Quality Assurance and Safety of Crops & Foods, 2017; 9 (3): 335-344

Product categories and hazard categories in the RASFF notifications: dependences between chosen variables

M. Pigłowski

Gdynia Maritime University, Morska 81-87, 81-225 Gdynia, Poland; m.piglowski@wpit.am.gdynia.pl

Received: 6 September 2016 / Accepted: 5 March 2017

RESEARCH ARTICLE

Abstract

The paper examined if there was any dependence between product and hazard categories in the Rapid Alert System for Food and Feed notifications in 2008-2015 using the cluster analysis. It also analysed which the dependences between particular product and hazard categories took into consideration the type of notifications and also other variables, i.e. year, notifying country, notification basis, risk decision, distribution status and action taken using scatterplots. It was noticed that the notifications were most frequently related to: pathogenic micro-organisms in meat and meat products (other than poultry), poultry meat and poultry meat products and heavy metals in fish and fish products (for alert notifications), pesticide residues in fruits and vegetables (for information notifications) and mycotoxins in nuts, nut products and seeds and pesticide residues in fruits and vegetables (for border rejections, which were almost half of the notifications). However, these categories were not always most frequently notified and also there were some changes in the number of notifications each year. Six countries were particularly active in notifying: Germany, Italy, Netherlands and the United Kingdom and also France and Spain. The notification basis were mainly official controls on the market for alert notifications and information notifications or border control (consignment detained) for border rejections. The risk was usually undecided or serious for alert notifications and undecided for information notifications and border rejections. The action taken was withdrawal from the market for alert and information notifications or re-dispatch and destruction for border rejections. The trends in the number of notifications can be helpful in the legislative process and planning controls and audits. Consumer attention should be to a greater extent paid to products manufactured in Europe. Further research should concern detailed identification of hazards in particular product categories, including type of notifications and also product origin, if possible.

Keywords: alert notifications, information notifications, border rejections, cluster analysis, scatterplots

1. Introduction

The legal basis for the Rapid Alert System for Food and Feed (RASFF) is the Regulation EC/178/2002 (EP and Council, 2002), although the system was already created in 1979. When risks to public health are detected in the food chain the RASSF enables to exchange information between its members, i.e. 28 European Union (EU) countries, the European Commission, the European Food Safety Authority (EFSA), the European Free Trade Association (EFTA) Surveillance Authority (ESA), Norway, Iceland, Liechtenstein and Switzerland. In the RASFF four types of notifications can occur: alert notifications (when food or feed presenting a serious risk is already on the market and rapid actions are required), information notifications (when a risk in food or feed placed on the market was identified, but the rapid actions are not necessary), border rejections (when the risk health was found in food or feed consignments after testing and it was rejected on the external border of the EU or the European Economic Area) and news (any other information related to the food or feed safety, which was not classified as alert or information notification, but can be interesting for food authorities) (EC, 2016). The RASFF effectiveness relies on its simplicity of operation and legal obligation of the member to notify the European Commission or take action when the serious risk related to food appears (Hargin and Shears, 2013; Rose *et al.*, 2009). The activity of particular countries with regard to notifying was varied; yet, four RASFF members had so far been the key: Italy, Germany, the United Kingdom and Spain (Giorgi and Lindner, 2009; Petróczi *et al.*, 2010; Taylor *et al.*, 2013). In these countries and also in France and the Netherlands food turnover was the largest among the EU countries (FoodDrinkEurope, 2014).

Hirschauer and Zwoll (2008) noted, however, that the RASFF is the after-the-fact responsiveness tool. Thomson *et al.* (2012) indicated that it may not report incidents that never crossed the border. Bánáti (2011) believed that this tool cannot prevent contaminated food from entering the food chain and the market. A similar opinion was expressed by Van de Brug *et al.* (2014), who stated that the RASFF is based on the existing knowledge on known hazards and is not designed to identify new and unexpected hazards (Marvin and Kleter, 2009). Lancova *et al.* (2011) noted that the RASFF notifications can relate to substances in harmless concentrations, compliant with the existing regulations, whereas the overall mixture of contaminations may rise to effects higher than expected due to additive or synergistic interactions.

