

1 **Identification of potentially emerging food safety issues**
2 **by analysis of reports published by the European**
3 **Community's Rapid Alert System for Food and Feed**
4 **(RASFF) during a four-year period**

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16 **RUNNING TITLE**

17 RASFF analysis of emerging food safety issues

18
19 **KEY WORDS**

20 Food safety, rapid alert system, emerging risks, trend analysis, chemical hazards,
21 microbiological hazards, mycotoxins, biological hazards, physical hazards, food hygiene,
22 food quality, food labeling, fraud, food packaging, food contact substances, dyes,
23 *Anisakis simplex*

24
25 **ABBREVIATIONS**

26 BfR, German Federal Institute for Risk Assessment; EFSA, European Food Safety
27 Authority; EFTA, European Free Trade Association; ESA, EFTA Surveillance Authority;
28 EHDAB, 2-ethylhexyl-4-dimethylaminobenzoate; EU, European Union; Eurostat,
29 Statistical Office of the European Communities; FSA, UK Food Standards Agency;
30 GMO, genetically modified organism; ITX, 2-isopropyl-thioxanthone; RASFF, European
31 Commission's Rapid Alert System for Food and Feed; UK, United Kingdom; USA,
32 United States of America

33
34 **ABSTRACT**

35 The SAFE FOODS project undertakes to design a new approach towards the early
36 identification of emerging food safety hazards. This study explored the utility of
37 notifications filed through RASFF, the European Commission's Rapid Alert System for
38 Food and Feed, to identify emerging trends in food safety issues. RASFF information
39 and alert notifications published in the four-year period of July 2003 – June 2007 were
40 assigned to categories of products and hazards. For chronological trend analysis, a basic
41 time unit of three months was chosen. Data within each hazard category were analyzed
42 for chronological trends, relationships between product and hazard categories, regions of
43 origin, and countries filing the notifications. Conspicuous trends that were observed
44 included a rise in the incidence of food contact substances, particularly 2-isopropyl-
45 thioxanthone, as well as of chemical substances migrating from utensils and fraud-related
46 issues. Temporary increases were noted in the incidences of the unauthorized dye Para

1 Red, genetically modified organisms, the pesticide isophenfos methyl, and herring worm,
2 *Anisakis simplex*. National and European authorities themselves have signaled these
3 conspicuous trends and taken measures. It is recommended to add complementary data
4 to RASFF data, including safety assessments, risk management measures, background
5 data on hazards and surveillance patterns, for a holistic approach towards early
6 identification of emerging hazards.

1

2 **1. Introduction**

3 The landscape of food safety management in Europe has undergone recent changes as a
4 result of the European Community's policy towards strengthening public confidence in
5 food safety. As a part of this policy, the European Community has implemented its
6 regulation 178/2002/EC, better known as the "General Food Law" (this regulation and
7 others mentioned in the following sections can be retrieved from the Eur-Lex website at
8 <http://europa.eu.int/eur-lex>). This law describes, among others, the establishment of the
9 European Food Safety Authority (EFSA), which has become the independent European
10 agency for risk assessment of all categories of potential food hazards. In addition, the
11 law also sets out the establishment of the Rapid Alert System for Food and Feed
12 (RASFF) hosted by the statistical service of the European Commission. Under the
13 RASFF system, members, such as national food control authorities of the European
14 Union (EU) member states, are obliged to notify any measures regarding to food safety,
15 such as recalls of food and feed products and arrestment of imported consignments not
16 complying with food legislations. The introduction of RASFF has further formalized a
17 procedure of centralized reporting that existed before RASFF. Two types of notifications
18 to RASFF are discerned:

- 19 • "Alert" notifications of findings/measures that may have implications for other
20 members of the RASFF system, such as other EU member states
- 21 • "Information" notifications, where members report findings or measures that may
22 not necessarily have implications for other members, since the pertinent products
23 have not reached their markets.

24 The other members can subsequently check if this information may have consequences
25 for the food safety in their own member states and undertake the required follow-up
26 measures.

27

28 The European Commission publishes weekly overviews of RASFF alert and information
29 notifications on its website. In addition, it publishes annual reports of the notifications.
30 These annual reports provide an overview of the numbers of notifications and the
31 categories of food products and hazards that they pertained to. In addition, each annual
32 report highlights conspicuous developments within the particular year. The RASFF
33 annual reports and the weekly overviews of RASFF notifications are available through
34 the RASFF website (RASFF, 2007). The data on the RASFF website do not contain
35 details on the size of the consignment, the number of samples taken, and the identity of
36 the product and its operators. Although no detailed protocols appear to exist, the
37 consignments that RASFF reports pertain to are usually large and sampling and analysis
38 is carried out to established protocols, such as ISO (Van Kooij, Dutch Food and
39 Consumer Product Safety Authority, personal communication). Some members of the
40 RASFF network, including the Italian, German, and Swedish authorities, also publish
41 updates and reviews of the data reported through RASFF, sometimes with a particular
42 focus on their national situation. In addition, a recent publication provides details on the
43 procedures by which the British authorities process and select data for submission
44 through RASFF, as well as handle urgencies related to notifications received from other
45 members of RASFF. For example, the Food Incidents Branch of the British Food

1 Standards Agency acts as contact for RASFF, and conveys information on hazards
2 originating from within the United Kingdom (UK) to RASFF. In addition, RASFF alerts
3 that are relevant to the UK are relayed as domestic food alerts through emails to local
4 authorities and stakeholders (Salmon, 2005).

5
6 SAFE FOODS is the acronym of an integrated project sponsored mainly by the European
7 Commission as part of its the Sixth Framework Program for Research and Technology
8 Development. This project aims to develop and ameliorate methods for risk assessment
9 and risk analysis of food safety. SAFE FOODS consists of various work packages
10 addressing specific topics within the field, including the use of advanced analytical
11 methods for detecting changes in crops caused by agricultural practices; the use of
12 advanced statistical methods to estimate cumulative human exposure to multiple food
13 contaminants and natural toxicants; consumer perception of food safety management;
14 institutional arrangements for implementing food safety policies; and the development of
15 a new risk analysis model for food safety. The authors of this paper collaborated within
16 the frame of Work Package 2, which aims to develop a framework and methodology for
17 the early identification of emerging food safety hazards.

18
19 In order to explore the possibility to identify emerging trends in food safety hazards, we
20 have carried out an analysis of the data notified to RASFF. While the annual reports may
21 provide an overview of each year's notifications, it is realized by the authors that the
22 number of reports available (years 2002-06) and the one-year period covered by each
23 report would pre-empt an in-detail analysis of recent short-term trends. Therefore the
24 authors have used the data from the weekly overviews of the notifications during a four-
25 year period from July 2003 until June 2007 as a basis for calculations and trend analysis.
26 The main outcomes and conspicuous findings are presented and discussed below.

27 **2. Materials and methods**

28 Weekly overviews containing tables with data of alert and information notifications have
29 been obtained in PDF format from the RASFF website. Data covering the period July 1st,
30 2003 – June 30th, 2006 have been parsed into an Excel spreadsheet file. Any *post hoc*
31 corrections and withdrawals of these data as reported in the weekly overviews have also
32 been carried out. Data have been stored by separation into the same columns as in the
33 PDF files, with the following column headings until week 14 of 2007:

- 34 • Date;
- 35 • Member notifying the report;
- 36 • Reference number;
- 37 • Product with reason for notifying; and
- 38 • Country of origin.

39 From week 15 in 2007 on, the layout of the weekly reports published by RASFF has been
40 changed, so that the country of origin has become integrated into the column with the
41 product and reason for notifying. In addition, two columns have been added with new
42 types of additional information, *i.e.* the type of control (*e.g.* market control) and the status
43 of product distribution and risk mitigating measures (*e.g.*, recalls).

44

1 Columns have been added by the authors to the Excel spreadsheet with information on
2 the following items taken from the weekly reports:

- 3 • Notification type (alert or information);
- 4 • Year-week number (*e.g.* 2003-27); and
- 5 • Indication if the notification pertains to feed (notifications pertaining to feed are
6 highlighted in blue typeface in the original document, which is not recognized as
7 such in a spreadsheet).

8
9 In order to facilitate analysis, data have been parsed into additional columns for:

- 10 • Quarter of the year, *e.g.* 2003-3 for the third three-month period of 2003;
- 11 • Region of RASFF member that has filed the notification, *i.e.* “Commission”;
12 “ESA” [European Free Trade Association (EFTA) Surveillance Authority, *i.e.*
13 Iceland, Liechtenstein, and Norway]; “EU-15” (“old” member states of the EU,
14 *i.e.* Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy,
15 Luxemburg, Netherlands, Portugal, Spain, Sweden, and United Kingdom); and
16 “new member states” (Bulgaria, Cyprus, Czech Republic, Estonia, Hungary,
17 Latvia, Lithuania, Malta, Poland, Rumania, Slovakia, and Slovenia);
- 18 • Product categories, *i.e.* “animal feed”; “baby food”; “bakery”; “beverage”;
19 “composite & mixed”; “confectionery”; “dairy”; “egg product”; “food
20 supplement”; “fruit & processed fruit”; “honey & bee product”; “meat”;
21 “mushroom”; “not specified”; “nut”; “oil & fat”; “other”; “poultry”; “seafood”;
22 “seaweed”; “snack”; “spice & condiment”; “utensil”; “vegetable, cereal, & other
23 crops.” Each notification has been assigned to a single product category. If
24 multiple categories occur in the same notification, the latter has been classified
25 into the “composite & mixed” category. An additional column has been added to
26 indicate if the notification pertained to the packaging of the pertinent product.
27 These various categories by and large resemble those used by the European
28 Commission in its annual RASFF reports;
- 29 • Hazard categories, *i.e.* “biological”; “chemical”; “defective packaging”; “fraud”;
30 “hygiene”; “labeling”; “microbiological”; “mycotoxin”; “not known”;
31 “nutritional”; “physical”; “quality,” and “transport.” Please note that the term
32 “biological” pertains to those hazards beyond microbiological ones, such as
33 insects and parasites present in food. “Chemical” pertains to hazards of a
34 chemical nature, while mycotoxins are considered as a separate kind of hazard,
35 given the large number of notifications and comparatively low number of specific
36 substances in the latter group. Three hazard categories at maximum have been
37 identified for each notification;
- 38 • Specific hazards for the categories of biological- (maximum 2 items), chemical-
39 (7), defective packaging- (2), fraud- (2), hygienic- (1), labeling- (2),
40 microbiological (7), mycotoxin- (3), nutritional (1), physical- (5), quality- (2),
41 transport (1), and non-specified & other (1) hazards; and
- 42 • Country of provenance and region of provenance. The country of provenance is
43 the same as identified by RASFF, while the additional column with this
44 information provides for consistent annotation of these countries facilitating
45 analysis. As regions of provenance, the following items are discerned: “Africa,
46 sub-Saharan”; “Asia”; “Australia-Pacific”; “Central & South America”; “EU”;

1 “Europe (non-EU)”; “Middle East & North Africa”; “North America”; “not
2 specified”; “unknown”; and “unclear”. For notifications on products originating
3 from EU countries, an additional column specifies if these countries belong either
4 to the EU-15 countries or the new member states (same as for notifications). New
5 member states are designated as “Europe (non-EU)” for notifications filed on
6 dates prior to their accession to the EU and as “EU” and “new member state” after
7 these dates (May 1st, 2004, for 10 countries, and January 1st, 2007, for two
8 countries).

