ISSN 2623-6575
UDK 60
UDK 631
UDK 663
UDK 630

GLASILO FUTURE

PUBLIKACIJA FUTURE - STRUČNO-ZNANSTVENA UDRUGA ZA PROMICANJE ODRŽIVOG RAZVOJA, KULTURE I MEĐUNARODNE SURADNJE, ŠIBENIK

VOLUMEN 2 BROJ 5-6

PROSINAC 2019.

UDK 60, 631, 663, 630 ISSN 2623-6575 (Online) *Glasilo Future (2019) 2 (5-6)*

Glasilo Future

Stručno-znanstveni časopis

Nakladnik:
FUTURA
Sjedište udruge: Šibenik

Adresa uredništva:
Bana Josipa Jelačića 13 a, 22000 Šibenik, Hrvatska / *Croatia*
☏ / 🖷: +385 (0) 022 218 133
✉: urednistvo@gazette-future.eu / editors@gazette-future.eu
🌍: www.gazette-future.eu

Lektura i grafička priprema: Ančica Sečan Matijaščić, mag. act. soc.
Objavljeno: 31. prosinca 2019. godine.
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UDK 60, 631, 663, 630 ISSN 2623-6575 (Online) *Glasilo Future (2019) 2 (5-6)*

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FUTURA – stručno-znanstvena udruga za promicanje održivog razvoja, kulture i međunarodne suradnje, Bana Josipa Jelačića 13 a, 22000 Šibenik, Hrvatska

(2019) 2 (5-6) 01–72

SADRŽAJ:

Salmonella spp. in RASFF notifications involving Croatia in the period from 01/01/2014 to 31/12/2018

Emilija Friganović[1]*, Nikolina Tokmakčija[1,2], Ančica Sečan Matijaščić[3], Mirko Kelava[4], Mladenka Šarolić[1], Boris Dorbić[1]

izvorni znanstveni rad (original scientific paper)

doi: 10.32779/gf.2.5-6.2

Abstract

The Rapid Alert System for Food and Feed (RASFF) enables a fast exchange of information between bodies and institutions involved in the system (EU Member States' national food safety authorities, Commission, EFSA, ESA, Norway, Liechtenstein, Iceland and Switzerland) in order to respond promptly to the health risks associated with food, food contact materials or feed. *Salmonella* is an important cause of EU foodborne outbreaks, most frequently reported pathogenic microorganism in food in the last few years. The aim of this study was to analyze RASFF notifications on food products contaminated with *Salmonella* spp. involving Croatia in the period from 01/01/2014 to 31/12/2018. All data were downloaded from the RASFF database (RASFF portal) and processed in MS Excel 2010. The collected data provided information on the: country(ies) of origin and distribution of the contaminated product, notifying country, product and product category, notification type, risk decision, notification basis, distribution status, action taken and, for some of the notifications, a *Salmonella* spp. serovar. Notifications mainly concerned "poultry meat and poultry meat products". Just over half of the reported food products originated from Poland, Brazil and Italy. Croatia was notifying country in nearly half of the published notifications. In scarcely over one-eighth of the notifications the country of origin of the contaminated product was also the notifying country. Majority of the notifications were classified as alert notifications and of serious risk. Most of the *Salmonella* spp. notifications were based on official controls on the market and on company's own check.

Key words: RASFF, notifications, *Salmonella* spp., food, Croatia.

[1] Veleučilište "Marko Marulić" u Kninu, Petra Krešimira IV 30, 22300 Knin, Republika Hrvatska.
* E-mail: emilija.friganovic@veleknin.hr.
[2] Završena studentica preddiplomskog stručnog studija Prehrambena tehnologija.
[3] Udruga Futura Šibenik, Bana Josipa Jelačića 13 a, 22000 Šibenik, Republika Hrvatska.
[4] Nastavni zavod za javno zdravstvo Dr. Andrija Štampar, Mirogojska cesta 16, 10000 Zagreb, Republika Hrvatska.

