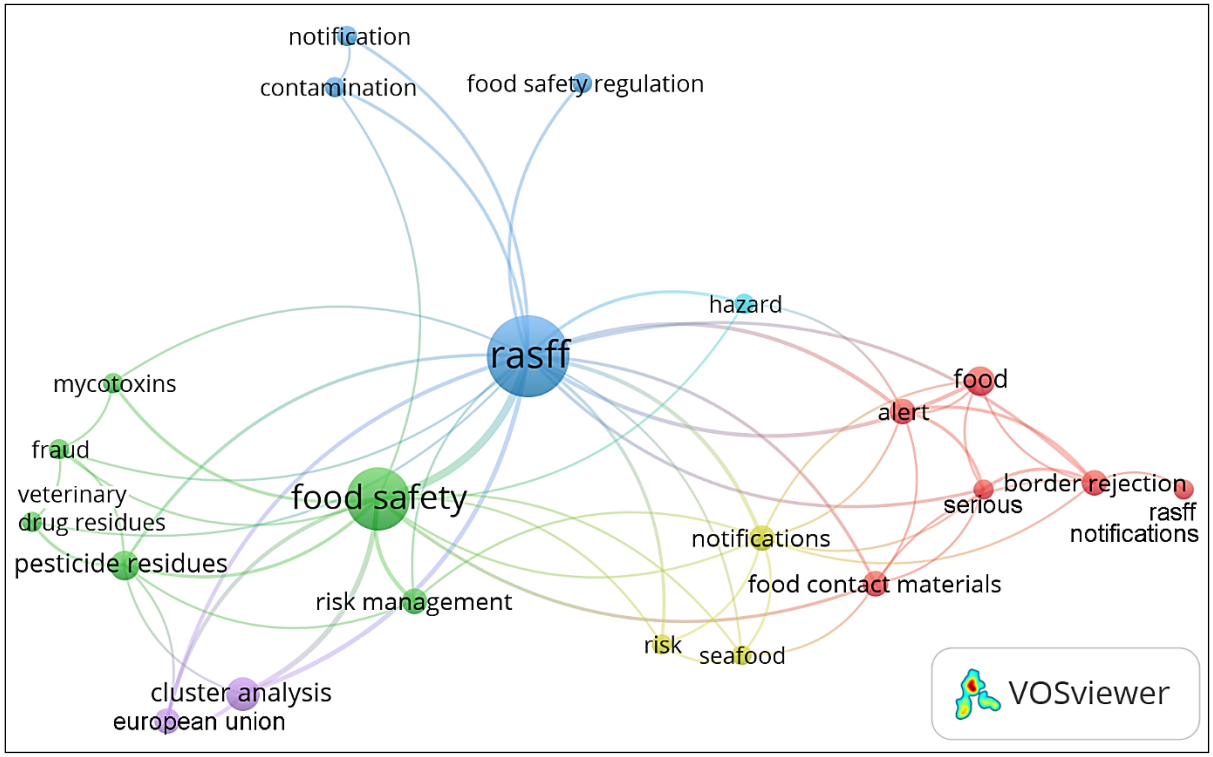

Figure 4. Map of links between the keyword "RASFF" and other keywords indicated by the authors. Source: own research.

The word "RASFF" (blue colour in the middle of the map) is most often combined with "food safety" (green colour). On the left side of the map, also in the green cluster are four hazards categories. i.e.: mycotoxins, fraud (adulteration/fraud), veterinary drug residues (veterinary products) and pesticide residues. The map also shows one product group – seafood (olive at the bottom), one product category – food contact materials and two notification types

– alerts and border rejections (red at the right). Thus, it should be noticed that the authors did not indicate in keywords many of the product categories and hazard categories reported in the RASFF, however, they may have referred to them in their works. Whereas, among other data, only the notification type was specified. A more detailed map (i.e. also taking into account individually occurring keywords) could give a more complete characterisation of the links, but interpreting this map would require dividing it into individual parts and enlarging them.

It should be pointed out that searching using keywords in databases of scientific papers (Table 6) also concerns the text of the papers, and is therefore very accurate, but may only involve a single occurrence of the word itself (rather than presenting the results of a detailed study). In turn, authors of scientific works define keywords (Figure 4) in a subjective manner. Thus, the number of works related to the RASFF, as well as the keywords used by the authors, are not necessarily indicative of the scope of their research. However, considering Table 6 and Figure 4, it is noteworthy that there is a relatively small number of works on products such as nuts and seeds, herbs and spices and hazards including pathogenic micro-organisms and migration. This may be due to the very different types of products and hazards in these categories and the associated difficulty in interpreting the results. However, these are issues that could potentially be an area for further in-depth analysis of notifications reported in the RASFF.

5. Conclusions

The biggest inconvenience associated with the Rapid Alert System for Food and Feed (RASFF) database is the lack of access to historical data, i.e. up to and including 2019, and the redirection and collection of data on certain hazard categories (for example, adulteration) previously available in the RASFF to other networks, accessible now only to the supervisory authorities of European Union countries. Open access to all these data should be reinstated, allowing free use by researchers, consumers and companies, involved in the food chain. It would also be appropriate to consider the re-inclusion of the United Kingdom in the RASFF, as its exclusion from the system has interrupted the continuity of a significant share of the notifications, so there is no possibility of tracking trends in a reliable way.

Deficiencies in the RASFF data should be remedied and standardised in terms of notation and language (appropriate guidance should be addressed by the European Commission to the RASFF member contact points). In addition, where appropriate, full Latin names of products and hazards should be required, which would avoid many inaccuracies in the data. The file exported from the database should also include data on hazard categories, as well as, other data. However, it is also important to point out that the RASFF database does not include information on the number/quantity of notified products and the scale of the hazards, which makes it difficult to assess the real risk for the consumer.

As a reason for the non-disclosure of trade product and company names in the RASFF database, the protection of the economic interests of these companies, based in the European Union, should be indicated. Meanwhile, the European consumer should have access to them, as is the case in the United States or Australia, where this type of data is published in the open. It is worth noting that in the European Rapid Alert System for Dangerous Products (RAPEX) for non-food products, such data are presented, but this is probably due to the fact that they are mainly sourced from outside the EU.

Most authors analyse RASFF notifications only in terms of numbers or percentages, whereas studies of this type should be more cross-sectional and multidimensional, indicating relationships and similarities between different product categories and hazard categories, as well as the other type of data. Potential areas for further research could have been notifications for nuts and seeds, herbs and spices and hazards including pathogenic micro-organisms and migration, also taking into account data such as: year of notification, notifying country, country of origin, notification basis, distribution status and action taken. However, it should be borne in mind that the results of the analysis of the data reported in the RASFF should be interpreted with caution. This is because the number and details of notifications depend on the number of RASFF members at any given time, as well as on the varying activity of the supervisory authorities of the different countries resulting from food safety problems in a particular country, and the awareness, training and experience of authorities' staff.

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