ORIGINAL ARTICLE

MEAT AND MEAT PRODUCTS – ANALYSIS OF THE MOST COMMON THREATS IN THE YEARS 2011 – 2015 IN RAPID ALERT SYSTEM FOR FOOD AND FEED (RASFF)

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ABSTRACT

Background. The key tool used in the European Union in order to eliminate the risks associated with the consumption of potentially hazardous food is RASFF - Rapid Alert System for Food and Feed Safety. The RASFF was established to increase accountability and strengthening cooperation between states of the European Union in the field of food safety control.

Objective. The aim of this study was to explore the trends and temporal and spatial distribution of notifications on food safety hazards between January 2011 and December 2015 with a special emphasis on meat and meat products on the basis of notification from RASFF.

Material and methods. The study analyzed notifications on the annual reports of the RASFF published by the European Commission and requests added to the portal RASFF in the period 01.01.2011 - 31.12.2015 on the category of "meat and meat products (other than poultry) and "poultry meat and poultry meat products". Analysis included detailed information on each notification, such as the classification and date, hazard category, notifying country, country origin.

Results. The most common classifications of notification were 'alert' and 'border rejection'. Generally, basis of this notifications were 'company's own check' and 'official control on the market'. Pathogenic microorganisms were the most often hazard of category in which the higher number of notifications concerned with *Salmonella* spp.

Conclusion. Alert notification which is the most dangerous for consumers were the most common type of classification for notifications on 'meat and meat product' category. The most of notifications in category 'poultry meat and poultry meat products' were the result of border control. Pathogenic microorganisms were the reason for the huge number of notifications in studied product categories. Many of notifications were associated with products which origin countries were outside RASFF member states.

Key words: *RASFF, food safety, meat and meat products, poultry meat and poultry meat products*

STRESZCZENIE

Wprowadzenie. Kluczowym narzędziem stosowanym w Unii Europejskiej w celu wyeliminowania ryzyka związanego ze spożywaniem potencjalnie niebezpiecznej żywności jest RASFF - System Wczesnego Ostrzegania o Niebezpiecznej Żywności i Paszach. Stworzenie Systemu miało na celu zwiększenie odpowiedzialności i wzmocnienie współpracy pomiędzy państwami Unii Europejskiej w zakresie kontroli bezpieczeństwa żywności.

Cel. Celem niniejszego opracowanie była analiza powiadomień zgłoszonych do systemu RASFF w latach 2011 - 2015 dotyczących mięsa i produktów mięsnych.

Materiał i metody. W niniejszym opracowaniu przeprowadzono analizę powiadomień dostępnych w rocznych sprawozdaniach RASFF i znajdujących się w portalu RASFF opublikowanych przez Komisję Europejską w okresie 01.01.2011 - 31.12.2015. Analizowane zgłoszenia należały do kategorii „mięso i produkty mięsne (inne niż drób) i „mięso i produkty drobiowe". Badania opierały się na informacjach zawartych w raportach rocznych systemu RASFF i platformie internetowej Systemu RASFF.

Wyniki. Najczęściej zgłoszenia klasyfikowane były jako powiadomienia alarmowe lub odrzucenia na granicy. Podstawą zgłoszeń były głównie kontrole wewnętrzne lub urzędowe kontrole. Najczęściej pojawiającym się zagrożeniem były patogenne mikroorganizmy, które najczęściej spowodowane były obecnością *Salmonella* spp. Krajami, które najczęściej wysyłały zgłoszenia do Systemu RASFF były Włochy w przypadku kategorii 'mięsa i produktów mięsnych' oraz Holandia w przypadku 'drobiu i produktów z drobiu'.

Wnioski. Powiadomienia alarmowe, które stanowią największe zagrożenie dla konsumenta były najczęściej pojawiającym się typem zgłoszeń w przypadku mięsa i produktów mięsnych. Najwięcej powiadomień w kategorii 'drób i produkty drobiowe' było wynikiem kontroli granicznej. Patogenne organizmy były powodem ogromnej liczby zgłoszeń w badanych kategoriach produktów. Duża liczba zgłoszeń związana była z produktami, które pochodziły z krajów spoza UE, nie objętych systemem RASFF.