On the other hand, the RASFF database was recommended as a tool to identify hazards (Banach *et al.*, 2016; Kleter *et al.*, 2009). Kleter and Marvin (2009) stated that the RASFF is the system, which early warns against the emerging hazards in the food production chain. Similarly, Spichtinger and Astley (2009) believed that this tool allows identification of the emerging issues. Marvin *et al.* (2009b) thought that the trends in the RASFF data combined with the information on the potential impact on health and trade can be a useful basis for identifying hazards that are likely to increase in future. Marvin *et al.* (2009a) added that these trends can be specific and longer-term. Such an attempt (i.e. using data from the RASFF) was made e.g. by Bouzembrak and Marvin (2016) with regard to prediction of the food fraud type. The RASFF can, however, help in identifying potential problems before they become widespread or can be helpful for authorities on targeting products or sectors in ever-decreasing resources (Hargin and Shears, 2013). Trevisani and Rosmini (2008) stated that the RASFF findings should be used to review the control system. In turn, Van Egmond *et al.* (2007) believed that the RASFF notifications provide useful data for the development of new EU measures as the European Commission regulations.

Kleter *et al.* (2009) in a broad discussion, to some degree also Wiig and Kolstad (2005), Hoffbauer *et al.* (2012) and the annual RASFF reports (EC, 2016) mainly focused on presenting separately (and mostly only in a quantitative way) the individual product and hazard categories (but, they also present elements, chemical compounds or micro-organisms causing hazards). Oreopoulou *et al.* (2009a) tried also to present changes in time related to some product or hazard categories. However, only in the reports (and in a limited way) some other variables, such as: year, origin, notifying country, notification basis were taken into account. Therefore, the goal of the article was to examine if product categories and hazard categories were dependent on each other (if yes, in which way) and to examine in a comprehensive way the relationships between particular product categories or hazard categories and other variables, such as: year, notifying country, notification basis, risk decision, distribution status and action taken, taking into consideration the notification types.

2. Data and methods

In the RASFF database the data concerning particular notification types (classification) were available for: alert notifications (from 1979), information notifications (from 1989 to 2011), and after division: information for attention (from 2011), information for follow-up (from 2010), border rejections (from 2008) and for news there was no data. Therefore, in order to compare various notification types the period 2008-2015 (eight years) was adopted and three types of information notifications were combined. The notification lists were exported separately to Excel for particular hazard categories, because searching the results did not indicate them. It also allowed considering more than one hazard category in a single notification, if it occurred. Finally, in Excel the database was created with the following eight variables for food: product category, hazard category, year, notifying country, notification basis, risk decision, distribution status and action taken for all notifications (22,521 cases) and also with division into three particular notification types, i.e. alert notifications (4,421; 20% of all notifications), information notifications (7,218; 32% of all notifications) and border rejections (10,882; 48% of all notifications).

In some cases there was no data for variables: notification basis, distribution status and action taken, therefore these empty fields were filled in with '(not specified)'. Unfortunately, it was not possible to take into account the data related to the countries the notifications concerned, because the origin and/or distribution within one notification could often refer to several different countries (e.g. raw materials could originated from few various countries, and besides, the product could be manufactured, packed or re-packed in other countries).

In order to examine how variables are clustered within particular notification types the cluster analysis was applied using Statistica 12 (Tulsa, OK, USA). The following settings were adopted: the analysis method: joining (tree clustering), linkage rule: complete linkage, distance measure: Euclidean distance. K-means clustering was also applied as another cluster analysis method with indication of two, three and four clusters. The dependence of the product category and the hazard category within each of the notification types and other six variables (i.e. year, notifying country, notification basis, risk decision, distribution status and action taken) was graphically examined using (bubble) scatterplots. In each of the scatterplot presented the dependences between values of two variables. These dependences were the stronger, the greater were the sizes of the bubbles. All scatterplots (52 figures) can be found in the supplementary online material numbered Figure S1-Figure S9 on separate pages.

3. Results and discussion

In Figure 1 agglomeration clustering (tree diagrams) for various notification types was presented. The arrangement of variables within the clusters for all notifications (Figure 1A) and information notifications (Figure 1C) and less for alert notifications (Figure 1B) was very similar. In case of these notification types we can speak about two clusters (the first – product category, hazard category, notifying country, and the other – notification basis, risk decision, year, distribution status and action taken). However, the dependence between variables the product category and the hazard category was direct. The arrangement of variables within border rejections (Figure 1D) was slightly different and we can speak about three clusters (the first – product category and notifying country, the second – notification basis, risk decision, distribution status, year and action taken, and the third – hazard category).