Introduction

The Rapid Alert System for Food and Feed (RASFF), operated by the European Commission, enables a fast exchange of information between bodies and institutions involved in the system (EU Member States' national food safety authorities, European Commission, EFSA – The European Food Safety Authority, ESA – The European Free Trade Association Surveillance Authority, Norway, Liechtenstein, Iceland and Switzerland) in order to respond promptly to the direct or indirect health risks associated with food, food contact materials or feed (EC, 2019a; EC, 2019b). Whenever a RASFF network member has information about aforementioned health risks, an immediate notification procedure has to be initiated. RASFF notifications may be alert notification, information notification for follow-up, information notification for attention, border rejection notification and news. Follow-up notifications encompass additional information to the original notification (EC, 2019b; EC, 2019c).

Salmonella spp. are one of the most infectious food borne pathogens causing considerable issues worldwide in both human and veterinary medicine (Ryan et al., 2017). Members of the genus *Salmonella* in the family Enterobacteriaceae are Gram-negative, oxidase negative, catalase positive, facultatively anaerobic, nonspore-forming rod-shaped bacteria. With the exception of *Salmonella enterica* ser. Gallinarum, they are motile bacteria (Lopes et al., 2016; Schofield, 1945, as cited in Ryan et al., 2017). Genus *Salmonella* consists of only two species, *Salmonella enterica* and *Salmonella bongori*. The species *Salmonella enterica* is divided into six subspecies: *Salmonella enterica* subsp. *arizonae*, *Salmonella enterica* subsp. *enterica*, *Salmonella enterica* subsp. *diarizonae*, *Salmonella enterica* subsp. *houtenae*, *Salmonella enterica* subsp. *indica* and *Salmonella enterica* subsp. *salamae*. There are 2557 serovars belonging to *Salmonella enterica* and just 22 belonging to *Salmonella bongori* (Grimont and Weill, 2007). *Salmonella* in humans causes two forms of the disease, typhoid fever and nontyphoidal salmonellosis. The first form rarely occurs in countries of good sanitation services and hygiene standards but nontyphoidal salmonellosis is increasingly present in developed countries and is the most common clinical form of salmonellosis (Habrun, 2009). According to European Food Safety Authority and the European Centre for Disease Prevention (2018; 2019) salmonellosis remains the second most common zoonosis in humans in the EU after campylobacteriosis. In about one in three foodborne outbreaks in the EU in 2018 the causative agent was *Salmonella.* "After a long period of a declining trend, the trend for salmonellosis in humans has stabilized over the last five years. In food, the highest levels of *Salmonella*-positive samples occurred in poultry meat and other meat, intended to be cooked before consumption" (EFSA and ECDC, 2019). The Table 1. gives, among other data, data on total number of confirmed salmonellosis cases in humans, notification rates and number of outbreaks and related cases for EU in the period 2014 – 2018.

Table 1. Reported or confirmed human cases (or cases/deaths) of salmonellosis, notification rates and reported number of outbreaks and related cases (or cases/deaths) for Croatia and EU in the period 2014 – 2018.

Salmonellosis	**No. of cases or cases/deaths or outbreaks**					**Data source**
Croatia	**2014**	**2015**	**2016**	**2017**	**2018**	
Total no. of reported cases	1,494/1	1,593/0	1,259/4	1,251/0	1,349/1	(CIPH, 2019a), (CIPH, 2019b), (CIPH, 2018), (CIPH, 2017), (CIPH, 2016), (CIPH, 2015).
Total no. of reported outbreaks	30	32	29	29	14	
– outbreak-related cases/deaths	222/-	165/0	276/-	192/0	98/0	
Total no. of reported carrier state outbreaks	0	0	1	2	0	
– outbreak-related cases	0	0	2	14	0	
Total no. of confirmed cases	1,494	1,593	1,240	1,242	1,323	(EFSA and ECDC, 2019)
Total no. of confirmed cases/100,000 population (notification rates)	35.2	37.7	29.6	29.9	32.2	
EU	**2014**	**2015**	**2016**	**2017**	**2018**	**Data source**
Total no. of confirmed cases	92,012	94,477	94,425	91,59	91,857	(EFSA and ECDC, 2019)
Total no. of confirmed cases/100,000 population (notification rates)	20.7	21.0	20.5	19.7	20.1	
Total no. of outbreaks	1,048	1,216	1,372	1,241	1,581	
– outbreak-related cases	9,208	8,531	11,428	9,607	11,581	