Słowa kluczowe: *RASFF, bezpieczeństwo żywności, mięso i produkty mięsne, drób i produkty drobiowe*

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INTRODUCTION

Consumer perception relates to access and availability to fresh, safe and variable food. Ensuring food safety is becoming increasingly important in the context of increasing imports many variety of products from all over the world. In 2015 year in European Union Countries, 14 293 thousand tons of poultry meat, 7591 thousand tons of bovine and 22 958 thousand tons of pig meat were produced. In addition the 651 thousand tons of poultry (mainly from Brasil, Thailand and Ukraine), 324 thousand tons of bovine (mainly from Brasil, Uruguay and Argentina) and 33 thousand tons of pig meat (mainly from China, Japan and Mexico) were imported into European Union Countries [3-5].

According to data published in Statistical Yearbook of Agriculture 2015, meat consumption in Poland per capita was 73.6 kg/year, therein 39.1 kg/year pork, 1.6 kg/year beef and 28.2 kg/year poultry meat [14]. That numbers suggest that meat and meat products are in demand in human diet. Therefore, food safety in this group of products is especially important.

In 2002 year the European Parliament and Council made the Regulation (EC/178/2002) which laying down the general principles and requirements of food law, establishing the European Food Safety Authority (EFSA) and laying down procedures in matters of food safety [13]. In Section 1 of chapter IV, this Regulation defined Rapid Alert System, identifies the members of the system, gives the Commission appropriate power and sets out the confidentiality requirements for the RASFF system. The RASFF (The Rapid Alert System for Food and Feed) is an early warning system for Food and Feed. Creation of the system was intended to facilitate the safety of food and feed control authorities through the creation of an effective tool for exchange of information on major threats identified in relation to food and feed and take appropriate preventive measures in the EU countries. The exchange of information helps the members of the system to act in response to a health threat caused by food or feed in more rapidly and in a coordinated way [9].

The RASFF system includes all the countries of the European Union and European Economic Area (currently 31 countries). The structure of the system involves efficient exchange of information between member states. In every country of the RASFF network the contact points. Their role is to transmit and receive notifications of risks associated with food that does not meet the safety requirements. National contact points are required to immediately notify the European Commission and the European Food Safety Authority (EFSA) of any detected potential risks associated with food or feed for consumer. Actions taken are aimed at restricting the placing on the market or withdraw from the market products that may pose a danger to consumers [9]. When the System RASFF member detected threat for food safety, the countries contact point must be notified of this. Next the notification is verified by the European Commission contact point, classified as alert, information or border rejection and transmits to all network members and European Food Safety Authority (EFSA).

According to seriousness of the risk identified, the RASFF system provided four types of notification: alert, information, border rejection and news. The RASFF system distinguishes the following notification basis: border control, official control on the market, company own-check, consumer complaint and food poisoning. Notifications which are available on the RASFF web platform have many information, for example notified country, type of products, type of classification, product's category, hazard category, distribution/origin country. All of them are very important and possible to assess the food safety control [9].

MATERIAL AND METHODS

The study analyzed the annual reports of the RASFF published by the European Commission and requests added to the portal RASFF in the period of 01.01.2011 - 31.12.2015 on the category of "meat and meat products (other than poultry) and "poultry meat and poultry meat products". Annual reports of the RASFF system and the platform which are general available were used in this study. The number of notifications on products of selected categories, types of notifications, hazard categories, product origin and countries in which the notifications were made were analyzed. Data analysis and visualization of results were performed with Excel, Microsoft Office 2007.

RESULTS

In the analyzed period, total number of notification in RASFF portal was 16305, 4801 of them related to food products of animal origin. Among all notifications on products of animal origin 37% of them were notified about fish and fish products. The second and third largest category were meat and meat products (other than poultry) and poultry meat and poultry meat products which summary accounted for 35% of all notifications for food of animal origin (Table 1) [15].

Over the five years the annual number of notifications of meat and meat products as well as poultry and poultry products was variable (Figure 1). The largest number of notifications in both cases was recorded in 2013. In years 2011 - 2013 the number of notifications of meat and meat products were significantly higher than the number of notifications for poultry. These values have changed in the 2014 and 2015 year, however, differences in the number of notifications are not as significant [15].