- 9 • Replicate numbers, overall and for each hazard category per notification. In order
10 to allow for counting the frequency with which each hazard occurred, replicates
11 have been created for each notification containing multiple hazards. Each
12 replicate contains a single specific hazard, such as the chemical substance “Sudan
13 4.” The replicates were assigned a number in a separate column, *i.e.* “Rep1” for
14 the first replicate, “Rep2” for the second, “Rep3” for the third, etcetera. The same
15 has been done for each replicate for a specific hazard category. For example, if a
16 notification would have mentioned two chemical and one biological hazards, three
17 replicates (Rep1, Rep2, Rep3) would have been created with hazard replicates
18 “Chem1” and “Chem2” containing the two chemical hazards and “Microb1”
19 containing the single microbiological hazard. In addition, an additional column
20 “count” has been created with the number 1 assigned to each replicate, which was
21 used for counting, by adding up all the counts in the cells of the pivot table
22 created in Excel file using the organized data described above as input. This pivot
23 table has been used in order to carry out the investigations mentioned below.
24

25 For the analysis of the overall data, the following items were investigated:

- 26 • The chronology of the overall number of notifications have been considered, *i.e.*
27 the number of notifications per quarter (three-month period), with sixteen quarters
28 in total for the four-year period considered. The three-month period have been
29 chosen as unity of time because of the variable number of reports for each week
30 and for each hazard within a given week, while this shorter-than-one-year interval
31 allowed to investigate possible short-term trends;
- 32 • In addition, the chronology for each product- and hazard- category have been
33 considered, as well as that of regions of countries filing notifications and of the
34 regions of origin of notified products; and
- 35 • Also the possible relationships between products *versus* hazards, products *versus*
36 countries filing reports, hazards *versus* countries filing reports, products *versus*
37 region of origin, and hazards *versus* regions of origin have been considered.
38

39 Notifications pertaining to each hazard category have been analyzed for the following
40 attributes:

- 41 • Chronology of all notifications for the specific hazard category;
- 42 • The same for the notifications for the product categories and specific hazards that
43 have been notified for the particular hazard category. For chemical hazards,, also
44 the agent categories have been included as a kind of clusters of hazards of the
45 same type (*e.g.* allergen, drug residue, food additive, pesticide);

- 1 • Specific hazards versus specific product categories, *i.e.* which hazards occur in
- 2 which products;
- 3 • Region of origin of products notified for the particular hazard category, including
- 4 a breakdown for product categories and for the specific hazards; and
- 5 • Same as the previous point for the regions of countries filing reports.

6
7 Data have been checked by the operators for conspicuous upward or downward trends, as
8 well as “blips” in the number of notifications over time, as well as for specific
9 associations between products, hazards, regions of origin, and countries filing reports.
10 Because the number of reports is low for many specific hazards, no statistical program
11 has been used for this purpose. The data have been visually inspected for large and
12 conspicuous differences, taking into account the possible background variability in
13 reports.

14 **3. Results**

15 The weekly overviews that are available on the RASFF website cover the period from
16 May 19th, 2003 (week 21) on. Data from July 2003 until June 2007 covering sixteen
17 quarters (three-month periods) have been selected for further analysis. These three-
18 month periods serve as the basic unit for chronological analysis of the data because the
19 number of notifications may vary from one week to another, while longer periods than
20 three months may conceal short-term trends.

21 **3.1. General**

22 Table 1 gives an overview of the frequencies by which notifications assigned to the main
23 product and hazard categories, regions of origin and sources of notifications occurred. In
24 total, the data include 11,403 notifications consisting of 3,275 alert notifications (29%)
25 and 8,128 information notifications (71%, Table 1). This division between alert and
26 information notifications is not homogeneously distributed over the various hazard
27 categories (data not shown). In particular, alert notifications account for only a
28 comparatively small fraction (7%) of all notifications on mycotoxin-related hazards,
29 which constitute a major group. The same holds true for alert notifications on products
30 from the Middle East & North African region, as well as on products consisting of nuts,
31 in both of which mycotoxins are the predominant hazard. This indicates that in many of
32 these cases, the consequences of the finding of mycotoxins may not extend towards other
33 members of the RASFF network. The large number for mycotoxin-related hazards
34 nevertheless may indicate an important problem.

35
36 Alert notifications have also been issued more frequently for products originating from
37 inside the EU (62%) than from regions outside the EU (2-17% per region, data not
38 shown). A possible explanation for this discrepancy is that consignments imported from
39 non-EU countries can be halted at the port of entry whereas products originating from
40 within the EU may be more easily moveable within the community borders.

41
42 Within the EU, the new member states have started filing reports from the second quarter
43 of 2004 on, accounting for 18% of total reports at the end of the period considered, *i.e.*
44 the second quarter of 2007. The contribution of new member states to notifications on

1 products coming from this group of countries is conspicuously high, *i.e.* 62% of all
2 reports pertaining to these products (data not shown).

3
4 Besides the EU member states and the European Commission, also the ESA countries
5 Iceland, Liechtenstein, and Norway participate in the RASFF network. Many (62%) of
6 the reports filed by ESA countries pertain to microbiological hazards.

7
8 In addition, the results in Table 1 also show that the notifications are not evenly
9 distributed over the various categories of products and hazards. With regard to products,
10 for example, the main categories consist of nuts, seafood, and spices & condiments,
11 which together cover more than half of the notifications (55%). The major hazard
12 categories include chemical hazards (44%), mycotoxins (29%), and microbiological
13 hazards (17%), which together account for the majority of the notifications (90%).

14
15 The chronological development of the total notifications and the main chemical
16 substances and food products during the period July 2003 – June 2007 is depicted in
17 Figure 1. The graph shows no clear trend and appears to vary around the average of
18 approximately 700 reports per quarter. No conspicuous trends can be observed either in
19 the time series of the main hazard and product categories, regions of origin, and sources
20 of notifications, except for i) a temporary high for the minor product category of oils and
21 fats in the fourth quarter of 2004; ii) higher numbers of reports for the product category
22 of vegetable, cereal, and other crops in the last year of the surveyed period; and iii) a
23 gradual increase in the number of reports on the product category of utensils. The blip in
24 the chronology of reports on oil and fat relates to an increased number of reports on the
25 occurrence of dye Sudan 4 in palm oil imported from Western Africa. The higher
26 numbers for vegetables, cereals, and other crops relate to two issues, *i.e.* the occurrence
27 of GMOs in rice and of the illegal pesticide isophenfos-methyl in peppers. The rising
28 numbers of utensils notified in the course of the studies period correlate with increasing
29 numbers of reports on utensils originating from China and showing migration of heavy
30 metals and food contact substances. These issues are discussed more in detail for
31 chemical hazards below.

32 **3.2. Chemical hazards**

33 In total, 4,911 reports pertain to one or more chemical hazards, which mainly occur in the
34 product categories of seafood (1,487 reports, 30%) and spice & condiment (749 reports,
35 15%). As stated above, the chemical hazards have been sorted into agent categories, each
36 of which can be further broken down into specific chemical substances. For example, the
37 category of allergens contains the specific substances of histamine and sulfite. Both
38 compounds are grouped together with allergens, since these substances can cause the
39 same reactions in consumers as allergens. Sulfite is used as preservative, while histamine
40 is formed by microbial activity in stored fish, in particular in scombroid fish types (*e.g.*
41 mackerel).

42
43 Besides several notable exceptions, no conspicuous overall trends occur in the timelines
44 of the products, agents, and specific substances within the chemical hazards. Exceptions
45 to this general observation are noted for various product and chemical hazard categories,

1 including the product categories of oil & fat; utensils; and vegetables, cereal & other
2 crops; as well as the chemical hazard subcategories of drug residues and food contact
3 substances. Conspicuous trends are also noted for the specific hazards of genetically
4 modified organisms (GMOs), the specific food contact substance 2-isopropyl-
5 thioxanthone (ITX), and the dyes Para Red and Sudan 4, as discussed below.

6
7 The nitrofurans antibiotics furazolidone and nitrofurazone, as well as the chloramphenicol
8 antibiotic, are the main drug residues (Table 2). The highest scores for these three
9 antibiotics, *i.e.* in total 75 reported incidences, occur in the first quarter of the studied
10 period, which also accounts for the fact that drug residues appear to have declined
11 somewhat from an initial high in the first quarter (Figure 2). Seafood is the most
12 predominant product category in which drug residues have been detected, accounting for
13 approximately half of the notifications. In addition, the second most notified product,
14 honey & other bee products, account for approximately one-quarter of the notifications.

15
16 The “blip,” *i.e.* the temporary increase in the notifications for food contact substances is
17 accounted for by the rapid rise in notifications for ITX in the second half of 2005 (Figure
18 3). ITX is an ink-component, which can migrate from printed food packaging materials
19 into foods. It accounts for 32% of all food contact substances that have been reported.
20 All the 117 reports on ITX have been filed by EU-15 countries, predominantly Italy, and
21 also pertained exclusively to products coming from this region, mainly consisting of
22 beverages, dairy products, and baby food. The food contact substance category does not
23 include heavy metals, which, in a number of cases, also occur in materials in contact with
24 food.

25
26 Another temporary high is noted in the notifications on the product category of oil & fat
27 during the last quarter of 2004 (Figure 4). Most of this is accounted for by a transient rise
28 in reports on the presence of unauthorized dye Sudan 4 in palm oil imported from African
29 countries. The RASFF annual review of the year 2004 mentions that these notifications
30 pertained to crude, red-colored palm oils of a particular type, *i.e.* “Zomi,” a specialty
31 product that constitutes a fraction of total palm oil imports into the EU. In addition, the
32 unauthorized dye Para Red shows a blip in the course of the second quarter of 2005
33 (Figure 5b). This dye mainly occurs in spices & condiments, most of which originate
34 from the EU and the Russian Federation. The agent category of dyes in general and the
35 predominant Sudan dyes 1 and 4 show a tendency towards lower values at the end of the
36 period considered (Figure 5a). In general, the main product categories to which reports
37 on dyes pertain are spices & condiments (64%) and oil & fat (11%).