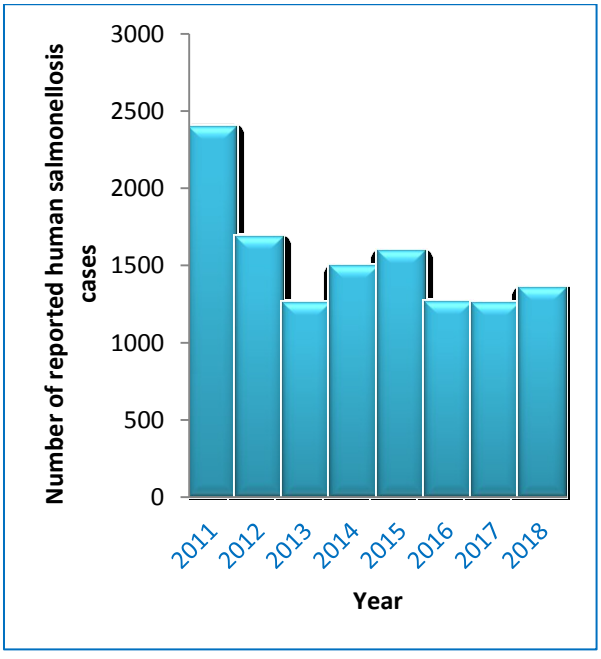


Figure 1. Chart – Reported human salmonellosis cases, Croatia, 2011 – 2018 year.
Source of data: (CIPH, 2019a).

According to Croatian Institute of Public Health (2019a) salmonelloses are relatively numerous in Croatia, but have shown a stable trend over the last years (Figure 1.) due to highly complex preventive measures, given the large number of contagion sources among humans and animals. Overview of reported human cases/deaths of salmonellosis, reported number of outbreaks and related cases/deaths and number of confirmed cases of salmonellosis and notification rates for Croatia in the period 2014 – 2018 is given in Table 1.

An overview of RASFF notifications, notifications concerning *Salmonella* spp. in the period 2014 – 2018 is given in Table 2.

Table 2. Total RASFF notifications and notifications concerning *Salmonella* spp. in the period 2014 – 2018.

Notification type	**Year and number of notifications**					**Data source**
	2014	**2015**	**2016**	**2017**	**2018**	
Alert notification	751	775	847	942	1,118	(EC, 2019b), (EC, 2018), (EC, 2017), (EC, 2016), (EC, 2015).
Information notification for follow-up	410	392	378	596	493	
Information notification for attention	623	495	598	706	675	
Border rejection notification	1,373	1,387	1,170	1,588	1,401	
News	-	-	-	-	12	
Total	**3,157**	**3,049**	**2,993**	**3,832**	**3,699**	
Follow up notifications	5,910	6,204	7,288	9,117	10,484	
Follow-ups per original notification	1,9	2	2,4	2,4	2,8	
Notifications regarding *Salmonella* spp.	**Year and number of notifications**					**Data source**
	2014	**2015**	**2016**	**2017**	**2018**	
In food	327	415	343	675	536	(EC, 2019d).
In feed	150	107	106	112	144	
Total (food and feed)	477	522	449	787	680	
Relative share of *Salmonella* spp. notifications in the overall notifications	15.1 %	17.1 %	15.0 %	20.5 %	18.4 %	
Alert notification	132	137	121	171	194	(EC, 2019d).
Information notification for follow-up	87	62	79	106	117	
Information notification for attention	86	76	111	94	98	
Border rejection notification	172	247	138	416	271	

The aim of this study was to analyze RASFF notifications on food products contaminated with *Salmonella* spp. involving Croatia in the period from 01/01/2014 to 31/12/2018.

