# Chapter 2
# RASFF Alert and Information Notifications. A Statistical Review

**Abstract** This chapter contains a statistical evaluation of RASFF alert notifications in general. The study concerns the comparison between recorded alerts in two different temporal periods, the broad 1979–1990 and the four-year 2011–2014 intervals. The analysis of product categories and hazard categories has been performed with the aim of defining the next 'emerging concerns' by the food safety viewpoint. Moreover, authors have analysed all calculated results with relation to a new risk classification (seven different risk typologies, including adulteration, and fraud episodes, processing failures, allergens, and GMO). In addition, the chapter discusses chemical risks and contaminants, including also allergens.

**Keyword** Adulteration · Alert notification · Allergens · Chemical contamination · General sensorial failures · GMO · HACCP · Hazard category · Processing failures · RASFF

## 2.1 The RASFF and the Analysis of Notifications. An Overview

The Rapid Alert System for Food and Feed (RASFF) has been created in the European Union with the aim of providing rapid exchange information between European Union (EU) Member States with relation to national controls on food and feed products (Bánáti and Klaus 2010; European Commission 2009; Jaud et al. 2013; Paganizza 2013). In general, the RASFF can make easier the rapid communication between RASFF member Countries—notifying members—and the European Commission when potential information concerning serious health risks related to foods or feeds are available (Sect. 1.1; Jezsó 2015). Because of the critical importance of rapid communications, all information—also named 'notifications'—concern the detail of food or feed-related risks and correlated measures

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for the protection of consumers' health, with temporal limits. The most important examples are surely withdraw and recall actions when speaking of foods and feed products on the market (Sect. 1.1; European Commission 2009).

In accordance with the Commission Regulation (EU) No 16/2011 of 10 January (European Commission 2011), the RASFF can give the following notification details:

- Reference number
- Notification date
- Last update
- Notification type
- Action taken. The role of the Food Business Operator (FBO) is also mentioned
- Origin of the notification
- Information about the distribution of the food or feed on the EU market at the date of the original notification
- Product category
- Information with relation to unacceptable risks
- Information with relation to the receiving Country or Countries
- Origin of the product (different from the origin of notification).

In addition, the nature of different notifications should be explained. Notifications may be subdivided (Sect. 1.2) in three main categories, named 'original notifications', and two non-original notifications, depending on the associated hazard:

(1) Original notifications: alert notifications, border rejection notifications, and information notifications.
(2) Non-original notifications: follow-up notifications; other information, also named 'news'.

Actually, original notifications can be easily used with the aim of defining a useful food safety approach against old and new (emerging) risks. This concept is intrinsically linked with the Hazard Analysis and Critical Control Points (HACCP) approach in food industries (Gurnari 2015; Unnevehr and Jensen 1999). The calculation of shelf life and the practical management of certain processing indicators during production are useful; the development of statistical tools and software products is also interesting when speaking of the analysis of risks in a proactive and predictive manner (Parisi 2002; Parisi et al. 2004, 2016a, b). Moreover, most known quality management standard are based on this idea (Stilo et al. 2008).

At present, RASFF notifications are studied from the statistical viewpoint and results are provided by the European Commission's RASFF team (European Commission—Health and Food Safety 2015) by means of an annual report. With the exclusion of 2015 and 2016 years, elaborated data cover the whole 2002–2014 period; in addition, some data are available with relation to the whole number of notifications since 1999 (698 notifications) to 2014 (European Commission 2009).

On these bases, the RASFF can be a useful tool for the preventive evaluation of old and emerging food safety risks in the EU. In other words, the tendency of food-related risks may be investigated by means of RASFF data. Several authors have already made interesting studies with relation to restricted temporal periods (Hruska and Franek 2009; Jaud et al. 2013; Zhang et al. 2012). These researches have demonstrated that the definition of dedicated indicators could be useful when speaking of emerging issues and predictive approaches (Kleter et al. 2009). Moreover, examined data from EU food monitoring may be combined with other data concerning different aspects of the food and beverage sector: good examples could be production costs and economic indicators (Palou 2005).

Anyway, the analysis of RASFF data is not simple because each notification may be classified in five different ways. Moreover, RASFF hazards are a broad group of terms. Roughly, these factors could be classified as:

(a) Chemical substances
(b) Microbiological agents
(c) Various parasites
(d) Food packaging concerns, including hygienic failures
(e) General food and hygiene concerns
(f) Quality failures
(g) Food adulterations
(h) Nutritional labeling concerns.

On the other hand, this is only a provisional list because of the apparently uninterrupted evolution of the whole food and beverage sector. This trend cannot be stopped because the field is inextricably connected with non-food activities and disciplines such as general microbiology, chemical processes and engineering, economics, regulatory norms, etc. Consequently, the analysis of RASFF notifications and related causes can be used only with the aim of tracing a hopefully good prediction of future food concerns.

This chapter aims to give a reliable estimation of current and past tendencies in the field of food safety. Because of the high frequency of border rejection notifications and situations with ‘undecided’ or ‘not serious’ risk decisions (information for attention and follow-up), Authors have decided to subdivide the analytical research in two different chapters with relation to serious risks and the block of food and feed commodities at EU borders. For these reasons, Chap. 3 is dedicated to border rejection notifications. The following Sections of Chap. 2 discuss:

(a) The analysis of most recurrent food safety concerns with rapid required actions (alert notifications) and related ‘product categories’ in the following periods: 1979–1990 (11 years) and 2011–2014 (four years)
(b) The analysis of most recurrent food safety concerns with rapid required actions (alert notifications) and related ‘hazard categories’ in the following periods: 1979–1990 (11 years) and 2011–2014 (four years)
(c) The discussion of observed differences between the above-mentioned temporal periods

(d) The study of observed concerns by a more specific HACCP viewpoint with the addition of adulteration episodes and other food safety concerns
(e) A brief comparison between obtained results and trends on the one hand, and the most recent overview of hazard categories with reference to information notifications (year 2014) on the other side.

Statistical elaborations have been made on the basis of RASFF original data. In general, the RASFF Portal[1] can be used to obtain interesting data on a condition that several inputs are given. With reference to our study, the following parameters have been used for research purposes:

(a) Classification of notifications (alert)
(b) Hazard category (variable)
(c) Date of notification (interval between two temporal dates)
(d) Product category.

## 2.2 RASFF Alert Notifications. Food Safety Concerns and Related 'Agents' (1979–1990)

The initial years of RASFF notifications have considered exclusively alert notifications by member countries until 1989. For this reason, authors have decided to study the situation of most common food safety alerts by a RASFF viewpoint in the broad 1979–1990 period (11 years).

The first part of statistical evaluations has concerned the composition of food safety notifications (alerts only) with relation to the product category (Figs. 2.1 and 2.2). In detail, it should be noted that the current classification of products is based on three definitions: food, feed, and food contact materials (European Commission—Health and Food Safety 2015). However, one single alert notification has been found in the RASFF between 1979 and 1990 with relation to the detection of lead in animal feeding stuffs (product category: animal nutrition, obsolete; date: 10/11/1989, reference: 1989.24). As a consequence, the total number of alert notifications in this period (201 references) is mainly ascribed to food products and food packaging materials. Figure 2.1 shows the subdivision of notifications with relation to 12 categories (alcoholic beverages—fruits and vegetables), while Fig. 2.2 gives the overview of notifications for the remaining 12 products (herbs and spices—wine).

In general, the largest part of alert notifications—78.2 %—with associated high food safety concerns are ascribed to the following categories of products (related percentage values are mentioned in brackets):

[1]The RASFF Portal can be accessed at the following link: https://webgate.ec.europa.eu/rasff-window/portal/?event=SearchForm&cleanSearch=1.