In Table 1 variables in clusters according to k-means clustering were presented. If only two clusters were indicated, one of them always contained the same three variables: product category, hazard category and notifying

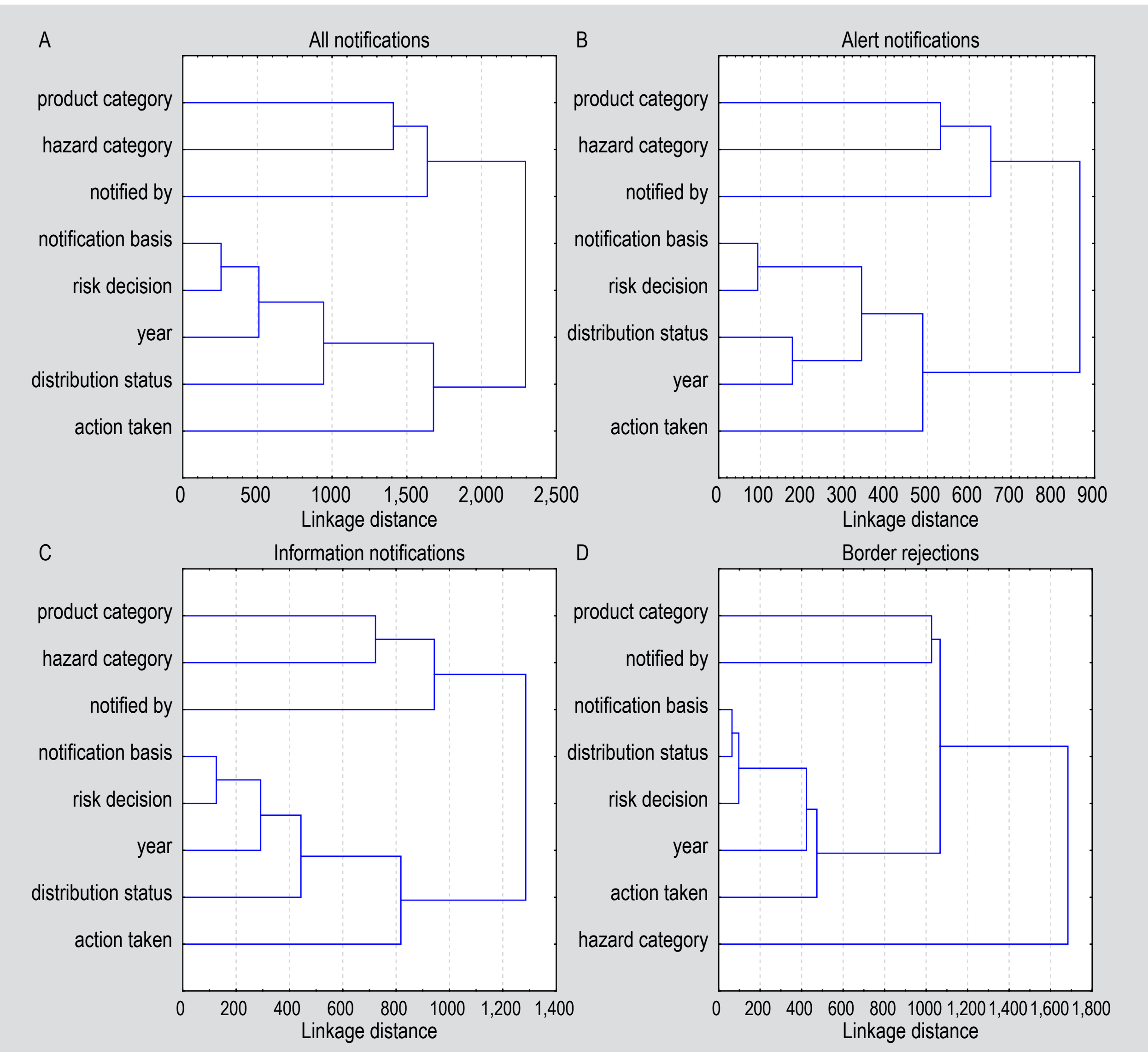

Figure 1. Agglomeration clustering for various notification types.

Table 1. Variables in clusters according to k-means clustering.