Materials and methods

All data were downloaded from the RASFF portal database (EC, 2019d) and processed in MS Excel 2010 (univariate descriptive statistics). The search criteria were as follows: "Subject: *Salmonella*",

"Notified from: 01/01/2014", "Notified till: 31/12/2018", "Product type: food" and "Country: Croatia (HR)". The collected data provided information on the: country(ies) of origin and distribution of the contaminated product, notifying country, product and product category, notification type, risk decision, notification basis, distribution status, action taken and, for some notifications, a *Salmonella* spp. serovar.

Results and discussion

In the period from 01/01/2014 to 31/12/2018, a total of 63 RASFF notifications link Croatia to food products contaminated with *Salmonella* spp., either as the country of origin of the food product, the country where the product was distributed or the country that published the notification. Croatia was notifying country in almost half of the published notifications (49.2 %), followed by Netherlands (7.9 %) and Germany (7.9 %) with 5 published notifications each. Other countries published 1 – 4 notifications. Contaminated products in question originated in 11 EU countries and 7 non-EU countries. The country of origin of food products contaminated with *Salmonella* spp. in 34.9 % of notifications was Poland, then Brazil, Italy and Germany in 9.5 %, 7.9 % and 6.3 % of notifications, respectively. Croatia has been listed three times (4.8 %) as the country of origin of the contaminated product and notifications have been published by Austria, Croatia and Hungary. Only in 12.7 % of notifications the country of origin of the contaminated product was also the notifying country suggesting that public health threats were not recognized at the shortest period possible (Table 3.).

The majority of RASFF notifications on food products contaminated with *Salmonella* spp. involving Croatia in the period from 01/01/2014 to 31/12/2018, regarding the food product categories, referred to "poultry meat and poultry meat products" with a total of 39 notifications (61.9 %), then to "herbs and spices" (7.9 %), and to other categories with four, three, two or one notification (Table 3. and Table 4.). Most notifications were published in 2017, and 68.2 % referred to the category "poultry meat and poultry meat products", compared to 55.6 % referred to the same category for a year 2016, and 77.8 % referred to the same category for a year 2018.

One of the RASFF notifications in 2016 was linked to one family outbreak of salmonellosis in Croatia that resulted in a death of a child affected, after consuming eggs that were not properly cooked. As epidemiological and microbiological investigation revealed, the contaminated eggs originating from one of the European countries were the vehiculum of infection of other people in several European countries as apart of multinational outbreak (CIPH, 2017). According to Croatian Institute of Public Health (2017) "this incident highlights the importance of maintaining early warning systems with the possibility of information exchange in the country, but also Croatia with other countries".

Table 3. RASFF notifications on food products contaminated with *Salmonella* spp. involving Croatia in the period from 01/01/2014 to 31/12/2018 by country of origin and notifying country, by year and notifying country, as well as by year and food product category.

Country of origin	Notifying country													SUM	
	HR	AT	CZ	DE	DK	EE	FR	GB	HU	IT	NL	SI	SK	#	%
HR	1	1	-		-	-	-	-	1*	-	-	-	-	3	4.8
DE	1	1	-	2	-	-	-	-	-	-	-	-	-	4	6.3
ES	-	-	-	-	-	-	-	1	-	-	-	-	-	1	1.6
FR	-	-	-	-	-	-	2		-	-	-	-	-	2	3.2
HU	3	-	-	-	-	-	-	-	-	-	-	-	-	3	4.8
IT	4	-	-	-	-	-	-	-	-	1	-	-	-	5	7.9
NL	-	-	-	-	-	-	-	-	-	1	2	-	-	3	4.8
PL	13	-	-	2	3	1	-	-	1+1*	-	1	-	-	22	34.9
RO	2	-	-	-	-	-	-	-	-	-	-	-	-	2	3.2
SI	2	-	-	-	-	-	-	-	-	-	-	-	-	2	3.2
SK	1	-	-	-	-	-	-	-	-	-	-	-	-	1	1.6
BR	3	-	1	-	-	-	-	-	-	-	-	1	1	6	9.5
IND	-	1	-	-	-	-	-	1	1	-	-	-	-	3	4.8
JOR	-	1	-	-	-	-	-		-	-	-	-	-	1	1.6
SAD	-	-	-	-	-	-	-	1	-	-	-	-	-	1	1.6
THA	1	-	-	-	-	-	-	-	-	-	-	1	-	2	3.2
TR	-	-	-	1	-	-	-	-	-	-	-	-	-	1	1.6
UGA	-	-	-	-	-	-	-	-	-	-	2	-	-	2	3.2
SUM	31	4	1	5	3	1	2	3	3	2	5	2	1	SUM	
Year	HR	AT	CZ	DE	DK	EE	FR	GB	HU	IT	NL	SI	SK	#	%
2014	-	1	-	-	-	-	-	-	-	-	-	-	-	1	1.6
2015	5	3	-	1	1	-	1	1	-	-	1	-	-	13	20.6
2016	11	-	-	1	1	-	-	1	-	1	3	-	-	18	28.6
2017	10	-	1	3	-	1	-	1	2	1	-	2	1	22	34.9
2018	5	-	-	-	1	-	1	-	1	-	1	-	-	9	14.3
SUM #	31	4	1	5	3	1	2	3	3	2	5	2	1	63	SUM
SUM %	49.2	6.3	1.6	7.9	4.8	1.6	3.2	4.8	4.8	3.2	7.9	3.2	1.6	100	

