

## JOINT ECDC-EFSA RAPID OUTBREAK ASSESSMENT

# Multi-country outbreak of multiple *Salmonella enterica* serotypes linked to imported sesame-based products

14 October 2021

### Abstract

Since January 2019, 121 cases of *Salmonella enterica* infections with six different serotypes linked to sesame-based products have been reported in five EU/EEA countries. The serotypes are *S. Amsterdam*, *S. Havana*, *S. Kintambo*, *S. Mbandaka*, *S. Orion*, and *S. Senftenberg*. Case interviews in four countries revealed consumption of sesame-based products (halva or tahini) prior to illness. Almost half of the cases are in children  $\leq 10$  years, who also represent over half of hospitalised cases. No deaths have been reported.

Since November 2019, 14 batches of sesame-based products originating from Syria, tested positive for one or multiple *Salmonella* outbreak strains (twelve from Brand A, two from Brand C).

Based on available epidemiological, microbiological, and traceability information, the probable vehicles of infection are sesame-based products imported from Syria, at least in countries involved in the traceability of the positive batches. These products are sealed and ready to be consumed, suggesting that the contamination occurred before the products reached the European Union/European Economic Area (EU/EEA) market.

The intermittent occurrence of human cases and the identification of positive food samples since 2019 indicate the availability of the contaminated sesame-based products on the EU/EEA market for over two years. This has posed a risk for human infections and severe clinical illness with several *Salmonella* serotypes, particularly among children.

Control measures implemented since August 2020 on the involved batches of sesame-based products have not prevented the occurrence of human cases to date. Moreover, the concerned products have a long shelf life and might still be stored in people's homes.

Considering the limited information on product manufacturing and distribution, there remains a risk for new *Salmonella* infections in the EU/EEA linked to imported sesame-based products from Syria.

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## Event background

On 26 April 2021, Sweden reported clusters of two serotypes of *Salmonella*, which had similar demographic features with a majority of cases among young children in the Epidemic Intelligence Information System (EPIS UI-716, now in EpiPulse (European surveillance portal for infectious diseases) as an event 2021-FWD-00020). The infections were reported as domestically acquired and the cases were geographically spread. The detected serotypes were *S. Havana* sequence type (ST) 1526 and *S. Mbandaka* ST413.

The outbreak evolved to include additional *Salmonella* serotypes connected to the EPIS event created by Sweden.

## EU/EEA outbreak case definition

The European outbreak case definition is as follows:

### A confirmed outbreak case:

- A laboratory-confirmed case of *Salmonella enterica* spp. infection with any of the following outbreak-related serotypes: *S. Amsterdam*, *S. Havana*, *S. Kintambo*, *S. Mbandaka*, *S. Orion*, and *S. Senftenberg* and with symptom onset on or after 1 January 2019 (date of sampling, date of receipt by the reference laboratory, or date of notification if other dates are not available),

AND

- Fulfilling the laboratory criterion: with an isolate clustering within 15 SNPs (single nucleotide polymorphism) by the national SNP pipeline OR within five cg-allelic differences (AD) by the national cgMLST pipeline from an outbreak-related *Salmonella* serotype OR clustering within five cg-allelic differences from any other isolate in a centralised single linkage analysis.

### A possible outbreak case:

- A laboratory-confirmed case of *Salmonella enterica* spp. infection with any of the following outbreak-related serotypes: *S. Amsterdam*, *S. Havana*, *S. Kintambo*, *S. Mbandaka*, *S. Orion*, and *S. Senftenberg* and with symptom onset on or after 1 January 2019 (date of sampling, date of receipt by the reference laboratory, or date of notification if other dates are not available),

AND

- At least one of the following epidemiological links in seven days prior disease onset:
  - Human-to-human transmission.
  - Exposure to a common source.
  - Reported consumption of tahini or halva products.

## Outbreak-related *Salmonella* serotypes

- **S. Amsterdam** outbreak strain belongs to ST590.
- **S. Havana** outbreak strain belongs to ST1526 and Sweden's national cluster analysis shows a variation within the cluster of 1-9 SNPs. The nearest allelic profile in Enterobase is classified as HC05-247762.
- **S. Kintambo** outbreak strain belongs to ST8754.
- **S. Mbandaka** outbreak strain belongs to ST413 and Sweden's national cluster analysis shows a variation within the cluster of 0-10 single nucleotide polymorphisms (SNPs). The nearest allelic profile in Enterobase is classified as HC05-220697 (Enterobase HierCC-cgMLST scheme, 'HC5' indicating a cluster of isolates within five core genome alleles in single linkage analysis) [1]. The sequence of the US isolate from January 2021 is available on the National Center for Biotechnology Information (NCBI): PNUSAS188154 with a run accession number [SRR13377904](https://www.ncbi.nlm.nih.gov/nuccore/SRR13377904).
- **S. Orion** outbreak strain belongs to ST8043.
- **S. Senftenberg** outbreak strain belongs to ST14.

## Epidemiological and microbiological investigations of human cases

After the urgent inquiry by Sweden, several countries responded with detections of genetically closely-related *Salmonella* serotypes (*S. Amsterdam*, *S. Havana*, *S. Kintambo*, *S. Mbandaka*, *S. Orion*, and *S. Senftenberg*), which had microbiological and/or epidemiological links to sesame-based products or representative human outbreak isolates. The description by country below reflects the situation as of 4 October 2021.

**Sweden** has reported five clusters with human isolates closely related to food isolates with a total of 37 cases:

- A cluster of *S. Havana* with 12 cases, seven males, six 0-4 years old and with onset of disease between 6 July 2019 and 24 August 2021;
- A cluster of *S. Kintambo* with seven cases 1-77 years, five males and with onset of disease between 18 June 2021 and 13 September 2021;
- A cluster of *S. Mbandaka* with 12 cases, seven females, six 0-3 years old and with onset of disease between 20 January 2020 and 10 July 2021;
- A cluster of *S. Orion* with four cases, two females and two males, 57-88 years old with onset of disease between 15 November 2020 and 27 May 2021;
- A cluster of *S. Senftenberg* with two males, 25 and 46 years, sampled in May and October 2020.

Many cases were reported to have names that could originate from the Middle East. No travel history was reported for 34 of 37 cases.

**Denmark** has reported nine confirmed cases: three cases of *S. Havana* infection, three cases of *S. Mbandaka* infection, one case each of *S. Amsterdam*, *S. Kintambo*, and *S. Orion* infections. Five cases were from 2021 (with sample dates February 12, to July 21) and none of these had been travelling prior to disease onset. Travel information was not available for the two cases from 2019 and the two cases from 2020.

**Germany** has reported 72 cases with 36 of *S. Havana* (33 confirmed and three probable), 12 isolates of *S. Mbandaka*, 12 of *S. Orion* (11 confirmed and one probable), six of *S. Senftenberg* ST14, five of *S. Amsterdam*, and one case with co-infection of *S. Amsterdam* and *S. Mbandaka*. In May 2019, Germany reported an outbreak of *S. Havana* infections primarily among children (ECDC EPIS UI-559). No vehicle of infection could be identified at that time since patient interviews were hindered either by language barriers or lack of consent. The *S. Havana* outbreak strain could retrospectively be linked to sesame-based products and has been intermittently observed since 2019 with latest date of sampling on 3 June 2021. No travel has been reported for 22 cases and it is unknown for 50 cases.

**Norway** has reported five cases: two with infections of *S. Mbandaka*, two with *S. Orion* and one with *S. Havana* infection. One of the cases (a child with *S. Havana* infection) with sampling date on 28 January 2020 reported travel to the United Arab Emirates prior to illness, but the four other cases reported no travel.

**The Netherlands** reported two cases: one case of *S. Mbandaka* and one case of *S. Orion* in 2021. The case of *S. Mbandaka* is a one and a half-year-old child living in a neighbourhood with residents of different nationalities. The case of *S. Orion* is a female, 79 years old and with sampling date on 27 May 2021.

**Canada** has reported eight confirmed cases: five cases of *S. Mbandaka*, two cases of *S. Havana* and one case of *S. Orion*, which cluster with the respective outbreak strains. The five *S. Mbandaka* cases (isolates with 0-5 AD) have dates of onset between 5 November 2019 and 31 July 2021. The two *S. Havana* cases (both isolates with 5 AD) have dates of onset on 16 April 2019 and 6 June 2019. The one *S. Orion* case (isolate with 1 AD) has a date of onset on 16 May 2021. Canada also has one case of *S. Tennessee* with a date of onset on May 20, 2021, which reported consuming pistachio halva.

**United States** has reported six *S. Mbandaka* isolates, which have been uploaded to the National Center for Biotechnology Information (NCBI), from January 2021 to September 2021. Ill people range in age from less than one to 57 years, with a median age of 19.5 years. Illness onset dates range from 19 November 2020 to 5 September 2021. Epidemiological data are limited. Interviews were conducted with two people: both report shopping at international markets that carry a predominance of Arabic/Middle Eastern foods and ingredients, and both report eating foods containing tahini. Additionally, five of the six ill people were reported to have surnames that could indicate Middle Eastern origin. Interviews are still pending on the remaining ill people. Two people have traveled to Syria and have not been reachable by public health officials.