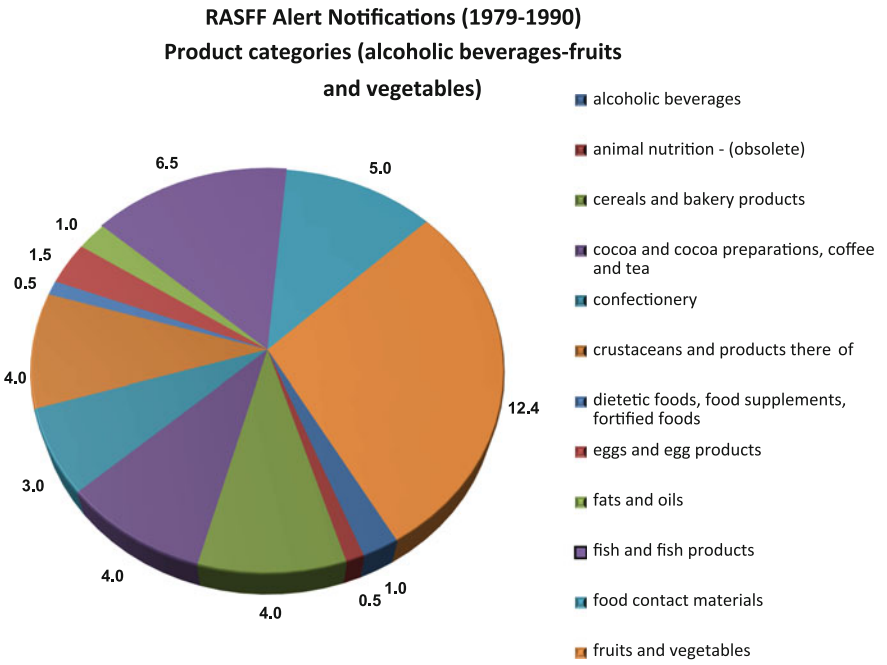



**Fig. 2.1** The RASFF and food safety. Statistical evaluation of food safety alerts in the 1979–1990 temporal period (11 years). The subdivision of notifications concerns 12 products categories (from 'alcoholic beverages' to 'fruits and vegetables'). The remaining 12 product categories are shown in Fig. 2.2

(1) Molluscs and products thereof (obsolete category, 15.9 %)
(2) Meat and meat products (other than poultry: 12.9 %)
(3) Fruit and vegetables (12.4 %)
(4) Milk and milk products (8.5 %)
(5) Fish and fish products (6.5 %)
(6) Food contact materials (5.0 %)
(7) Wine (5.0 %)
(8) Cereals and bakery products (4.0 %)
(9) Cocoa and cocoa preparations, coffee and tea (4.0 %)
(10) Crustaceans and products thereof (4.0 %).

Substantially, the main part of food safety concerns in the 1979–1990 period appear mainly linked with foods of animal origin (total percentage value: 47.8 %), while vegetable foods are relevant enough (25.4 %) with the most important category of 'fruits and vegetables' (12.9 %). Food contact materials appear to have a low importance (5.0 %); however, the presence of these notifications in the first years of the RASFF system should be noted. It could be also highlighted that certain transformed products—confectionery; 'dietetic foods, food supplements,

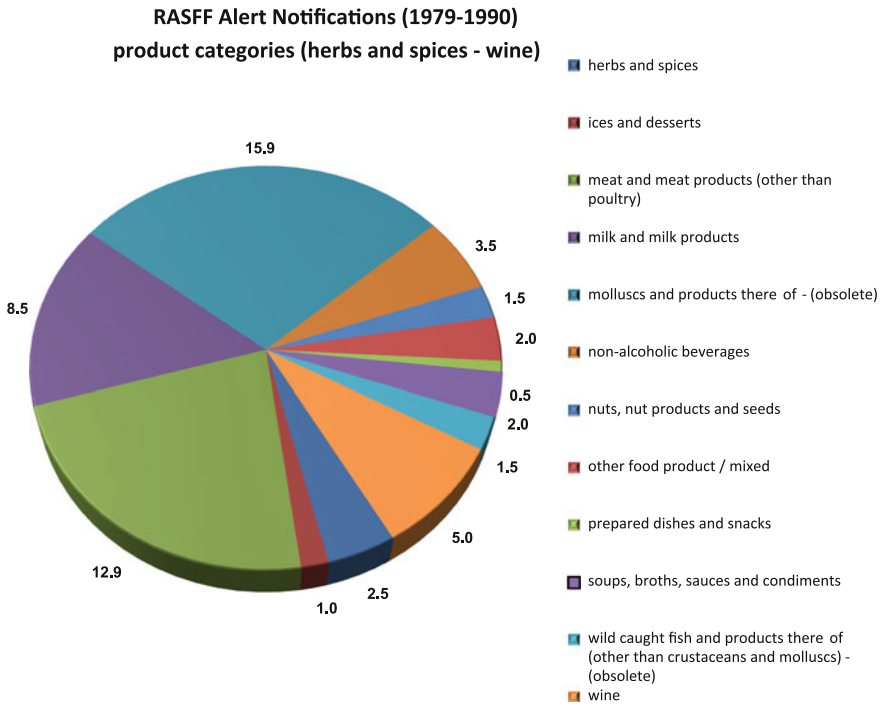



**Fig. 2.2** The RASFF and food safety. Statistical evaluation of food safety alerts in the 1979–1990 temporal period (11 years). The subdivision of notifications concerns 12 products categories (from: 'herbs and spices' to 'wine'). The remaining 12 product categories are shown in Fig. 2.1

fortified foods'; herbs and spices; prepared dishes and snacks—are not mentioned with notable frequency. Actually, the current situation is not similar (Sect. 2.4).

The second part of the study concerns the analytical evaluation of alert notifications with reference to hazard categories, as currently defined by the RASFF system (European Commission 2010; Kleter et al. 2009; Leuschner et al. 2013; Tedesco et al. 2008; Wiig and Kolstad 2005). Figure 2.3 shows the situation in the 1979–1990 period. The most important alerts are ascribed mainly to pathogenic microorganisms (20.7 %), biotoxins (19.7 %) and non-pathogenic microorganisms (9.1 %). It has to be clarified that the term 'biotoxins' concerns mainly marine toxins such as shellfish biotoxins (Delia et al. 2015; Motarjemi and Lelieveld 2013). As a result, it may be inferred that 49.5 % of the total number of alert notifications in the initial years of the RASFF system have concerned the microbiological risk in the HACCP ambit. This result may be considered also as the measure of the psychological impact of food scares in the above mentioned period: microbial contamination episodes have been discussed broadly in the scientific literature since 1970s (Gordon 1973). On the other hand, the 'chemical risk' appears relevant enough (22.8 %) if four hazard categories are considered together (related percentage values are expressed in brackets):

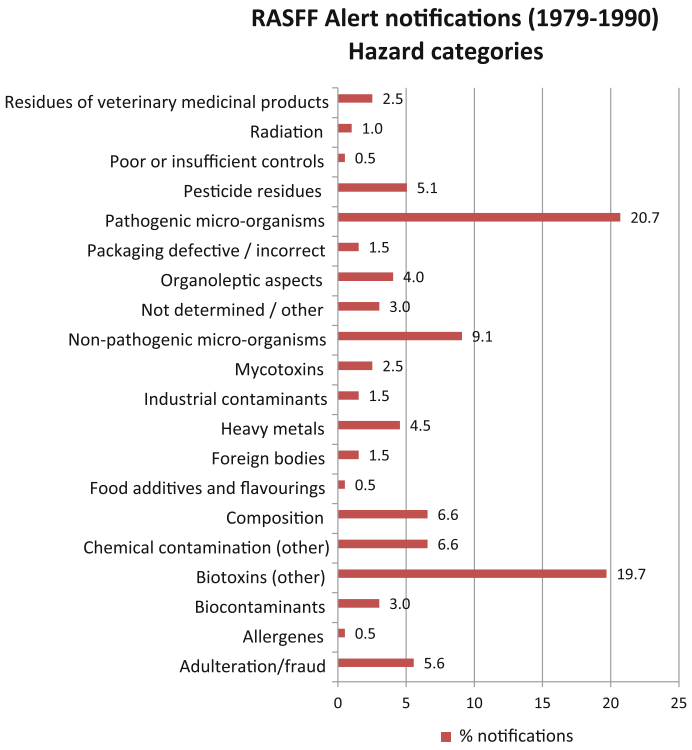



**Fig. 2.3** The analytical evaluation of RASFF alert notifications with reference to hazard categories in the 1979–1990 period

- Chemical contamination. This category concerns all possible contamination episodes without detection of pesticides, heavy metals and other mentioned contaminants in remaining hazard categories (6.6 %)
- Composition (6.6 %)
- Pesticide residues (5.1 %)
- Heavy metals (4.5 %).

It should be also noted (Fig. 2.3) that:

(a) General sensorial alterations and non-determined food safety problems can reach an interesting 7.0 % value when considered together
(b) Notifications concerning foreign bodies account for only 1.5 % of the total number of alert notifications
(c) Adulteration and fraud situations 'weights' 5.6 % if compared with the total number of alert notifications. This result can be interesting enough because the historical period cannot contemplate 'global' food scandals such as the problem of horsemeats (Bánáti 2014; O'Mahony 2013; Premanandh 2013).

With reference to the 1979–1990 temporal interval, there are 20 notified hazard categories (according to the modern RASFF system):

- Adulteration/fraud
- Allergens
- Biocontaminants
- Biotoxins (other)
- Chemical contamination (other)
- Composition
- Food additives and flavourings
- Foreign bodies
- Heavy metals
- Industrial contaminants
- Mycotoxins
- Non-pathogenic micro-organisms
- Not determined/other
- Organoleptic aspects
- Packaging defective/incorrect
- Pathogenic microorganisms
- Pesticide residues
- Poor or insufficient controls
- Radiation
- Residues of veterinary medicinal products.

The above mentioned list corresponds to the RASFF vision of food- and feed-related hazards. However, HACCP managers could find some difficulties when analysing the whole database for clarification purposes 'as it is'. For this reason, the list of hazard categories could be modified with the aim of providing interested users a sort of HACCP vision of the 'alert' level in the RASFF area.