Food product category	Bivalve molluses and products thereof	Cereals and bakery products	Cocoa and cocoa preparations, coffee and tea	Confectionery	Dietetic foods, food supplements, fortified foods	Eggs and egg products	Fruits and vegetables	Herbs and spices	Meat and meat products (other than poultry)	Nuts, nut products and seeds	Poultry meat and poultry meat products
SUM #	1	1	2	1	2	4	1	5	4	3	39
SUM %	1.6	1.6	3.2	1.6	3.2	6.3	1.6	7.9	6.3	4.8	61.9
2014	-	-	-	-	-	1	-	-	-	-	-
2015	-	-	1	-	1	-	1	2	-	1	7
2016	-	1	-	-	-	3	-	1	1	2	10
2017	1	-	1	1	1	-	-	1	2	-	15
2018	-	-	-	-	-	-	-	1	1	-	7

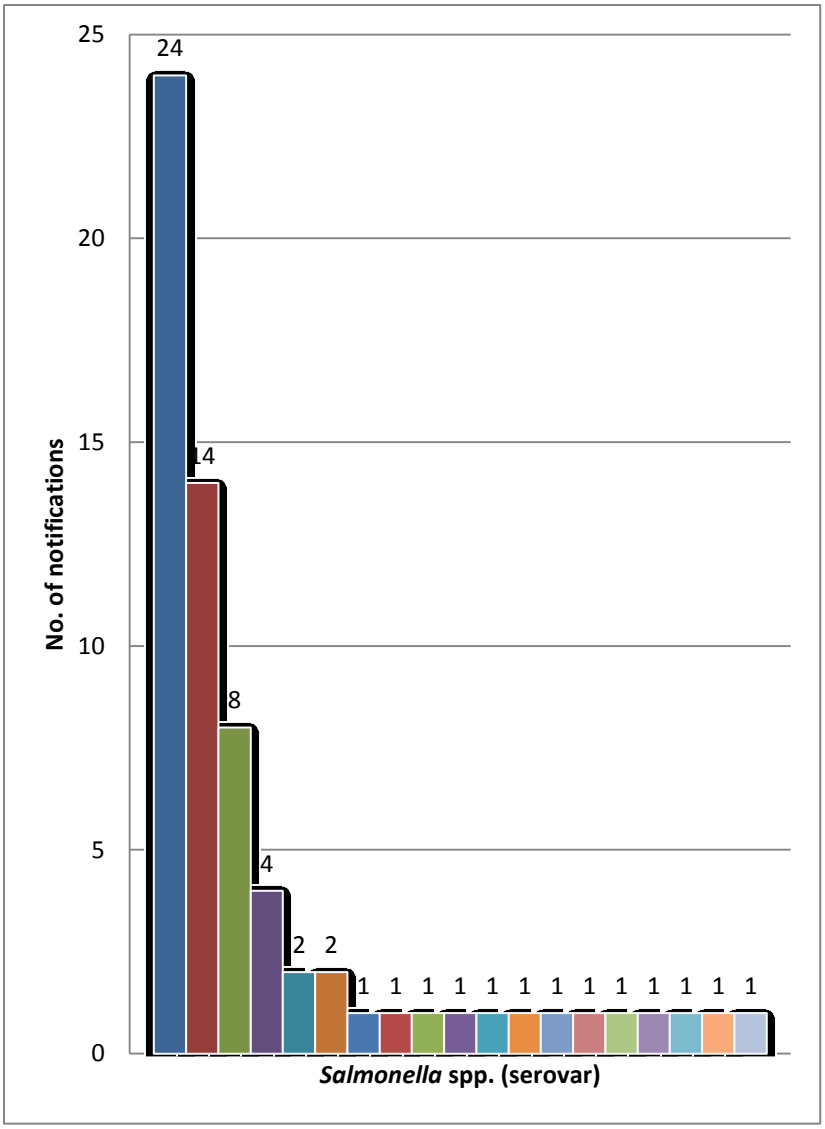
*Note: * In one case, two countries were countries of origin (both Croatia and Poland).*
Legend: AT – Austria, CZ – Czech Republic, DE – Germany, EE – Estonia, ES – Spain, FR – France, GB – United Kingdom, HR – Croatia, HU – Hungary, IT – Italy, NL – Netherlands, PL – Poland, RO – Romania, SI – Slovenia, SK – Slovakia; BR – Brazil, IND – India, JOR – Jordan, THA – Thailand, TR – Turkey, UGA – Uganda, USA – United States.