38
39 As regards the agent category of allergens, the main substances within this category are
40 sulfite and histamine, with sulfite making up for slightly less (63%) than two-thirds of the
41 total number of notifications (Table 2). Histamine mainly occurs in seafood, which, as
42 mentioned above, relates to its formation by bacteria in stored fish.

43
44 With regard to heavy metals, slightly more than half of the reported substances are
45 present in seafood and 25 percent in utensils. Cadmium, mercury, and lead are the most
46 predominant heavy metals, making up nearly three-quarters of the total number of

1 notifications (Table 2). Cadmium and mercury are mainly associated with seafood
2 products, while chromium and nickel were associated with utensils.

3
4 In the product category of utensils, a gradual overall increase in the number of
5 notifications on chemical hazards is observed (Figure 6). This increase appears to relate
6 mainly to migration of heavy metals (*e.g.* chromium, nickel, lead) or organic substances
7 (4,4'-diaminophenylmethane, aromatic primary amines, formaldehyde) used for plastic
8 production from utensils imported from China.

9
10 Fruits and vegetables constitute slightly more than 80 percent of the notifications for
11 pesticides. The number of different chemical substances is comparatively high, 91 in
12 total, with many pesticides reported only once or a few times. The sixteen most
13 predominant pesticides with at least ten reports for each pesticide together constitute 65%
14 of the total number of reported pesticide residues, the highest being dimethoate
15 accounting for 31 reported incidences (8%; Table 2). The second-most reported
16 pesticide, isophenfos-methyl, shows a blip in the first half of 2007 (Figure 7). In all
17 cases, this relates to the illegal presence of this unauthorized organophosphate pesticide
18 in bell peppers (paprika) from Spain.

19
20 GMOs account for 171 reports, with the first 11 reports in the first three years of the
21 period considered, and the remainder in the last year (Figure 8). This increase during the
22 last year relates to two issues, that is, the occurrences of unauthorized GMO varieties in
23 rice products from the USA and China and in maize in animal feed products imported
24 from the USA. These increased numbers also cause a conspicuous elevation in the
25 chronology of all reports on products from the USA.

26 **3.3. Microbiological hazards**

27 Various types of microbiological hazards have been reported through the RASFF system,
28 including bacteria, moulds, and viruses. Bacteria constitute the largest group of
29 microbiological hazards, with more than a hundred specific microbe species, subspecies,
30 and strains having been reported. Table 3 provides an overview of the reports on
31 microbiological hazards. As can be deferred from the data in this table, the most
32 important product categories are seafood, meat, poultry, spice & condiment, animal feed,
33 and dairy products.

34
35 As regards bacteria, *Salmonella* and its subspecies are the most numerous, accounting for
36 1,121 (57%) of reports on bacteria. Various subspecies of *Salmonella* account for all but
37 one of the 197 reports on microbiological hazards in animal feed. *Salmonella*
38 *typhimurium*, including the phage types DT104, DT108, and U302, mainly occur in meat
39 and poultry (92% of 131 reports). The distribution of other subspecies of *Salmonella*
40 over the various product categories may differ from one to another. For example,
41 *Salmonella enteritidis* accounts for two-thirds of the 27 reports on microbiological
42 contaminations of egg products.

43
44 The second largest category of bacteria, *Listeria monocytogenes* (16%), is mainly
45 associated with animal products (92%), including dairy, meat, poultry, and seafood. The

1 counts of reports on *L. monocytogenes* are comparatively low, *i.e.* varying between 3 and
2 9, in the last six quarters studied as compared to the range of values in the preceding
3 quarters, *i.e.* between 12 and 51.

4
5 The third most frequently notified bacterium, *Escherichia coli* and specific strains,
6 accounts for 144 reports in total and was particularly linked with seafood (48%) and
7 spices & condiments (21%). Another conspicuous item is that the 107 reports on
8 bacterium *Vibrio* and its subspecies solely occur in seafood.

9
10 As regards moulds, it is noted that they occur in a variety of products, while constituting
11 the sole source of microbiological contamination of nuts (15 reports). As mentioned
12 below, nuts are major contributors to the reports on mycotoxins, which are compounds
13 formed by moulds.

14
15 Noroviruses accounted for nine out of twelve reports in total for viruses. Five of the
16 contaminations with norovirus occur in seafood (oysters), one in a composite product
17 (raspberry crumble), and two in fruit & processed fruit (raspberry).

18 **3.4. Mycotoxins**

19 The most predominant category of mycotoxins is aflatoxins, which accounts for 93% of
20 all reported mycotoxins (Table 4). Most of the reports on aflatoxins (84%) pertain to
21 their occurrence in nuts. Pistachios, particularly from Iran, accounts for many of the
22 reports on nuts, while aflatoxins also occur in, for example, peanuts, almonds, hazelnuts,
23 and Brazil nuts. The origin of these pistachios also relates to the high share (49%) of the
24 Middle Eastern and North African region as area of provenance of products containing
25 aflatoxins.

26
27 In most of the 167 reported instances, ochratoxin A occurs in the product categories of
28 beverages (*i.e.* raw coffee & derivatives, and cocoa powder), fruit & processed fruits
29 (mainly raisins/sultanas and figs), spices & condiments (mainly pepper), and vegetables,
30 cereals & other crops (cereals). One out of the 20 reports pertaining to ochratoxin A in
31 cereals explicitly mentions the organic origin of the rye in which it occurs.

32
33 Most of the reports on fumonisin, *i.e.* 51 out of 55, pertain to maize and derived products,
34 such as meal and polenta. Sixteen reports explicitly mention the maize to be organic. As
35 regards the origin of products containing fumonisin, most of the products (95%) originate
36 from various “old” EU member states (EU-15).

37
38 The occurrence of patulin has been reported 13 times, divided over the three product
39 categories of beverages (9 reports, fruit juices such as apple juice), baby food (3 reports),
40 and fruit & processed fruit (1 report). In one instance, the origin of apple juice in which
41 patulin has been observed is stated to be organic. Patulin was reported for the first time
42 through RASFF in 2005.

43
44 One report on deoxynivalenol and two on zearalenone have been filed in this period,
45 pertaining to the occurrence of these mycotoxins in maize or maize meal.

1
2 With regard to aflatoxin M1 in dairy, one report on aflatoxins in cultured dairy has been
3 filed during the period considered.

4 **3.5. Biological hazards**

5 Besides microbiological hazards, other hazards of a biological nature have been reported
6 through the RASFF system. These biological hazards consist mainly of parasitic worms
7 and nematodes, as well as of insects (Table 5).

8
9 The parasitic “herring worm” *Anisakis simplex* forms the most predominant hazard,
10 constituting 33% of the reported hazards and being exclusively associated with seafood
11 (Table 5). This and other parasitic worms may occur in fresh fish that has not been
12 frozen after catchment. A blip is observed in the notifications for *Anisakis* in the last
13 quarter of 2004 (Figure 9). Main regions of origin of products containing *Anisakis* are
14 the EU-15 and non-EU European countries (Croatia, Iceland, Norway). All but four
15 reports on *Anisakis* have been filed by Italy. No conspicuous features or trends can be
16 observed in the reports on the other biological hazards.

17 **3.6. Physical hazards**

18 A large fraction (66%) of the 179 notifications reporting physical hazards are alert
19 notifications. The major physical hazards reported are the occurrence of foreign bodies
20 consisting of glass in products, suffocation hazard, and the presence of non-specified
21 materials and metal pieces (Table 6). Suffocation hazard relates to product dimensions,
22 such as of jelly cups used as candy. Confectionery is predominant (92%) among the 39
23 reports on suffocation hazards, and also constitutes the largest product category with
24 physical hazards overall.

25 **3.7. Hygiene-related issues**

26 Information notifications constitute the majority (87%) of the reports on hygiene-related
27 issues, indicating that the identified problems are of local relevance. Temperature control
28 of refrigerated and frozen products in the food chain constitute the main hygienic
29 problem, accounting for 67% of the reports (Table 7). The main product category is
30 seafood with 32 reports (41%), of which 29 reports pertain to problems with temperature
31 control. Five-sixths (5/6, 83%) of the reports pertain to products imported from non-EU
32 countries.

33 **3.8. Quality-related issues**

34 In total, 181 issues have been reported, the most predominant being organoleptic
35 characteristics and spoilage. The most predominant product in this field is seafood
36 (Table 8).

37 **3.9. Labeling-related issues**

38 Most of the 204 notified labeling-related issues pertain to incorrect labels, undeclared
39 allergenic ingredients, and unlabeled irradiation. Composite & mixed products form the
40 largest category of products (Table 9). The most predominant origin of the products is
41 the EU (40%). More than half of the issues reported for products from the EU pertain to

1 undeclared allergens, whilst the remaining issues are heterogeneous. Asian products
2 account for 30% of the notifications. The most frequently reported issues in Asian
3 products are unlabeled irradiation (42%) and incorrect labels (not specified, 31%).

4 **3.10. Fraud-related issues**

5 The main fraud-related issues are illegal imports and lack of authorization of
6 establishments and of transits. The main products are meat, seafood, and composite &
7 mixed products (Table 10). As regions of origin, Asia accounts for 44% and the EU for
8 22% of the products for which fraud-related issues have been reported. The numbers of
9 reports per time-unit indicate an overall increase over the four-year period considered, the
10 number of reports per quarter appear to have increased after mid-2005 (Figure 10). In the
11 latter period, some member countries have filed multiple reports on the same product
12 category or on the same issue. For example, Germany has filed five reports on poultry
13 and Lithuania 14 reports on meat and four on animal by-products.

14 **3.11. Issues related to packaging**

15 The most predominant issues pertaining to packaging are damaged packaging (24 of 68
16 issues in total) and defective packaging (22 issues). Main product categories include
17 meat with 14- and seafood with 15- out of 66 notifications in total (Table 11). All but
18 one of the 14 notifications on meat pertain to products from the Central and South
19 American region, *i.e.* Brazil. Malta has filed seven notifications on damaged packaging
20 of corned beef within a limited time frame. In total, the most important regions of origin
21 are Asia (23 notifications) and Central and South America (15 notifications).