## Epidemiological overview

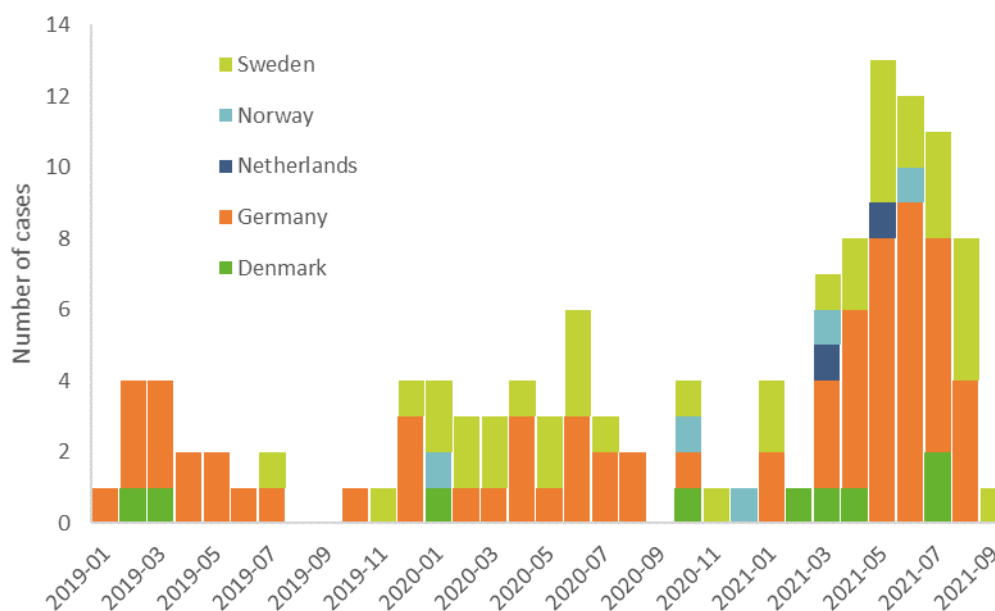
Between 1 January 2019 and 4 October 2021, six different *Salmonella* serotypes have been linked to 121 confirmed cases from five EU/EEA countries. The most common serotype reported in humans is *S. Havana* (n=49) followed by *S. Mbandaka* (n=30), *S. Orion* (n=19), *S. Kintambo* (n=8), *S. Senftenberg* (n=8), and *S. Amsterdam* (n=6) (Table 1). In addition, one German case had co-infection with serotypes *S. Amsterdam* and *S. Mbandaka* (Table 1). Germany reported four possible cases, of which three were *S. Havana* and one *S. Orion*. Further, Canada reported five *S. Mbandaka*, two *S. Havana*, and one *S. Orion* case (three cases in 2019, one in 2020 and four in 2021) and the United States reported six *S. Mbandaka* cases (one case in 2020 and five cases from 2021), all microbiologically linked to this event.

The first confirmed case of *S. Havana* was detected in Germany with disease onset on 8 January 2019 and the isolate of the most recent case with *S. Kintambo* infection was reported in Sweden with onset of disease on 13 September 2021. The epidemic curve shows the annually increasing magnitude of the outbreak with a notable increase of infections in March 2021 (Figure 1).

**Table 1. *Salmonella enterica* serotypes of confirmed cases in five EU/EEA countries, Canada, and the United States, 1 January 2019–4 October 2021**

Country	<i>S. Havana</i>	<i>S. Mbandaka</i>	<i>S. Orion</i>	<i>S. Kintambo</i>	<i>S. Senftenberg</i>	<i>S. Amsterdam</i>	<i>S. Amsterdam + S. Mbandaka</i>	Total
Denmark	3	3	1	1	0	1	0	9
Germany	33	12	11	0	6	5	1	68
Netherlands	0	1	1	0	0	0	0	2
Norway	1	2	2	0	0	0	0	5
Sweden	12	12	4	7	2	0	0	37
<b>Total EU/EEA</b>	<b>49</b>	<b>30</b>	<b>19</b>	<b>8</b>	<b>8</b>	<b>6</b>	<b>1</b>	<b>121</b>
Canada	2	5	1	0	0	0	0	8
United States	0	6	0	0	0	0	0	6
<b>Total</b>	<b>51</b>	<b>41</b>	<b>20</b>	<b>8</b>	<b>8</b>	<b>6</b>	<b>1</b>	<b>135</b>

**Figure 1. Distribution of confirmed *Salmonella enterica* infections (*S. Amsterdam*, *S. Havana*, *S. Kintambo*, *S. Mbandaka*, *S. Orion*, and *S. Senftenberg*) by country and year-month in five EU/EEA countries, 1 January 2019–4 October 2021**



A demographic overview of confirmed cases by countries is presented in Table 2. In Germany and Norway, the median age of cases was  $\leq 10$  years although infections have been reported in all age groups (Tables 2 and 3).

Children below 10 years account for almost half (45.4%) of the confirmed cases, followed by 37.8% of adults aged 25–64 years (Table 3). The male-to-female ratio is 1.20, which is driven by significantly more males in the age group 45–64 years ( $p < 0.01$ ) (Table 3). This difference is attributed to more male than female cases reported in this age group in Germany. Of 52 confirmed cases with available information, 42.3% were hospitalised. Of these, 54.5% were children  $\leq 10$  years. No deaths were reported among confirmed cases. Travel history was reported for 63 cases (52.1%) and of these, only one reported travel to United Arab Emirates.

**Table 2. Epidemiological and demographic characterisation of confirmed *S. enterica* infections (*S. Amsterdam*, *S. Havana*, *S. Kintambo*, *S. Mbandaka*, *S. Orion*, and *S. Senftenberg*) in five EU/EEA countries, 1 January 2019–4 October 2021**

Country	Confirmed cases	Dates of sampling	Female	Male	Age range (median), years	Hospitalised
Denmark	9	25.2.2019 - 21.7.2021	2	7	<1 - 73 (14)	3/9
Germany*	68	14.1.2019 - 24.8.2021**	32	34	<1 - 69 (10)	16/38
Netherlands	2	17.3. - 27.5.2021	1	1	1 - 79 (40)	Unk***
Norway****	5	28.1.2020 - 7.6.2021	3	2	1 - 45 (5)	3/5
Sweden	37	7.7.2019 - 17.9.2021	16	21	<1 - 88 (33)	Unk
<b>Total</b>	<b>121</b>		<b>54</b>	<b>65</b>		<b>22/52</b>

\* Gender unknown for two cases

\*\* date of receipt to the National Reference Centre in Robert Koch Institute, Germany

\*\*\*Unk = Unknown

\*\*\*\* One case reported travel to United Arab Emirates prior to illness

**Table 3. Distribution of confirmed *S. enterica* infections (*S. Amsterdam*, *S. Havana*, *S. Kintambo*, *S. Mbandaka*, *S. Orion*, and *S. Senftenberg*) by sex and age groups in five EU/EEA countries, 1 January 2019–4 October 2021**

Age group (years)	Female	Male	Total	p-value
< 1	10	6	16	ns*
1-10	19	19	38	ns
11-24	5	3	8	ns
25-44	10	15	25	ns
45-64	3	17	20	< 0.01
≥ 65	7	5	12	ns
<b>Total</b>	<b>54</b>	<b>65</b>	<b>119</b>	<b>ns</b>

\*ns = not significant by chi-square test

## Information from patient interviews

In Germany, a patient interview of one *S. Orion* case in 2021 revealed consumption of several sesame-based products. A German case with co-infection of two *Salmonella* serotypes reported consumption of roasted sesame seeds, which tested negative for *Salmonella*.

In Denmark, interview data was available for 3/5 cases from 2021. All three (two *S. Mbandaka* cases and the *S. Kintambo* case) reported having consumed tahini. The six cases from 2019-2021 where interview data was not available were all registered with family names indicating origin from Middle East countries. Exposure to traditional Middle East dishes as tahini is thus not unlikely.

In Norway, the two *S. Mbandaka* cases reported having eaten sesame seed products. The other three cases were not interviewed.

In Sweden, one *S. Havana* case reported consumption of halva product of Brand A. In the shop where the halva product was purchased by the case, other halva products were found positive for *Salmonella* serotypes different from *S. Havana*.

## Microbiological and environmental investigations of food and control measures

This section summarises country-specific information on microbiological investigations and traceability analyses of the products, and control measures implemented by the involved countries as reported through the RASFF notifications 2019.3988, RASFF 2021.3351, RASFF 2021.3974 and RASFF 2021.4045 as of 7 October 2021 (11 follow-ups - *fups*, 32 *fups*, 1 *fup*, and 0 *fups*, respectively). A visual representation is provided in Figure A1 (Annex 1). The *Salmonella* isolates from sesame-based products from Syria are summarised in Table A1 (Annex 1).

### Germany

The following food isolates clustering with the outbreak strains according to the WGS analyses performed either at national level or according to the ECDC/EFSa joint WGS analysis were identified:

- One isolate of *S. Havana* was detected in tahini Batch A (800g), Brand A, sampled on 29 October 2019 at the German Wholesaler A;
- Four isolates of *S. Amsterdam*, *S. Havana*, and *S. Mbandaka* were detected in four samples of tahini Batch B, Brand A, sampled on 21 and 28 July 2020 at the German Retailer A and on 14 July 2021 at the German Retailer I;
- One isolate of *S. Havana* was detected in tahini Batch C, Brand A, sampled on 29 July 2020 at the German Retailer A;
- One isolate of *S. Orion* was detected from tahini Batch E, Brand A, sampled on 29 July 2020 at the German Retailer A;
- Two isolates of *S. Orion* and *S. Amsterdam* were detected from halva 'pistachio' Batch P (400 g and 900 g), Brand C, sampled on 16 July 2021 at the German Wholesaler A;
- One isolate of *S. Kintambo* was detected from tahini Batch Q (400 g), Brand C, sampled on 9 July 2021 at the German Wholesaler A.