In other words, the statistical evaluation of most important and recurring alert notifications could be made with the 'translation' of the list of RASFF hazard categories in the following list of 'HACCP risks and other food safety concerns':

- Microbiological risks
- Chemical risks
- Foreign bodies
- Adulteration and fraud episodes
- General sensorial failures
- Other food safety concerns: processing failures
- Other food safety concerns: allergens, genetically modified organisms (GMO) and novel foods.

The new classification of HACCP risks and other concerns should be explained.

For clarification purposes, 'microbiological risks' concern the following hazard categories:

(1) Transmissible spongiform encephalopathy (TSE), also known as the 'mad cow disease' (Caughey and Chesebro 1997; Jeffrey and Gonzalez 2004)
(2) Biocontaminants
(3) Biotoxins (other)
(4) Mycotoxins
(5) Non-pathogenic micro-organisms
(6) Parasitic infestation
(7) Pathogenic microorganisms.

Secondly, 'chemical risks' comprehend the following categories:

- Chemical contamination (other)
- Composition
- Feed additives
- Food additives and flavourings
- Heavy metals
- Industrial contaminants
- Pesticide residues
- Radiation
- Residues of veterinary medicinal products.

'Foreign bodies' and 'adulteration and fraud episodes' coincide with the above mentioned hazard categories of the same name.

Subsequently, 'general sensorial failures' concern 'not determined/other' notifications and organoleptic aspects. The group of 'processing failures' means the following categories:

- Absent, incomplete, or incorrect labeling
- Migration
- Packaging defective/incorrect
- Poor or insufficient controls.

These risks and concerns are correlated to processing failures, packaging defects, quality control activities and labeling problems.

It should also be clarified that the general HACCP approach concerns microbiological risks, chemical hazards, and the detection of foreign bodies. However, the new classification takes into count the 'new entry' of authenticity concerns (adulteration and fraud episodes). Moreover, sensorial defects and unclear situation would need a separated classification; the same thing can be affirmed when speaking of allergens and GMO on the one hand (possibility of psychological adverse reactions in consumers; allergic reactions) and all possible non-food related failures with one or more process relationship (Baker and Burnham 2001; Hubbard 2012). However, the new approach should be comprehensible for HACCP managers and professional auditors facing sectoral concepts in a more simplified manner.

The new classification of 'HACCP risks and other food safety concerns' can be useful because of the possible interpretation of alert notifications on the basis of the

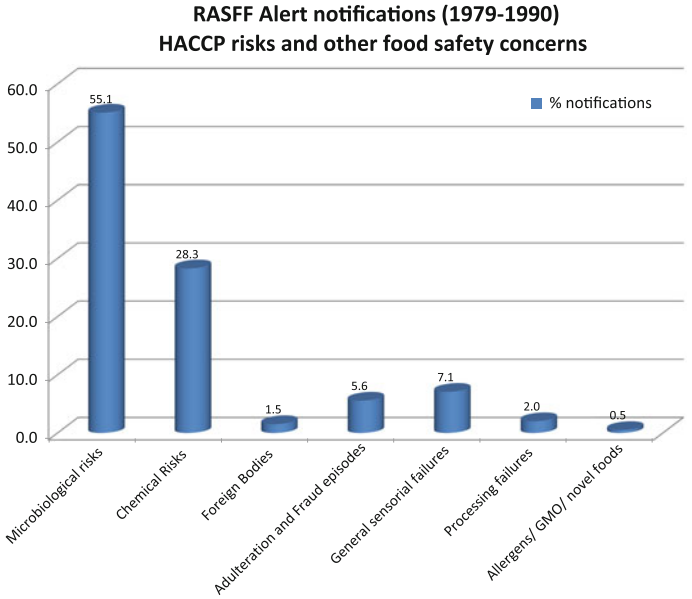



**Fig. 2.4** The analytical evaluation of RASFF alert notifications (1979–1990) with reference to a new classification: 'HACCP risks and other food safety concerns'. The proposed classification concerns: microbiological risks, chemical risks, foreign bodies, adulteration and fraud episodes, general sensorial failures, other food safety concerns: processing failures, other food safety concerns: allergens, GMO and novel foods

hazard analysis and critical control approach. Substantially, HACCP (and quality) managers working in food companies and other players of the whole food and feed chain would need to analyse the trend of food hygiene and public safety menaces during long periods. The aim is naturally the reliable prediction of new and emerging failures; in addition, each forecast concerning a new or recurring (cyclic) food safety concern may be very useful when speaking of the general trend of raw materials and certain finished products in the (globalised) market (Connor 1994; Cotterill 1986; Falguera et al. 2012).

Consequently, authors have re-elaborated RASFF alert notifications between 1979 and 1990: Fig. 2.4 shows the new situation.

Once more, the 'microbiological risk' group appears the most recurring menace: 55.1 % of the total number of alert notifications is linked with microbiological food scares. As a result, it can be confirmed that the first level-food menace between 1970s and 1990s was perceived in strict connection with microbiological 'agents'.

Chemical risks account for 28.3 % of the total amount of alert notifications (Fig. 2.4). Actually, chemical 'menaces' are extremely variegated; however, it can be noted that official authorities had already considered the world of food products as an interconnected sector (foods/packages/chemicals/other services) in the last decades.

General sensorial failures and unclear situations have generated 7.1 % of the total number of RASFF alerts (Fig. 2.4): this result corresponds to an approximate 12.9 % value if compared with microbiological failures only. On the other hand, many sensorial defects appear caused by microbial spreading: should this hypothesis be assumed, the total number of alert notifications in the RASFF area by microbiological 'agents' could rise to 62.2 %. Interestingly, adulteration and fraud episodes reach 5.6 %, while GMO and allergens (Barbieri et al. 2014) do not seem serious menaces between 1979 and 1990. Processing failures are only 2.0 %. Finally, the detection of foreign bodies has been highlighted 1.5 times on 100 RASFF alert notifications; from the safety viewpoint, it could be affirmed that the 'physical risk' (Corlett and Pierson 1992; Corlett and Stier 1991; Hoornstra et al. 2001) had been managed well in the last decades.

After this overview of RASFF results in the initial years, an interesting comparison may be performed with analogous calculated data between 2011 and 2014.

## 2.3 Recent RASFF Alert Notifications. Food Safety Concerns and Related 'Agents' (2011–2014)

After many years, the RASFF has been significantly grown and modified: as a simple example, the continuous evolution of notifications (from the simple 'alert' to the issue of 'information' documents and border rejections and the final subdivision of information notifications) have generated a more complex framework of the entire food safety in the RASFF area. Because of the necessity of analysing a notable complexity of data (Potter et al. 2012), authors have decided to study the situation of most common food safety alerts by a RASFF viewpoint after the first 'mad cow' episodes, between 2011 and 2014 (Pennings et al. 2002).

The first part of statistical evaluations has concerned the composition of food safety notifications (alerts only) with relation to the product category (Figs. 2.5, 2.6 and 2.7). Once more, the current classification of products is based on three definitions: food, feed and food contact materials (Sect. 2.2). In Difference to the early years of the notification system, the RASFF portal reports the subdivision of total alerts (2449 documents) in the following way:

(1) Food-related notifications: 2,187
(2) Feed-related notifications: 115
(3) Food-contact materials-related notifications: 147.

In other terms, 89.3 % of the total alert notifications are ascribed to the type category: food; on the other side, 10.7 % concern feeds and food-contact materials. These results demonstrate that a certain attention to food packaging materials and feeds is expected.

Figure 2.5 shows the subdivision of notifications in relation to 12 categories (alcoholic beverages—feed additives), while Figs. 2.6 and 2.7 give the overview of notifications for the remaining products.