22 **4. Discussion**

23 The RASFF system contains registers of notifications of known hazards covering a wide
24 variety of subjects, such as chemical substances, micro-organisms, parasites, hygiene,
25 packaging, quality, labeling, and fraud. Food safety monitoring by RASFF members
26 focuses on these hazards, based on their known toxic properties, which may make them
27 appear of less emergent nature. Nevertheless, the notifications may still provide valuable
28 information regarding emerging hazards, such as those that are re-emerging or those that
29 are detected in products that were previously not considered to contain them.

30
31 In the current study, the data that are available from the weekly RASFF reports published
32 on Internet have been analyzed for the occurrence of possible trends occurring during the
33 period July 2003 – June 2007.

34
35 A number of conspicuous findings are noted. For example, there is an increasing trend
36 towards notifications of the chemical substance category of food contact substances over
37 time, with a peak at the end of 2005 (Figure 3). This is linked with the high number of
38 notifications for the ink substance ITX. This compound has initially been detected in
39 food products intended for babies. Following these reports, ITX has also been detected in
40 formulas for growing-up children, as well as in other fluid products, mainly fruit juices.
41 In addition, EFSA's Scientific Panel on Food Additives, Flavorings, Processing Aids and
42 Materials in Contact with Food has issued an opinion on the safety of ITX and another
43 ink substance, 2-ethylhexyl-4-dimethylaminobenzoate (EHDAB), for public health

1 (EFSA, 2005a). The Panel considers, among others, the potential intake of ITX by
2 babies, children, and adults, using conservative estimates. With regard to the possible
3 toxicity of ITX, the Panel concludes that the data available do not indicate genotoxicity of
4 ITX. However, given the incompleteness of toxicity data, the Panel has been unable to
5 make any further comments on the safety of ITX (EFSA, 2005a). Based on this opinion,
6 EFSA advises that the observed levels of ITX in food products give no further health
7 concerns, but that further studies are needed if exposure are to be continued (EFSA,
8 2005b).

9
10 The German risk assessment institute BfR has also assessed the issue of printing ink
11 constituents present in beverages. It concludes that, based on the limited data available, it
12 cannot fully assess the potential health consequences of exposure to high levels of ITX in
13 beverages. BfR furthermore concludes that it cannot exclude the possibility of transfer
14 from the outside of packages to the inside by “set-off” when the packaging materials are
15 rolled or stacked in such a way during storage and production that both sides come into
16 contact with each other. Therefore, it concludes that there is a need for requirements for
17 the safety of printing inks to be used on food product packaging (BfR, 2005a).

18
19 Considering EFSA's advice and the withdrawal of affected products from the Italian
20 market, the EU Standing Committee on the Food Chain and Animal Health has decided
21 not to take any measures at the EU level (European Commission, 2005c). In addition,
22 popular press has reported that the food packaging industry intends to abandon the use of
23 ITX-containing inks. The recently adopted European Community Regulation
24 2023/2006/EC formulates requirements for Good Manufacturing Practice. This includes
25 the requirement that printing inks for food product packaging be formulated and handled
26 in such a way that they are not transferred to the food contact surface of the packaging by
27 means of “set-off” or migration through the packaging.

28
29 An observation that can be inferred from these developments is that an analysis of the
30 long-term trends within RASFF data probably would not have been able to predict a
31 novel finding such as ITX being present in foods. This finding has triggered a process of
32 “broadening” the scope, both at the risk assessment level, *i.e.* the consideration that
33 similar compounds as ITX may show the same behavior, and at the risk management
34 level, *i.e.* measures against transfer of any printing ink to food contact surfaces. A further
35 step can be to make an inventory of other compounds used on food packaging that are
36 similar to ITX and to measure the presence of these compounds.

37
38 A related issue pertaining to substances migrating from materials in contact with food is
39 the apparent trend towards more frequent incidences involving utensils (Figure 6). The
40 observed increase mainly relates to utensils imported from China that show migration
41 either of heavy metals from metal parts or of organic substances from plastics. The issue
42 of migration from kitchenware has previously received interest from institutions like the
43 British Food Standards Agency (FSA). A project of the FSA, which was finished in
44 2003, has identified a number of potential compounds that can migrate from kitchenware.
45 It concludes that these migrants are likely to stay below the legal threshold levels (FSA,
46 2003). In addition, the RASFF annual report over the year 2005 mentions that organic

1 substances, like the primary aromatic amines mentioned above, originate from nylon
2 products (RASFF, 2007). Such migration is not allowed under Directive 2002/72/EC on
3 plastics. Furthermore, this report mentions the agreement reached in 2005 between the
4 EU and China to cooperate in the field of sanitary and phytosanitary issues, including the
5 migration from utensils.

6
7 In more general terms, European Community Regulation 1935/2004/EC on materials
8 likely to come into contact with foods has recently come into force, amending previous
9 legislation on food contact substances, for example with regard to "active" or "intelligent"
10 packaging. This Regulation provides an annex with a list of materials, including, for
11 example, ceramics, glass, paper, and plastics, which may need authorization before being
12 used commercially. Following several occasions involving contact substances that were
13 not included within this list, such as certain plasticizers migrating into oily foods,
14 supplementary European Community legislation is currently being prepared to
15 accommodate these items. Among other things, the EU is currently preparing a
16 community-wide "positive list" of food additives that can come into contact with foods,
17 such as food contact substances migrating from utensils, and that have been assessed. In
18 addition, provisions are being made to include refined exposure assessments as well
19 (FSA, 2005a). Another example of an amendment to this legislation, as proposed by the
20 German authorities, is the lowering of the threshold levels for lead and cadmium
21 migrating from ceramics (BfR, 2005b). This recommendation by BfR, as well as by the
22 Swedish and Norwegian, food safety authorities has been brought to the attention of the
23 EFSA advisory forum. In addition, a survey carried out by the Norwegian Food Safety
24 Authority indicates that the migration of lead and cadmium appears to be higher on
25 average in handcrafted pottery as compared to industrial pottery. Lowering the
26 thresholds may therefore require additional measures by this particular branch of the
27 ceramics industry (VKM, 2004).

28
29 With regard to dyes in foodstuffs, there appears to be a sudden increase of the occurrence
30 of Para Red in the second quarter of 2005. This dye mainly occurs in spices &
31 condiments that predominantly originate from the EU and the Russian Federation. These
32 data may indicate a recent trend towards dyes other than Sudan dyes. From these data, it
33 cannot be concluded whether this reflects either a change in use of non-authorized
34 "alternatives" to Sudan or an increased scope of dyes analyzed by food control agencies
35 in food and feed products. The EU and its member states have taken action, including
36 recalls of products containing Para Red, which is an azo dye that is similar to the Sudan
37 dyes. The presence of Sudan dyes in food products has been notified since their first
38 detection in chilli pepper in 2003 (European Commission, 2005a). Both Para Red and
39 Sudan dyes are commonly used for non-food purposes and their use in food and feed is
40 illegal. Sudan dyes have been classified as genotoxic and carcinogenic. Advisers to the
41 British Food Standards Agency assumed that Para Red is also likely to be a genotoxic
42 carcinogen (FSA, 2005b). With regard to Para Red, the EU is striving towards
43 harmonization of detection methods for azo dyes and widening the scope of the dyes
44 included in the analysis (European Commission, 2005b). The cause of the occurrence of
45 these potentially toxic, illegal dyes lies in the deliberate addition of these compounds,
46 apparently in order to impart more attractive- or higher valued- color, such as in the case

1 of red-colored palm oil (see above). Given the reportedly widespread occurrence of
2 illegal Sudan dyes in food in some third countries outside Europe, a continued alertness
3 for the presence of these dyes and possible alternatives is warranted. Whilst the illegal
4 use of dyes itself may constitute a trend, prediction of the presence of specific dyes in
5 particular foods needs additional data, including, for example, the added value imparted
6 by colors to particular foods, the availability of non-food dyes, their toxicity, and the food
7 controls in nations of origin. In addition, reports from non-EU countries may also
8 provide indications. In this respect, the establishment of a “worldwide RASFF” currently
9 being prepared by the EU as mentioned by the RASFF annual report over 2006 (RASFF,
10 2007), could be useful for the early identification of emerging hazards outside the EU.

11
12 Another conspicuous trend in the occurrence of specific chemical hazards is the increase
13 in number of reports on pesticides in the first quarter of 2007. This increase relates to a
14 temporary rise in the number of reports on the occurrence of residues of the isophenfos-
15 methyl pesticide in fresh Spanish bell peppers (paprika). This pesticide has not been
16 approved for use in the EU, but appears to be used in China. Limited data are available
17 on its toxicity, whilst its presence in foods should be restricted given that it belongs to the
18 toxic class of organophosphate insecticides. Based on informal indications of the use of
19 isophenfos-methyl by Spanish farmers, German authorities have analyzed Spanish
20 peppers harvested in autumn 2006 and reported its presence through RASFF. Following
21 this report, other authorities also have analyzed peppers for isophenfos-methyl or re-
22 checked the details of analyses previously carried out on peppers. The presence of the
23 pesticide also led to recall from the market, such as in Finland. In Spain, measures have
24 been taken to further restrict the use of isophenfos, which accounts of the occurrence of
25 residues of isophenfos-methyl in only several samples at negligible levels during a
26 follow-up analysis. Another organophosphate pesticide, isocarbophos, has subsequently
27 also been found on peppers and reported through RASFF (CVUA, 2007; VWA, 2007).

28
29 Similar to Para Red, the case of isophenfos-methyl highlights that reports on deliberately
30 used, potentially toxic, and illegal compounds may suddenly increase and decrease. In
31 both cases, the food control agencies’ knowledge of the potential illegal use of the
32 particular substances, *i.e.* Para Red and isophenfos-methyl, instigated their analysis. The
33 detection of another unauthorized pesticide, *i.e.* isocarbophos, indicates that also other
34 pesticides besides isophenfos-methyl may potentially have been used. Risk measures
35 inside the EU appeared to have contributed to an effective mitigation of the risks. As
36 previously noted for dyes, a systematic inventory of other candidate illegal compounds
37 and their target crops may be warranted.

38
39 Another temporary high in the last year of the period studies was that in the number of
40 reports on genetically modified organisms (GMOs), which started to rise in the third
41 quarter of 2006 and peaked in the last quarter of the same year. The occurrence of three
42 different genetically modified (GM) crop varieties underlies this trend. Many of these
43 reports pertain to the occurrence of GM rice in rice kernels and derived products
44 imported from the USA. This GM rice has been grown for experimental purposes in the
45 USA and accidentally gotten into rice seeds used by rice growers in the Southern USA.
46 Following this incident, measures have been taken by the US authorities to ensure that

1 consignments for export are checked for the presence of this rice, as required also by the
2 EU. In addition, a petition has been filed for market approval of this rice, which has
3 subsequently been granted by the American authorities. On the EU side, the authorities
4 have responded quickly by implementing an analytical method to test for this rice. EFSA
5 has published a scientific opinion on this rice, concluding that based on the limited data
6 known at that time, this rice is not likely to constitute a health concern (EFSA, 2006).

