

Food fraud and prediction

Hans Marvin and Yamine Bouzembrak (RIKILT Wageningen UR)



Outline

- Food fraud
- Developing a food fraud early warning system using European media monitor (EMM)
- Food fraud prediction

Food fraud, GFSI definition

'A collective term encompassing the **deliberate and intentional** substitution, addition, tampering, or misrepresentation of food, food ingredients or food packaging, labelling, production information, or false or misleading statements made about a product **for economic gain** that could impact consumer health'

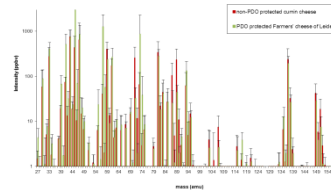
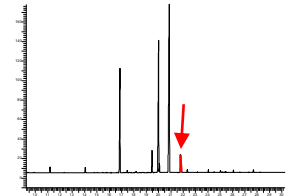
Food fraud may result in a food safety risk



Identification of fraud: research at RIKILT

■ Analytical methods (chemical, physical, microscopy)

- Targeted approach: single marker
- Untargeted approach: Multiple markers
 - fingerprints



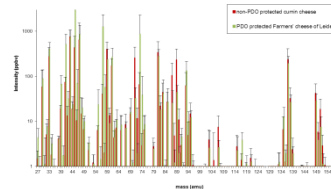
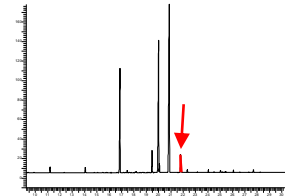
■ Text mining approach (MedISys)

■ Trend analysis (databases (RASFF, EMA, UPS etc) & prediction modelling (agent modelling, Bayesians network)

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European Media Monitor (EMM)




EMM; characteristics

The Europe Media Monitor (EMM) provides advanced analysis systems for monitoring of both traditional and social media.

- EMM applies text mining techniques to screen different types of media on the world wide web: websites, databases, blogs, ..etc.
- EMM is updated every 10 minutes, 24 hours per day.
- EMM gathers reports from news portals world-wide in 60 languages.
- EMM contain 3 portals: NewsBrief, NewsExplorer and MedISys

(<http://emm.newsbrief.eu/overview.html>)

MedISys: public health related topics



advanced search

Top Stories

Event Extraction

Recent Disease Incidents

Alert Statistics

Communicable Diseases

Symptoms

Bioterrorism

Nuclear

Chemical

ECDC

EFSA

Other

Continents

Official Sources

Sources List

Most Active Topics

Toxic

In combination with: Canada;

Stay alert beneath the dome

globaltimes Thursday, March 5, 2015 12:44:00 PM CET | info [other]

If you've lived in Shanghai for a while, then you're no stranger to smog. But after the documentary film Beneath the Dome came out last week, the attention called to the damage that the constant smog does to people's health grows ever higher. Although the city's environment bureau said that in 2014,.....

Incêndio em porto de Vancouver emite produtos tóxicos e provoca evacuações

noticias-r7 Thursday, March 5, 2015 3:02:00 AM CET | info [en] [other]

Toronto (Canadá), 4 mar (EFE).- As autoridades do Canadá evacuaram parcialmente nesta quarta-feira o porto de Vancouver, no litoral do Pacífico, após um incêndio no terminal de contêineres que emite substâncias tóxicas. A prefeitura de Vancouver também aconselhou aos residentes da parte central da.....

Swine Flu

In combination with: Portugal; Netherlands; Belgium;

СОСТОЈБА СО ГРИП ВО РЕПУБЛИКА МАКЕДОНИЈА, СЕЗОНА 2014/2015 (до 9-та недела, до 01.03.2015)

iph Thursday, March 5, 2015 10:55:00 AM CET | info [en] [other]

ЕПИДЕМИОЛОШКИ ПОДАТОЦИ Во текот на 9-тата недела од 2015 година (од 23.02 - 01.03.2015 година), во Република Македонија се пријавени 4.781 новозаболено лице од грип/заболувања слични на грип, што претставува зголемување на бројот на регистрирани случаи во однос на минатата недела за 43,7%....