Table 4. RASFF notifications on food products contaminated with *Salmonella* spp. involving Croatia in the period from 01/01/2014 to 31/12/2018 by food product category, year and country of origin.

Food product category	Year and Country of origin					SUM (Country of origin)
	2014	2015	2016	2017	2018	
Bivalve molluscs and products thereof	-	-	-	NL (1)	-	NL (1)
Cereals and bakery products	-	-	DE (1)	-	-	DE (1)
Cocoa and cocoa preparations, coffee and tea	-	NL (1)	-	PL (1)	-	NL (1), PL (1)
Confectionery	-	-	-	PL (1)	-	PL (1)
Dietetic foods, food supplements, fortified foods	-	IND (1)	-	ES (1)	-	ES (1), IND (1)
Eggs and egg products	DE (1)	-	PL (2) HR (1)	-	-	PL (2), DE (1), HR (1)
Fruits and vegetables	-	JOR (1)	-	-	-	JOR (1)
Herbs and spices	-	ES (1) HR (1)	IND (1)	TR (1)	IND (1)	IND (2), ES (1), HR (1), TR (1)
Meat and meat products (other than poultry)	-	-	IT (1)	DE (1) HR+PL (1)*	NL (1)	DE (1), HR (1)*, IT (1), NL (1), PL (1)*
Nuts, nut products and seeds	-	DE (1)	UGA (2)	-	-	DE (1), UGA (2)
Poultry meat and poultry meat products	-	PL (2) FR (1) HU (1) IT (1) RO (1) SK (1)	PL (5) IT (3) HU (1) THA (1)	BR (6) PL (6) HU (1) RO (1) THA (1)	PL (4) SI (2) FR (1)	PL (17), BR (6), IT (4), HU (3), RO (2), THA (2), SI (2), FR (2), SK (1)
SUM (per Year)	1	13	18	22	9	

*Note: * In one case, two countries were countries of origin (both Croatia and Poland).*
Legend: AT – Austria, CZ – Czech Republic, DE – Germany, EE – Estonia, ES – Spain, FR – France, GB – United Kingdom, HR – Croatia, HU – Hungary, IT – Italy, NL – Netherlands, PL – Poland, RO – Romania, SI – Slovenia, SK – Slovakia; BR – Brazil, IND – India, JOR – Jordan, THA – Thailand, TR – Turkey, UGA – Uganda, USA – United States.