Table 1. Statement number of applications for food of animal origin in individual years [RASFF annual reports from the years 2011-2015]

Product category	Number of notification					
	2011	2012	2013	2014	2015	Summary
Fish and fish products	482	373	311	323	297	1786
Meat and meat products (other than poultry)	172	184	250	157	159	922
Poultry meat and poultry meat products	72	117	215	185	176	765
Bivalve molluscs and products thereof	68	53	123	125	61	430
Crustaceans and products thereof	75	60	54	72	59	320
Milk and milk products	50	52	43	66	59	270
Cephalopods and products thereof	78	53	22	21	18	192
Eggs and eggs products	13	17	6	5	14	55
Honey and royal jelly	10	8	6	2	7	34
Gastopods	0	4	2	5	3	14
Animal by-products	0	8	0	5	nd	13

Table 2. The number of notifications in different hazard category for meat and meat products (other than poultry) and poultry and poultry meat products

Hazard category	Number of notifications	
	Meat and meat products (other than poultry)	Poultry meat and poultry meat products
Pathogenic microorganisms	53.41%	80.16%
Residues of veterinary medicinal products	14.29%	2.50%
Adulteration / fraud	7.36%	1.05%
Poor or insufficient controls	5.22%	3.42%
Allergens	3.62%	1.05%
Foreign bodies	3.62%	0.66%
Organoleptic aspects	2.13%	1.71%
Heavy metals	1.81%	0.53%
Food additives and flavourings	1.28%	-
Labeling absent/incomplete/incorrect	1.28%	1.31%
Packaging defective / incorrect	1.28%	0.53%
Industrial contaminants	1.17%	0.39%
TSEs	0.96%	-
Composition	0.75%	0.13%
Non-pathogenic microorganisms	0.75%	0.13%
Radiation	0.43%	-
Parasitic infestation	0.21%	-
Other	0.21%	-
Feed additives	0.11%	6.18%
Pesticide residues	0.11%	0.26%

Classification and basis of notifications

Classification type of recorded notifications per year were presented on Figure 2. In all years the most common classification of notifications in 'meat and meat products' category was alert, especially in 2015 their number was the highest. On the second place in this product category were the notifications classified as border rejection, which had the highest level in 2013 year. In 'poultry meat and poultry meat products' the most common classification type was border rejection. Only in 2011 year the number of this type of notification was the same as information for follow up (which in the next year had the lowest number of notification). In the next year border rejection were the most numerous group of notification [15].

In case of meat and meat products (other than poultry) category the most common type of notifications was 'alert notification' – 349. The basis of this notification were: company's own check ($n = 145$), official control in the market ($n = 160$), consumer complaint and food poisoning ($n = 18$) and border control - consignment released ($n = 8$). Every of border rejection notification based on border control - consignment detained ($n = 230$). In the case of

information for follow up most notifications were the basis of official control on the market (*n* = 99), 43 of notifications were the basis on company's own check, 14 on consumer complaint, 10 on border control - consignment released and 1 on each food poisoning, official control following RASFF notification, official control in non-member country. Information for attention were mainly basis on official control on the market (*n* = 82), company's own check (*n* = 51), border control - consignment released (*n* = 37), 3 food poisoning and 1 consumer complaint (Figure 3) [15].

In the case of poultry meat and poultry meat products the most common classification type on notifications was border rejection – 311 notifications, in all cases on the border control consignment was detained. Alert notifications mainly based on company's own check (*n* = 101), official control on market (*n* = 81). Three notifications in this type of classification based on food poisoning, 2 on consumer complaint and 1 on the border control. Within information for attention, 120 of notification based on official control in the market, 36 on company's own check, 22 on border rejection, 3 on food poisoning and 1 on consumer complaint. Notification classified as information for follow up based in 48 cases on official control in the market, 14 on company's own check, 4 on border control and consumer complaint (Figure 4).