8.500 décès supplémentaires cet hiver, la grippe pointée du doigt

lamontagne Wednesday, March 4, 2015 9:21:00 PM CET | info [en] [other]

La forte épidémie de grippe, actuellement en reflux, a contribué à une nette augmentation de la mortalité cet hiver, évaluée à ce stade à 8.500 décès supplémentaires toutes causes confondues par l'Institut de veille sanitaire (InVS). Cette surmortalité, qui touche de façon importante les plus de 65.....

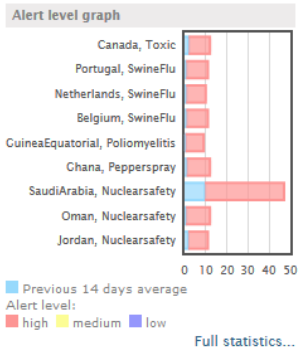
Tools

Thursday, March 5, 2015 1:36:00 PM CET


manage

info


Alert level graph





No collection of publications on food fraud

 DG Joint Research Centre
DG Home Affairs
DG Health and Consumers

Manuals/Tutorials (access to w3c upon request)
Contact: emm@jrc.ec.europa.eu
disclaimer.

 **efsa**
European Food Safety Authority
Committed to ensuring that Europe's food is safe

 **ecdc**
European Centre for Disease Prevention and Control