7
8 The other GM rice implicated with the rising trend in reports on GMOs is insect-resistant
9 GM rice from China in various imported Chinese food and feed products. The RASFF
10 reports follow press releases by non-governmental organizations that have commissioned
11 the analysis of rice products for the presence of GM rice, following their previous, less
12 specific claim of GM rice being present in products sampled in China itself. The reports
13 in 2006 have led to recalls of the implicated products (SCFCAH, 2006)

14
15 The third GM variety is GM maize that has already been positively assessed for its safety
16 by EFSA, but which has not yet been given the regulatory approval for marketing (EFSA,
17 2007). This GM maize has been observed to occur in animal feed commodities exported
18 from the USA, some of which have been arrested at the port of entry or recalled from the
19 market. The presence of this maize in animal feed materials, including maize gluten, has
20 been anticipated by the European authorities based on the regulatory approval for
21 marketing in the USA, with that in the EU still pending (SCFCAH, 2007).

22
23 The issue of the low-level presence in commodities of GM crops that have been
24 authorized by the exporting nation but not by the importing nation itself is currently being
25 addressed by Codex Alimentarius. In addition, exporting nations are obliged to file
26 information on GMOs that may occur in internationally traded consignments into the
27 Biosafety Clearinghouse as established under the Cartagena Protocol on Biodiversity.
28 Whilst Codex has already established general guidance for the safety assessment of
29 genetically modified foods derived from crops and micro-organisms, the national
30 regulations and approval procedures for these GMOs may still differ among each other.
31 Therefore, recurrence of this kind of issue cannot be excluded, and measures aiming to
32 prevent the adventitious presence of unauthorized GMOs in imported consignments
33 likely have to be continued.

34
35 In the case of antibiotics in seafood, the apparent decline from the first quarter onwards
36 probably relates to the improvement of the control and prevention of drug residues in
37 exporting countries in the course of 2003-04, as indicated also by the RASFF annual
38 review. Before the time period considered in this study, the EU has imposed sanctions on
39 imported products containing nitrofurans and chloramphenicol. During the period
40 studied, measures have also been taken regarding malachite green and leucomalachite
41 green, which are used as unauthorized dyes with fungicidal properties. The numbers of
42 reports on these two compounds show a less pronounced peak for both compounds in the
43 third quarter of 2005, with 11 reports for malachite green and 13 for leucomalachite
44 green.

45

1 A high number of information notifications on the presence of aflatoxins in nuts are
2 noted, particularly on pistachio nuts from Iran. Comprehensive measures have already
3 been put in place by the EU for the control on imported consignments of nuts that may
4 contain mycotoxins, including, for example, pistachios, hazelnuts, peanuts, and Brazil
5 nuts. Measures on pistachios imported from Iran are discussed in more detail, for
6 example, by the RASFF annual reports over the years 2004 and 2005 (RASFF, 2007).

7
8 With respect to microbiological hazards, *Salmonella* spp. and *Listeria monocytogenes*
9 constitute the bacteria that are most frequently notified through RASFF. The RASFF
10 annual report 2004 highlights the occurrence of *L. monocytogenes* in smoked fish and the
11 fact that in 2004, no legal thresholds for this bacterium in fish existed (RASFF, 2007).
12 Contamination with *L. monocytogenes* may occur in fish processing facilities, from which
13 it may be difficult to eradicate. In addition, it is a bacterium that can grow under cold
14 conditions and if no further processing occurs in the consumer household, it may pose a
15 microbiological hazard. Although food infections with *L. monocytogenes* are considered
16 to be rare, the health impact may be severe, particularly in sensitive populations.

17
18 The risks associated with *L. monocytogenes* in food have been recognized by EU
19 scientific committees. This awareness has contributed to the promulgation of
20 microbiological requirements for maximum levels of *L. monocytogenes* in ready-to-eat
21 foods, including smoked and raw fish, in Regulation 2073/2005/EC. Furthermore, EU
22 member states are obliged to report the outcomes of monitoring for listeriosis, which is
23 the disease caused by infection with *L. monocytogenes*, among humans and livestock, as
24 laid down in Directive 2003/99/EC and Decision 2002/253/EC. For example, EFSA
25 reports that the monitoring results have shown that the incidence of listeriosis in 2004 is
26 increased compared to the average of the preceding five years (EFSA, 2005c).

27
28 Another bacterium, *Vibrio* and its subspecies, is found to be solely linked to seafood,
29 which may be accounted for by its ubiquitous presence in marine environments.

30
31 With regard to biological hazards, a blip in the number of notifications is observed for the
32 fish and human parasite *Anisakis*, a nematode which is also known as “herring worm”
33 (Figure 9). This parasite usually is eradicated by freezing after catchment and
34 evisceration of fish. *A. simplex* is able to sustain digestion after consumption and to
35 cause harm to visceral organs. It also is a known food allergen. Various authorities,
36 including the Italian Ministry of Health and the EFTA Surveillance Authority (ESA), as
37 well as RASFF in its annual report for the year 2004, have acknowledged the temporary
38 increase in notifications on *A. simplex*, although they do not mention a cause of this
39 increase (RASFF, 2007). As regards mackerel imported from Norway, the Norwegian
40 Food Safety Authority have concluded that the processing establishments have not
41 breached European Community regulations (ESA, 2005). Same as for listeriosis
42 mentioned above, member states have to report the monitoring outcomes for anisakidosis,
43 which is the disease caused by *A. simplex* and related nematodes, in animals used for food
44 production.

45

1 The notifications on fraud-related issues appear to become slightly more frequent in the
2 last year of the period studied (Figure 10). In these final quarters, Germany, Italy,
3 Lithuania, and United Kingdom have filed multiple reports within relatively short periods
4 on the same products. This may indicate that these notifications are outcomes of focused,
5 temporary actions against certain types of fraud that the national agencies might have
6 been suspicious of. In addition, the RASFF annual report over the year 2005 mentions
7 that illegal imports of animal products that are unsuitable for marketing are on the rise.
8

9 Interestingly, in most of the cases described above, notifications have given rise to
10 measures at national and EU levels. The issues have also been addressed by RASFF in
11 its annual reports (RASFF, 2007). The information on the number and the contents of the
12 notifications can give an indication of increased occurrence of a certain chemical food
13 hazard or heightened alertness. On the other hand, these data may not provide insight
14 into the actual impact on health and trade, for example.
15

16 For the purpose of providing a "holistic" basis to anticipate future developments, the
17 authors envision a combination of RASFF trend analysis and complementary data, such
18 as food control programs carried out by EU member states at borders and on the market,
19 trade statistics (import, export), safety assessments, risk management measures, and
20 background information on the pertinent types of chemical hazards. This would help
21 putting the observed trends into perspective. For example, as described above, the EU
22 and national institutions are striving towards including more food contact substances and
23 dyes into the scope of regulations and control measures. This in turn may lead to higher
24 numbers of notifications, also for substances that have hitherto not been considered.
25

26 In addition, it may also be useful to take into account developments outside the food
27 manufacture chain that impact on hazards within it. Such an approach has been
28 recommended by the EMRISK project, which extends upon the findings of the previous
29 PeriApt project. The approach recommended by EMRISK discerns various "influential
30 sectors," such as science & technology, industry & trade, environment & energy, and
31 economy and finance. Within these sectors, 217 relevant indicators have been identified
32 based upon case studies, expert advice, and various selection criteria. Changes in these
33 indicators serve as signals for the potential emergence of a hazard. This constitutes a
34 fundamental part of the pre-early warning system recommended by EMRISK for the pro-
35 active, anticipatory identification of food hazards. Additional features of the EMRISK
36 approach include the use of automated searches on the Internet based on "indicative
37 questions," of which the output signals have to be evaluated by experts and other
38 stakeholders (VWA, 2006). Currently, a system as recommended by EMRISK is not
39 operational yet.
40

41 It is worth noting in this regard that the Statistical Office of the European Communities
42 (Eurostat) recently started an initiative towards combining data from food monitoring and
43 control in the EU with other data, such as risk management measures, cost efficiency,
44 public health statistics, food consumption, trade, production, economics, and consumer
45 accessibility (Eurostat, 2005). Eurostat envisages these data as inputs for risk assessment
46 and management, while in our opinion, they may also serve the identification of emerging

1 issues. For example, in case of GMOs occurring in imports to the EU, this may be
2 checked for by considering a combination of factors, including the authorization of a
3 GMO in a foreign country, the commercial availability of the GMO, the amount of
4 commodities containing the same crop as the GMO from the country authorizing the
5 GMO to the EU, and the number of controls carried out on imports.

6
7 It would be worthwhile to investigate the further development of the notifications of the
8 categories of interest during the follow-up periods.

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15 **Conflict of interest statement**

16 All authors are professionals employed by RIKILT - Institute of Food Safety and by the
17 Catholic University of the Sacred Heart, and as such do not have any interests that may
18 conflict with the contents of the article above.

