Analysis of RASFF notifications on fats and oils

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RASFF (Rapid Alert System for Food and Feed) is a system, that enables the rapid information exchange when a risk to human health is detected, to maintain the food safety. The aim of the study was to analyse the data in the RASFF portal to determine the risks in oils and fats. The data in the database were extracted for the period 2005-2020 and analysed for notification type, risks, notifying country, risk decision, notification basis, action taken and distribution status of the product. A total of 399 notifications were reported and the most frequent hazard consisted in unauthorised colours observed mainly in palm oils. Polycyclic aromatic hydrocarbons were the second important risk observed in vegetable oils. Glycidyl esters were noted in the last three years and has an increasing tendency. Nearly half of the notifications were determined at official controls in the market. The results reported herein give an insight look to the status of fats and oils, to contribute to product safety and risk management.
Keywords: Fat, food safety, hazard, oil, RASFF

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INTRODUCTION

Food safety has gained a great deal of attention in recent years in all parts of the World due to the increase in food supply chain. The European Union (EU) established the Rapid Alert System for Food and Feed (RASFF) to exchange information between member states and take early precautions to ensure food and feed safety. The legal basis for the RASFF is Regulation (EC) No. 178/2002. The RASFF portal, the internet tool made available to public, is an interactive database that includes the information on food and feed notifications. The RASFF database contains details on each notification; date of the case, notification type, notification basis, notifying country, the hazard, the action taken, distribution status and risk decision. There are three types of notifications: alert, information, and border rejection, depending on the seriousness of the risk. Alert notifications are used when food has a serious risk on the market and when rapid action is required. Information notifications are sent when a risk has been identified that does not require rapid action, because the product is not on the market. "Information notification for follow-up" is for products that are or may be placed on the market in another member country, 'information notification for attention' is for products that are only in the notifying member country; or not yet on the market; or no longer on the market. Border rejection concern consignment of food rejected at the borders of EU and EEA for reason due to a risk to human health.
The notification basis specifies what type of control, report, or investigation are at the base of the notification. There are different categories for the basis of notification: "border control" indicates notification that started after a sample analysis performed at a border post, "official control on the market" shows official control on the EEA internal market, "company own-check" points the notification initiated by a company notifying the outcome of a self-check to

the competent authority, “consumer complaint” indicates a notification started by a consumer lodging a complaint with the competent authority.
The RASFF database announces the variable “action taken” to report the action already taken or to be taken by the notifying country at the time of notification. Moreover, “distribution status” represents the existing information on the possible distribution of the product on the market at the time of notification. Additionally, “risk decision” variable is declared by RASFF portal pointing the risk possibility for the notification denoted as serious, not serious, and undecided.
RASFF database has been used previously by different authors. Food fraud [1, 2], presence of foreign bodies [3], *Listeria monocytogenes* [4], seafood products [5], food contact materials recall [6], allergen-related recalls [7], dairy products [8], meat and meat products [9], metallic food contact materials and products [10], biogenic amines [11], mycotoxin notifications [12] have been analysed in detail for a better monitoring of food safety issues. Analysis of fats and oils have not been published so far. Hence, the objective of the current study was to analyse the RASFF notifications on fats and oils during 2005-2020 period to highlight the main hazards affecting different fat/oil categories.

MATERIALS AND METHODS

The notifications recorded in the RASFF database under the product category “fats and oils” were extracted for the period 01/01/2005 to 31/12/2020 in .xls format. As the years 1981-2004 contained incomplete data on notification basis, distribution status and country of origin, the whole datasets for this period were removed from analysis. Each RASFF occasion contains the following information: date of notification, notification type, notification basis, notifying country, subject, action taken, distribution status and risk decision. The notifications (n=399) were processed in an excel file for further analysis.

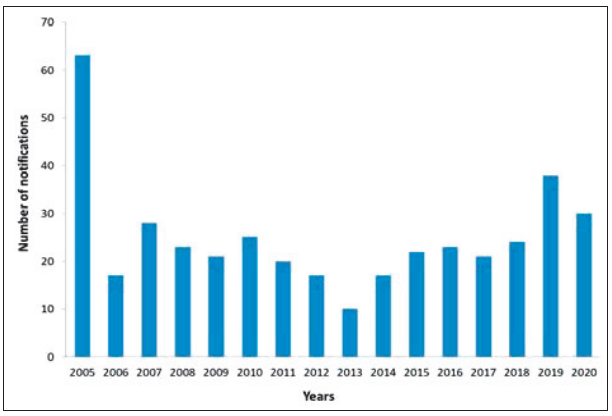

Figure 1 - Fats and oils notifications in the RASFF database (2005-2020)