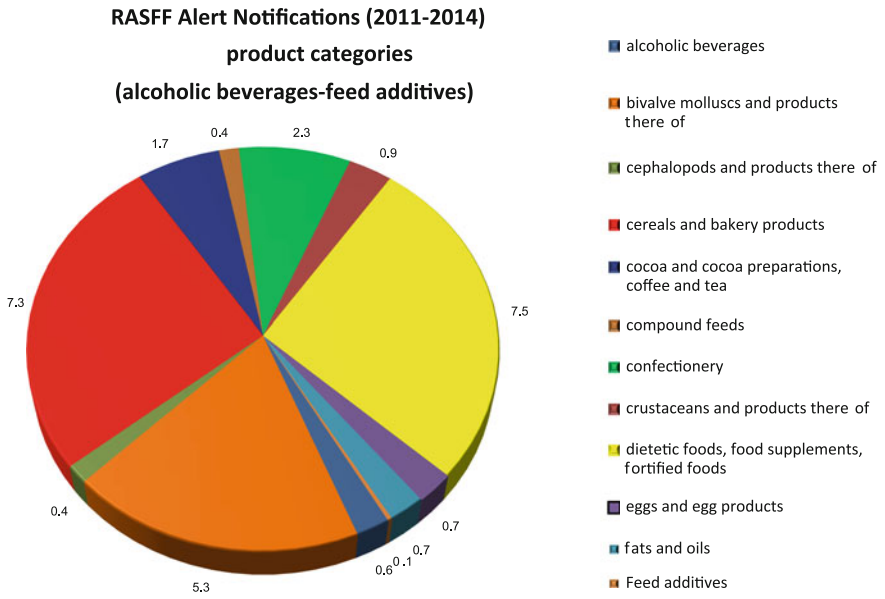



**Fig. 2.5** The RASFF and food safety. Statistical evaluation of food safety alerts viewpoint in the 2011–2014 temporal period (four years). The subdivision of notifications concerns 12 products categories (from: 'alcoholic beverages' to 'feed additives'). The remaining product categories are shown in Figs. 2.6 and 2.7

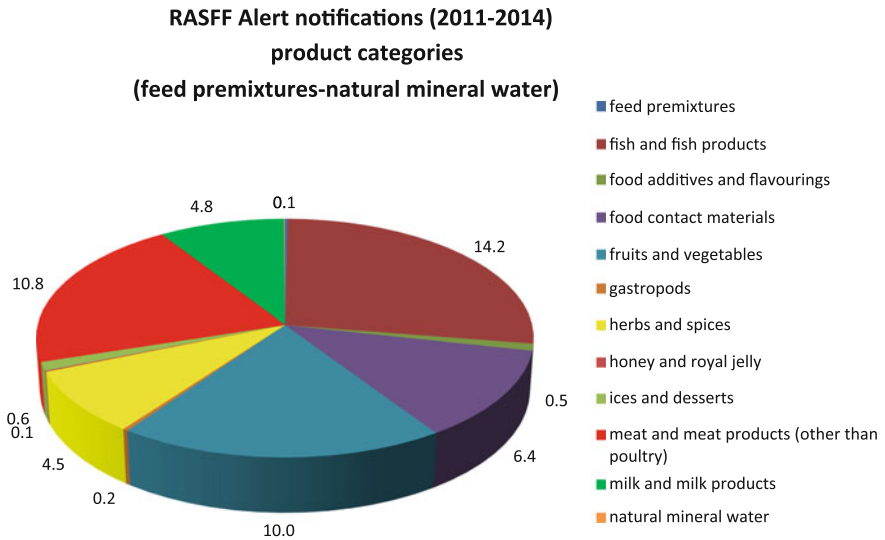



**Fig. 2.6** The RASFF and food safety. Statistical evaluation of food safety alerts viewpoint in the 2011–2014 temporal period (four years). The subdivision of notifications concerns 12 products categories (from: 'feed premixtures' to 'natural mineral water'). The remaining product categories are shown in Figs. 2.5 and 2.7

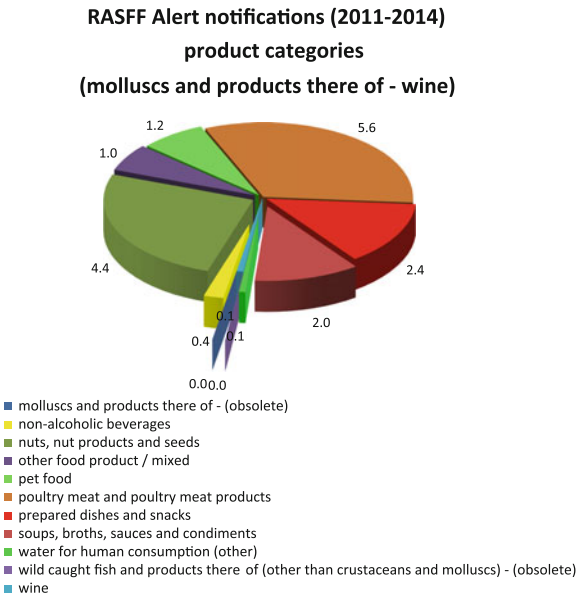



**Fig. 2.7** The RASFF and food safety. Statistical evaluation of food safety alerts viewpoint in the 2011–2014 temporal period (four years). The subdivision of notifications concerns 11 products categories: from: 'molluscs and products thereof—(obsolete)' to 'wine'). The remaining product categories are shown in Figs. 2.5 and 2.6

In general, the major part of alert notifications—78.2 %—with associated high food safety concerns are ascribed to the following product categories (related percentage values are mentioned in brackets):

(1) Fish and fish products (14.2 %)
(2) Meat and meat products (other than poultry, 10.8 %)
(3) Fruits and vegetables (10.0 %)
(4) Dietetic foods, food supplements, fortified foods (7.5 %)
(5) Cereals and bakery products (7.3 %)
(6) Food contact materials (6.4 %)
(7) Poultry meat and poultry meat products (5.6 %)
(8) Bivalve molluscs and products thereof (5.3 %)
(9) Nuts, nut products, and seeds (4.4 %).

The comparison between 1979–90 and 2011–14 results has demonstrated that:

(a) Alerts concerning fish and fish products have been notified with a substantial augment: +7.7 %; as a result, high concerns related to fish products are now the first cause of alert in the RASFF area. It can be inferred that these foods are undoubtedly 'under pressure'
(b) Alert notifications related to meat and meat products are slightly diminished if compared to early years (variation: −2.1 %). On the other hand, this product category is surely under strict control at present (2nd place)
(c) Fruit and vegetables show a little decrease (−2.4 %). The third place in the special list of products categories implies that the surveillance remains high

(d) Dietetic foods, food supplements and fortified foods show a remarkable amount of alert notifications between 2011 and 2014 (7.5 %); the same category had 0.5 % of total alert notifications between 1979 and 1990. A possible explanation could be correlated with the notable increase of dietetic products in the last years
(e) Cereals and bakery products have reached the 5th place in the above mentioned list with +3.3 % in comparison with 1979–1990
(f) Food contact materials are often cited in RASFF alert notifications (6th place is unchanged), but the number of notifications is different; a −1.4 %—decrease has been calculated
(g) Poultry and similar products are ranked 7th in the 2011–2014 list
(h) Bivalve molluscs and products thereof hold the 8th place with 5.3 %. In contrast, the obsolete category of 'molluscs and products thereof' reached a notable 15.9 % in 1979–1990
(i) Milk and milk products have 'lost' many places in the 2011–2014 list of alert notifications: the amount of documents (4.8 %) is really lower than the previous number of alerts (8.5 %). It could be supposed that the safety surveillance on this food category has been really 'sharp'
(j) Finally, the comparison between the two lists shows the 'new entry' of nuts, nut products, and seeds (probably because of many concerns related to mycotoxins) and the reduced importance of wines (from 5.0 in 1979–1990 to 0.1 % in 2011–2014).

In general, there are not prevailing areas when speaking of product categories at present. In addition, the increase of dietetic products, food supplements and the remarkable importance of bakery products (and cereals) and transformed products (soups, prepared dishes. etc.) seem to have modified and fragmented the previous 'framework' of alert notifications. In other words, the statistical analysis of 2011–2014 alerts seems to show the current situation of food market shares.

The second part of the study concerns the analytical evaluation of alert notifications with reference to hazard categories, as currently defined by the RASFF system (Sect. 2.3). Figure 2.8 shows the situation in the 2011–2014 period. The most important alerts have been ascribed mainly to:

(1) Pathogenic microorganisms (30.3 %; previous value: 20.7 %)
(2) Heavy metals (11.8 %; previous value: 4.5 %)
(3) Allergens and mycotoxins (9.3 %; previous values: 0.5 and 2.5 % respectively).

With the exception of pathogen agents (1st place in 1979–1990 and 2011–2014; unchanged importance as food safety risk), the remaining top dangers in the first 11 years of RASFF alerts—biotoxins and non-pathogenic microorganisms have undoubtedly reached lower results: 2.6 instead of 19.7 % and 0.6 instead of 9.1 % respectively.

In general, it may be inferred that the psychological impact of food scares between 2011 and 2014 and the publication of new information about food safety have completely changed the framework of food safety concerns. In other words,

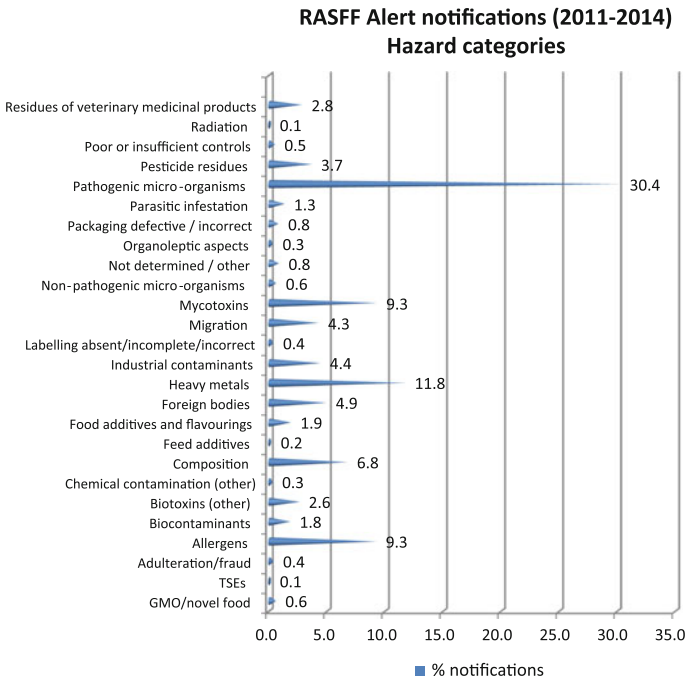



**Fig. 2.8** The analytical evaluation of RASFF alert notifications with reference to hazard categories in the 2011–2014 period

the statistical evaluation of most important and recurring alert notifications could be made with the 'translation' of the list of RASFF hazard categories in the list of 'HACCP risks and other food safety concerns' (Sect. 2.2). This approach can be used with the aim of simplifying the study of 'risk profiles' according to the RASFF. Once more, the proposed list mentions:

- Microbiological risks
- Chemical risks
- Foreign bodies
- Adulteration and fraud episodes
- General sensorial failures
- Other food safety concerns: processing failures
- Other food safety concerns: allergens, genetically modified organisms (GMO) and novel foods.