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2 **Tables**3 **Table 1 - RASFF reports over the period July 2003 – June 2007, main**
4 **categories**

Category	Number of reports	
	Frequency	Percentage (%)
Total	11,403	100
Notification type		
Alert	3,275	29
Information	8,128	71
Product categories		
Animal feed	382	3
Baby food	68	1
Bakery	53	<1
Beverage	322	3
Composite, mixed	508	4
Confectionery	170	1
Dairy	204	2
Egg product	58	1
Food supplement	270	2
Fruit, processed fruit	632	6
Honey, bee product	177	2
Meat	603	5
Mushroom	43	<1
Nut	2,891	25
Oil and fat	183	2
Poultry	333	3
Seafood	2,198	19
Seaweed	52	<1
Snack	92	1
Spice, condiment	1,179	10
Utensil	342	3
Vegetable, cereal, other crops	574	5
Other	48	<1
Not specified	21	<1
Hazard categories ¹		
Biological hazard	227	2
Chemical hazard	5,600	44
Defective packaging hazard	68	1
Fraud hazard	256	2
Hygiene hazard	78	1
Labeling hazard	204	2
Microbiological hazard	2,176	17
Mycotoxin hazard	3,619	29
Nutritional hazard	1	<1
Physical hazard	185	1
Quality hazard	181	1

Transport hazard	7	<1
Not known	39	<1
Regions of origin		
Africa, sub-Saharan	580	5
Asia	2,828	25
Australia-Pacific	82	1
Central and South America	906	8
EU (EU-15, new member state)	3,029 (2,599, 430)	27 (23, 4)
Europe (non-EU)	1,282	11
Middle East and North Africa	1,960	17
North America	499	4
Not specified	119	1
Unclear / unknown	118	1
Sources of notifications		
European Commission	7	<1
ESA countries	347	3
EU-15 countries	9,694	85
New member states	1,354	12
Not specified	1	<1

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¹ The total number of reported hazards amounted to 12,641, which exceeds the total number of reports because of multiple hazards notified through single reports in some cases

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2 **Table 2 - Chemical hazards reported through RASFF over the period**
 3 **July 2003 – June 2007**

<i>Category</i>	<i>Number of reports</i>	
	<i>Frequency</i>	<i>Percentage (%)</i>
<u>Total notifications</u>	4,911	
<u>Notification type</u>		
Alert	1,831	37
Information	3,080	63
<u>Product categories</u>		
Animal feed	186	4
Baby food	43	1
Bakery	25	1
Beverage	197	4
Composite, mixed	173	4
Confectionery	96	2
Dairy	48	1
Egg product	28	1
Food supplement	227	5
Fruit, processed fruit	321	7
Honey, bee product	166	3
Meat	106	2
Mushroom	24	<1
Not specified	9	<1
Nut	9	<1
Oil and fat	166	3
Other	28	1
Poultry	40	1
Seafood	1,487	30
Seaweed	52	1
Snack	16	<1
Spice, condiment	749	15
Utensil	328	7
Vegetable, cereal, other crops	387	8
<u>Substance categories ¹</u>		
Additive (not specified)	3	<1
Allergen	590	11
Biogenic amines	1	<1
BSE	80	1
Caffeine and taurine	6	<1
Chemical substance	9	<1
CO	107	2
Contaminant	1	<1
Disinfectant	14	<1
Drug residue	801	14
Dye	1183	21
Ethanol	1	<1
Feed additive	5	<1
Food additive	220	4
Food contact substance	363	6
Food ingredient	3	<1

<i>Category</i>	<i>Number of reports</i>	
	<i>Frequency</i>	<i>Percentage (%)</i>
Glycol ether	12	<1
GMO	171	3
Heavy metal	885	16
Herb	34	1
Hydrocarbons	7	<1
Irradiation	101	2
Microbial toxin	78	1
Mineral	59	1
Narcotic	11	<1
Natural toxin	72	1
Nitrate/nitrite	43	1
Novel food	56	1
Peroxide	2	<1
Pesticide	411	7
pH	2	<1
Pollutant	204	4
Processing contaminant	46	1
Radioactivity	16	<1
Veterinary drug	1	<1
Vitamin	2	<1
<u>Specific hazards ²</u>		
<i>Allergen</i>	<i>590</i>	<i>100</i>
- Histamine	131	22
- Sulfite, sulfur dioxide	371	63
- Other (13 substances)	88	15
<i>Drug residue</i>	<i>801</i>	<i>100</i>
- Chloramphenicol	113	14
- Furazolidone	118	15
- Leucomalachite green	68	8
- Malachite green	56	7
- Nitrofurazone	135	17
- Other (67 substances)	311	39
<i>Dye</i>	<i>1183</i>	<i>100</i>
- Para Red	54	5
- Sudan 1	497	42
- Sudan 4	301	25
- Other (33 substances)	331	28
<i>Food contact substance</i>	<i>363</i>	<i>100</i>
- 4,4-Diaminodiphenylmethane	42	12
- Formaldehyde	25	7
- ITX - isopropyl thioxanthone	117	32
- Migration (not specified)	29	8
- Primary aromatic amines	43	12
- Other (31 substances)	107	29
<i>Heavy metal</i>	<i>885</i>	<i>100</i>
- Arsenic	48	5
- Cadmium	262	30
- Chromium	81	9
- Lead	131	15

<i>Category</i>	<i>Number of reports</i>	
	Frequency	Percentage (%)
- Mercury	255	29
- Nickel	65	7
- Other (11 substances)	43	5
<i>Pesticide residue</i>	<i>411</i>	<i>100</i>
Dimethoate	31	8
Isofenphos-methyl	28	7
Omethoate	25	6
Oxamyl	24	6
Methamidophos	20	5
Methomyl	23	6
Monocrotophos	19	5
Other (84)	241	59

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¹ The number of reported specific chemical hazards amounted to 5,600

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² Specific hazards that amounted to 5% or more in each substance category are featured in the table

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2 **Table 3 - Microbiological hazards reported through RASFF over the**
 3 **period July 2003 – June 2007**

<i>Category</i>	<i>Number of reports</i>	
	Frequency	Percentage (%)
<u>Total notifications</u>	1,942	
<u>Notification type</u>		
Alert	832	43
Information	1,110	57
<u>Product categories</u>		
Animal feed	173	9
Baby food	14	1
Bakery	5	<1
Beverage	31	2
Composite, mixed	83	4
Confectionery	9	<1
Dairy	124	6
Egg product	27	1
Food supplement	31	2
Fruit, processed fruit	29	1
Meat	365	19
Mushroom	14	1
Not specified	2	<1
Nut	15	1
Oil and fat	1	<1
Other	6	<1
Poultry	259	13
Seafood	460	24
Snack	6	<1
Spice, condiment	229	12
Vegetable, cereal, other crops	59	3
<u>Specific hazards ²</u>		
<i>General</i>		
Aerobic mesophiles	44	2
Mesophiles	26	1
Other general microbiological hazards (7)	26	1
<i>Bacteria</i>	1958	100
bacteria (not specified)	12	1
<i>Bacillus cereus</i>	32	2
<i>Campylobacter</i>	22	1
<i>Campylobacter jejuni</i>	19	1
Coliforms	32	2
<i>Enterobacteriaceae</i>	48	2
<i>Escherichia coli</i>	124	6
<i>Escherichia coli</i> O157	10	1
fecal coliforms	17	1
<i>Listeria monocytogenes</i>	314	16

<i>Pseudomonas aeruginosa</i>	15	1
<i>Salmonella spp</i>	421	22
<i>Salmonella Agona</i>	41	2
<i>Salmonella anatum</i>	14	1
<i>Salmonella Derby</i>	14	1
<i>Salmonella enterica</i>	10	1
<i>Salmonella enteritidis</i>	54	3
<i>Salmonella Hadar</i>	12	1
<i>Salmonella Hvittingfoss</i>	10	1
<i>Salmonella Indiana</i>	14	1
<i>Salmonella infantis</i>	16	1
<i>Salmonella Mbandaka</i>	23	1
<i>Salmonella Montevideo</i>	11	1
<i>Salmonella Salamae</i>	14	1
<i>Salmonella Senftenberg</i>	32	2
<i>Salmonella Stanley</i>	11	1
<i>Salmonella Tennessee</i>	19	1
<i>Salmonella typhimurium</i>	60	3
<i>Salmonella typhimurium</i> DT 104	62	3
<i>Salmonella Virchow</i>	12	1
<i>Vibrio cholerae</i>	12	1
<i>Vibrio cholerae</i> NON O:1/NON O:139	15	1
<i>Vibrio parahaemolyticus</i>	72	4
Other bacterial hazards (131)	354	18
<i>Moulds</i>	110	100
Mould (not specified)	96	87
<i>Aspergillus flavus</i>	1	1
<i>Aspergillus fumigatus</i>	1	1
<i>Aspergillus glaucus</i>	1	1
<i>Aspergillus niger</i>	3	3
<i>Aspergillus ochraceus</i>	1	1
<i>Fusarium</i>	2	2
<i>Hyphomycetes</i>	5	5
<i>Viruses</i>	12	100
Calicivirus	1	8
Hepatitis A virus	2	17
Norovirus	9	75

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¹ The number of reported specific microbiological hazards amounted to 2,176

² Specific hazards that amounted to 1% or more in each microbe category are featured in the table

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2 **Table 4 - Mycotoxin hazards reported through RASFF over the period**
 3 **July 2003 – June 2007**

<i>Category</i>	<i>Number of reports</i>	
	<i>Frequency</i>	<i>Percentage (%)</i>
<u>Total notifications</u>	3,602	
<u>Notification type</u>		
Alert	259	7
Information	3,343	93
<u>Product categories</u>		
Animal feed	14	<1
Baby food	4	<1
Bakery	11	<1
Beverage	51	1
Composite, mixed	151	4
Confectionery	6	<1
Dairy	1	<1
Food supplement	4	<1
Fruit, processed fruit	233	6
Nut	2,830	79
Snack	54	1
Spice, condiment	161	4
Vegetable, cereal, other crops	82	2
<u>Specific hazards</u> ¹		
Aflatoxins	3,381	93
Deoxynivalenol	1	<1
Fumonisin	55	2
Ochratoxin A	167	5
Patulin	13	<1
Zearalenone	2	<1

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5 ¹ The number of reported specific mycotoxins amounted to 3,619

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2 **Table 5 - Biological hazards reported through RASFF over the period**
 3 **July 2003 – June 2007**

Category	Number of reports	
	Frequency	Percentage (%)
<u>Total notifications</u>	223	
<u>Notification type</u>		
Alert	90	40
Information	133	60
<u>Product categories</u>		
Bakery	1	<1
Beverage	8	4
Composite, mixed	10	4
Confectionery	4	2
Dairy	1	<1
Food supplement	2	1
Fruit, processed fruit	27	12
Honey, bee product	1	<1
Meat	12	5
Mushroom	1	<1
Nut	12	5
Other	4	2
Seafood	107	48
Snack	5	2
Spice, condiment	12	5
Vegetable, cereal, other crops	16	7
<u>Specific hazards ¹</u>		
<i>Anisakis, Anisakis simplex</i>	74	33
Insect (not specified)	83	37
Mite	16	7
Parasite (not specified)	25	11
Other hazards (18)	31	14

4 ¹ The number of reported specific biological hazards amounted to 227; specific hazards that accounted for
 5 >5% are featured in the table.
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2 **Table 6 - Physical hazards reported through RASFF over the period**
 3 **July 2003 – June 2007**

<i>Category</i>	<i>Number of reports</i>	
	<i>Frequency</i>	<i>Percentage (%)</i>
<u>Total notifications</u>	179	
<u>Notification type</u>		
Alert	119	66
Information	60	34
<u>Product categories</u>		
Animal feed	1	1
Baby food	5	3
Bakery	7	4
Beverage	17	9
Composite, mixed	27	15
Confectionery	50	28
Dairy	9	5
Fruit, processed fruit	8	4
Honey, bee product	4	2
Meat	3	2
Mushroom	2	1
Nut	1	1
Oil and fat	1	1
Other	1	1
Poultry	1	1
Seafood	3	2
Snack	7	4
Spice, condiment	16	9
Utensil	1	1
Vegetable, cereal, other crops	15	8
<u>Specific hazards</u> ¹		
Foreign body (not specified)	26	14
Glass	63	34
Metal	25	14
Suffocation hazard	42	23
Other (14)	29	16

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¹ The number of reported specific physical hazards amounted to 185; specific hazards that accounted for >5% are featured in the table.