On 13 November 2019, the food safety authority in Germany launched an alert notification in RASFF (2019.3988) to communicate the detection of *S. Havana* (antigenic formula (1),13,23:f,g:-) from the sesame paste product tahini Batch A (800g), Brand A. The *S. Havana* isolate matched the outbreak strain. The own-check sample was taken on 29 October 2019 at the German Wholesaler A that imported in Europe Batch A. This batch originated from Syria (Manufacturer A) and it was transported by the Syrian Wholesaler B (RASFF 2019.3988).

On 6 August 2020, the food safety authority in Germany notified the outcome of an official control performed at the German Retailer A. Seven samples of sesame paste were collected on 21, 28 and 29 July 2020, and *Salmonella* was found in six of them. Serotyping revealed the presence of *S. Amsterdam*, *S. Havana*, and *S. Mbandaka* in three samples belonging to tahini Batch B, Brand A. Sesame paste products sampled at retail level from tahini Batch B were imported from Syria by the German Wholesaler A and the German Wholesaler C. *S. Havana* was detected in one sample from tahini Batch C, Brand A. The wholesaler that traded tahini Batch C was not available in RASFF. *S. Senftenberg* was detected in one sample from tahini Batch D, Brand A, and *S. Orion* was isolated in one sample from tahini Batch E, Brand A. Tahini Batch C, tahini Batch D and tahini Batch E were imported by the German Wholesaler A. All these batches originated from the Syrian Manufacturer A and were transported by the Syrian Wholesaler B (RASFF 2019.3988).

The German Wholesaler A distributed the imported goods (batches not specified in RASFF) within Germany and to recipients in Finland (Finnish Retailer B).

On 27 July 2021, the food safety authority in Germany launched a notification in RASFF (2021.3974) to communicate the detection of *Salmonella* serogroup C from tahini Batch B (400g), Brand A (*fup0*, RASFF 2021.3974). The *Salmonella* isolate was typed as *S. Mbandaka* matching the outbreak strain (*fup1*, RASFF 2021.3974). The sample was taken on 14 July 2021 in an official control at the German Retailer I. Batch B (400g), Brand A, originating from Syria, was exported by the Syrian Exporter C and imported to Germany by the German Importer C. The product was then only distributed within Germany (*fup0*, RASFF 2021.3974).

On 29 July 2021, the food safety authority in Germany launched a notification in RASFF (2021.4045) reporting the detection of *S. Amsterdam*, *S. Kintambo*, *S. Orion*, and *S. Senftenberg* in sesame-based products (halva and tahini) of the Brand C, originating from Syria. *S. Orion* was isolated from halva 'pistachio' Batch P (400 g), Brand C. *S. Amsterdam* was isolated from halva 'pistachio' Batch P (900 g), Brand C. *S. Senftenberg* was isolated from tahini Batch Q (800 g), Brand C. *S. Kintambo* was isolated from tahini Batch Q (400 g), Brand C. Halva 'pistachio' Batch P (400 g and 900 g) was sampled at the German Wholesaler A on 16 July 2021. Tahini Batch Q (400 g and 800 g) was sampled at the German Wholesaler A on 9 July 2021. The German Wholesaler A had received the products from the Syrian Wholesaler B. The products were inspected immediately after importation in the context of own-checks, and they were not placed on the market (*fup0*, RASFF 2021.4045).

## Sweden

The following food isolates clustering with the outbreak strains according to the WGS analyses performed either at national level or according to the ECDC/EFSA joint WGS analysis were identified:

- One isolate of *S. Mbandaka* was detected from tahini Batch B (400g), Brand A, sampled on 9 June 2021 at the Swedish Retailer C;
- One isolate of *S. Havana* was detected from halva Batch F (800g) Brand A, sampled on 9 June 2021 at the Swedish Retailer D;
- Two isolates of *S. Havana* and *S. Amsterdam* were detected from halva 'pistachio' Batch G (400g), Brand A, sampled on 9 June 2021 at the Swedish Retailer D;
- One isolate of *S. Orion* was detected from halva 'extra pistachio' Batch H (400g), Brand A, sampled on 9 June 2021 at the Swedish Retailer D.
- One isolate of *S. Mbandaka* was detected from tahini Batch O (400 g), Brand A, sampled on 24 June 2021 at the Swedish Retailer C;
- One isolate of *S. Senftenberg* was detected from halva 'extra pistachio' Batch J (800g) of the Brand A, sampled on 28 June 2021 at the Swedish Company L.

Following the detection of *Salmonella* from sesame-based products (as reported by Germany in RASFF 2019.3988), on 9 June 2021 the food safety authority in Sweden performed a sampling of sesame-based products imported from Syria (RASFF 2021.3351). Eighteen products of halva and tahini from nine brands were collected. *Salmonella* was detected in five of them. Specifically, one isolate from tahini Batch B (400 g) was identified as *S. Mbandaka*, one isolate from halva Batch F (800 g) as *S. Havana*, two isolates from one sample of halva 'pistachio' Batch G (400g) as *S. Amsterdam* and *S. Havana*, and one isolate from halva 'extra pistachio' Batch H (400 g) as *S. Orion* (*fup13*, *fup21*, RASFF 2021.3351). All the aforementioned products were from Brand A. One *Salmonella* isolate from tahini Batch I from Brand B was also detected, but it was not possible to identify its serotype (*fup13*, RASFF 2021.3351). According to the whole genome sequencing (WGS) analysis performed in Sweden, the *S. Mbandaka* isolate from tahini Batch B (400g), Brand A, differed by 5-6 SNP from the two *S. Mbandaka* representative sequences and 7 SNP from the *S. Mbandaka* isolate found in tahini in Germany in 2020. The *S. Havana* isolate from halva Batch F (800g), Brand A, differed by 11-12 SNP from the two *S. Havana* representative sequences and by 11-14 SNP from the three German *S. Havana* food isolates. The *S. Orion* isolate from halva 'extra pistachio' Batch H (400g), Brand A, clustered with isolates from four human cases in Sweden and differed by 0 SNP from the *S. Orion* isolate found in tahini in Germany in 2020. The isolate of *S. Amsterdam* from halva 'pistachio' Batch G (400g), Brand A, matched the *S. Amsterdam* isolate found in tahini in Germany in 2020.

Tahini Batch B (400 g), Brand A and tahini Batch I, Brand B were collected on 9 June 2021 at the Swedish Retailer C. Halva Batch F (800 g), halva 'pistachio' Batch G (400 g), and halva 'extra pistachio' Batch H (400 g) were collected on 9 June 2021 at the Swedish Retailer D (RASFF 2021.3351).

The sesame-based products of the Brand A originated from Syria, were exported by the Syrian Exporter A and imported into Sweden on 9 September 2020 by the Swedish Importer A, that sold them to the Swedish Company A (tahini, halva, halva 'pistachio', and halva 'extra pistachio'), the Swedish Company B, the German Company C (tahini, halva, halva 'pistachio', and halva 'extra pistachio'), the Swedish Company D (tahini and halva 'extra pistachio'), and the Norwegian Company E (tahini and halva 'pistachio') (*fup6*, RASFF 2021.3351). The tahini Batch B, Brand A sampled at the Swedish Retailer C had been distributed by the Swedish Company A.

The Swedish Company A also received sesame-based products from the Swedish Importer B. Sesame-based products (tahini - sesame juice 800g and tahini 400g) were exported from Syria on 27 July 2020 by the Syrian Wholesaler B and imported into Sweden by the Swedish Importer B (*fup1*, RASFF 2021.3351).

Tahini Batch I, Brand B, originated from the Syrian Manufacturer B. The food safety authority in Sweden reported that it had been also delivered to the Swedish Company F, but only a few units had been distributed to customers in Sweden (*fup9*, RASFF 2021.3351).

On 24 June 2021, a local competent authority in Sweden collected a sample from tahini Batch O (400g), Brand A at the Swedish Retailer C (*fup20*, RASFF 2021.3351). *S. Mbandaka* was detected from the sample (*fup20*, *fup22*, RASFF 2021.3351).

In addition, on 28 June 2021 a local competent authority in Sweden collected a sample from halva 'extra pistachio' Batch J (800g) of the Brand A (*fup10*, RASFF 2021.3351), which tested *Salmonella* positive. The sample was collected at the Swedish Company L. The *Salmonella* isolate was typed as *S. Senftenberg* (*fup14*, RASFF 2021.3351). The halva 'extra pistachio' Batch J (800g) was delivered by the Swedish Importer A to the Swedish Company G, the Swedish Company H, the Swedish Company I, the Swedish Company J, the Swedish Company K, and to recipients in Germany and Norway (*fup10*, RASFF 2021.3351). In addition to Batch J (800g), the Swedish Company G, the Swedish Company H, the Swedish Company I, the Swedish Company J, and the Swedish Company K also received other sesame-based products of the Brand A from the Swedish Importer A, including tahini, halva, halva 'pistachio' and halva 'extra pistachio'.