RESULTS AND DISCUSSION

In the period of 2005-2020, a total of 399 notifications under the product type “fats and oils” were reported (Fig. 1). This category represents 0.85% of the total RASFF notifications related to food items (n=46582). The highest number of notifications was noted in the year of 2005 (n=126). This high number can be attributed to a significant number of reports on the presence of unauthorised colour Sudan in palm oils. Thereafter, a decreasing trend was observed in case numbers till 2013, followed by a slight increase. The year of 2019 (n=76) was the second key year in terms of the number of notifications.
Concerning the notification type; 37.09% of the cases were alert, 34.09% was information notifications whereas the remaining 28.82% were border rejections. Information notifications were divided into “information notification for follow-up” and “information notification for attention” subgroups in 2011 with the implementation of EC Regulation 16/2011 (European Commission, 2011). Information for attention ratio was 7.02%, and information for follow up was 7.77% after the year of 2011 for fats and oils.
The RASFF data showed that notifications were mainly based on official controls on the market (47.62%), border controls (40.60%), company’s own check (7.77%) and consumer complaint (3.51%). Border controls were of three types: “border control-consignment detained (n=138), border control-consignment released (n=21), border control-consignment under customs (n=3). Additionally, one case was reported to be based on monitoring of media, while one case was based on official control in a non-member country.
Considering the notifying country, wide variations in contributions were determined. Germany was the most notifying country (n=58, 14.54%), followed by United Kingdom (n=45, 11.28%), Poland (n=42, 10.53%) and Netherlands (n=41, 10.28%). Germany has been previously reported to be one of the key reporting countries contributing to RASFF notifications [6]. France (n=29), Belgium (n=27), Italy (n=26), Lithuania (n=17), Slovakia (n=14), Greece (n=11), Austria (n=10), Denmark (n=10), Slovenia (n=9), Finland (n=8), Sweden (n=7), Spain (n=7), Latvia (n=7), Ireland (n=5), Czech Republic (n=5), Portugal (n=4), Hungary (n=4), Switzerland (n=4), Norway (n=2), Estonia (n=2), Cyprus (n=2), Romania (n=1), Luxembourg (n=1) and Croatia (n=1) had notifications below 10% of the total number.
The notified fats and oils found in RASFF database were of 42 different types being palm (38.85%), sunflower (13.53%), soybean (4.76%), pumpkin seed (3.26%), hemp seed (3.01%), sesame (2.76%), coconut (2.76%), rapeseed (2.51%), olive oil (2.51%), mustard oil (2.26%), vegetable oil (2.01%), fat (2.01%), ghee (1.75%), lard (1.75%), margarine (1.50%), rice (1%), walnut (1%) oils and spread (1%). Besides, peanut, linseed, husk, sea buckthorn, black cumin oils

had three; flaxseed, grapeseed, olive pomace, cod liver, maize oils and butter had 2; chia seed, almond, edible, amaranth, fish, *Camelina sativa* seed, canola shortening, argan, hazelnut, cannabis, hot chili flavoured, garlic and mixed pickle oils had one notification. Additionally, some other products, namely, smoked fish, swordfish, shortfin mako, vinegar were categorised in the class of fats and oils and notified once.

Regarding the hazards, there were various types of risks affecting fats and oils, which can be categorised as unauthorised colour, polycyclic aromatic hydrocarbons, glycidyl esters, organoleptic characteristics, unsuitable transport, health certificate, erucic acid, mineral oil, illegal import, microbiological and hygienic hazards and others.

The most frequently observed risk in fats and oils were unauthorised colours. There were 134 colour notifications on the system, comprising 33.58% of all fat related hazards. The highest number of notifications were observed in 2005 (n=50), followed by 2019 (n=11) and 2015 (n=10). The number of unauthorised colour occasions were lower than 10, in the other years. Almost all unauthorised colour risks were observed in palm oils; with two exceptions, one was noted in palm kernel and one in grape kernel oil. The products with colour risk were originated mainly from Ghana (59.54%), Nigeria (15.26%), Senegal (9.16%), Guinea (6.87%). Additionally, Western Africa, Togo, Mali, Sierra Leone, Gambia, Guinea-Bissau were the other countries of origins having a total share of less than 10%. Sudan 4 was the most common unauthorised colour and detected in 124 palm (0.03-97 mg/kg) and 1 palm kernel oil (0.98 mg/kg). Sudan 3 was determined in 7 occasions (190-1317 µg/kg) in palm oil and Sudan 1 was observed in 5 cases (0.02-6.8 mg/kg); four of which were palm oil whereas 1 was edible oil made from grape kernels with chili from Italy. Sudan 7B was noted in 2 palm oil samples (50-130 µg/kg). Seven cases (palm oil) with E 160b-annato/bixin/norbixin (5.0-325.5 mg/kg) content was notified to the RASFF system in 2005-2006 years.