On these bases, calculated data have been re-elaborated: Fig. 2.9 shows related results.

Once more, the 'microbiological risk' group appears the most recurring menace: 46.1 % of the total number of alert notifications is linked with microbiological food scares. However, this result was 55.1 % between 1979 and 1990. As a consequence, it may be assumed that the 1st level—food menace is perceived in strict

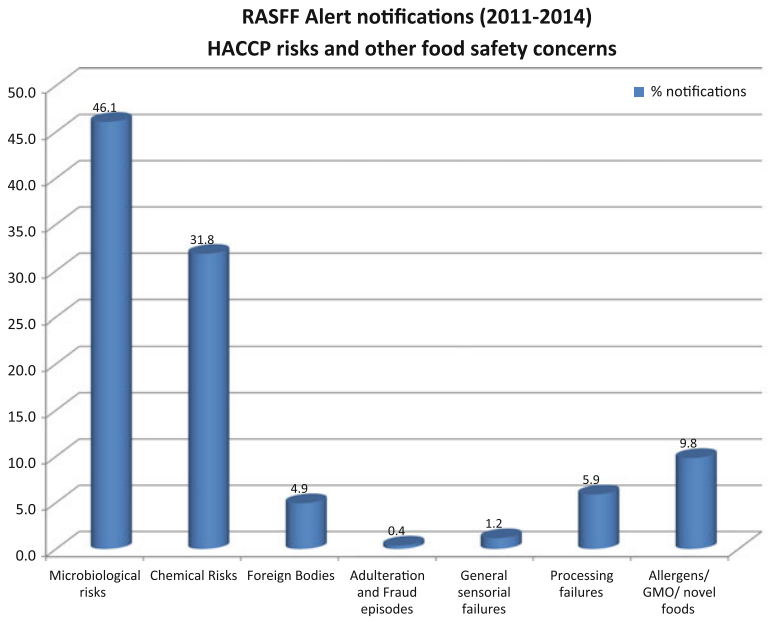



**Fig. 2.9** The analytical evaluation of RASFF alert notifications (2011–2014) with reference to a new classification: 'HACCP risks and other food safety concerns'. The proposed classification concerns: microbiological risks, chemical risks, foreign bodies, adulteration and fraud episodes, general sensorial failures, other food safety concerns: processing failures, other food safety concerns: allergens, GMO and novel foods

connection with microbiological 'agents' at present with a significant −9.0 % if compared with previous results (Sect. 2.2, Fig. 2.4). On the other hand, alert notifications can be evaluated with relation to the average amount of notifications per year. It should be noted that:

(a) The average number of alert notifications per year between 1979 and 1990 (11 years) with microbiological 'causes' is approximately 5.0 %
(b) The average quantity of alerts per year in the 2011–2014 period with microbiological agents is 11.5 %.

Substantially, the first place is ascribed to microbiological-related alerts and the level of attention has significantly grown in the last years: alert notifications per year are more than doubled if compared with previous data.

Chemical risks account for 31.8 % of the total amount of alert notifications (Fig. 2.9) between 2011 and 2014. Apparently, the number is increased in comparison with 1979–1990 (28.0 %, estimated decrease: −3.8 %). However, average numbers per year demonstrate clearly that the perception of chemical risks is extremely higher at present: the 2011–2014 estimation per year is 8.0 % and the calculated result for 1979–1990 (11 years) is only 2.6 %. In other terms, the attention for chemical risks in the food and feed sector is extremely high. Moreover,

the augment of chemical-related alert notifications per year has surpassed the analogous estimation for microbiological causes: ratios between 2011–14 and 1979–90 yearly average values are 2.3 and 3.1 when speaking of microbiological and chemical 'agents' respectively. Substantially, chemical 'menaces' seem to have higher perspectives if evaluated as concern factors.

General sensorial failures and unclear situations have generated 1.2 % of the total number of RASFF alerts (Fig. 2.9): this value was 7.0 % between 1979 and 1990. In addition, yearly amounts can be calculated and compared: 0.3 % in 2011–14 and 0.6 % between 1979 and 1990. Apparently, this result could be interpreted as the natural augment of knowledge when speaking of microbiological and chemical failures at least: in other terms, the higher the explained food safety concerns with a chemical or microbiological feature, the lower the number of unclear situations (without defined explanations). Interestingly, adulteration and fraud episodes reach 0.4 % only (this number was 5.5 % between 1979 and 1990). On the other side, GMO and allergens are perceived as serious menaces: the total number of alerts is 9.8 % in the 2011–14 period (yearly average value: 2.5 %), while the same amount was only 0.5 % between 1979 and 1990. It could be inferred that labeling and nutritional notifications may have an interesting increase in terms of concern because allergens and GMO are often correlated with insufficient or incorrect labeling episodes.

Processing failures reach 5.9 % (the 1979–90 value was 2.0 %). This result is extremely significant because of the increasing importance of process and food packaging failures (Hempel et al. 2012; Parisi 2011, 2012, 2013; Parisi et al. 2016a, b; Wybenga 2001): yearly average data are 0.2 and 1.5 % with relation to 1979–90 and 2011–14 periods respectively.

Finally, the detection of foreign bodies has been recorded 4.9 times on 100 RASFF alert notifications; from the safety viewpoints, it may be affirmed that the 'physical risk' is significantly augmented when speaking of safety perception: yearly average values are 0.1 and 1.2 % in 1979–90 and 2011–14 periods respectively.

As a result, the general comparison of results can be displayed in terms of HACCP-related risks. Table 2.1 shows the tendency of yearly average values of the different 'risk areas' in function of the observation period. Some interesting and surprising results can be highlighted:

(1) Allergens, GMO and novel foods show the most alarming trends (>25.0)
(2) The evolution of foreign bodies is extremely interesting (12.0)
(3) Surprisingly, the increase of processing failures (including food packaging effects and quality control problems, labeling errors, etc.) is more interesting than the 'performance' of chemical and microbiological risks
(4) Adulteration and fraud episodes do not appear so important when speaking of evolution trends, in spite of recent food scandals and the matter of authenticity
(5) The number of 'general sensorial failures' notification is reduced if compared with other risk categories.

**Table 2.1** HACCP-related risks and food safety concerns

| HACCP-risk and other food safety concern | % Yearly average result (1970–1990) | % Yearly average result (2011–2014) | Ratio between 2011–14 and 1979/90 periods |
|---|---|---|---|
| Microbiological risks | 5.0 | 11.5 | 2.3 |
| Chemical risks | 2.6 | 8.0 | 3.1 |
| Foreign bodies | 0.1 | 1.2 | 12.0 |
| Adulteration and Fraud episodes | 0.5 | 0.1 | 0.2 |
| General sensorial failures | 0.6 | 0.3 | 0.5 |
| Processing failures | 0.2 | 1.5 | 7.5 |
| Allergens/GMO/novel foods | <0.1 | 2.5 | >25.0 |

Observed trends of yearly average values of different 'risk areas' in function of the observation period

Naturally, the examination concerns only notified situations: however, this study may be helpful because of the possible determination of food safety risks by the HACCP viewpoint on new bases. As a simple example, the role of adulteration and fraud episodes appears reduced if compared with processing failures.

The difficulty of these situations is the possible coexistence of many visible effects and detections of different origin. Undoubtedly, the 'chemical' problem is serious because of the remarkable and constantly increasing amount of chemicals with some role in RASFF alert and non-alert notifications. This difficulty can be easily shown and discussed in Chap. 3. Many analytes and groups of different contaminants are often mentioned in recent alerts and other situations such as border rejections and information communications (European Commission—Health and Food Safety 2015).