After having contacted the Swedish Importer A, the food safety authority in Sweden reported that halva and tahini products (labelling and traceability information not available in RASFF) had also been imported into Sweden on 8 April 2020. These products were traced back to the Syrian Exporter B (*fup23*, RASFF 2021.3351).

The food safety authority in Sweden reported that tahini Batch K (800g) of the Brand A, imported by the Swedish Importer A and delivered to the Norwegian Company E was not distributed further (*fup26*, RASFF 2021.3351).

Furthermore, an official sample was collected on 14 September 2021, from halva 'pistachio' Batch R (800g) of the Brand A at the Swedish Company M. *S. Senftenberg* was isolated from the sample (*fup30*, RASFF 2021.3351). The Swedish Company M had purchased the product from the Swedish Company N. Halva 'pistachio' Batch R (800g) had been imported by the Swedish Importer D, which delivered it to the Swedish Company N (#503448, #505174, RASFF 2021.3351). The Swedish Company N had further distributed the product to recipients in Sweden, namely the Swedish Retailer J, the Swedish Retailer K, the Swedish Retailer L, the Swedish Retailer M, the Swedish Retailer N, the Swedish Retailer O, the Swedish Retailer P, and the Swedish Retailer Q (#504443, RASFF 2021.3351). The Swedish Importer D had delivered halva 'pistachio' Batch R (800g) to 25 other recipients in Sweden in addition to the Swedish Company N (#506139, RASFF 2021.3351).

On 14 September 2021, an additional sample was collected at the Swedish Company M from a halva product without markings (unknown batch, unknown brand). *S. Gatineau* was isolated from the sample (*fup30*, RASFF 2021.3351).

The food safety authority in Sweden reported that sesame-based products of the Brand C, that tested positive in Germany for *S. Amsterdam*, *S. Kintambo*, *S. Orion*, and *S. Senftenberg* were not sold in Sweden (*fup29*, RASFF 2021.3351). However, according to the whole genome sequencing (WGS) analysis performed in Sweden, the *S. Kintambo* isolate from tahini Batch Q (400 g) Brand C was found to cluster with human cases in Sweden (1-2 SNP). The *S. Orion* isolate from halva 'pistachio' Batch P (400 g) Brand C was found to cluster with isolates from human cases in Sweden (4-10 SNP), with the *S. Orion* isolate from tahini Batch E (Brand A) sampled in Germany in July 2020 (3 SNP), and with the *S. Orion* isolate from halva 'extra pistachio' Batch H (400g) (Brand A) sampled in Sweden in June 2021 (3 SNP). The *S. Amsterdam* isolate from halva 'pistachio' Batch P (900 g), Brand C, was found to cluster with the *S. Amsterdam* isolate from tahini Batch B (Brand A) sampled in Germany in July 2020 (1 SNP), and with the *S. Amsterdam* isolate detected from halva 'pistachio' Batch G (400g) (Brand A) sampled in Sweden in June 2021 (2 SNP). No matching isolates, either human or non-human, were found in Sweden for the *S. Senftenberg* isolate from tahini Batch Q (800 g), Brand C (*fup29*, RASFF 2021.3351).

## Norway

Overall, the following food isolates clustering with the outbreak strains according to the WGS analyses performed either at national level or according to the ECDC/EFSa joint WGS analysis were identified:

- One isolate of *S. Senftenberg* was detected from halva Batch F (800g), Brand A, sampled on 1 July 2021 at the Norwegian Company E;
- Two isolates of *S. Mbandaka* and *S. Havana* were detected from tahini Batch K (400g), Brand A, sampled on 28 June 2021 at the Norwegian Retailer E and on 1 July 2021 at the Norwegian Company E;
- Two isolates of *S. Mbandaka* and *S. Amsterdam* were detected from tahini Batch K (800g), Brand A, sampled on 21 July 2021 at the Norwegian Retailer G;
- Two isolates of *S. Orion* and *S. Mbandaka* were detected from halva Batch M (800g), Brand A, sampled on 5 July 2021 at a patient's home;
- Three isolates of *S. Mbandaka*, *S. Orion*, *S. Amsterdam* were detected from tahini Batch N (800g), Brand A, sampled on 8 July 2021 at the Norwegian Retailer F.

The food safety authority in Norway performed some official controls and samplings that followed the distribution of sesame-based products originating from Syria by the Swedish Importer A (*fup10*, *fup12*, RASFF 2021.3351). On 28 June 2021, a sample was collected from tahini Batch K (400g), Brand A at the Norwegian Retailer E (*fup5*, RASFF 2021.3351). *S. Mbandaka* was isolated from the sample (*fup15*, RASFF 2021.3351). The product had been delivered to the Norwegian Retailer E by the Norwegian Company E, that had purchased it from the Swedish Importer A. In addition, one sample of tahini Batch K (400g), Brand A and one sample from halva Batch F (800g), Brand A were collected at the Norwegian Company E on 1 July 2021. *S. Havana* and *S. Senftenberg* were isolated, respectively (*fup15*, *fup28*, RASFF 2021.3351). Halva Batch F and tahini Batch K were purchased directly from the Swedish Importer A. On 5 July 2021, one sample was collected from halva Batch M (800g) of the Brand A at a patient's home. The patient had purchased the product from the e-commerce A, that had purchased it from the Swedish Company O. *S. Mbandaka* and *S. Orion* were isolated from the sample (*fup16*, RASFF 2021.3351). On 8 July 2021, one sample was collected from tahini Batch N (800g), Brand A at the Norwegian Retailer F. *S. Amsterdam*, *S. Mbandaka* and *S. Orion* were isolated from the sample (*fup17*, RASFF 2021.3351). Tahini Batch N (800g) originated from the Syrian Manufacturer A and was labelled as imported by the Swedish Importer A. On 21 July 2021, four samples were collected from tahini Batch K (800g) of the Brand A at the Norwegian Retailer G. *S. Amsterdam*, *S. Mbandaka* and *S. Senftenberg* were isolated from the sample (*fup18*, *fup27*, *fup32*, RASFF 2021.3351). The product was purchased from the Norwegian Company E, that had in turn purchased it from the Swedish Importer A.



## Control measures

On 6 August 2020, the food safety authority in Germany reported that Batch A was withdrawn, recalled, and destroyed by the German Wholesaler A. Batch B, Batch C, Batch D and Batch E were recalled and an official detention of the remaining products was implemented. The German Wholesaler A informed its recipients and destroyed the remaining products (*fup3, 2019.3988*).

On 10 August 2020, the food safety authority in Finland reported that the Finnish Retail A withdrew and recalled the received sesame-based products. As precautionary measures, other sesame-based products from the same producer were withdrawn (*fup5, 2019.3988*).

On 30 June 2021, the food safety authority in Sweden performed an inspection at the Swedish Company B and reported that there were no sesame-based products (halva and tahini) left at the store (*fup6, 2021.3351*).

On 1 July 2021, the food safety authority in Norway reported that the Norwegian Company E withdrew the sesame products (halva and tahini) (*fup8, 2021.3351*).

On 5 July 2021, the food safety authority in Sweden reported that the products stocked at the Swedish Company F were awaiting destruction. In addition, the Swedish Company F informed the Syrian Manufacturer B of the *Salmonella* positive findings reported in RASFF 2021.3351 (*fup9, 2021.3351*).

On 7 July 2021, the food safety authority in Norway reported that the sesame-based products (halva and tahini) had been recalled on 02 July 2021 in Norway and a public warning had been published (*fup12, RASFF 2021.3351*).

The food safety authority in Germany informed the German Company C about the recall of affected products. The German Company C that had received sesame-based products from the Swedish Importer A on 24 April 2021 withdrew the products that were still present in its premises, i.e. halva 'pistachio' Batch L (800g) and halva 'pistachio' Batch G (400g), from the market (*fup11, RASFF 2021.3351*).

On 27 July 2021, the food safety authority in Germany communicated that tahini Batch B (400g), Brand A had been withdrawn by the German Importer C (*fup0, RASFF 2021.3974*).

On 29 July 2021, the food safety authority in Germany reported in RASFF that following the detection of *Salmonella* in own-check samples from halva 'pistachio' Batch P (400 and 900 g) and tahini Batch Q (400 g and 800 g), both of the Brand C, the same products were subject to official control and, after that, they were completely disposed of under official supervision (*fup0, RASFF 2021.4045*).

On 31 August 2021, a municipal authority in Sweden reported that the Swedish Importer A had withdrawn the sesame-based products remaining in the premises of the Swedish Company K (*#499521, RASFF 2021.3351*). On 2 September 2021, another municipal authority reported that the Swedish Company G and the Swedish Company H did not have any of the withdrawn products left (*#500029, RASFF 2021.3351*). On 8 September 2021, a third municipal authority in Sweden reported that the products had been removed from the shelves of the Swedish Retailer H and were awaiting being collected by the supplier (*#501069, RASFF 2021.3351*).