Clusters number	All notifications	Notification type		
		Alert notifications	Information notifications	Border rejections
2	year, risk decision, notification basis, distribution status (4 variables); product category, hazard category, notifying country, action taken (4 variables)	product category, hazard category, notifying country (3 variables); year, risk decision, notification basis, distribution status, action taken (5 variables)	product category, hazard category, action taken, notifying country (4 variables); year, risk decision, notification basis, distribution status (4 variables)	Product category, notifying country, hazard category (3 variables); risk decision distribution status, notification basis, year, action taken (5 variables)
3	action taken (1 variable); year, risk decision, notification basis, distribution status (4 variables); product category, hazard category, notifying country (3 variables)	product category, hazard category, notifying country (3 variables); year, risk decision, notification basis, distribution status (4 variables); action taken (1 variable)	notifying country, action taken (2 variables); product category, hazard category (2 variables); year, risk decision, notification basis, distribution status (4 variables)	hazard category (1 variable); product category, notifying country (2 variables); risk decision distribution status, notification basis, year, action taken (5 variables)
4	action taken (1 variable); year, risk decision, notification basis, distribution status (4 variables); product category, hazard category (2 variables), notifying country (1 variable)	notifying country (1 variable); year, risk decision, notification basis, distribution status (4 variables); action taken (1 variable); product category, hazard category (2 variables)	notifying country (1 variable); action taken (1 variable); year, risk decision, notification basis, distribution status (4 variables); product category, hazard category (2 variables)	product category (1 variable), notifying country (1 variable); risk decision distribution status, notification basis, year, action taken (5 variables); hazard category (1 variable)

country (regardless of the notification type). In case of all notifications and information notifications one more variable occurred: action taken. The variable the product category was always in the first place in the cluster (it was the closest to the cluster centre), and the variable the hazard category was in the second place from the cluster centre (with the exception of border rejections). If more than two clusters were indicated, mostly the division of this cluster (with variables the product category and the hazard category) occurred, not another cluster, into smaller clusters (with one or two variables). If four clusters were indicated, variables the product category and the hazard category were in one, two-element cluster (with the exception of border rejections, where they are separate one-element clusters). However, we cannot speak about similarity between the variables: the product category and the hazard category, but rather about the relationship.

The dependence of these two variables: the product category and the hazard category between each other presented in Figures S1a-S1d. The dependence between the variables the product category and the hazard category and other variables (year, notifying country, notification basis, risk decision, distribution status and action taken) within particular notification types were presented respectively in Figures S2a-S2f and S3a-S3f (for all notifications), S4a-S4f and S5a-S5f (for alert notifications), S6a-S6f and S7a-S7f (for information notifications) and S8a-S8f and S9a-S9f (for border rejections).

The scatterplots in Figures S1a-S1d indicated the main dependences between the product and the hazard categories. For all the notifications and also in case of border rejections there were pesticide residues in fruits and vegetables and mycotoxins in nuts, nut products and seeds (Figure S1a, S1d). It was linked with considerable part of border rejections in all the notifications (almost half, see 'Data and methods'). In case of alert notifications the following were mainly notified: pathogenic micro-organisms in meat and meat products (other than poultry), poultry meat and poultry meat products, milk and milk products and bivalve molluscs and products thereof; heavy metals in fish and fish products, but also mycotoxins in nuts, nut products and seeds; pesticide residues in fruits and vegetables, composition in dietetic foods, food supplements, fortified food or allergens in cereals and bakery products (Figure S1b). Whereas, in case of information notifications the attention first of all paid pesticide residues in fruits and vegetables and also pathogenic micro-organisms in meat and meat products (other than poultry) and poultry and poultry meat products; heavy metals in fish and fish products and composition in dietetic foods, foods supplements, fortified foods (Figure S1c).

The results related to product categories or hazard categories and particular variables in the notification type in question were summarised together. However, in case of variables: year and notifying country the data were scattered, which caused the difficulty in the analysis of scatterplots. In case of the other variables: notification basis, risk decision, distribution status and action taken the data were more focused, therefore the interpretation of the results was easier.