Figure 3. Basis of classification type of notification in category 'meat and meat product'
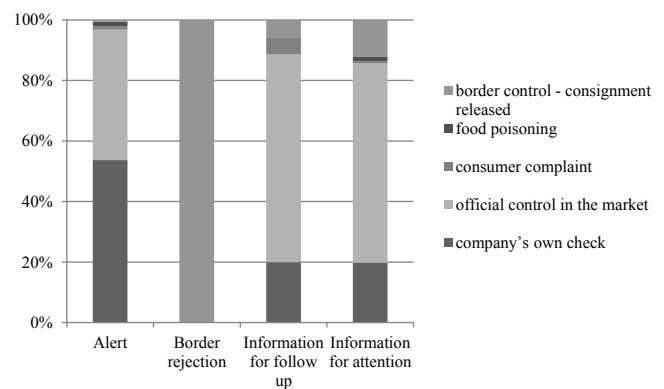
Figure 4. Basis of classification type of notification in category 'poultry meat and poultry meat products'

Hazard category

As far as a hazard category are concerned the most common hazard was pathogenic microorganisms in meat and meat products. *Salmonella* is most common cause of notifications in both cases. Around 91% of notifications on poultry meat and poultry meat products, and around 46% on meat and meat products (other than poultry) of category 'pathogenic microorganisms' were associated with the detection of this bacterium (Table 2).

The other common hazard category for meat and meat products (other than poultry) was residues of veterinary medicinal products – from all notifications in this group only 51 had serious risk decision. Reports of detection unauthorized presence of ivermectin (which is a potent ecto- and endo- parasitic agent with broad spectrum of activity which covers nematodes and arthropods) in beef from Brazil were received more often. Nitrofuran which is prohibited substance was also often notified, mainly in meat from Brazil. In the meat and meat product (other than poultry) the third in order of the most frequently reported hazard category was adulteration/fraud. Fifty four of this notification is associated with presence of equidae/horse DNA in sample of beef meat or beef meat products and all of them were notified in 2013 year. In 26 cases (37%), in this hazard category, origin country was Poland (Table 2).
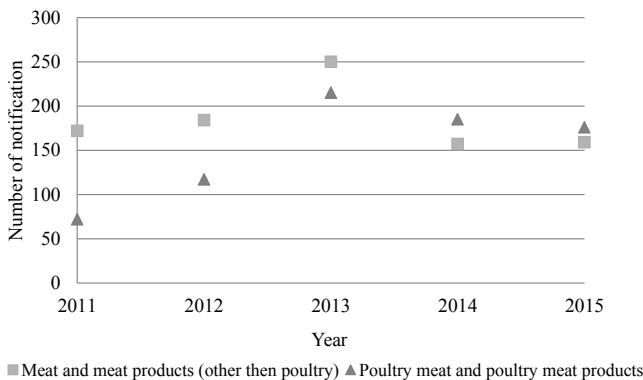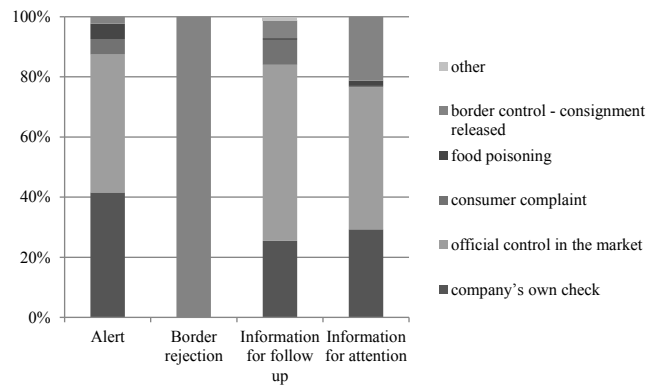

Figure 1. The number of notifications to the RASFF on categories of products

Figure 2. Notified category in the Rapid Alert System for Food and Feed in percentage per year

In case of poultry meat and poultry meat products, in addition to the previously mentioned hazard category, the most common was also feed additives and poor or insufficient controls. All notifications on feed additives concerned with presence of unauthorized substance – clopidol (which used in veterinary medicine as a anticoccidial substance). About 70% of notifications in this hazard category concerned products from Brazil, and about 25% from Israel (Table 2).

Pathogenic microorganisms and origin country

In poultry meat and poultry meat products, about half of notifications (n=232) concerned *Salmonella* spp. included meat which origin country was Brazil, 103 notifications were associated with products from Poland and 42 from France (Figure 5). Over the years, the number of notifications has greatly increased from 42 in 2011 to 169 in 2013. In the last two years the number of notifications decreased to 148 requests in 2014 and 145 in 2015. In notifications concerned pathogenic microorganisms in poultry meat and poultry meat products, the second most often detected threat was *Camphylobacter* spp. Within 5 years RASFF noted 37 notifications on *Camphylobacter* spp.