On 22 September 2021, another municipal authority in Sweden informed that the Swedish Company N had delivered back to its supplier the leftover of the halva 'pistachio' Batch R (800g), Brand A (*#504119, RASFF 2021.3351*). On 28 and 29 September 2021, additional municipal authorities in Sweden reported on the outcome of official controls regarding halva 'pistachio' Batch R (800g), Brand A, distributed by the Swedish Company N to recipients in Sweden. The Swedish Retailer J still had halva 'pistachio' Batch R (800g), which was removed from sale on 28 September 2021 (*#505333, RASFF 2021.3351*). The Swedish Retailer K had not been warned by the supplier, and it removed halva 'pistachio' Batch R (800g) from sale following the inspection of the local authority on 28 September 2021 (*#505400, RASFF 2021.3351*). The Swedish Retailer M and the Swedish Retailer N been warned by the supplier and removed halva 'pistachio' Batch R (800g) from sale (*#505244, #505566, RASFF 2021.3351*). The Swedish Retailer Q had not been warned by the supplier, but it had no products left originating from Syria (*#505291, RASFF 2021.3351*). The Swedish Retailer L had not been warned by the supplier, but it had no products left originating from it and it had not purchased products from the Swedish Company N since about six months earlier (*#505333, RASFF 2021.3351*). The Swedish Retailer P had not been warned by the supplier, but it did not have any of halva 'pistachio' Batch R (800g) (*#505563, RASFF 2021.3351*). The Swedish Retailer O also did not have any of the product at the time of the inspection of the local authority (*#505621, RASFF 2021.3351*). On 1 October 2021, a municipal authority in Sweden reported that the Swedish Importer D would contact all its customers that had received halva 'pistachio' Batch R (800g) (*#506139, RASFF 2021.3351*).

## European whole genome sequencing analysis of human and non-human isolates

WGS data of 13 representative human isolates were included in the centralised analysis:

- *S. Amsterdam*: Germany (n=1)
- *S. Havana*: Sweden (n=2), Norway (n=1)
- *S. Kintambo*: Denmark (n=1), Sweden (n=1)
- *S. Mbandaka*: Sweden (n=2), Norway (n=1)
- *S. Orion*: Germany (n=1), Norway (n=1)
- *S. Senftenberg*: Sweden (n=2).

A total of 28 food isolates (*S. Mbandaka* (n=8), *S. Amsterdam* (n=6), *S. Havana* (n=6), *S. Orion* (n=5), *S. Senftenberg* (n=2) and *S. Kintambo* (n=1)) were added to the joint WGS analysis. These included sequences of eleven food isolates from Germany, seven food isolates from Sweden and ten food isolates from Norway, retrieved by the EURL-*Salmonella*'s national reference laboratory (NRL) network. In addition, the NRL-*Salmonella* in Germany, Sweden and Norway shared with EFSA via the EURL-*Salmonella*, eight additional isolates, either not matching the outbreak strains or of different serotypes which were not included in the case definition, for which the joint WGS analysis was not performed.

Serotypes isolated in food and included in the case definition:

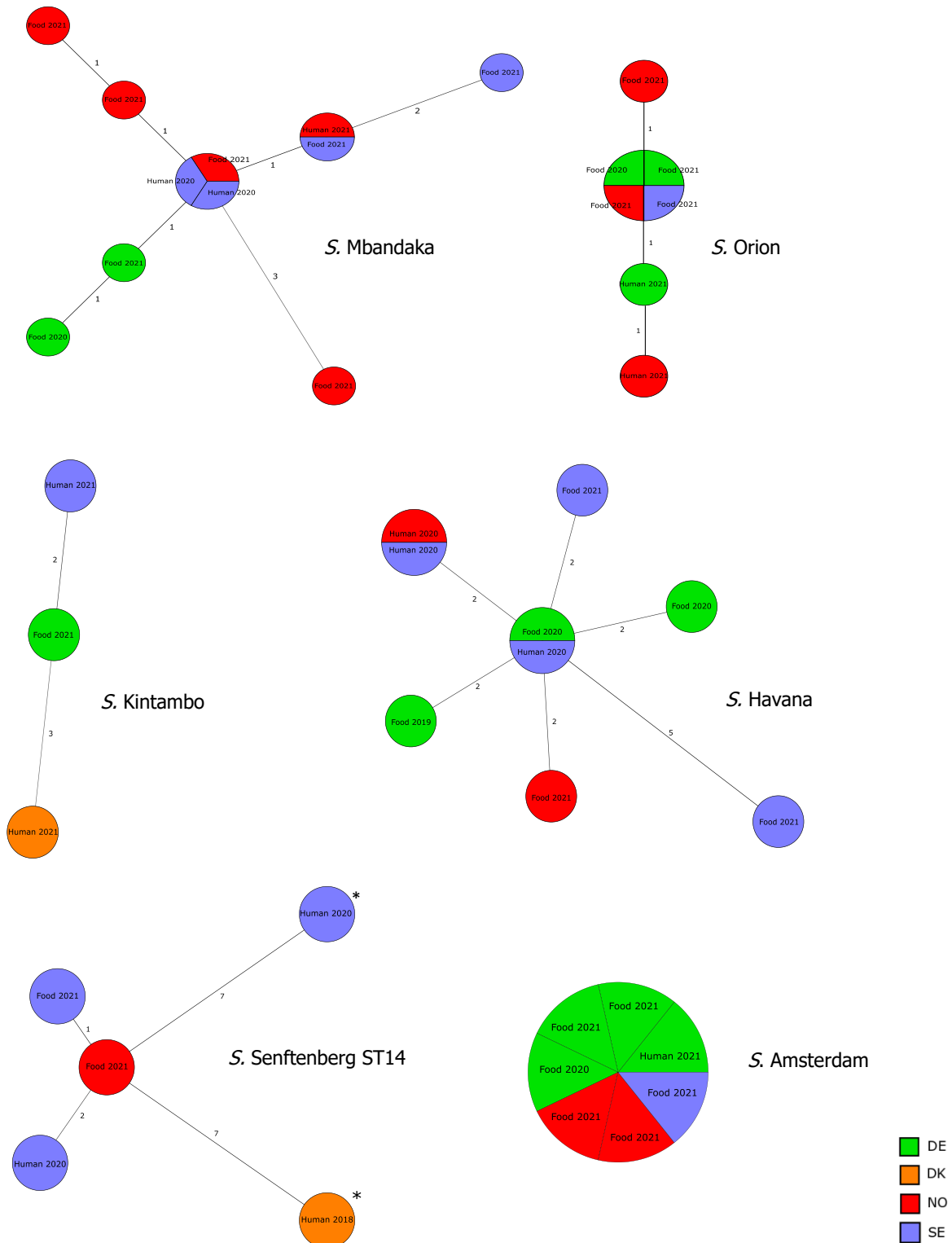
- *S. Amsterdam* ST590: three from Germany (Batch B, Batch P and an unknown batch), two from Norway (Batch N and Batch K), one from Sweden (Batch G);
- *S. Havana* ST1526: three from Germany (Batch A, Batch B and Batch C), one from Norway (Batch K), two from Sweden (Batch F and Batch G);
- *S. Kintambo* ST8754: one from Germany (Batch Q)
- *S. Mbandaka* ST413: two from Germany (Batch B), four from Norway (Batch K, Batch M and Batch N), two from Sweden (Batch B and Batch O);
- *S. Orion* ST8043: two from Germany (Batch E and Batch P), two from Norway (Batch M and Batch N), one from Sweden (Batch H);
- *S. Senftenberg* ST14: one from Norway (Batch F), one from Sweden (Batch J).

Additional food isolates not included in the joint WGS analysis:

- *S. Senftenberg* ST14 not matching the outbreak strain: one from Germany (Batch Q);
- *S. Senftenberg* ST217: one from Germany (Batch D), one from Norway (Batch K);
- *Salmonella enterica* subsp. O7 7:l,v:- : one from Sweden (Batch I);
- Two *S. Tennessee*, one *Salmonella enterica* subsp. I 6,7:l,v:- and one *Salmonella enterica* subsp. I 3,10:b:- isolated from sesame-based products in 2021 from unknown batches and brands, shared by the NRL-*Salmonella* in Germany

Minimum spanning trees (MSTs) based on cgMLST allelic profiles using Enterobase scheme were generated for all six *Salmonella* serotypes separately (Figure 2). Both Illumina and IonTorrent sequencing data were used in the analyses.

**Figure 2. Minimum spanning trees (cgMLST, Enterobase scheme) of *S. Mbandaka*, *S. Havana*, *S. Orion*, *S. Kintambo*, *S. Senftenberg* ST14, and *S. Amsterdam* including sequences of 13 human isolates from Denmark, Germany, Norway and Sweden, and 22 food isolates from Germany, Norway and Sweden, 1 January 2019–14 October 2021\***



\* One Swedish human isolate differs by seven allelic differences (AD) but fulfils confirmed EU/EEA case definition according to the national SNP pipeline. Another human isolate of *S. Senftenberg* ST14 with seven AD from Denmark is a historical isolate from 2018, which is included in the WGS analysis but excluded from the event description.