If taking into account all notifications, it can be seen that the most frequently notified product categories were: fruits and vegetables (the number of notifications was similar in the last years), nuts, nut products and seeds (the number of notifications decreased in the lat years) (Figure S2a). While within the hazard categories the most frequently notified were mycotoxins (the decrease in the last years), pesticide residues (the similar number of notifications in the last years) (Figure S3a). These product and hazard categories were predominantly notified by Italy, the Netherlands, the United Kingdom and Germany (Figures S2b and S3b). The notification basis for them were primarily the border control (and the consignment was detained) and to a much lesser extent the official control on the market (Figures S2c and S3c). The risk was usually undecided (Figures S2d and S3d). The detained products were not distributed (Figures S2e and S3e) and re-dispatched, destructed or withdrawn from the market (Figures S2f and S3f). The results for particular notifications types were yet more detailed.

In case of alert notifications the most frequently notified product categories were: meat and meat products (other than poultry), fruits and vegetables, fish and fish products and to a lesser extent: cereals and bakery products, dietetic foods, food supplements, fortified foods, nuts, nut products and seeds, bivalve molluscs and products thereof, milk and milk products and poultry meat and poultry meat products. In all these product categories we can talk about an increase or a stable trend of notifications in the last years (Figure S4a). However, in case of hazard categories a marked increase of notifications was seen last years and it was only in pathogenic micro-organisms. In case of heavy metals, mycotoxins, pesticide residues, composition the dependence was no distinct and in case of allergens there was slightly increase (Figure S5a). The alert notifications related to fish and fish products were made mainly by Italy and France, but also Germany (Figure S4a and S4b). The notifications basis for alert notifications were mainly official controls on the market and to a much lesser extent the company's own checks (Figures S4c and S5c). The risk was approximately equal for serious and undecided (Figures S4d and S5d). It was stated that products could be distributed on the market or to other member countries (Figures S4e and S5e) and were withdrawn from the market (Figures S4f and S5f).

The character of information notifications was quite similar to alert notifications. The most frequently notified were fruits and vegetables and fish and fish products, but also: meat and meat products (other than poultry), poultry and poultry meat products, dietetic foods, foods supplements, fortified foods (a stable trend or a slight decrease in the last years) (Figure S6a). In hazard categories we could observe also a slight decrease of notifications in case of pathogenic micro-organisms and a stable trend in case of pesticide residues, composition and heavy metals (Figure S7a). Similarly to alert notifications, information notifications were made mainly by Italy, but also by Germany, France, United Kingdom and Denmark (Figure S7a and S7b). The notification basis were official controls on the market (Figures S6c and S7c). The risk in information notifications was usually undecided (Figures S6d and S7d). The distribution of products was restricted to the notifying country (Figures S6e and S7e) and they were withdrawn from the market (Figures S6f and S7f).

The border rejections had a dominant share in all notifications. The most frequently notified products were: fruits and vegetables (the stable trend in the last years) and nuts, nut products and seeds (the decrease) (Figure S8a) and within hazard categories: mycotoxins (the decrease) and pesticide residues (the stable trend) (Figure S9a). These product and hazard categories were mainly notified by: Italy, Germany, United Kingdom, Netherlands and Spain (Figures S8b and S9b). The notification basis were border controls (Figure S8c and S9c) and the risk was usually undecided (Figures S8d and S9d). The detained consignment was not distributed (Figures S8e and S9e) and re-dispatched or destructed (Figures S8f and S9f).

The approach of the particular authors to the RASFF notifications varied very much. Some of them gave only product or hazard categories, others mentioned the occurring hazards in products. In rare cases the authors indicated the type of notification or countries that were most active in notifying (see 'Introduction'). However, variability of notifications in time, and also the notification basis, risk decision, distribution status and action taken were not widely examined.

There were some authors, who referred to the RASFF notifications indicating only the product category or the hazard category (without direct dependences between them). Notifications on fish were noted by Bush and Duijf (2011), on seafood (fish, crustaceans and molluscs) by Schröder (2008), crustaceans (shrimp) by Wan Norhana *et al.* (2010) and also on dietetic food by Petroczi *et al.* (2011). There were also mentioned notifications on: allergens (Kerbach *et al.*, 2009), additives (Oreopoulou *et al.*, 2009b), pathogenic micro-organisms, heavy metals, pesticides, allergens and mycotoxins (Orford *et al.*, 2014), mycotoxins, particularly aflatoxins (Alldrick *et al.*, 2009; Giorgi and Lindner, 2009; Pereira *et al.*, 2014; Spichtinger and Astley, 2009; Van der Fels-Klerx *et al.*, 2010), residues of veterinary medicinal products and industrial contaminants (Points *et al.*, 2015) and pesticide residues (Skretteberg *et al.*, 2015).