Polycyclic aromatic hydrocarbons (PAH) were the second frequent hazard for oils and fats. There were 121 occasions in the portal forming 30.33% of the total cases. The highest number of notifications were observed in 2016 (n=17), followed by 2007 (n=14), 2014 (n=12) and 2018 (n=10). The number of polycyclic aromatic hydrocarbon occasions were lower than 10 in the other years. Polycyclic aromatic hydrocarbon risk was observed mainly in sunflower (n=24), pumpkin seed (n=13), soybean (n=11) and palm (n=10) oils. The products with a PAH risk originated mainly from Ukraine. Benzo(a)pyrene (n=97) was the most detected PAH comprising 80.17% of the PAHs ranging among 2.0-571 µg/kg. Besides benzo(a)anthracene (6.2-6.9 µg/kg) and chrysene (6.5-13.7 µg/kg) were determined in a few products.

Glycidyl esters were the newly reported risks in fats and oils. There is an increasing trend in glycidyl ester notifications in the system (Fig. 2). This trend can be probably justified with the introduction in 2018 of EU Regulation 2018/290 of 26 February 2018 amended Regulation (EC) No 1881/2006 to establish upper limits of 1000 µg/kg of glycidyl fatty acid esters in vegetable oils and fats. The regulation indeed has prompted more control on this contaminant. The first glycidyl ester (12000 µg/kg) case was reported in 2017 for palm oils from Germany. The occurrence of 3-monochloropropane diol esters (3-MCPD-E) (2800 µg/kg) was also noted in the same notification. In the subsequent years, the presence of glycidyl esters were reported in various fat types from different countries, namely, in vegetable oils in chocolate products from Belgium; in vegetable fillings and vegetable oils from Netherlands, Turkey, United Arab Emirates; in palm oil from Malaysia and Ghana; grapeseed oil from Spain, margarine from Cyprus, rice bran oil from India, Italy, Thailand; ghee from Turkey, United Arab Emirates, Syria and spreadable fat from Belgium. Glycidyl ester levels were noted to be ranging among 1120-9365 µg/kg, whereas 3-MCPD-E levels were reported to be in 2800-7551 µg/kg.

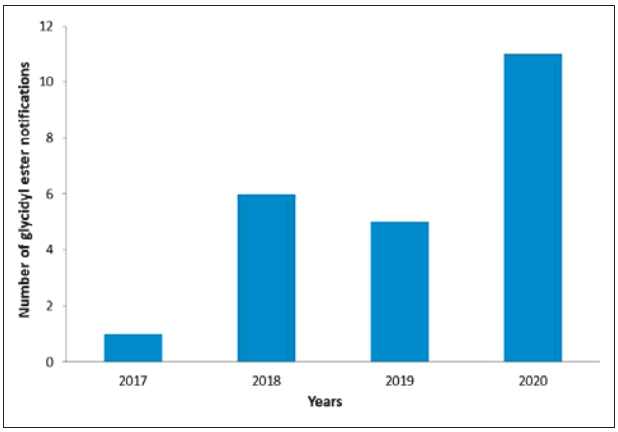

Figure 2 - Glycidyl ester notifications in the RASFF database (2005-2020)

Organoleptic defects were another type of risks noted for fats and oils. There were 12 hazards related with organoleptic defects in RASFF portal between 2005 and 2019. Olive oil from Morocco, Spain, Italy, West Bank and Gaza Strip; dairy spread from United Kingdom; palm oil from Nigeria; rapeseed oil from Belarus; soybean oil from Ukraine; coconut oil from the Philippines; ghee from United Kingdom were notified for their low organoleptic characteristics.

Unsuitable transport conditions were another hazard observed in fats and oils totalling 12 cases. Eight of them were detected in sunflower oils from Ukraine between 2007 and 2017. The remaining were rapeseed and soybean from Ukraine, lard from Sweden and soybean from Moldova.