Among the countries of products origin, Germany (43 notifications), Poland (n=29) and Spain (n=22)

occurred most frequently in notifications concerning *Salmonella* spp. in meat and meat products (other than poultry). Many of notifications were associated with the presence of Shiga toxin-producing *Escherichia coli* (n=184). Products contaminated this hazard most frequently came from Argentina (46 notifications), Brazil (n=40) and New Zeland (n=26) (Figure 6). *Listeria monocytogenes* was the reason of notifications only in 77 cases. In the period between 2011 and 2016 system RASFF recorded only one notification on *Clostridium botulinum*. Notification concerned sausages from Portugal, action taken was withdrawal from the market.

Notification country

The countries that sent the largest number of notifications in RASFF belong Italy, Netherlands and Germany in case of category meat and meat products (other than poultry) and Netherlands, Denmark and France for category poultry meat and poultry meat products (Figure 7). Notification from Poland accounted for 2.4% in product category 'meat and meat product' and 5.5% in 'poultry meat and poultry meat products'. The most common reason for notifications in the Netherlands concerning the poultry meat and poultry meat products was *Salmonella* spp.
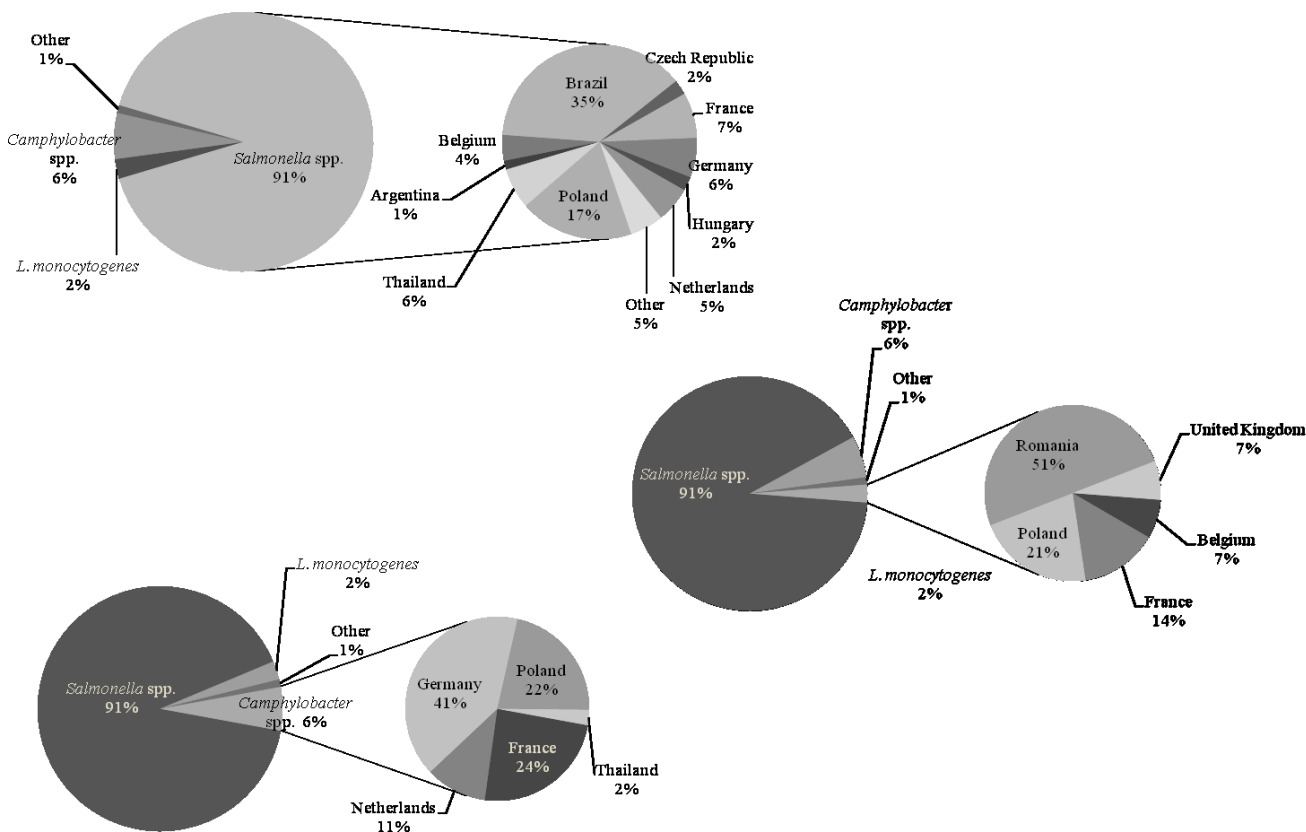