However, some of the dependences presented in Figures S1a-S1d were indicated when referring to the RASFF. Several authors mentioned hazard categories and product categories together. Unfortunately, the type of notification was rarely indicated (or two or more types were given together), therefore it was here omitted. Uyttendaele *et al.* (2014, 2015) and Van Boxsteal *et al.* (2013) paid attention to notifications related to mycotoxins, micro-organisms and pesticide residues in fruits and vegetables and herbs and spices and/or in nuts. Similarly, notifications related to mycotoxins, micro-organisms and pesticide residues, but also migration was noted by Banach *et al.* (2016). In turn, Brandão *et al.* (2015) mentioned about mycotoxins, micro-organisms and pesticide residues in fruits and vegetables, but also in meat products. Hoffbauer *et al.* (2012) noted notifications related to mycotoxins in nuts, mycotoxins and pesticide residues in fruits vegetables, but also heavy metals in fish and fish products, migration from food contact materials.

The above mentioned mycotoxins (particularly aflatoxins) were often notified under the hazard category, i.e. in dried fruits and figs (Bircan, 2009), nuts and cereals (Duarte *et al.*, 2010), fruits and vegetables, cereals (Majeed *et al.*, 2013), herbs and spices and nuts, cereals and bakery products, foodstuffs (Marin *et al.*, 2013), spices (Ozbey and Kabak, 2012), fruits and vegetables, herbs and spices and nuts (Van de Perre *et al.*, 2015; Van Egmond *et al.*, 2007). However, several authors mentioned only notifications related to mycotoxins in nuts (Ariño *et al.*, 2009; Clavel and Brabet, 2013; Ding *et al.*, 2012; Dini *et al.*, 2013; Freitas-Silva and Venâncio, 2011; García-Cela *et al.*, 2012; Georgiadou *et al.*, 2012; Marín *et al.*, 2012; Molyneux *et al.*, 2007; Rodrigues *et al.*, 2012; Wesolek and Roudot, 2016). Notifications on micro-organisms in herbs and spices were noted by Elviss *et al.* (2009) and in vegetables and herbs by Jacxsens *et al.* (2010).

However, notifications on microorganisms also related to: meat and poultry (Alonso-Hernando *et al.*, 2012; Álvarez-Fernández *et al.*, 2012; Jansen *et al.*, 2016), poultry (Lavelli, 2013), generally to seafood (Amagliani *et al.*, 2012), bivalve molluscs (Anacleto *et al.*, 2013, 2014, 2015; Boxman, 2010) or fish (Little *et al.*, 2012). Besides micro-organisms in fish Jespersen *et al.* (2014) indicated also notifications on residues of veterinary medicinal products and pesticide residues and Noël *et al.* (2011) mentioned notifications on heavy metals in crustaceans. Notifications related to residues of veterinary medicinal products in meat, poultry or seafood were not visible in Figure S1, however, they were also mentioned in: meat and poultry (Andreé *et al.*, 2010), aquaculture products (Broughton and Walker, 2010), fish (De Silva, 2012), crustaceans (Rico *et al.*, 2013) and parasites were noted in fish or fish products (Llarena-Reino *et al.*, 2015; Robertson *et al.*, 2014).

4. Conclusions

The dependence between the product category and the hazard category in the RASFF was direct within alert notifications and information notifications. In case of border rejections this relationship was additionally dependent on the notifying country. The main problems were pathogenic micro-organisms in meat and crustaceans and heavy metals in fish (for alert notifications), pesticide residues in fruits and vegetables (for information notifications) and mycotoxins in nuts (for border rejections).

The visible number of alert notifications, considered separately for the product category and hazard category, could be, however, only observed within fish and within pathogenic micro-organisms (the slightly upward or stable trend in the recent years). In turn, the number of information notifications within fruits and vegetables decreased and pesticide residues was stable last years. The basis of the alert and information notifications were mainly official controls on the market and the notified products were withdrawn from the market. The number of border rejections within nuts and mycotoxins also decreased in the recent years. These products were notified on the basis of border controls, consignments were detained and re-dispatched. This means that the manufacturer/importer/distributor paid less attention to food safety than countries' authorities. While, the notification basis should be first of all company's own checks.