Out of the total of 63 notifications associated with *Salmonella*, for 24 (38.1 %) the causative agent was listed only as *Salmonella* spp. (34.9 %) or as *Salmonella enterica* (3.2 %), and in all other cases the serovar was determined. The most common were two serovars, *Salmonella* ser. Enteritidis (22.2 %) and *Salmonella* ser. Typhimurium (12.7 %), and 16 more serovars were reported (Figure 2.) that were contaminants of certain food products one or more times. In two cases food products were contaminated with three *Salmonella* spp. serovars each.



Salmonella spp. + *S. enterica*	24
Salmonella ser. Enteritidis	14
Salmonella ser. Typhimurium	8
Salmonella ser. Infantis	4
Salmonella ser. Heidelberg	2
Salmonella ser. Kentucky	2
Salmonella ser. Agona	1
Salmonella ser. Barranquilla	1
Salmonella ser. Bareilly	1
Salmonella ser. Bredeney	1
Salmonella ser. Cubana	1
Salmonella ser. Dibra	1
Salmonella ser. Goldcoast	1
Salmonella ser. Mbandaka	1
Salmonella ser. Muenchen	1
Salmonella ser. Oranienburg	1
Salmonella ser. Stanley	1
Salmonella ser. Tennessee	1
Salmonella ser. Thompson	1

Note: In two cases food products were contaminated with three Salmonella spp. *serovars each.*

Figure 2. Chart – RASFF notifications on food products contaminated with *Salmonella* spp. involving Croatia in the period from 01/01/2014 to 31/12/2018 by *Salmonella* spp. serovar.

The majority of RASFF notifications on food products contaminated with *Salmonella* spp. involving Croatia in the period from 01/01/2014 to 31/12/2018 were classified as alert notifications (68.3 %) and 85.7 % of total number of notifications were of serious risk. Most of the *Salmonella* spp. notifications were based on official controls on the market (69.8 %) and 23.8 % were based on company's own check. 65.1 % of alert notifications and 55.0 % of information notifications were based on official controls on the market, while 23.3 % of alert notifications and 20,0 % of information notifications were based on company's own check. Food poisoning was notification basis in 4.76 % and consumer complaint in 1.6 % of respective *Salmonella* spp. notifications. Regarding the distribution status, 49.2 % of contaminated products were distributed to other member countries and in over 62.0 % of the notifications contaminated products were withdrawn or recalled. Total of 63 notifications associated with *Salmonella* spp. gave rise to 837 follow-up notifications, representing an average of 13.3

follow-ups per original notification (Table 5.).

Table 5. RASFF notifications on food products contaminated with *Salmonella* spp. involving Croatia in the period from 01/01/2014 to 31/12/2018 by notification type, risk decision, notification basis, distribution status and action taken.

Notification type / Total	Risk decision/ Total	Notification basis/ Total	Distribution status and Action taken + [fup]*/ Total
Alert notification (43; 68.3 %)	Serious (42)	Official control on the market (28)	Distribution to other member countries (17) Distribution restricted to notifying country (5) No distribution from notifying country (3) Product (presumably) no longer on the market (3)
			Withdrawal from the market (15) [204 fup] Recall from consumers (6) [126 fup] Withdrawal from recipient(s) (2) [6 fup] Informing recipient(s) (1) [22 fup] Destruction (1) [2 fup] Physical/chemical treatment (1) [32 fup] Re-dispatch (1) [2 fup] No action taken (1) [11 fup]
		Company's own check (10)	Distribution to other member countries (9) Distribution restricted to notifying country (1)
			Withdrawal from the market (6) [132 fup] Recall from consumers (1) [5 fup] Withdrawal from recipient(s) (1) [3 fup] Public warning - press release (1) [5 fup] Informing authorities (1) [42 fup]
		Food poisoning (3)	Distribution to other member countries (3)
			Withdrawal from the market (1) [9 fup] Informing recipient(s) (1) [180 fup] No action taken (1) [17 fup]
		Consumer complaint (1)	Distribution to other member countries (1)
			Recall from consumers (1) [7 fup]
	Not Serious (0)	-	-
	Undecided (1)	Company's own check (1)	Distribution restricted to notifying country (1)
			Recall from consumers (1) [3 fup]
Information notification for attention (17; 27.0 %)	Serious (12)	Official control on the market (9)	Product (presumably) no longer on the market (8) Distribution to non-member countries (1)
			Destruction (2) [0 fup] Withdrawal from the market (1) [0 fup] Recall from consumers (1) [1 fup] Informing recipient(s) (1) [1 fup] No stock left (1) [11 fup] No action taken (2) [0 fup] ND (1) [1 fup]
		Company's own check (3)	Product (presumably) no longer on the market (3)
			Destruction (1) [1 fup] No action taken (1) [0 fup] ND (1) [1 fup]
	Not Serious (5)	Official control on the market (5)	Product (presumably) no longer on the market (5)
			Withdrawal from recipient(s) (1) [4 fup] No action taken (3) [2 fup] No stock left (1) [2 fup]
	Undecided (0)	-	-