 **RIKILT**
WAGeningenUR

<http://medusa.jrc.it/medisys/homeedition/en/home>

EMM Food Fraud Filter Design steps

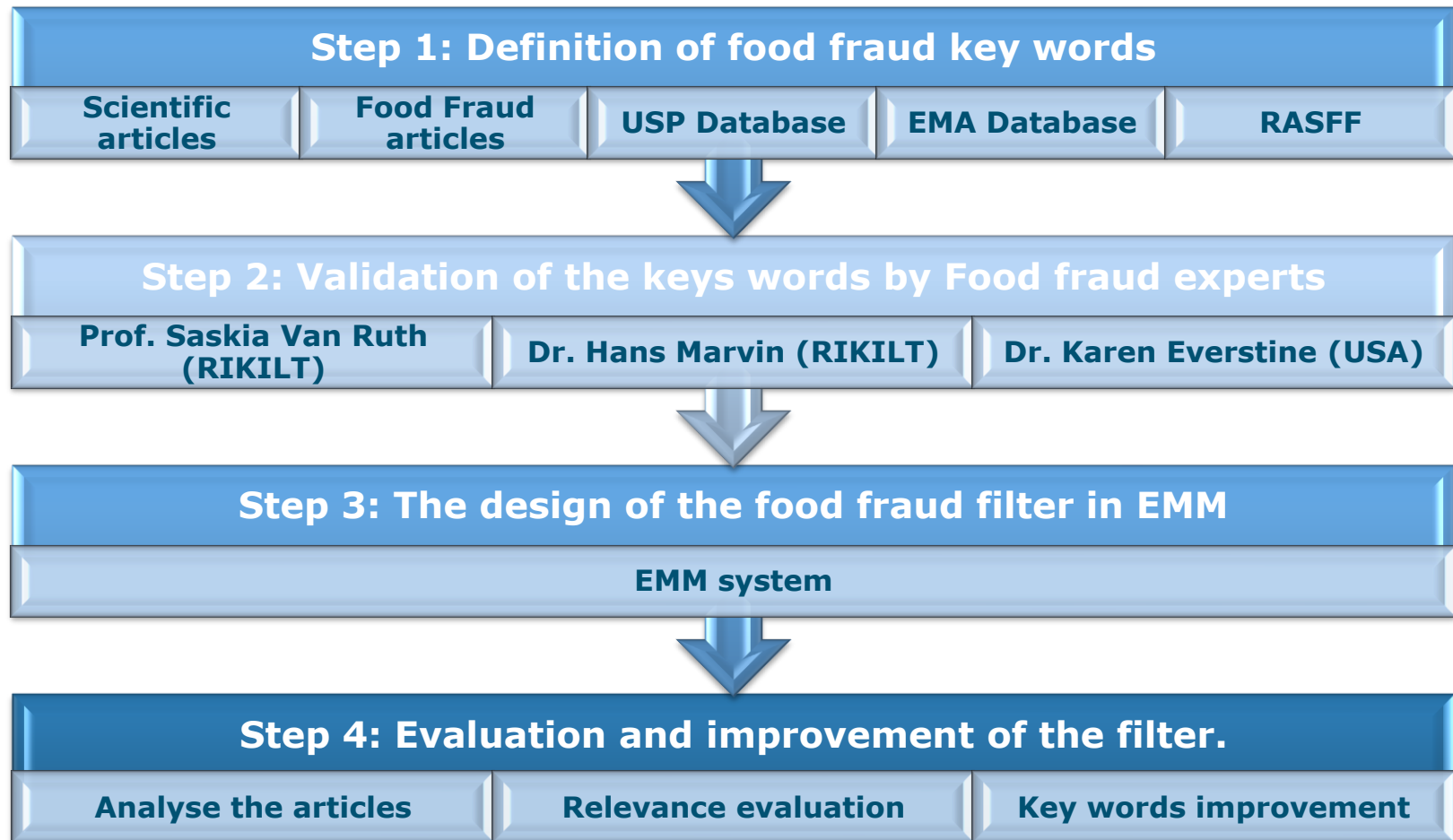


Figure.1: Design steps

Food Fraud keywords

Generic Key words	Specific key words	Excluded key word
<ul style="list-style-type: none"> • Food Fraud • Mislabelled • Counterfeit • Tampering • Misleading • False • Intentional substitution • Smuggling • Dilution • Substitution • ..etc 	<ul style="list-style-type: none"> • food+fraud • fake+food • mislabeled+food • economic+adulteration +food • food+adultration • counterfeit+food • olive+oil+dilution • olive+oil+fraud • counterfeit+olive+oil • mislabeled+olive+oil • honey+mislabling • honey+fraud 	<ul style="list-style-type: none"> • Fraud • Artificial Food • Counterfeit Medicine • Goods fraud • Wine • How to make fake alcohol? • How to make fake milk? • How to make fake Oil?
Total of included key words	64 x 8 = 512	