Figure 5. Notified microbiological hazards and origin country for category poultry meat and poultry meat products (%)
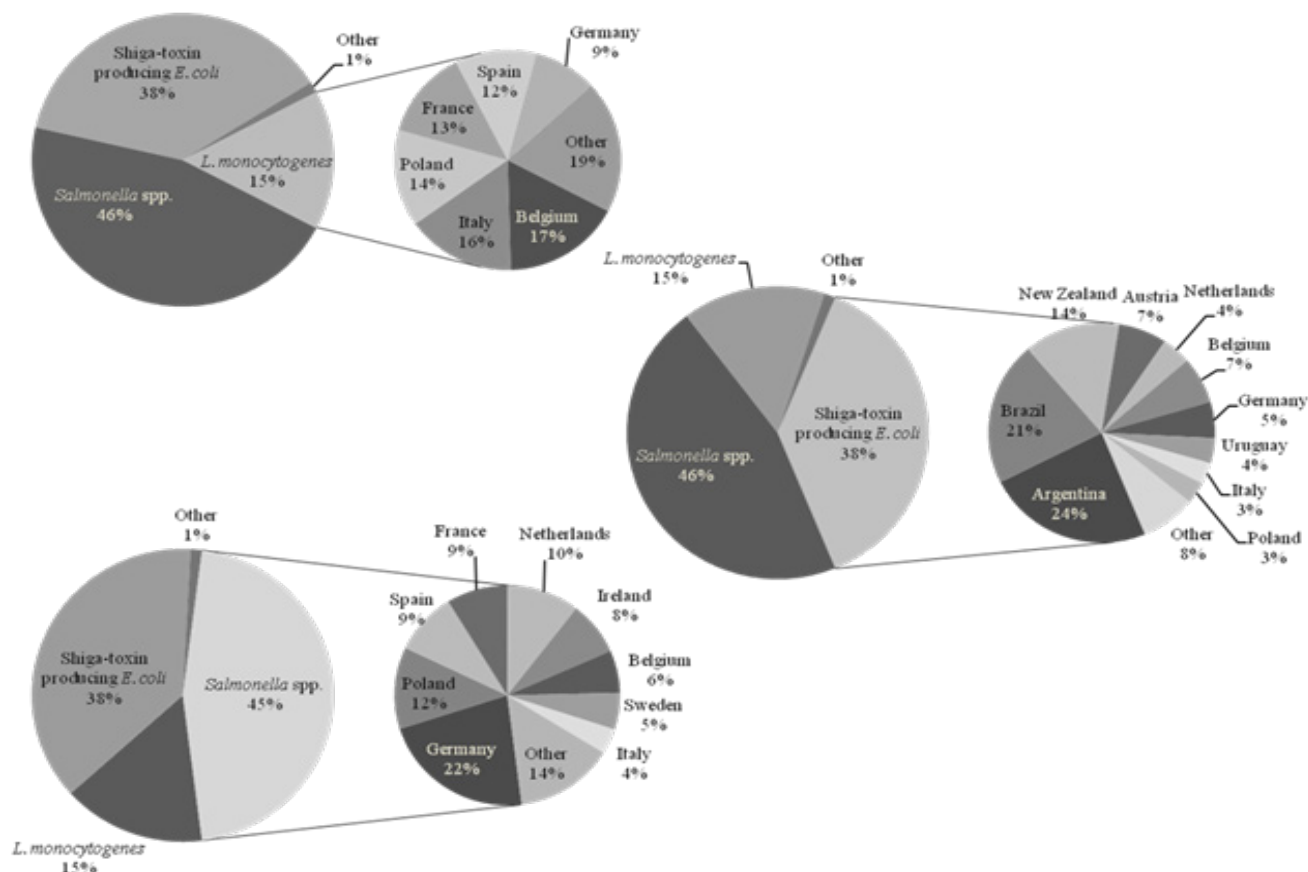
Figure 6. Notified microbiological hazards and origin country of them for category meat and meat products (other than poultry) (%)
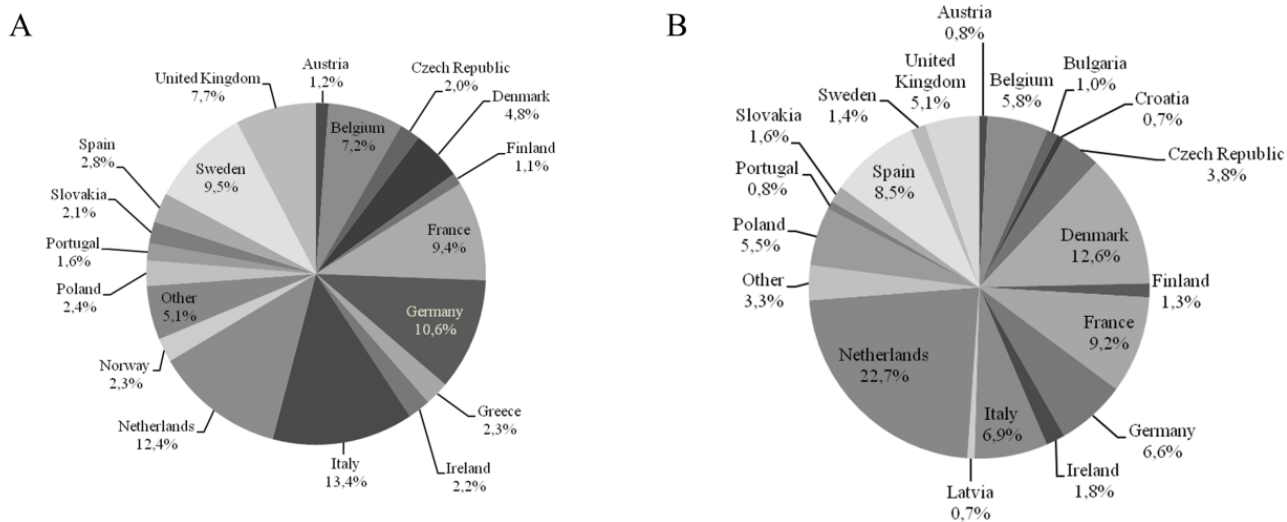