Notification type / Total	Risk decision/ Total	Notification basis/ Total	Distribution status and Action taken + [fup]*/ Total
Information notification for follow-up (3; 4.8 %)	Serious (0)	-	-
	Not Serious (3)	Official control on the market (2)	No distribution from notifying country (2)
			Withdrawal from the market (1) [1 fup] Informing authorities (1) [1 fup]
		Company's own check (1)	Distribution to other member countries (1)
			Recall from consumers (1) [3 fup]
	Undecided (0)	-	-
Total (%)	**Serious (85.7 %)** **Not Serious (12.7 %)** **Undecided (1.6 %)**	**Official control on the market (69.8 %)** **Company's own check (23.8 %)** **Food poisoning (4.8 %)** **Consumer complaint (1.6 %)**	**Distribution to other member countries (49.2 %)** **Product (presumably) no longer on the market (30.2 %)** **Distribution restricted to notifying country (11.1 %)** **No distribution from notifying country (7.9 %)** **Distribution to non-member countries (1.6 %)**
			Withdrawal from the market (38.1 %) **Recall from consumers (17.5 %)** **Withdrawal from recipient(s) (6.4 %)** **Informing recipient(s) (4.8 %)** **Informing authorities (3.2 %)** **Public warning - press release (1.6 %)** **Destruction (6.4 %)** **Physical/chemical treatment (1.6 %)** **Re-dispatch (1.6 %)** **---** **No action taken (12.7 %)** **No stock left (3.2 %)** **ND (3.2 %)** **---** **[837 fup]** (avg. **13.3** fup per orig. notif.)

Note: ND = no data available;

**[fup] = no. of follow-up notifications.*

Conclusion

RASFF notifications on food products contaminated with *Salmonella* spp. involving Croatia in the period from 01/01/2014 to 31/12/2018 mainly concerned "poultry meat and poultry meat products" (61.9 %). Majority of the reported food products originated from Poland (34.9 %), Brazil (9.5 %) and Italy (7.9 %). Almost half of the notifications were published by Croatia (49.2 %). Only in just over one-eighth of the notifications the country of origin of the contaminated product was also the notifying country suggesting that public health threats were not recognized at the shortest period possible. Majority of the notifications were classified as alert notifications (68.3 %) and of serious risk (85.7 %). Food poisoning was notification basis in 4.76 % of *Salmonella* spp. notifications. Most of the *Salmonella* spp. notifications were based on official controls on the market (69.8 %) and on company's own check (23.8 %). The worrying fact is that almost half of the contaminated products were distributed to other member countries, as well as the point that contaminated products were actually available to consumers, which does not dispute the fact that the RASFF system is effective in

terms of rapid response to health threats, but emphasizes the need to strengthen the preventive role of the competent authorities and food business operators themselves.

Acknowledgment

The paper was prepared using the results of a final thesis of Food technology student Nikolina Tokmakčija (see References).

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Primljeno: 12. prosinca 2019. godine ***Received:*** *December 12, 2019*

Prihvaćeno: 30. prosinca 2019. godine ***Accepted****: December 30, 2019*