Key Words Languages

Spanish



English



Chinese



German



Dutch

Italian



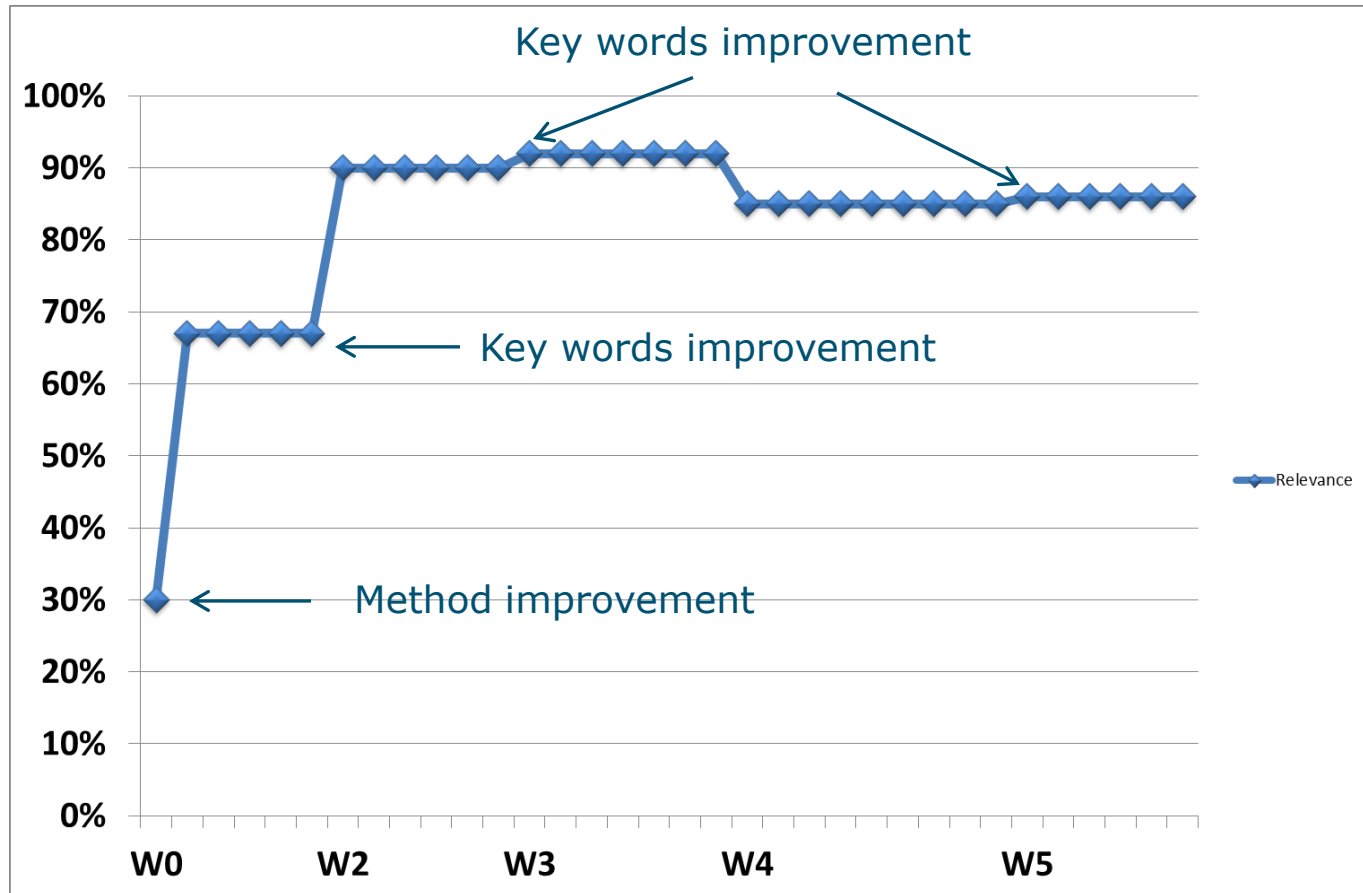
French



Arabic



Food fraud filter efficiency



Food Fraud filter efficiency:
More than 95 Food Fraud articles in last 2 months.
Relevance index = 86%.

MedISys adapted to detect food fraud

[advanced search](#)

- Top Stories
- Event Extraction
- Recent Disease Incidents
- Alert Statistics
- Communicable Diseases
- Symptoms
- Bioterrorism
- Nuclear
- Chemical
- ECDC
- EFSA
- Other
- Continents
- Official Sources
- Sources List

Latest News About - FoodIntegrity

10 < 1 2 > 10

Articles published more than 12 hours ago

[Beware Christmas food fraud, warns expert](#)

foodmanufacture Monday, November 3, 2014 7:57:00 PM CET | [info](#) | [other](#)

Manufacturers should be particularly vigilant over the festive season, warned food safety and brand protection firm Qadex. The firm's operations manager Tracey Cranney said: "Having to compete with successful low-price retailers is tough, especially heading into the festive season when food budgets will be cut to allow spending in other areas...."

Articles published more than 1 day ago

[QMS boss emphasises importance of Scotch meat quality assurance](#)

meatinfo Monday, November 3, 2014 11:36:00 AM CET | [other](#)

Speaking to around 150 farmers at McIntosh Donald's Producer Club Open Evening, Morton emphasised the value to Scottish livestock producers of having strong brands and robust quality assurance schemes. He said: "The Scottish red meat industry is committed to delivering a top-quality product, but one....."

Articles published more than 3 days ago

[Food industry must consider intentional contamination - NSF](#)

foodqualitynews Friday, October 31, 2014 5:47:00 PM CET | [info](#) | [other](#)

NSF International is an independent organization that writes standards, and tests and certifies products for the water, food, health sciences and consumer goods industries. Serban Teodoresco, global managing director, NSF's consulting and technical group within the food division, said it was important to have a proactive program in place....