Concerning health certificates, 13 cases were reported in the RASFF portal between 2007 and 2014. Nine

of them concerned the absence or improper certificate for sunflower oils from Ukraine, one of them for soyben oil from Ukraine, one for peanut oil from Hong Kong and one for cod liver oil from Colombia.
Erucic acid was a further risk found in the RASFF index. There were nine erucic acid (6.1-49.3%) notifications in the portal between 2009 and 2019. Seven of the occasions were detected in mustard oil; five from Bangladesh, one from India, one from Germany. The other two cases were garlic pickle and mixed pickle oils from Bangladesh.
Concerning the mineral oil, 12 cases were reported in RASFF portal. The first case was noted for sunflower oil from Ukraine. Five notification were noted for suspicion of mineral oil in sunflower oil from Ukraine in 2008. The other cases were for sunflower oil from Slovenia, Ukraine; palm oil from Lebanon; maize oil from Ukraine and walnut oil from United States. The latest case was recorded in 2020 and detailed in mineral oil saturated hydrocarbons (MOSH) and mineral oil aromatic hydrocarbons (MOAH) concentrations (59.5 and 25 mg/kg, respectively).
Microbiological and hygienic risks were also important hazard groups reported in the RASFF database that should be taken into consideration in terms of fat safety. The presence of *Salmonella enterica* and *anatum* were recorded in frozen pork fat products; the existence of *Listeria monocytogenes* was noted in lard with fried onions; butter and spread were reported to be infested with moulds. Bad hygienic states were notified for animal fat, pig fat and fish oil. Aflatoxin B1, was determined in coconut oil from India and peanut butter from the Philippines. Insect larvae were determined in sunflower kernels.
Illegal import was determined to be a significant risk type in fats and oils and 11 cases were reported. Illegal import of palm oil from Ghana, pig fat from Russian Federation, omega-3 fatty acid oil from China have been noted in the system.
Apart from mercury contamination in frozen swordfish and shortfin mako; lead in pig fat; dioxin in coconut fat and soybean oil; migration of epoxidised soybean oil from lids of glass jars containing chicken flavour chilli oil with tofu, lactoprotein in spread, endosulfan in olive oil, benzoic acid in margarine, allergic reaction caused by incorrect labelling (labelled as 100% vegetable) of sunflower margarine, ethylene oxide in sesame oil, food additive TBHQ - tertiary butylhydroquinone in shortenings, high content of peroxide values in porcine lard, fraud in olive and palm oils, traces of milk and milk ingredient in margarines, metal wire in lard, unsuitable/improper packaging for soybean and palm oils, tetrahydrocannabinol and cannabidiol in cannabis oil, bad traceability records for sunflower oil, unauthorised establishment for olive oil, best before date exceeded for sunflower oil, unauthorised placing