Germany, Italy, the Netherlands and the United Kingdom, to a lesser extent also France and Spain, were particularly active in the RASFF notifications. However, the risk for alert notifications was usually undecided and serious and for information notifications and border rejections was usually undecided. The notifying country should unambiguously indicate the risk decision: serious or not serious. In case of alert notifications it should state possible distribution on the market or to other member countries, for information notification distribution was restricted to the notifying country and for border rejection the products were not distributed.

The intensity (and changes) in the number of a particular type of notifications in subsequent years can be helpful for the European Commission and the European Parliament in the legislative process. The data from the RASFF can be used by the supervisory authorities of the EU (including the Food and Veterinary Office) and by particular countries in planning food controls or audits. However, it is also very important to increase the consumer awareness on hazards in food through EU and national programs in the mass media.

Supplementary material

Supplementary material can be found online at https://doi.org/10.3920/QAS2016.1004.

Figure S1a. Dependence of the product category and hazard category within all notifications.

Figure S1b. Dependence of the product category and hazard category within alert notifications.

Figure S1c. Dependence of the product category and hazard category within information notifications.

Figure S1d. Dependence of the product category and hazard category within border rejections.

Figure S2a. Dependence of the product category and year within all notifications.

Figure S2b. Dependence of the product category and notifying country within all notifications.

Figure S2c. Dependence of the product category and notification basis within all notifications.

Figure S2d. Dependence of the product category and risk decision within all notifications.

Figure S2e. Dependence of the product category and distribution status within all notifications.

Figure S2f. Dependence of the product category and action taken within all notifications.

Figure S3a. Dependence of the hazard category and year within all notifications.

Figure S3b. Dependence of the hazard category and notifying country within all notifications.

Figure S3c. Dependence of the hazard category and notification basis within all notifications.

Figure S3d. Dependence of the hazard category and risk decision within all notifications.

Figure S3e. Dependence of the hazard category and distribution status within all notifications.

Figure S3f. Dependence of the hazard category and action taken within all notifications.

Figure S4a. Dependence of the product category and year within alert notifications.

Figure S4b. Dependence of the product category and notifying country within alert notifications.

Figure S4c. Dependence of the product category and notification basis within alert notifications.

Figure S4d. Dependence of the product category and risk decision within alert notifications.

Figure S4e. Dependence of the product category and distribution status within alert notifications.

Figure S4f. Dependence of the product category and action taken within alert notifications.

Figure S5a. Dependence of the hazard category and year within alert notifications.

Figure S5b. Dependence of the hazard category and notifying country within alert notifications.

Figure S5c. Dependence of the hazard category and notification basis within alert notifications.

Figure S5d. Dependence of the hazard category and risk decision within alert notifications.

Figure S5e. Dependence of the hazard category and distribution status within alert notifications.

Figure S5f. Dependence of the hazard category and action taken within alert notifications.

Figure S6a. Dependence of the product category and year within information notifications.

Figure S6b. Dependence of the product category and notifying country within information notifications.

Figure S6c. Dependence of the product category and notification basis within information notifications.

Figure S6d. Dependence of the product category and risk decision within information notifications.

Figure S6e. Dependence of the product category and distribution status within information notifications.

Figure S6f. Dependence of the product category and action taken within information notifications.

Figure S7a. Dependence of the hazard category and year within information notifications.

Figure S7b. Dependence of the hazard category and notifying country within information notifications.

Figure S7c. Dependence of the hazard category and notification basis within information notifications.

Figure S7d. Dependence of the hazard category and risk decision within information notifications.

Figure S7e. Dependence of the hazard category and distribution status within information notifications.

Figure S7f. Dependence of the hazard category and action taken within information notifications.

Figure S8a. Dependence of the product category and year within border rejections.

Figure S8b. Dependence of the product category and notifying country within border rejections.

Figure S8c. Dependence of the product category and notification basis within border rejections.

Figure S8d. Dependence of the product category and risk decision within border rejections.

Figure S8e. Dependence of the product category and distribution status within border rejections.

Figure S8f. Dependence of the product category and action taken within border rejections.

Figure S9a. Dependence of the hazard category and year within border rejections.

Figure S9b. Dependence of the hazard category and notifying country within border rejections.

Figure S9c. Dependence of the hazard category and notification basis within border rejections.

Figure S9d. Dependence of the hazard category and risk decision within border rejections.

Figure S9e. Dependence of the hazard category and distribution status within border rejections.

Figure S9f. Dependence of the hazard category and action taken within border rejections.

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