Tools

Tuesday, November 4, 2014
1:10:00 PM CET

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[info](#) | [definition](#)

Languages

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lv	mk	mt	my	nl	no
pap	pl	ps	pt	ro	ru
rw	se	sk	sl	so	sq
sr	sv	sw	ta	tg	th
tr	uk	ur	vi	zh	
all					

Interface: en - English

Breaking News on the Food and Drink Manufacturing Sector

Wine fraud in the UK is 'massive', says expert

By Nicholas Robinson+, 03-Dec-2014

Related topics: Food Safety, Beverages

Fraud in the UK's wine industry is rampant because the sector has failed to implement the controls necessary to stamp it out, a food safety expert has claimed.

Wine fraud in the UK has been grossly underestimated because of the way the sector is structured, claimed the food safety expert, who did not want to be named.

Big wine companies were not placing enough emphasis on preventing fraud and, as a result, crooks were cashing in on the opportunity, he said.

Food fraud costs UK firms £11bn a year



By Laurence Gibbons+

28-Nov-2014

Last updated on 28-Nov-2014 at 13:02 GMT



Fraud is costing the food industry £11.2bn a year

l'avenir.net

NEWSLETTER JOURNAL CONNEXION S'ABONNER

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Fraude à la viande: la commune de Mol « pas au courant » des activités de Willy Selten

Accueil > Belgique - jeudi 29 janvier 2015 14h37 - Belga



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Üb

Stellen | Motor | Immobilien | Flohmarkt | Partnerschaft | Foto | Bücher

Startseite » Chronik im Überblick » Chronik

Artikel vom Dienstag, 17. Februar 2015

2.500 Tonnen gefälschte Lebensmittel beschlagnahmt

Von Mozzarella, frisch gemachten Meeresfrüchten und falschem Whisky: Mehr als 2.500 gefälschte oder verdorbene Lebensmittel haben die Behörden in 47 Ländern der Schwerpunkt-Operation „Opson IV“ beschlagnahmt. Auch Italien war betroffen.



Unter den beschlagnahmten Lebensmitteln fanden sich Mozzarella, Erdbeeren, getrocknete Früchte. - Foto: APA/AP

Diskutieren
Versenden

Unter der Koordination von Interpol und Europol nahmen die Behörden im vergangenen Dezember und Jänner teil, berichtete Europol.

The horrors of food fraud: vodka which kills and rotting fish disguised with chemicals

Sunday 22 February 2015

UK: An illicit factory producing fake vodka was discovered in Poland. The factory was found to have more than 20,000 empty bottles of vodka which had contained screenwash used to make the bottles look like they contained vodka. The finished product was found to contain high levels of isopropyl alcohol.

The finished product was found to contain high levels of isopropyl alcohol.

THE HINDU

SEARCH

Home News Opinion Business Sport S & T Features Entertainment Books World
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NATIONAL » KERALA

KOLLAM, March 1, 2015

Updated: March 1, 2015 08:37 IST

Most organic food in market is fake: food safety official

Yes Bank™ Remit to India - 50p More per Euro + 2N&3D Hotel stay vouchers „Zero Fees„Apply Now!
yesbankremit.in/Euro

Ads by Google

SPECIAL CORRESPONDENT

COMMENT (3) · PRINT · T T

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A.K. Mini, Assistant Food Safety Commissioner (Kollam), inaugurating a seminar on food safety in Kollam on Saturday. Photo: C. Suresh Kumar