## 2.4 Chemical Risks by the RASFF Viewpoint

In relation to most known and notified chemical risks (chemical contamination and other origins, including microbiological contamination), this list is not exhaustive and concerns chemical contaminants by different origins:

- Metals and related compounds: arsenic, boron compounds, cadmium, chromium, lead, lithium, manganese, mercury, nickel, vanadium
- Oxidising agents: hydrogen peroxide
- Psychoactive compounds: tetrahydrocannabinol
- Food supplements: magnesium aspartate
- Biocontaminants: aflatoxins, histamine, tropane alkaloids
- Amino acids: β-alanine
- Alkaloids: synephrine, yohimbine, vinpocetine, etc.

- Different vitamins
- Pesticides and insecticides: acetamiprid, anthraquinone, carbaryl, carbendazim, chlorpyriphos, 2,2-dichlorovinyl dimethyl phosphate (dichlorvos), ethephon, hexaconazole, imidacloprid, iprodione, profenofos, tebuconazole, etc.

This list shows the prevalence of chemicals with microbiological origin and/or different explanations (contamination, packaging migrations, etc.). With the exception of pesticides, a relevant part of these contaminants seem to be correlated with adulteration/fraud episodes. However, the evolving trend of alert notifications is not apparently serious. Consequently, non-alert notifications—in particular, border rejection notifications—should be studied. Chapter 3 discussed border rejections in detail.

The discussion of most common chemical contaminants is not simple. Probably, a good basis for this discussion may also be the Regulation (EC) No 1881/2006 (Donati 2015) because this document has fixed maximum levels for certain contaminants in foods at the EU level. The following substances have been considered (Donati 2015):

- Nitrate (sodium or potassium nitrate, E251 and E252 respectively)
- Mycotoxins (aflatoxins, ochratoxin A, patulin, deoxynivalenol, zearalenone, fumonisins)
- Metals: cadmium, lead, mercury, (inorganic) tin)
- 3-monochloropropane-1,2 diol esters (3-MCPD)
- Dioxins and dioxin-like polychlorinated biphenyls (PCB)
- Polycyclic aromatic hydrocarbons (PAH).

Table 2.2 shows a list of above-mentioned chemicals and related groups, when possible and applicable, with names, properties, toxicological effects, and contamination sources. Nitrates are used for cured meats to prevent the growth of *Clostridium botulinum* and the related toxin production (Honikel 2008); consequently, they should not be considered 'contaminants' and their role is not discussed here.

However, the attention for many contaminants in the entire food and feed chain has influenced the constant increase of the number of chemical menaces: the following list adds other substances and related classes:

(a) Pesticides: this word covers acaricides, biocides, insecticides, fungicides, herbicides, plant growth regulators, and rodenticides
(b) Veterinary medicines
(c) Radionuclides
(d) Acrylamide
(e) Melamine
(f) Ethyl carbamate.

Table 2.3 shows a list of above-mentioned chemicals and related groups, when possible and applicable, with toxicological effects and contamination sources.

**Table 2.2** Chemical risks in the food and feed industry

| Chemical risk: substance or group | Chemical name, if available | Toxicological effects | Contamination sources/involved agents |
|---|---|---|---|
| Mycotoxins (see below): | | | Contaminated food and feed crops (microbiological causes) |
| | Aflatoxins $B_1$, $B_2$, $G_1$, $G_2$ and $M_1$ | Human carcinogens and mutagens<br>Other consequences:<br>gastrointestinal diseases<br>Kidney disorders<br>immunosuppressive reducing resistance | Produced by<br>*Aspergillus flavus, A. parasiticus, A. nomius* |
| | Ochratoxin A | Nephrotoxic agent<br>possible human carcinogen agent<br>genotoxic molecule | Produced by: *Penicillium errucosum, Aspergillus ochraceus, A. niger* |
| | Patulin | Some immunotoxic and genotoxic effects<br>Alteration of the intestinal barrier function | Produced by several *Aspergillus, Byssochlamys, Paecilomyces, Penicillium* species |
| | Zearalenone | Different toxic effects have been studied; however, this molecule is potentially dangerous if absorbed in high quantity (alternatively, exposure has to be very long, in temporal terms) | Produced mainly by *Fusarium graminearum* and other *Fusarium* species |
| | Fumonisins $B_1$, $B_2$ and $B_3$ | Liver and kidney tumours (rodents) | Produced by: *Fusarium verticillioides, F. proliferatum* |
| | Deoxynivalenol (vomitoxin) | Nausea, vomiting, gastrointestinal upset, dizziness,<br>diarrhoea and headache | Produced by: *Fusarium graminearum, F. culmorum* |
| Metals: arsenic, cadmium, chromium, lead, mercury, (inorganic) tin | | Different adverse health consequences: neurologic and neurobehavioral damages; cardiovascular diseases; developmental abnormalities, hearing damages; tumours; hematologic damages | Anthropogenic activities: industrial (food and feed, non-food industries) and farming productions; storage and delivery activities; migration from food-contact materials. Bioaccumulation is demonstrated |

(continued)

**Table 2.2** (continued)

| Chemical risk: substance or group | Chemical name, if available | Toxicological effects | Contamination sources/involved agents |
|---|---|---|---|
| 3-monochloropropane-1,2 diol esters (3-MCPD) | | Kidney disorders; nephropathy; tubular hyperplasia; adenomas;<br>3-MCPD is currently considered as a possible carcinogen agent in human beings | By-product of reactions involving glycerol, phospholipids or triacylglycerols on the one hand and hydrochloric acid on the other side. Generally, this situation is observed in fatty foods |
| Dioxins and dioxin-like polychlorinated biphenyls (PCB) | | Different adverse effects including: damages to nervous, immune and endocrine systems; reproductive damages to the reproductive function; tumours | Environmental contaminants with accumulation risks in the food chain. The combustion of industrial o domestic waste materials has been demonstrated |
| Polycyclic aromatic hydrocarbons (PAH) | | Potentially genotoxic and carcinogenic agents in human beings | Environmental contaminants, mainly because of the incomplete combustion of organic matter or different chemicals |

Names, toxicological effects, and contamination sources (Creppy 2002; Donati 2015; Logrieco et al. 2002; Peraica et al. 1999; Puel et al. 2010; Shibamoto et al. 2007; Tchounwou et al. 2012)

**Table 2.3** Chemical risks correlated to the presence of certain environmental contaminants

| Chemical risk: substance or group | Toxicological effects | Contamination sources/involved agents |
|---|---|---|
| Pesticides: acaricides, biocides, insecticides, fungicides, herbicides, plant growth regulators, rodenticides, and veterinary medicines | Acute illness effects include: poor concentration, panic attacks, headaches, craps, coma and death (severe situations only)<br>Chronic illness effects include: various cancers, Alzheimer and Parkinson diseases, cardiovascular problems, reproductive damages, asthma | Environmental contaminants: their origin is linked with anthropogenic activities for food production purposes on large scale |
| Radionuclides | Severe cancer risks<br>cardiovascular disease<br>hereditary consequences | Nuclear accidents and environmental diffusion |
| Acrylamide | Neurotoxic agent in human beings and animals<br>Possible reproductive damages<br>Carcinogen agent in animals<br>Possible carcinogen agent in human beings | High-temperature reactions between amino acids and carbohydrates. This situation frequently occurs during cooking processes |
| Melamine | Nephrotoxicity, kidney injury, death | Food adulteration<br>Migration from food-contact plastic materials<br>Contamination by fertilisers |
| Ethyl carbamate (urethane) | Genotoxic and carcinogen agent in animals<br>Possible carcinogen agent in human beings | By-product of certain fermentation processes in alcoholic beverages |

Names, toxicological effects, and contamination sources (Donati 2015; Edwards 1973; Gill and Garg 2014; Hernández et al. 2011, 2013; Hilts and Pelletier 2009; Kamiya et al. 2015; Lee 2013; Rai et al. 2014; Shipp et al. 2006)

Finally, the problem of allergens has to be highlighted. The recent Regulation (EU) No 1169/2011 on the provision of food information to consumers concerns two important points with relation to the EU area:

(a) The mention of allergenic substances on the label of prepacked foods, and
(b) The mandatory mention of allergenic substances when speaking of non-prepacked foods.

In addition, certain quality systems such as the Global Standard for Food Safety, Issue 7, have recently introduced the evaluation of allergen risks when speaking of food lubricants. Obviously, it should be noted that lacking of complete mention of allergens results in production of an unsafe food article.

As a clear result, the definition of most known and cited chemical contaminants, including also allergens, should be provided. At present, the Annex II of the Reg. (EU) No 1169/2011 shows the following list of substances or products with possible allergies or intolerance effects:

- Cereals containing gluten (wheat, rye, barley, oats, spelt, kamut or their hybridised strains), and products thereof, with the following exceptions:
  - Wheat-based glucose syrups including dextrose and wheat-based maltodextrins[2]
  - Glucose syrups based on barley
  - Cereals used for making alcoholic distillates including ethyl alcohol of agricultural origin
- Crustaceans and products thereof
- Eggs and products thereof
- Fish and products thereof, with the exception of:
  - Fish gelatine used as carrier for vitamin or carotenoid preparations
  - Fish gelatine or Isinglass used as fining agent in beer and wine
- Peanuts and products thereof
- Soybeans and products thereof, with the exception of:
  - Fully refined soybean oil and fat (see Footnote 2)
  - Natural mixed tocopherols (E306), natural *D*-alpha tocopherol, natural *D*-alpha tocopherol acetate, and natural *D*-alpha tocopherol succinate from soybean sources
  - Vegetable oils derived phytosterols and phytosterol esters from soybean sources
  - Plant stanol ester produced from vegetable oil sterols (soybean sources)

[2]Please read the original document with relation to this exception.