Figure 7. Number of notification by notified country in category: A - meat and meat products (other countries (%): Cyprus 0.9; Latvia 0.8; Romania 0.5; Bulgaria 0.5; Lithuania 0.5; Switzerland 0.4; Estonia 0.4; Luxemburg 0.3; Malta 0.3; Hungary 0.2; Iceland 0.1); B- poultry meat and poultry meat products (other countries (%): Romania 0.5; Lithuania 0.4; Malta 0.4; Iceland 0.3; Estonia 0.3; Slovenia 0.3; Greece 0.3; Luxemburg 0.1; Norway 0.1; Commission Service 0.1, Switzerland 0.1)

DISCUSSION

General number of notifications in RASFF system in years 2011 – 2015 gradually decreased, from 3708 in 2011 year to 2984 notifications in 2015 [6, 7, 8, 9, 10]. This trend is not so clear in case of notifications on studied categories of products. In 'meat and meat product' and 'poultry meat and poultry meat product' categories number of notifications increased to 2013 year and then in last two years a little decreased. In case of 'poultry meat and poultry meat products' number of notifications in 2015 year is higher than in 2011.

In years 2011 – 2015 total numbers of notifications by category of notifications was similar. Every year notifications classified as 'border rejection' was the most numerous [8-12]. However, in case of meat and meat products different trends were indicated. In category 'meat and meat products' the largest classification of notification was 'alert' throughout the entire period of time. On the second place was border rejection in year 2011, 2012, 2014. In case of 'poultry meat and poultry meat products' except year 2011 the most common notification classification was 'border rejection'. It may indicate that imported meat and meat products pose a considerable risk of consumers in the European Union. *Jansen* et al. noted that border rejection notifications are increasing exponentially, frequently due to Salmonella in poultry and shiga-toxin-producing *E. coli* in meat and meat products.

Notification basis on total number of notifications was generally 'border control – consignment detained' and 'official control on the market'. Notifications based on 'company's own check' in general accounted for few in 2011 – 2012 to several percent in last three years [8, 9, 10, 11, 12]. In selected product categories the most often basis of notification (except notifications classified as 'border rejection') were 'official control on the market' and 'company's own check'. Especially in case of 'alert' notifications 'company's own check' was the main basis of notification.