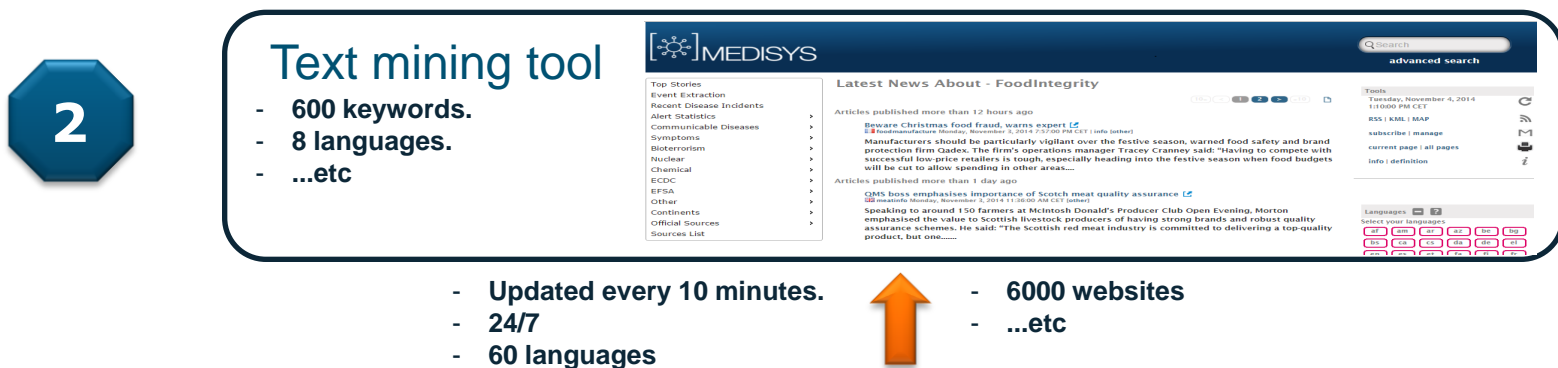
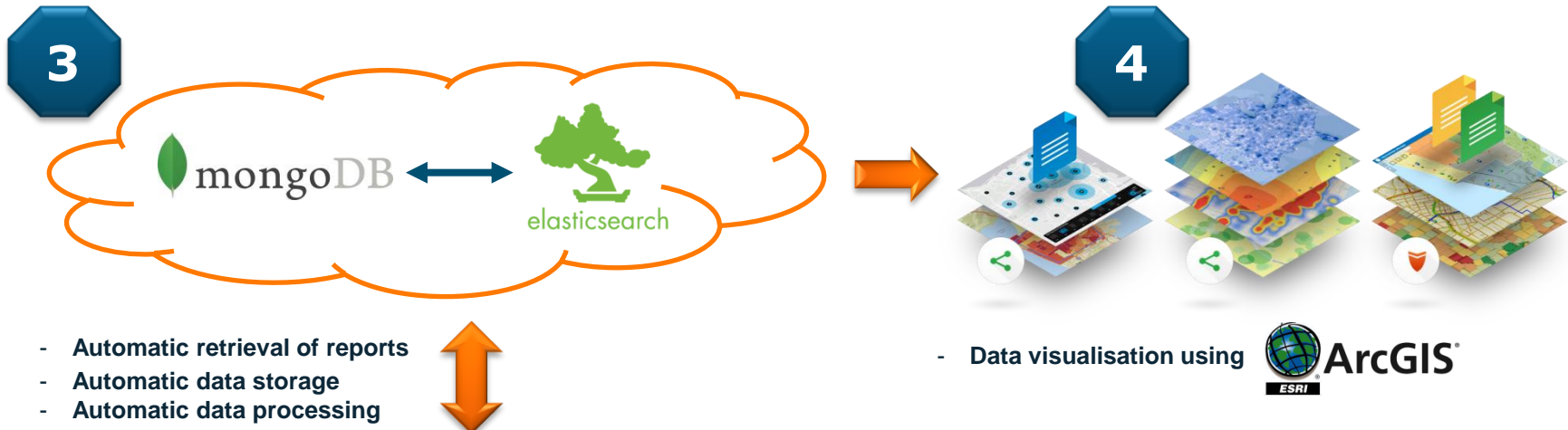
Much of the organic foods available in the markets are fake, Assistant Food Safety Commissioner (Kollam) A.K. Mini has said.