- Milk and products thereof (including lactose), with the exception of:
  - Whey used for making alcoholic distillates including ethyl alcohol of agricultural origin
  - Lactitol
- Nuts, namely: almonds (*Amygdalus communis L.*), hazelnuts (*Corylus avellana*), walnuts (*Juglans regia*), cashews (*Anacardium occidentale*), pecan nuts (*Carya illinoinensis* (Wangenh.) K. Koch), Brazil nuts (*Bertholletia excelsa*), pistachio nuts (*Pistacia vera*), macadamia or Queensland nuts (*Macadamia ternifolia*), and products thereof, with the exception of nuts used for making alcoholic distillates including ethyl alcohol of agricultural origin
- Celery and products thereof
- Mustard and products thereof
- Sesame seeds and products thereof
- Sulphur dioxide ($SO_2$) and sulphites at concentrations of more than 10 mg/kg or 10 mg/litre in terms of total $SO_2$ which are to be calculated for products as proposed ready for consumption or as reconstituted according to the instructions of the manufacturers
- Lupin and products thereof
- Molluscs and products thereof.

The allergen risk is extremely variegated. On the one side, it has to be recognised that immunoglobulin E-mediated food allergy has to be considered as an important chronic disease with different symptoms; sometimes, allergenic substances can be life-threatening for people with food allergy (Muraro et al. 2014). There are not reliable solutions for food allergies; consequently, concerned people have to eat allergen-free foods. On the other side, allergenic substances are ubiquitous components of the whole food and feed chain; as a result, the best strategy appears the rapid communication of used or present allergens in foods. Manufacturers have a difficult responsibility because of the possible cross-contamination between different production lines in the same environment (Allen et al. 2014). For this reason, the monitoring action of RASFF notifications can be very useful, with a special attention to border rejections (Chap. 3).

## References

Allen KJ, Turner PJ, Pawankar R, Taylor S, Sicherer S, Lack G, Rosario N, Ebisawa M, Wong G, Mills ENC, Beyer K, Fiocchi A, Sampson HA (2014) Precautionary labelling of foods for allergen content: are we ready for a global framework? World Allergy Organ J 7(1):10. doi:10.1186/1939-4551-7-10

Bánáti D (2014) European perspectives of food safety. J Sci Food Agric 94(10):1941–1946. doi:10.1002/jsfa.6611

Bánáti D, Klaus B (2010) 30 years of the Rapid Alert System for Food and Feed. Eur Food Feed Law Rev 5(1):10–21

Barbieri G, Barone C, Bhagat A, Caruso G, Conley ZR, Parisi S (2014) The prediction of Shelf Life values in function of the chemical composition in soft cheeses. In: Barbieri G, Barone C, Bhagat A, Caruso G, Conley ZR, Pa-risi S (eds) The influence of chemistry on new foods and traditional products. SpringerBriefs in Chemistry of Foods. Springer International Publishing, Cham. doi:10.1007/978-3-319-11358-6_2

Baker GA, Burnham TA (2001) The market for genetically modified foods: consumer characteristics and policy implications. Int Food Agribus Manag Rev 4(4):351–360. doi:10.1016/s1096-7508(02)00091-5

Caughey B, Chesebro B (1997) Prion protein and the transmissible spongiform encephalopathies. Trends Cell Biol 7(2):56–62. doi:10.1016/S0962-8924(96)10054-4

Connor JM (1994) North America as a precursor of changes in Western European food-purchasing patterns. Eur Rev Agric Econ 21(2):155–173. doi:10.1093/erae/21.2.155

Corlett DA, Stier RF (1991) Risk assessment within the HACCP system. Food Control 2(2): 71–72. doi:10.1016/0956-7135(91)90139-n

Corlett DA Jr, Pierson MD (1992) Hazard analysis and assignment of risk categories. In: Pierson MD, Corlett DA Jr (eds) HACCP—Principles and Applications, pp 29–38. Springer US. doi:10.1007/978-1-4684-8818-0_4

Cotterill RW (1986) Market power in the retail food industry: evidence from Vermont. Rev Econ Stat 68(3):379–386. doi:10.2307/1926014

Creppy EE (2002) Update of survey, regulation and toxic effects of mycotoxins in Europe. Toxicol Lett 127(1–3):19–28. doi:10.1016/s0378-4274(01)00479-9

Delia AS, Caruso G, Melcarne L, Caruso G, Parisi S, Laganà P (2015) Biological Toxins from Marine and Freshwater Microalgae. In: Caruso G, Caruso G, Laganà P, Delia AS, Parisi S, Barone C, Melcarne L, Mazzù F (eds) Microbial toxins and related contamination in the food industry (pp 13–55). SpringerBriefs in Chemistry of Foods, Springer International Publishing. doi:10.1007/978-3-319-20559-5_2

Donati C (2015) Risk analysis, contaminants and impact on health in imports of non-animal origin: the EU context. In: Montanari F, Donati C, Jezsó V (eds) Risk regulation in non-animal food imports. SpringerBriefs in Chemistry of Foods SpringerBriefs in Chemistry of Foods. Springer International Publishing, Cham, pp 57–95. doi:10.1007/978-3-319-14014-8_1

Edwards CA (ed) (1973) Environmental pollution by pesticides, vol 3. Springer US, New York. doi:10.1007/978-1-4615-8942-6

European Commission (2009) The Rapid Alert System for Food and Feed of the European Union. Luxembourg: Office for Official Publications of the European Communities, Brussels—COM (2009)25 final of 28/1/2009. doi:10.2772/10448. http://ec.europa.eu/food/safety/rasff/docs/rasff30_booklet_en.pdf. Accessed 04 March 2016

European Commission (2010) The Rapid Alert System for Food and Feed—annual report 2009. European Commission, Brussels. doi:10.2772/88477. http://ec.europa.eu/food/safety/rasff/docs/rasff_annual_report_2009_en.pdf. Accessed 04 March 2016

Commission European (2011) Commission Regulation (EU) No 16/2011 of 10 January 2011 laying down implementing measures for the rapid alert system for food and feed. Off J Eur Union L 6:7–10

European Commission—Health and Food Safety (2015) RASFF for safer food—The Rapid Alert System for Food and Feed—2014 annual report. http://ec.europa.eu/food/safety/rasff/docs/rasff_annual_report_2014.pdf. Accessed 04 March 2016

Falguera V, Aliguer N, Falguera M (2012) An integrated approach to current trends in food consumption: moving toward functional and organic products? Food Control 26(2):274–281. doi:10.1016/j.foodcont.2012.01.051

Gill HK, Garg H (2014) Pesticide: environmental impacts and management strategies. In: Larramendy ML, Soloneski S (eds) Pesticides—toxic effects. Intech, Rijeka, pp 187–230

Gordon MA (1973) The hot dog as pathogen carrier. JAMA, J Am Med Assoc 223(5):558. doi:10.1001/jama.1973.03220050058027

Gurnari G (2015) Technology, chemistry and food hygiene: a multidisciplinary approach for the reduction of microbial risk. In: Gurnari G (ed) Safety protocols in the food industry and emerging concerns. SpringerBriefs in Chemistry of Foods, Springer International Publishing, Cham. doi:10.1007/978-3-319-16492-2_5

Hempel AW, Gillanders RN, Papkovsky DB, Kerry JP (2012) Detection of cheese packaging containment failures using reversible optical oxygen sensors. Int J Dairy Technol 65(3):456–460. doi:10.1111/j.1471-0307.2012.00849.x

Hernández AF, Parrón T, Alarcón R (2011) Pesticides and asthma. Curr Opin Allergy Clin Immunol 11(2):90–96. doi:10.1097/ACI.0b013e3283445939

Hernández AF, Parrón T, Tsatsakis AM, Requena M, Alarcón R, López-Guarnido O (2013) Toxic effects of pesticide mixtures at a molecular level: their relevance to human health. Toxicol 307:136–145. doi:10.1016/j.tox.2012.06.009

Hilts C, Pelletier L (2009) Background paper on occurrence of melamine in foods and feed. World Health Organization, Geneva. http://www.who.int/foodsafety/fs_management/melamine_3.pdf. Accessed 09 March 2016

Honikel KO (2008) The use and control of nitrate and nitrite for the processing of meat products. Meat Sci 78(1):68–76. doi:10.1016/j.meatsci.2007.05.030