## ECDC and EFSA risk assessment for the EU/EEA

An outbreak involving six *Salmonella* serotypes (*S. Amsterdam*, *S. Havana*, *S. Kintambo*, *S. Mbandaka*, *S. Orion*, and *S. Senftenberg*) with an epidemiological and/or microbiological link to sesame-based products (halva/tahini) has been ongoing in five EU/EEA countries since 1 January 2019. By 4 October 2021, confirmed cases were reported in Denmark (n=9), Germany (n=68), the Netherlands (n=2), Norway (n=5), and Sweden (n=37). In addition, eight cases have been reported in Canada and six cases in the United States. The epidemic curve of confirmed cases in the EU/EEA shows an annually increasing magnitude with a notable increase of infections in March 2021 (Figure 1). This is likely a surveillance artefact as sequencing data, which is used for the classification of confirmed cases, may not be available for cases dating two to three years back. Nevertheless, the cases seem to occur intermittently. Almost half of confirmed cases (45.4%) are in children ≤10 years, who also represent the majority of hospitalised cases (12/22). The demographic and background data of cases indicate the vehicle of infection could be a product largely consumed by young children, and that was sold in stores with customers with a Middle East background as a target group. Interviews of eight cases in total (in Denmark, Germany, Norway, and Sweden) revealed consumption of tahini/halva products.

Between November 2019 and July 2021, 12 batches of sesame-based products (halva and tahini of Batch A, Batch B, Batch C, Batch E, Batch F, Batch G, Batch H, Batch K, Batch J, Batch N, Batch M, and Batch O) of the same brand (Brand A), sampled in Germany, Sweden or Norway, tested positive within their shelf-life for one or multiple *Salmonella* serotypes, namely *S. Amsterdam*, *S. Havana*, *S. Mbandaka*, *S. Orion*, and *S. Senftenberg* matching the outbreak strains (based on the EU WGS analysis and/or clustering analysis at national level). In particular, six batches of Brand A (Batch B, Batch F, Batch G, Batch K, Batch M and Batch N) were found positive for more than one outbreak strain. One batch of halva (Batch M), which tested positive for *S. Mbandaka* and *S. Orion*, was sampled at a patient's home in Norway.

All the 12 batches of the sesame-based products of Brand A positive for the outbreak strains were imported in the EU/EEA from Syria and distributed to food business operators sited in Finland, Germany, Norway, and Sweden. Microbiological results from testing of the contaminated batches at the production level and from the processing environment were not available in RASFF.

In July 2021, one batch of halva 'pistachio' (Batch P) and one batch of tahini (Batch Q) from an additional brand (Brand C) sampled in Germany tested positive for the *S. Amsterdam* and *S. Orion* outbreak strains and for the *S. Kintambo* outbreak strain, respectively. These batches originated from Syria (unknown manufacturer) but they were not placed on the EU market.

Based on the available epidemiological, microbiological, and traceability information, the probable vehicles of infection in confirmed cases are sesame-based products (halva and tahini) imported from Syria. However, the traceability of the positive batches cannot explain all the cases, for example those reported in Denmark, although 3/5 interviewed Danish cases reported consumption of tahini. The involved products are sealed products ready to be consumed, which suggests that the contamination happened before the products reached the EU/EEA market. The intermittent occurrence of human cases and the identification of positive food samples containing isolates representing multiple *Salmonella* serotypes since 2019 indicate the availability of contaminated sesame-based products in the EU/EEA market for over two years. This has posed a risk for human infections and severe clinical illness with several *Salmonella* serotypes, particularly among children.

Control measures (withdrawals, recalls, and destructions) on the involved batches of sesame-based products have been implemented since August 2020 by the food safety authorities in Germany, Sweden, Norway, and Finland. However, these have not prevented the occurrence of human cases up to September 2021. Of the 12 batches of Brand A positive for the outbreak strains, two have their best before date at the beginning of 2021, two in mid-2021, four at the end of 2021, and four at the beginning of 2022. The two positive batches of Brand C have their best before date in mid-2023. Some studies have shown that *Salmonella* can survive in sesame-based products for several months [2-4]. Moreover, the concerned products have a long shelf life and might still be stored in people's homes. Consumers unaware of the recalls could continue consuming these products and potentially become ill.

Considering the limited background information on product manufacturing, including growing and harvesting, and on distribution (gaps in the batches distribution pattern) to guide a complete trace-back and forward investigation analysis, there remains a risk for new *Salmonella* infections in the EU/EEA linked to imported sesame-based products from Syria.

## Options for response

ECDC encourages countries to continue sequencing human isolates of domestically-acquired *S. Amsterdam*, *S. Havana*, *S. Kintambo*, *S. Mbandaka*, *S. Orion*, and *S. Senftenberg* infections and any other *Salmonella* serotypes linked to consumption of sesame-based products. If isolates match with a representative isolate in respective serotype clusters, countries may consider interviewing cases for possible consumption of sesame-based products. ECDC encourages public health authorities to be in contact with food safety authorities should new cases with microbiological or epidemiological links to sesame-based products or the clusters in this event be detected. Any new epidemiological/case-related information should be reported in ECDC EpiPulse (2021-FWD-00020). ECDC can offer sequencing support to those countries who have identified possible cases but have no capacity to sequence the isolates.

EFSA encourages Member States to perform sequencing of *S. Amsterdam*, *S. Havana*, *S. Kintambo*, *S. Mbandaka*, *S. Orion*, *S. Senftenberg* and any other *Salmonella* serotypes food isolates related to the RASFF notifications 2019.3988, 2021.3351, 2021.3974, and 2021.4045 and/or linked to the present cluster either microbiologically (serogroup or ST) or epidemiologically (e.g. consumption of sesame-based products by the human cases or isolates linked to the companies involved as in RASFF 2019.3988, 2021.3351, 2021.3974, and 2021.4045), and to share these sequences with EFSA and the EURL-*Salmonella*. Further information about food traceability investigation can be requested from the RASFF contact point of the relevant countries.

## Source and date of request

ECDC sent a request for a Rapid Outbreak Assessment to EFSA on 19 August 2021 and EFSA accepted it on 20 August 2021.

## Consulted experts and national contact points

**ECDC experts (in alphabetical order):** Cecilia Jernberg, Johanna Takkinen.

### Public health experts:

Denmark: Eva Litrup, Luise Müller (Statens Serum Institut)

Germany: Anika Meinen, Sandra Simon (Robert Koch Institute)

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All public health experts have submitted declarations of interest, and a review of these declarations did not reveal any conflict of interest.

**EFSA staff (in alphabetical order):** Lorena Corredor Barrera, Ernesto Liebana Criado, Stefania Musella, Denise Pezzutto, Valentina Rizzi, Mirko Rossi, Eleonora Sarno.

**European Union Reference Laboratory for *Salmonella* (EURL-*Salmonella*):** Robin Diddens, Kirsten Mooijman, Angela van Hoek.

**RASFF contact points: Finland, Germany, Norway, Sweden.**

### National experts consulted by the RASFF contact points:

Finland: Mika Varjonen (Finnish Food Authority)

Norway: Margrethe Hovda Røed (Norwegian Food Safety Authority), Olaug Taran Skjerdal (Norwegian Veterinary Institute), Bjarne Bergsjø (Norwegian Veterinary Institute), Camilla Sekse (Norwegian Veterinary Institute)

Sweden: Mats Lindblad (Swedish Food Agency)

## Disclaimer

ECDC issued this outbreak assessment document in accordance with Article 10 of Decision No 1082/13/EC and Article 7(1) of Regulation (EC) No 853/2004 establishing a European Centre for Disease Prevention and Control (ECDC), and with the contribution of EFSA in accordance with Article 31 of Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002, 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.

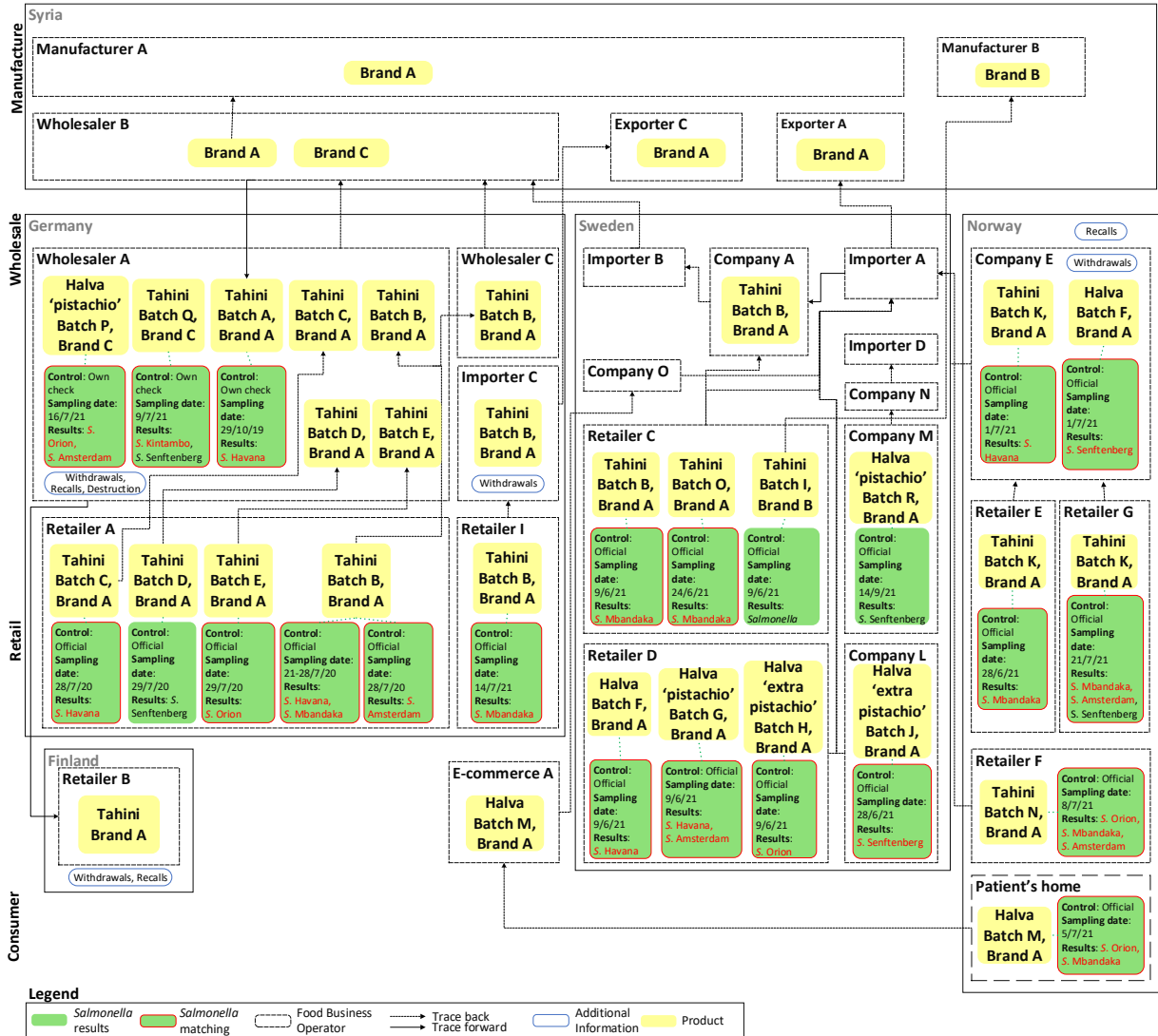
In the framework of ECDC's mandate, the specific purpose of an ECDC-EFSA outbreak assessment is to present different options on a certain matter. The responsibility on the choice of which option to pursue and which actions to take, including the adoption of mandatory rules or guidelines, lies exclusively with EU/EEA Member States. In its activities, ECDC strives to ensure its independence, high scientific quality, transparency and efficiency.