The most frequently occurring hazard category in studied time period in RASFF were 'pathogenic microorganisms', 'mycotoxins' and 'pesticide residues' [8, 9, 10, 11, 12]. In 'poultry meat and poultry meat products' and 'meat and meat products' product category 'pathogenic microorganisms' were also the most common hazards. Hazard category 'residues of veterinary medicinal products' and 'adulteration/ fraud' were also common in case of 'meat and meat products' category. In 'poultry meat and poultry meat products' the next common notified hazard category were 'feed additives' and poor or insufficient controls. Usually in hazard category 'pathogenic microorganisms' the RASFF system notified presence of bacteria such as *Escherichia coli*, *Salmonella* spp. or *Listeria monocytogenes*. In studied product category this microorganisms were also most common. Additionally in case of 'poultry meat and poultry meat products' *Camphylobacter* spp. also appeared. In RASFF annual report from 2013 year we could find information that the most of notifications reported in this hazard category were reported in products from third countries (countries which are not member of European Union). Actually, the most common notified pathogenic microorganism such as *Salmonella* spp. in poultry meat and Shiga–toxin producing *E. coli* in meat came from countries outside EU. This fact can be associated with active imports this products into EU.

For example beef and veal are mainly imported from Brazil, Uruguay and Argentina. Notification in RASFF about meat and meat products showed that Shiga-toxin producing *E. coli* was mainly detected in products from Brazil and Argentine [3, 4, 5]. However, not much less numerous notifications concerning *Salmonella* spp. and *L. monocytogenes* on meat products refer to products which generally originate from EU countries. A similar situation occurs in the case of poultry meat and poultry meat products. According to *Hansen* et al. the most important factors in preventing *Salmonella sp*. in meat and meat products are maintaining good hygiene conditions and to avoid cross-contamination in the meat processing chain after slaughter.

In 2013 year the RASFF system notified increase in notifications on category 'meat and meat products' related with fraud, exactly related to food products adulterated with horse meat. Through the first notification and rapidly reaction of all members states that practice was quickly investigated and built comprehensive traceability which could restricted that problem [1]. This horse meat scandal revealed the problem with adulteration in food sector, and caused that European Commission started working on creation the similar to RASFF system which concerning information refer to fraudulent activities (Food Fraud System) (RASFF 2013). Since the date of its creation in July 2013 the Food Fraud Network were exchanged on 60 cases in 2014 and 106 cases in 2015 year [11, 12].

Although the maximum residue limit (MRL) and list of prohibited substance in food was defined, RASFF notifications for residues of veterinary medicinal products was still appeared. RASFF system divided residues of four groups depending on the "legal status" of the detected substance: prohibited substances, residue level above MRL, unauthorized and unauthorized substance. Prohibited substance included explicitly forbidden for use veterinary medicines. Unauthorized substances were not explicitly banned in legislation, this substances have not been authorized for use in veterinary medicines. Unauthorized is the group of substance which are authorized only for particular use (not for all animals). Residue level above MRL means that the limit of legislation maximal residues in tissues of animal has been exceeded [7]. In category 'meat and meat products' RASFF mainly notified presence of metabolite prohibited substance nitrofuran and unauthorized in reported cases presence of ivermectin. Nitrofuran has short half-lives and do not occur generally as residues in foods. It formed reactive metabolites and they have toxicity and carcinogenicity influence on living organisms [2]. Ivermectin is a board-spectrum antiparasitic substance, which is used in animal and also in human treatment. As all drugs it may cause side effects mainly due to neurotoxicity.

CONCLUSIONS

1. Alert notification – the most dangerous for consumers were mainly basis on company's own check which could evidence that food safety control system like HACCP, GHP or GMP work properly.
2. Many of notifications in the RASFF system is caused by the increasing import of food products. This reason also influenced the increased on notifications for products which origin country was the countries outside the RASFF member states.
3. Official control in the Polish market was the common basis of notification what constitutes about proper action of food safety control.
4. Pathogenic organisms were the most dangerous hazard in meat and meat products. Contaminated products comes mainly from the third countries.

Conflict of interest
The authors declare no conflict of interest.

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