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2 **Table 7 - Hygiene hazards reported through RASFF over the period**
 3 **July 2003 – June 2007**

<i>Category</i>	<i>Number of reports</i>	
	<i>Frequency</i>	<i>Percentage (%)</i>
<u>Total notifications</u>	78	
<u>Notification type</u>		
Alert	10	13
Information	68	87
<u>Product categories</u>		
Bakery	1	1
Beverage	2	3
Composite, mixed	5	6
Dairy	1	1
Meat	14	18
Nut	2	3
Poultry	11	14
Seafood	32	41
Snack	1	1
Spice, condiment	3	4
Vegetable, cereal, other crops	6	8
<u>Specific hazards ¹</u>		
Feces	9	12
Temperature control	52	67
Other (3)	17	22

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¹ Specific hygiene hazards that accounted for >10% are featured in the table

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2 **Table 8 - Quality issues reported through RASFF over the period July**
 3 **2003 – June 2007**

<i>Category</i>	<i>Number of reports</i>	
	Frequency	Percentage (%)
<u>Total notifications</u>	178	
<u>Notification type</u>		
Alert	68	38
Information	110	62
<u>Product categories</u>		
Baby food	1	1
Beverage	17	10
Composite, mixed	8	4
Confectionery	2	1
Dairy	5	3
Egg product	1	1
Food supplement	1	1
Fruit, processed fruit	19	11
Meat	28	16
Mushroom	3	2
Nut	16	9
Oil and fat	1	1
Other	2	1
Poultry	3	2
Seafood	35	20
Snack	1	1
Spice, condiment	14	8
Utensil	9	5
Vegetable, cereal, other crops	12	7
<u>Specific hazards</u> ¹		
Organoleptic characteristics (not specified)	63	35
Preservation	11	6
Smell	32	18
Spoilage	47	26
Yeast	14	8
Other (6)	14	8

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¹ The number of reported specific quality issues amounted to 181; specific hazards that accounted for >5% are featured in the table.

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2 **Table 9 - Labeling issues reported through RASFF over the period**
 3 **July 2003 – June 2007**

<i>Category</i>	<i>Number of reports</i>	
	<i>Frequency</i>	<i>Percentage (%)</i>
<u>Total notifications</u>	199	
<u>Notification type</u>		
Alert	88	44
Information	111	56
<u>Product categories</u>		
Animal feed	1	1
Baby food	2	1
Bakery	9	5
Beverage	6	3
Composite, mixed	57	29
Confectionery	18	9
Dairy	5	3
Food supplement	14	7
Fruit, processed fruit	9	5
Honey, bee product	2	1
Meat	13	7
Not specified	2	1
Nut	4	2
Oil and fat	1	1
Other	1	1
Poultry	1	1
Seafood	30	15
Snack	2	1
Spice, condiment	17	9
Utensil	1	1
Vegetable, cereal, other crops	4	2
<u>Specific hazards ¹</u>		
incorrect label	64	31
undeclared milk	19	9
undeclared peanut	12	6
undeclared soy	12	6
undeclared sulphites	21	10
unlabeled irradiation	37	18
other hazards (26)	39	19

4 ¹ The number of reported specific labeling issues amounted to 204; specific hazards that accounted for >5%
 5 are featured in the table.

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2 **Table 10 - Fraud-related issues reported through RASFF over the**
 3 **period July 2003 – June 2006**

<i>Category</i>	<i>Number of reports</i>	
	Frequency	Percentage (%)
<u>Total notifications</u>	248	
<u>Notification type</u>		
Alert	59	24
Information	189	76
<u>Product categories</u>		
Animal feed	7	3
Bakery	3	1
Beverage	1	<1
Composite, mixed	42	17
Confectionery	4	2
Dairy	11	4
Egg product	2	1
Food supplement	3	1
Fruit, processed fruit	1	<1
Honey, bee product	5	2
Meat	58	23
Not specified	8	3
Nut	11	4
Oil and fat	4	2
Other	6	2
Poultry	20	8
Seafood	46	19
Snack	1	<1
Spice, condiment	13	5
Vegetable, cereal, other crops	2	1
<u>Specific issues of non-compliance</u> ¹		
Authorization	72	28
Best before date	25	10
Certificate	42	16
Import	78	30
Not specified	7	3
Stamp	5	2
Trade	19	7
Other (6)	8	3

4 ¹ The number of reported specific issues amounted to 256; specific issues that accounted for >5% are
 5 featured in the table.

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2 **Table 11 - Defective packaging-related issues reported through**
 3 **RASFF over the period July 2003 – June 2006**

<i>Category</i>	<i>Number of reports</i>	
	Frequency	Percentage (%)
<u>Total notifications</u>	66	
<u>Notification type</u>		
Alert	14	21
Information	52	79
<u>Product categories</u>		
Baby food	1	2
Bakery	1	2
Beverage	4	6
Composite, mixed	10	15
Dairy	2	3
Fruit, processed fruit	4	6
Meat	14	21
Nut	2	3
Other	1	2
Seafood	15	23
Snack	4	6
Spice, condiment	1	2
Utensil	5	8
Vegetable, cereal, other crops	2	3
<u>Specific issues of non-compliance</u> ¹		
Corrosion	10	15
Damaged packaging	24	35
Defective packaging	22	32
Other (6)	12	18

4 ¹ The number of reported specific issues amounted to 68; specific hazards that accounted for >10% are
 5 featured in the table.

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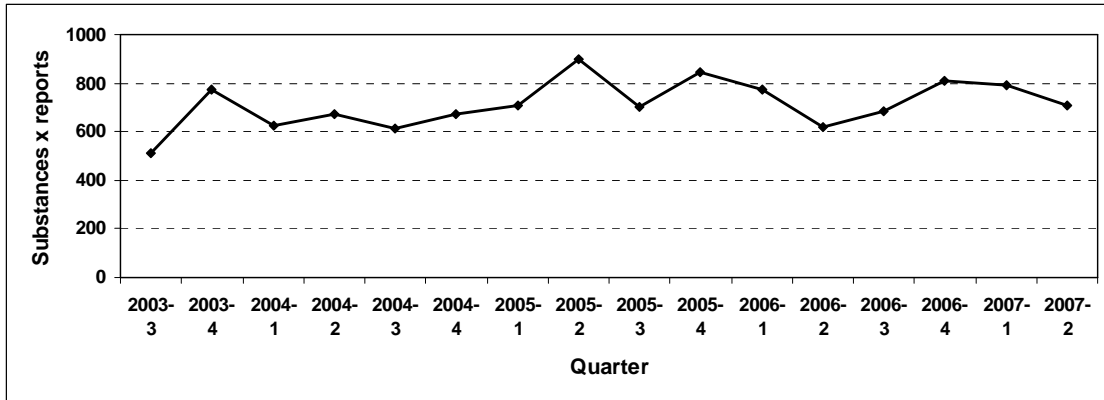
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2 **Figures**

3 **Figure 1 - Chronology of RASFF notifications – overall**

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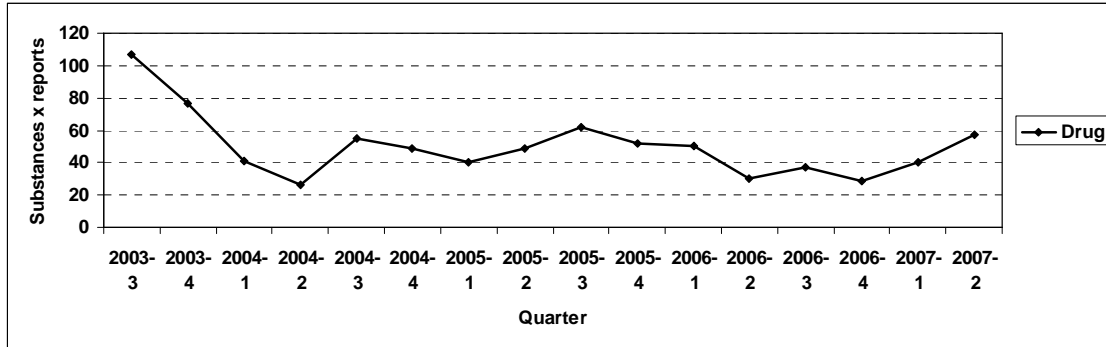
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2 **Figure 2 - Chronology of the occurrence of drug residues reported**
3 **through RASFF**

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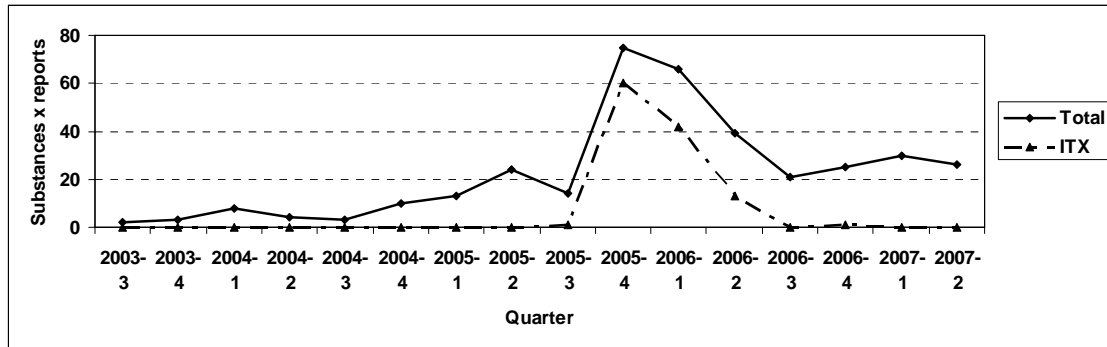


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2 **Figure 3 - Chronology of the occurrence of food contact substances**
 3 **reported through RASFF**