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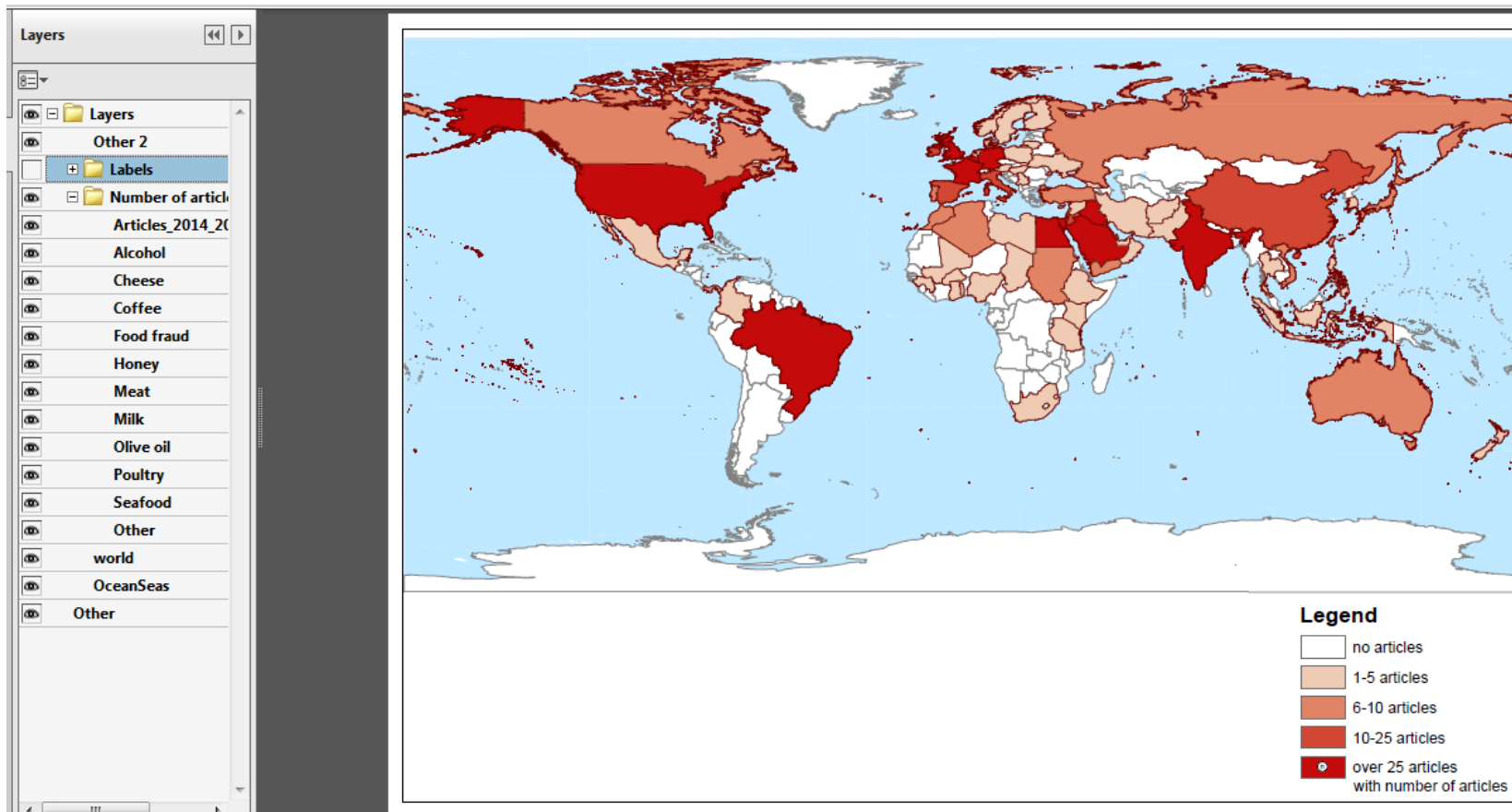
EMM Food Fraud Filter Design steps