Hoornstra E, Northolt MD, Notermans S, Barendsz AW (2001) The use of quantitative risk assessment in HACCP. Food Control 12(4):229–234. doi:10.1016/s0956-7135(01)00019-6

Hruska K, Franek M (2009) Rapid alert system for food and feed: the semicarbazide notifications. Vet Med 54, 11:561–564. http://www.agriculturejournals.cz/publicFiles/13633.pdf. Accessed 04 March 2016

Hubbard MR (2012) Statistical quality control for the food industry, 3rd edn. Springer Science+ Business Media, New York

Kamiya K, Ozasa K, Akiba S, Niwa O, Kodama K, Takamura N, Zaharieva EK, Kimura Y, Wakeford R (2015) Long-term effects of radiation exposure on health. Lancet 386(9992):469–478. doi:10.1016/s0140-6736(15)61167-9

Kleter GA, Prandini A, Filippi L, Marvin HJP (2009) Identification of potentially emerging food safety issues by analysis of reports published by the European Community's Rapid Alert System for Food and Feed (RASFF) during a four-year period. Food Chem Toxicol 47(5):932–950. doi:10.1016/j.fct.2007.12.022

Jaud M, Cadot O, Suwa-Eisenmann A (2013) Do food scares explain supplier concentration? An analysis of EU agri-food imports. Eur Rev Agric Econ 40(5):873–890. doi:10.1093/erae/jbs038

Jeffrey M, Gonzalez L (2004) Pathology and pathogenesis of bovine spongiform encephalopathy and scrapie. In: Harris DA (ed) Mad Cow disease and related spongiform encephalopathies, pp 65–97. Springer, Berlin. doi:10.1007/978-3-662-08441-0_3

Jezsó V (2015) Managing risks in imports of non-animal origin: EU emergency measures. In: Montanari F, Donati C, Jezsó V (eds) Risk regulation in non-animal food imports. SpringerBriefs in Chemistry of Foods SpringerBriefs in chemistry of foods. Springer International Publishing, Cham, pp 57–95. doi:10.1007/978-3-319-14014-8_3

Lee KG (2013) Analysis and risk assessment of ethyl carbamate in various fermented foods. Eur Food Res Technol 236(5):891–898. doi:10.1007/s00217-013-1953-6

Leuschner RG, Hristova A, Robinson T, Hugas M (2013) The Rapid Alert System for Food and Feed (RASFF) database in support of risk analysis of biogenic amines in food. J Food Compos Anal 29(1):37–42. doi:10.1016/j.jfca.2012.09.004

Logrieco A, Mule G, Morett A, Bottalico A (2002) Toxigenic Fusarium species and mycotoxins associated with maize ear rot in Europe. Eur J Plant Pathol 108(7):597–609. doi:10.1007/978-94-010-0001-7_1

Motarjemi Y, Lelieveld H (eds) (2013) Food safety management: a practical guide for the food industry. Academic Press, London, Waltham and San Diego

Muraro A, Hoffmann-Sommergruber K, Holzhauser T, Poulsen LK, Gowland MH, Akdis CA, Mills EN, Papadopoulos N, Roberts G, Schnadt S, van Ree R, Sheikh A, Vieths S (2014) EAACI Food Allergy and Anaphylaxis Guidelines. Protecting consumers with food allergies: understanding food consumption, meeting regulations and identifying unmet needs. Allergy 69, 11:1464–1472. doi:10.1111/all.12453

O'Mahony PJ (2013) Finding horse meat in beef products—a global problem. QJM 106(6):595–597. doi:10.1093/qjmed/hct087

Paganizza V (2013) RASFF (Rapid Alert System for Food and Feed) Lo scambio rapido di informazioni nel settore degli alimenti e dei mangimi, tra prassi e diritto. Dissertation, University of Ferrara

Palou M (2005) Towards Food Safety Statistics at the EU Level. Presentation submitted to the Joint UNECE/EUROSTAT/FAO/OECD Meeting on Food and Agricultural Statistics in Europe, Rome, 29 June–1 July 2005. http://www.unece.org/stats/documents/ces/ac.61/2005/33.e.ppt. Accessed 04 March 2016

Parisi S (2002) I fondamenti del calcolo della data di scadenza degli alimenti: principi ed applicazioni. Ind Aliment 417:905–919

Parisi S (2011) Food packaging and technological compliance. The importance of correct storage procedures. Food Packag Bull 20, 9:14–18

Parisi S (2012) Food packaging and food alterations. The user-oriented approach. Smithers Rapra Technology Ltd, Shawbury

Parisi S (2013) Food industry and packaging materials. User-oriented guidelines for users. Smithers Rapra Technology Ltd, Shawbury

Parisi S, Barone C, Caruso G (2016a) La standardizzazione dei parametri chimici iniziali nei formaggi semiduri tramite l'uso di un programma in Basic: il CYPEP Lite, versione 1.00.1. Ind Alimen, in press

Parisi S, Barone C, Caruso G (2016b) Packaging failures in frozen curds. The use of a BASIC software for mobile devices. Food Packag Bull, in press

Parisi S, Delia S, Laganà P (2004) Il calcolo della data di scadenza degli alimenti: la funzione Shelf Life e la propagazione degli errori sperimentali. Ind Aliment 438:735–749

Pennings JME, Wansink B, Meulenberg MTG (2002) A note on modeling consumer reactions to a crisis: the case of the mad cow disease. Int J Res Mark 19(1):91–100. doi:10.1016/s0167-8116(02)00050-2

Peraica M, Radic B, Lucic A, Pavlovic M (1999) Toxic effects of mycotoxins in humans. Bull World Health Organ 77, 9:754–766. http://www.who.int/bulletin/archives/77(9)754.pdf?ua=1. Accessed 04 March 2016

Potter A, Murray J, Lawson B, Graham S (2012) Trends in product recalls within the agri-food industry: empirical evidence from the USA, UK and the Republic of Ireland. Trends Food Sci Technol 28(2):77–86. doi:10.1016/j.tifs.2012.06.017

Premanandh J (2013) Horse meat scandal–a wake-up call for regulatory authorities. Food Control 34(2):568–569. doi:10.1016/j.foodcont.2013.05.033

Puel O, Galtier P, Oswald IP (2010) Biosynthesis and toxicological effects of patulin. Toxins 2(4):613–631. doi:10.3390/toxins2040613

Rai N, Banerjee D, Bhattacharyya R (2014) Urinary melamine: proposed parameter of melamine adulteration of food. Nutr 30(4):380–385. doi:10.1016/j.nut.2013.07.013

Shibamoto T, Yasuhara A, Katami T (2007) Dioxin formation from waste incineration. In: Ware GW, Whitacre DM, Gunther FA (eds) Reviews of environmental contamination and toxicology, pp 1–41. Springer, New York. doi:10.1007/978-0-387-36903-7_1

Shipp A, Lawrence G, Gentry R, McDonald T, Bartow H, Bounds J, Macdonald N, Clewell H, Allen B, Van Landingham C (2006) Acrylamide: review of toxicity data and dose-response analyses for cancer and noncancer effects. Crit Rev Toxicol 36(6–7):481–608. doi:10.1080/10408440600851377

Stilo A, Parisi S, Delia S, Anastasi F, Bruno G, Laganà P (2008) Food Security in Europe: comparison between the" Hygiene Package" and the British Retail Consortium (BRC) & International Food Standard (IFS) protocols. Ann Ig 21(4):387–401

Unnevehr LJ, Jensen HH (1999) The economic implications of using HACCP as a food safety regulatory standard. Food Policy 24(6):625–635. doi:10.1016/s0306-9192(99)00074-3

Tchounwou PB, Yedjou CG, Patlolla AK, Sutton DJ (2012) Heavy metal toxicity and the environment. In: Luch A (ed) Molecular, clinical and environmental toxicology, vol 3: Environmental Toxicology, pp. 133–164. Springer, Basel. doi:10.1007/978-3-7643-8340-4_6

Tedesco D, Barbieri C, Lugano S, Garavaglia L (2008) Aflatoxin contamination risk: bioactive natural compounds for animal health and healthy food. In: Faye B, Sinyavskiy Y (eds) Impact of pollution on Animal Products, pp 177–184. Springer, Netherlands. doi:10.1007/978-1-4020-8359-4_19

Wiig A, Kolstad I (2005) Lowering barriers to agricultural exports through technical assistance. Food Policy 30(2):185–204. doi:10.1016/j.foodpol.2005.04.003

Wybenga F (2001) Air transport incident data and analysis of packaging failures. In: Proceedings of the dangerous goods panel meeting, Singapore, 14–18 May 2001

Zhang Y, Wells E, Chen J (2012) Analyzing Food safety alerts in European Union Rapid Alerts Systems For Food And Feed. In: Committee on strengthening core elements of regulatory systems in developing Countries; Board on global health; Board on Health Sciences Policy; Institute of Medicine; Riviere JE, Buckley GJ (eds) Ensuring safe foods and medical products through stronger regulatory systems abroad. National Academies Press, Washington, D.C

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