This report was written under the coordination of an internal response team at ECDC, with contributions from EFSA, at the behest of the European Commission based on a mandate requesting scientific assistance from EFSA in the investigation of multinational food-borne outbreaks (Ares (2013) 2576387, Mandate M-2013-0119, 7 July 2013).

All data published in this rapid outbreak assessment are correct to the best of ECDC's and EFSA's knowledge as of 14 October 2021. Maps and figures published do not represent a statement on the part of ECDC, EFSA or its partners on the legal or border status of the countries and territories shown.

# Annex 1. Food traceability and analyses

**Figure A1.** Graphical representation of the traceability, testing information and control measures of sesame-based products positive for *Salmonella*, as reported by the involved countries under the RASFF notifications 2019.3988, 2021.3351, 2021.3974, and 2021.4045



**Table A1. *Salmonella* isolates from sesame-based products from Syria**

<i>Salmonella</i> serotype	Sequence type (ST)	Country of sampling	Date of sampling	Product	Batch	Brand	Match with outbreak strain
Havana	ST1526	Germany	29 Oct 2019	Tahini	Batch A	Brand A	Match
			28 Jul 2020	Tahini	Batch B	Brand A	Match
			29 Jul 2020	Tahini	Batch C	Brand A	Match
		Sweden	9 Jun 2021	Halva	Batch F	Brand A	Match
			9 Jun 2021	Halva 'pistachio'	Batch G	Brand A	Match
		Norway	1 Jul 2021	Tahini	Batch K	Brand A	Match
Mbandaka	ST413	Germany	21 Jul 2020	Tahini	Batch B	Brand A	Match
			14 Jul 2021	Tahini	Batch B	Brand A	Match
		Sweden	9 Jun 2021	Tahini	Batch B	Brand A	Match
			24 Jun 2021	Tahini	Batch O	Brand A	Match
		Norway	21 Jul 2021	Tahini	Batch K	Brand A	Match
			28 Jun 2021	Tahini	Batch K	Brand A	Match
			5 Jul 2021	Halva	Batch M	Brand A	Match
			8 Jul 2021	Tahini	Batch N	Brand A	Match
Orion	ST8043	Germany	29 Jul 2020	Tahini	Batch E	Brand A	Match
			16 Jul 2021	Halva 'pistachio'	Batch P	Brand C	Match
		Sweden	9 Jun 2021	Halva 'extra pistachio'	Batch H	Brand A	Match
		Norway	5 Jul 2021	Halva	Batch M	Brand A	Match
			8 Jul 2021	Tahini	Batch N	Brand A	Match
Amsterdam	ST590	Germany	28 Jul 2020	Tahini	Batch B	Brand A	Match
			16 Jul 2021	Halva 'pistachio'	Batch P	Brand C	Match
		Sweden	9 Jun 2021	Halva 'pistachio'	Batch G	Brand A	Match
		Norway	21 Jul 2021	Tahini	Batch K	Brand A	Match
			8 Jul 2021	Tahini	Batch N	Brand A	Match
		Senftenberg	ST14	Germany	9 Jul 2021	Tahini	Batch Q
Sweden	28 Jun 2021			Halva 'extra pistachio'	Batch J	Brand A	Match
Norway	1 Jul 2021			Halva	Batch F	Brand A	Match
ST217	Germany		29 Jul 2020	Tahini	Batch D	Brand A	Not match
	Norway		21 Jul 2021	Tahini	Batch K	Brand A	Not match
Unknown <sup>1</sup>	Sweden	14 Sept 2021	Halva 'pistachio'	Batch R	Brand A	Unknown <sup>1</sup>	
Kintambo	ST8754	Germany	9 Jul 2021	Tahini	Batch Q	Brand C	Match
Unknown	Unknown	Sweden	9 Jun 2021	Tahini	Batch I	Brand B	Unknown

Unknown = not reported in RASFF and not identifiable through WGS analysis

<sup>1</sup>Isolate not available for WGS analysis.



## Annex 2. Disease background

### Disease characteristics

Background information about salmonellosis can be found in the disease fact sheets from ECDC, CDC, and WHO [5-7].

### Disease surveillance for salmonellosis in the EU/EEA

#### ***S. Amsterdam*, *S. Havana*, *S. Kintambo*, *S. Mbandaka*, *S. Orion*, and *S. Senftenberg* isolation in humans**

***S. Amsterdam*** was a rare serotype (139th most common) in 2015-2019 with an annual average of six cases reported among eight countries. In 2019, 11 cases were reported by four countries: United Kingdom (n=6), France (n=3), Italy (n=1), and the Netherlands (n=1). In the five-year period, cases were most common among children 0-4 years old (30%) and 24-44 years old (40%). There was no significant difference in cases by gender (15 females and 13 males). History of travel was reported for 3/14 cases. One case had travelled to Egypt in 2016 and one to Uganda in 2019.

***S. Havana*** was a rare serotype (60th most common) in the EU/EEA in 2015-2019. It was reported by 20 EU/EEA countries with an annual case number of 45-73 confirmed cases per year. The UK, Germany and France accounted for 32%, 16% and 12%, respectively, of the cases in this period. Most cases were in children below four years of age (25%) followed by persons 25-44 years (22%) and over 65 years (22%) old. There was no difference between genders. Travel information was available for 64% cases and of these, the majority (75%) were domestically acquired.

***S. Kintambo*** was a rare serotype (141st most common) in 2015-2019 with an annual average of five cases reported among four countries. In 2019, three cases were reported in two countries: United Kingdom (n=2) and Germany (n=1). In the five-year-period, cases were most common among children below five years old (46%) and adults over 45 years (42%). There were more females (n=18) than males (n=7) reported in the five-year-period, which was driven by the difference by gender in cases above 65 years (five females, no males). Most cases (65%) reported no travel. Only 3/10 cases reported travel history, but no travel destination was reported.

***S. Mbandaka*** was the 34th most common serotype in the EU/EEA in 2015-2019. It was reported by 24 EU/EEA countries with an annual case number of 162-209 confirmed cases per year. The UK, Germany and France accounted for 30%, 17% and 16%, respectively, of the cases in this period. Most cases were in persons 25-44 years (24%) followed by adults 45-64 years (22%) and over 65 years (19%) old. There was no difference between genders. Travel information was available for 71% cases and of these, the majority (67%) were domestically acquired. Thailand, India, and Egypt accounted for 24%, 19% and 7%, respectively, of the travel-associated cases.

***S. Orion*** was a rare serotype (144th most common) in 2015-2019 with an annual average of five cases reported among 10 countries. In 2019, five cases were reported by three countries: the United Kingdom (n=3), France (n=1), and Italy (n=1). In the five-year period, cases were most common among adults over 24 years old (87%) and there was no significant difference in cases by gender (12 females and 11 males). History of travel was reported for 4/14 cases and one of them reported travel to Egypt in 2015.

***S. Senftenberg*** was a well-reported serotype (45th most common) in 2015-2019 with an annual average of 117 cases reported among 21 countries. In 2019, 119 cases were reported with 76% of cases attributed to five countries: the United Kingdom (n=30), Germany (n=19), France (n=15), Austria (n=15), and Belgium (n=11). In the five-year period, cases were most common among adults 25-64 years old (55%). There was no significant difference in cases by gender. Most cases (65%) reported no travel. Among cases with known travel history, Egypt was the most common destination (18%) followed by India (14%).