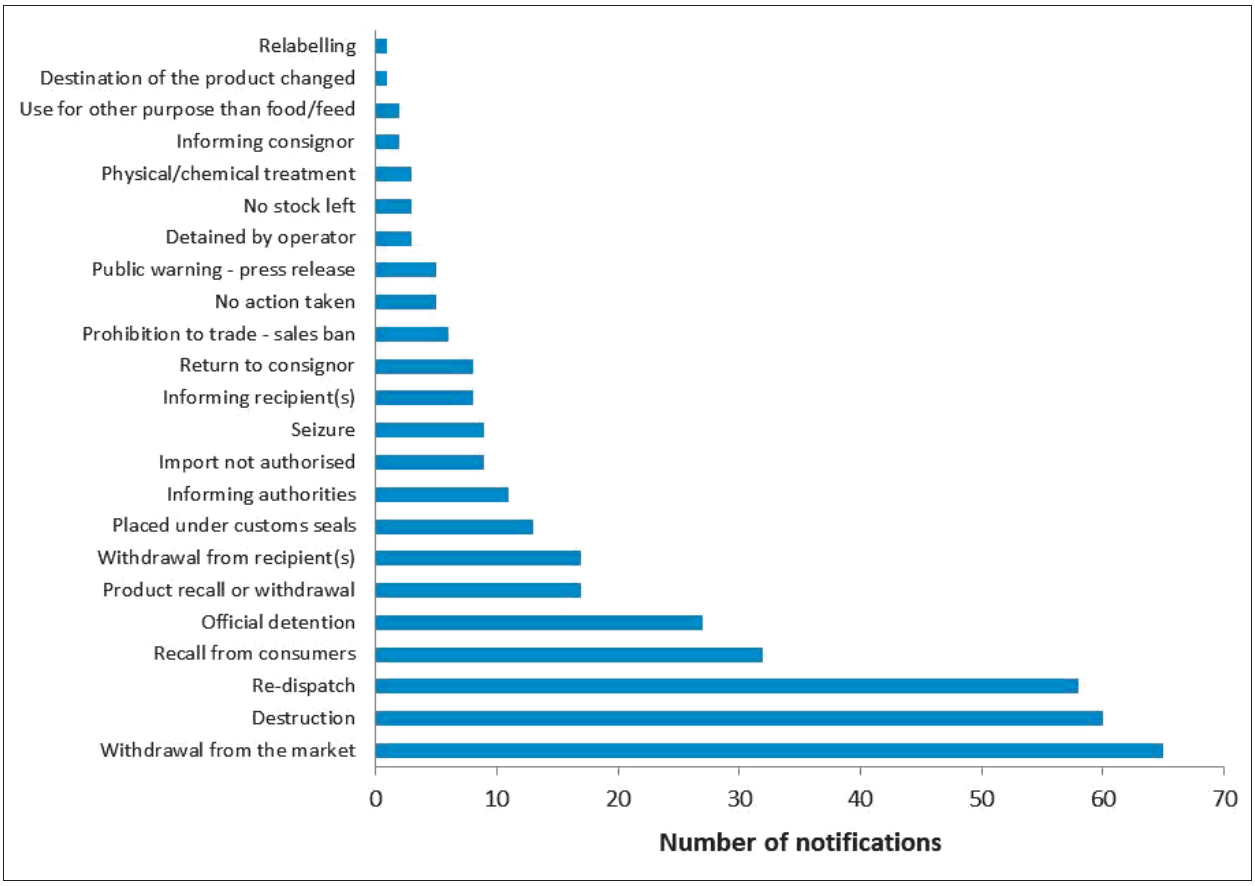

Figure 3 - Actions taken response to notifications

on the market of edible oil and cod liver oil, missing import declaration for sesame seed oil, undeclared peanut in plant-based spread were the other hazards recorded in the portal.

In response to the notifications, the most common action taken was the withdrawal of the products from the market (17.81%), and then destruction (16.44%), re-dispatch (15.89%), recall from consumers (8.77%), official detention (7.40%) (Fig. 3). The remaining actions (33.7%) were product recalling or withdrawal (n=17), withdrawal from the recipient(s) (n=17), placing under custom seals (n=13), informing authorities (n=11), unauthorising the import (n=9), seizure (n=9), informing recipient(s) (n=8), returning the product to consignor (n=8), prohibition to trade –sales ban (n=6), public warning-press release (n=5), detaining by operator (n=3), physical/chemical treatment (n=3), informing consignor (n=2), using for other purpose then food (n=2), changing the destination of the product (n=1) and relabelling (n=1). Also, in five cases no action was taken and in three cases the stock was reported to be finished. Additionally, on 34 occasions, the action taken was not reported in the RASFF system.

The data about the distribution status in the RASFF portal showed that 21.80% of the products were reported to be distributed to other member countries, 21.30% were not distributed, 17.54% were distributed on the market, 16.29% were distributed to notifying country and 13.78% of the products were not yet placed on the market. The remaining status types issued less than 10 notifications and were reported as not to be distributed from the notifying country, product (presumably) no longer on the market, product allowed to travel to destination under custom seals, no stock left, product already consumed, distribution to non-member countries.

Concerning the risk decisions, 59.15% of the notifications were not classified (undecided), 33.58% were serious and 7.27% were not serious. RASFF notifications by notification type and risk decisions is given in Table I. The categorisation of "serious" and "not-serious" was involved in the system in 2011, until then the riskiness of the cases had not been assessed.

Table I - RASFF notifications by notification type and risk decisions

Notification type	Risk Decision		
	Undecided	Serious	Not serious
Alert	75	73	-
Information (before 2011)	77	-	-
Information for attention (after 2011)	8	24	2
Information for follow-up (after 2011)	13	-	12
Border rejection	63	37	15

CONCLUSION

The RASFF portal has been a useful and functional tool to monitor the food safety risks in a chronological timeline. The data in RASFF has critical importance to predict future hazards and take necessary precautions. From this point of view, fats and oils notifications were analysed in this study in terms of hazards reported in the system and the properties of notifications. Unauthorised colours were the main risk determined in palm oil and polycyclic aromatic hydrocarbons were noted in vegetable oils. The occasions were mainly notified as "alert" indicating the seriousness of the safety risk. Most cases were notified at the official controls in the market and the main notifying country was Germany. Hope is that the current summarised analysis report on fats and oils reveals the general situation of the safety issues of fats and oils.

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