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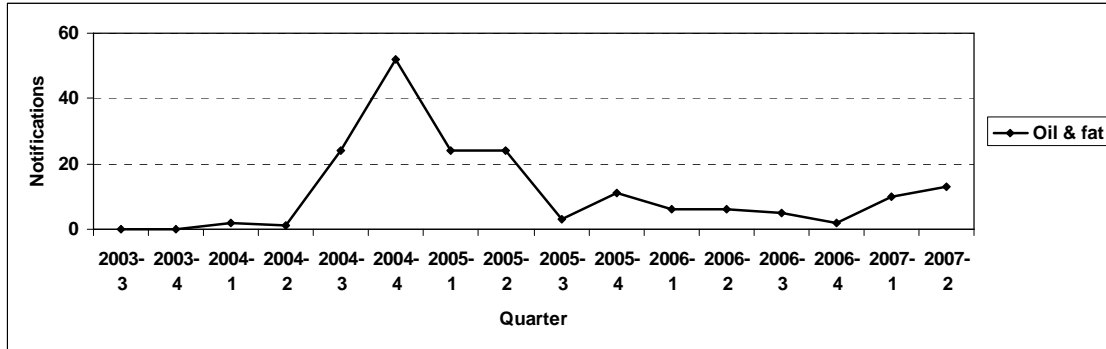


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2 **Figure 4 - Chronology of RASFF notifications on the product category**
3 **of oil & fat**

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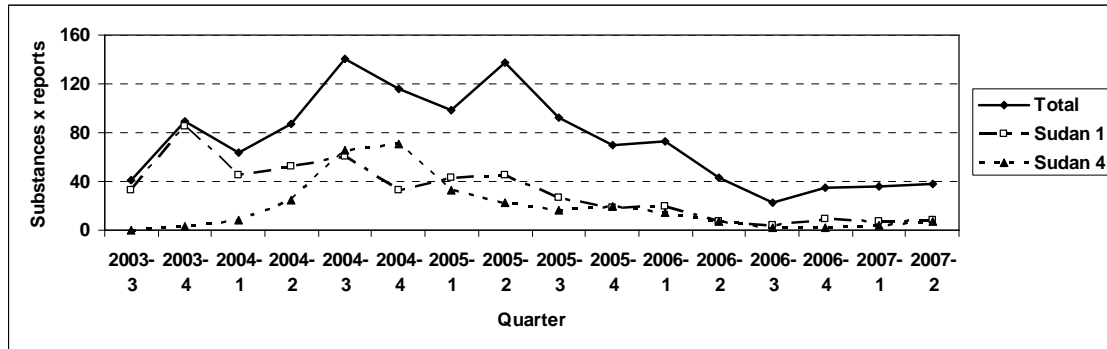
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2 **Figure 5 - Chronology of the occurrence of dyes reported through**
 3 **RASFF**

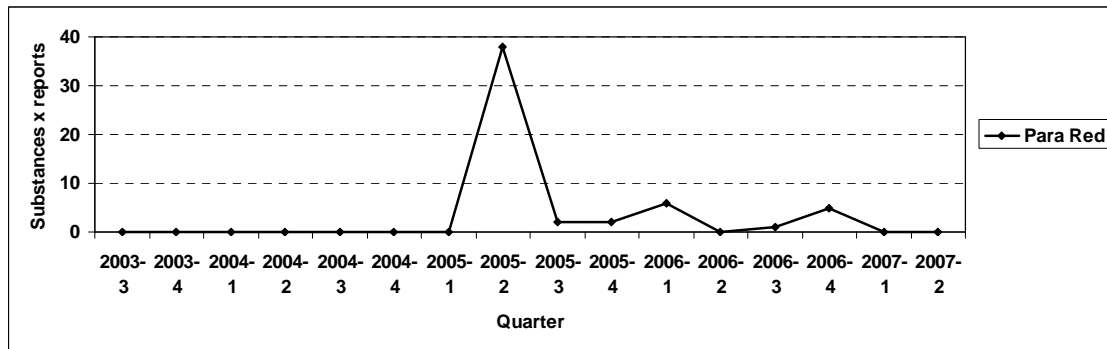
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5 **A)**



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7 **B)**



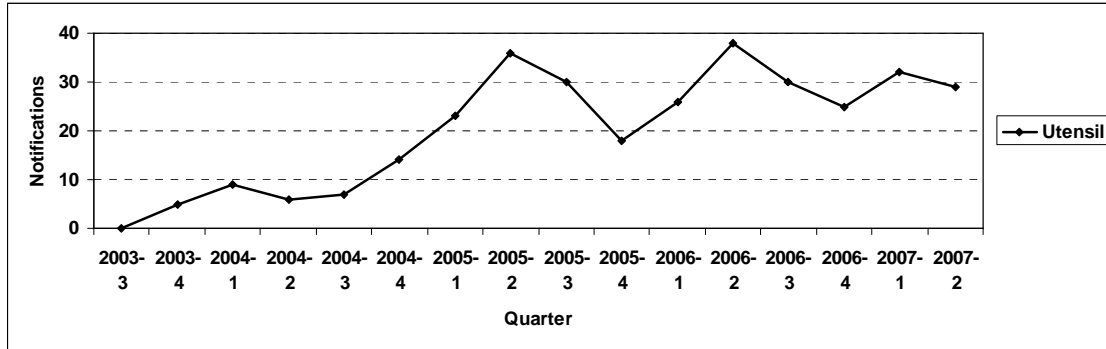
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2 **Figure 6 - Chronology of RASFF notifications on chemical hazards in**
3 **utensils**

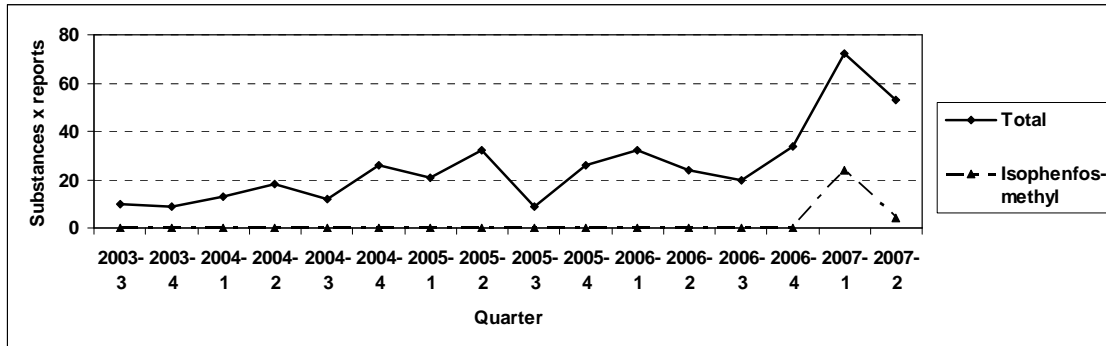
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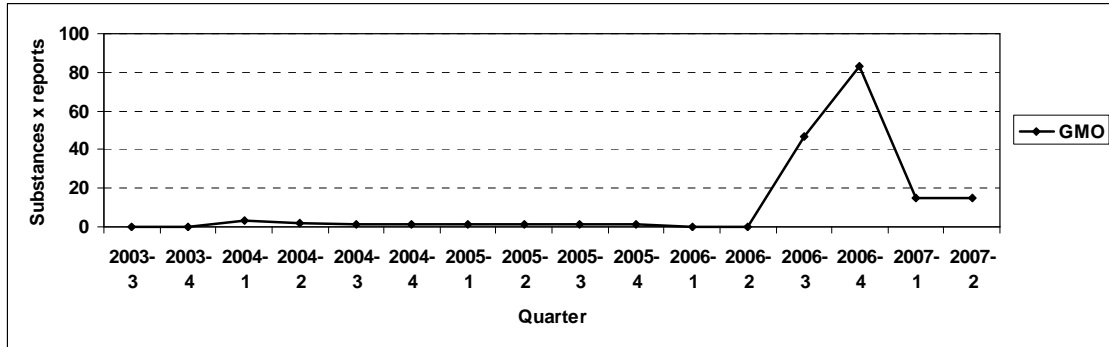
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1 **Figure 7 - Chronology of RASFF notifications on pesticide hazards**
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1 **Figure 8 - Chronology of RASFF notifications on genetically modified**
2 **organisms (GMOs)**
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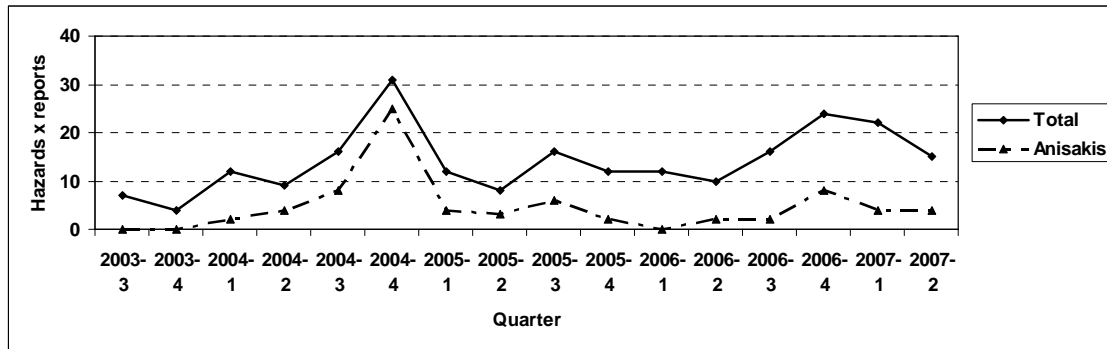


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2 **Figure 9 - Chronology of the occurrence of biological hazards and the**
 3 **specific hazard of herring worm (*Anisakis simplex*) reported through**
 4 **RASFF**

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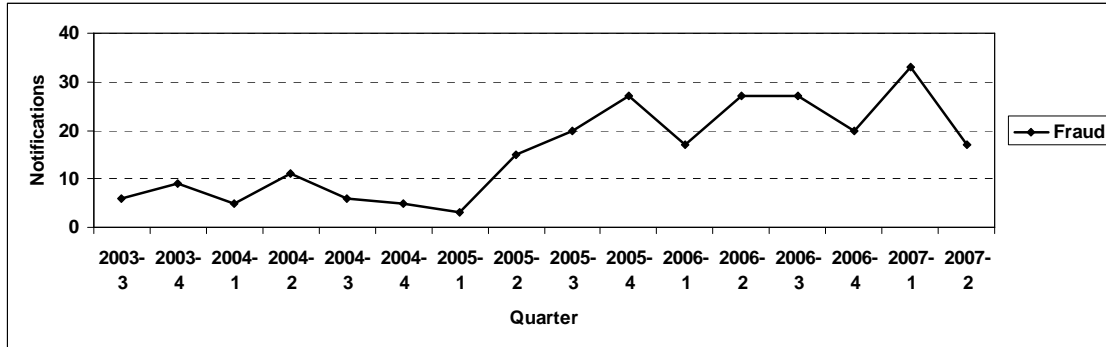
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2 **Figure 10 - Chronology of RASFF notifications on fraud-related**
3 **issues**

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