Further information can be found in the online *Surveillance atlas of infectious diseases* [8].

#### **Food-borne outbreaks caused by *S. Amsterdam*, *S. Havana*, *S. Kintambo*, *S. Mbandaka*, *S. Orion*, and *S. Senftenberg***

This section summarises country-specific data on food-borne outbreaks associated with *S. Amsterdam*, *S. Havana*, *S. Kintambo*, *S. Mbandaka*, *S. Orion*, and *S. Senftenberg* as reported from 2015 to 2019 to EFSA by EU Member States in accordance with the Zoonoses Directive 2003/99/EC. At the time of data reporting, the United Kingdom was an EU Member State.

No ***S. Amsterdam***, ***S. Havana***, ***S. Kintambo***, and ***S. Orion*** food-borne outbreaks were reported.

During these five years, two weak-evidence food-borne outbreaks caused by ***S. Mbandaka*** were reported by Spain in 2016 and Slovakia in 2018. The reported food vehicles were '**Unknown**'. In total, 13 human cases were reported (11 cases in Spain and two in Slovakia). One non-EU country (Serbia), reported one strong-evidence food-borne outbreak in 2018. The reported food vehicle was '**Eggs and egg products**'. In total there were eight cases, no hospitalised patients, and no deaths.

During the same period, a total of three outbreaks caused by ***S. Senftenberg*** were reported by two EU Member States. Ninety-six human cases were reported by two Austria and Croatia. There were nine hospitalised patients and no deaths.

Specifically, two strong-evidence food-borne outbreaks were reported by Austria in 2016 and by Croatia in 2017. The reported food vehicles were '**Broiler meat (*Gallus gallus*) and products thereof**' in Austria and '**Other or mixed red meat and products thereof**' in Croatia. In total, there were 91 human cases (34 cases in Austria and 57 cases in Croatia), nine hospitalisations (five in Austria and four in Croatia), and no deaths. One weak-evidence food-borne outbreak was reported by Croatia in 2015. The reported food vehicle was '**Unknown**'. In total, there were five human cases, no hospitalised patients and no deaths.

## Occurrence of *S. Amsterdam*, *S. Havana*, *S. Kintambo*, *S. Mbandaka*, *S. Orion*, and *S. Senftenberg* in RTE and not-RTE food

This section summarises country-specific data on the occurrence of *S. Amsterdam*, *S. Havana*, *S. Kintambo*, *S. Mbandaka*, *S. Orion*, and *S. Senftenberg* for the matrices 'Food – RTE' and 'Food non-RTE' from 2015 to 2019 as reported to EFSA by the EU Member States in accordance with the Zoonoses Directive 2003/99/EC. At the time of data reporting, the United Kingdom was an EU Member State.

Over these five years, one unit positive for ***S. Amsterdam*** out of 93 total units tested (1.07%) was reported to EFSA for the matrix 'Food non-RTE' by one EU Member State (Greece). The unit that was positive belonged to the matrix '**Seeds, dried**' (one unit reported by the Greece in 2015).

For the years 2015–2019, 16 units positive for ***S. Havana*** out of 1 733 total units tested (0.92%) were reported to EFSA for the matrix 'Food RTE and non-RTE' by four EU Member States (Belgium, the Netherlands, Portugal, and Slovakia).

The two units positive for *S. Havana* out of the 57 total units tested (3.5%) for the matrix '**Food RTE**' belonged to '**Spices and herbs**' (one unit reported by the Netherlands in 2015) and '**Cheeses made from sheep's milk**' (one unit reported by Portugal in 2019).

The 14 units positive for *S. Havana* out of the 1 676 total units tested (0.83%) for the matrix '**Food non-RTE**' consisted in '**Meat from pig**' (two units reported by Belgium in 2015) and in '**Meat from broilers (*Gallus gallus*)**' (12 units reported by Slovakia in 2018).

For the years 2015–2019, no units were reported to be positive for ***S. Kintambo***.

During these five years, 101 units positive for ***S. Mbandaka*** out of 59 599 total units tested (0.16%) were reported to EFSA for the matrix 'Food RTE and non-RTE' by 18 EU Member States (Austria, Belgium, Bulgaria, Croatia, Czechia, Denmark, Estonia, France, Greece, Hungary, Italy, Latvia, the Netherlands, Poland, Portugal, Romania, Slovakia, and Spain) and by two non-EU Member States (Switzerland and the United Kingdom).

The two units positive for *S. Mbandaka* out of the 233 total units tested (0.85%) for the matrix '**Food RTE**' were reported to EFSA by one EU Member State (Hungary) and belonged to '**Coconut - coconut products**' (reported in 2015) and '**Other processed food products and prepared dishes**' (reported in 2017).

The 91 units positive for *S. Mbandaka* out of the 58 799 total units tested (0.15%) for the matrix '**Food non-RTE**' belonged to the following matrices: '**Eggs and egg products**' (two units reported by Hungary in 2015, one unit by Spain in 2015, and one unit Portugal in 2015); '**Meat from bovine animals**' (one unit reported by Romania in 2015, one unit by Estonia in 2018, and two units by France in 2019); '**Meat from broilers (*Gallus gallus*)**' (two units from Austria in 2018 and 2019, 26 units from Belgium from 2015 to 2019, four units from Croatia in 2018 and 2019, three units from Czechia in 2015 and in 2018, one unit from Latvia in 2019, seven units from the Netherlands in 2017, 2018, and 2019, seven units from Poland in 2018, one unit from Romania in 2015, and one unit from Slovakia in 2017); '**Meat from duck**' (two units reported by Denmark and Hungary in 2019 and 2017, respectively); '**Meat from other animal species or not specified**' (one unit reported by Croatia in 2018 and three by Italy in 2017, 2018, and 2019); '**Meat from pig**' (one unit by Bulgaria in 2018, one unit by Demark in 2019, three units by Estonia in 2015 and 2016, two units by France in 2019, one unit by Italy in 2018, one unit by Romania in 2015); '**Meat from poultry, unspecified**' (two units by Belgium in 2015 and one unit by Poland in 2019); '**Meat from spent hens**' (eight units reported by Belgium in 2015 and 2018); '**Meat, mixed meat**' (one unit reported by Romania in 2015); '**Other processed food products and prepared dishes**' (two units reported by the Netherlands in 2017); and '**seeds, dried**' (two units reported by Greece in 2015).

In addition, eight units positive for *S. Mbandaka* out of 567 total units tested for the matrix '**Food non-RTE**' were reported to EFSA by the two non-EU countries (Switzerland and the United Kingdom). and belonged to the following matrices: '**Meat from broilers (*Gallus gallus*)**' (two units reported by Switzerland in 2015 and one

unit by the United Kingdom in 2017), '**Meat from other animal species or not specified**' (four units reported by the United Kingdom in 2017 and 2018) '**Meat from pig**' - (one unit reported by the United Kingdom in 2018).

During these five years, four units positive for ***S. Orion*** out of 279 total units tested (1.43%) were reported to EFSA only for the matrix '**Food non-RTE**' by two EU Member States (Greece, and the Netherlands).

The four units positive belonged to the following matrix '**Seeds, dried,**' (three units reported by the Greece in 2015, and one by Netherlands in 2017).

During the same period, 43 units positive for ***S. Senftenberg*** out of 11 765 total units tested for the matrix 'Food RTE and non-RTE' were reported to EFSA by 11 EU Member States (Austria, Belgium, Bulgaria, Cyprus, France, Germany, Greece, Italy, Latvia, the Netherlands and Spain) and by one non-EU Member State (the United Kingdom).

The seven units positive for *S. Senftenberg* out of the 947 total units tested (0.73%) for the matrix '**Food RTE**' belonged to following matrices: '**Vegetables**' (one unit reported by Cyprus in 2018); '**Spices and herbs**' (two unit reported by France in 2018), and '**Molluscan shellfish - cooked**' (three unit reported in 2015 and one unit in 2016 by Spain).

The 31 units positive for *S. Senftenberg* out of the 10 809 total units tested (0.28%) for the matrix '**Food non-RTE**' belonged to the following matrices: '**Meat from broilers (*Gallus gallus*)**' (two units reported by Austria in 2015 and in 2016, six units reported by Belgium in 2015 and in 2017, , two units by Italy in 2019, and three units Latvia in 2019); '**Meat from pig**' (one unit by Bulgaria in 2019 and one unit by Italy in 2018); '**Meat from spent hens (*Gallus gallus*)**' (one unit reported by Belgium in 2018); '**Meat from turkey**' (five units reported by Austria in 2019 and one unit reported by Germany in 2015); '**Molluscan shellfish**' (one unit reported by Italy 2019 and one unit by Spain 2015); '**Other processed food products and prepared dishes**' (two units reported by Italy in 2015); '**Seeds, dried**' (one unit reported by Cyprus in 2016, two units by Greece in 2015, and two units by Netherlands in 2015 and 2016).

In addition, five units positive for *S. Senftenberg* out of nine total units tested for the matrix '**Food non-RTE**' were reported to EFSA by one non-EU country (the United Kingdom). The five units positive belonged to the following matrices: '**Meat from other poultry species**' (three reported in 2015), '**Meat from pig**' (one in 2017), and '**Meat from broilers (*Gallus gallus*)**' (one in 2017).

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