4

Data visualisation using ArcGIS

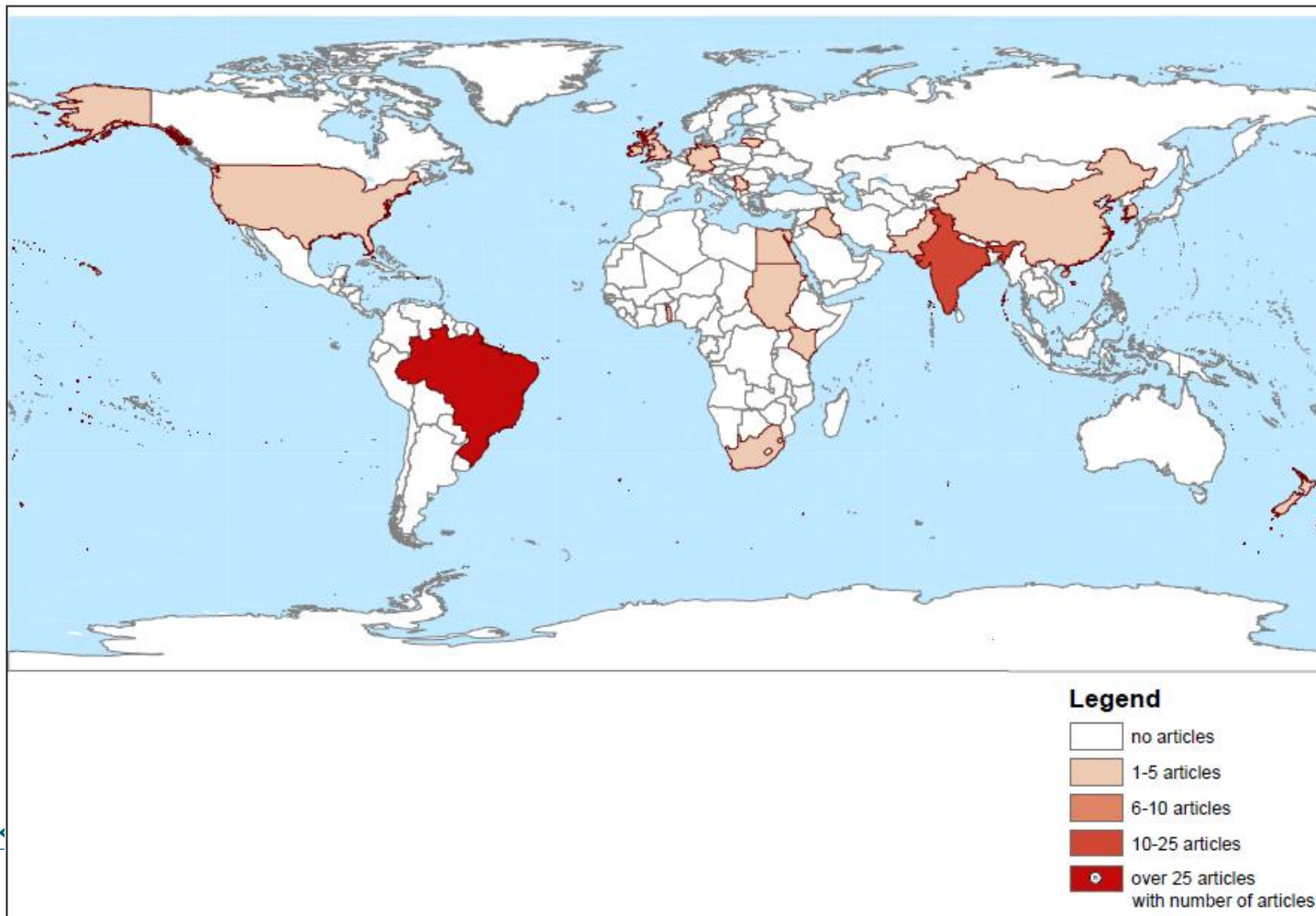
Food fraud reports (overall) in MedISys (period September 2014 to December 2015; N = 1114)



4

Data visualisation using ArcGIS

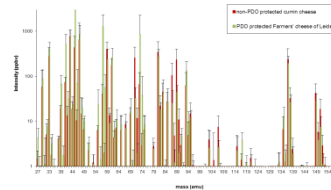
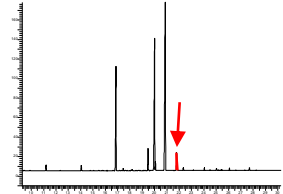
Food fraud reports (milk) in MedISys (period September 2014 to December 2015)



Identification of fraud: research at RIKILT

■ Analytical methods (chemical, physical, microscopy)

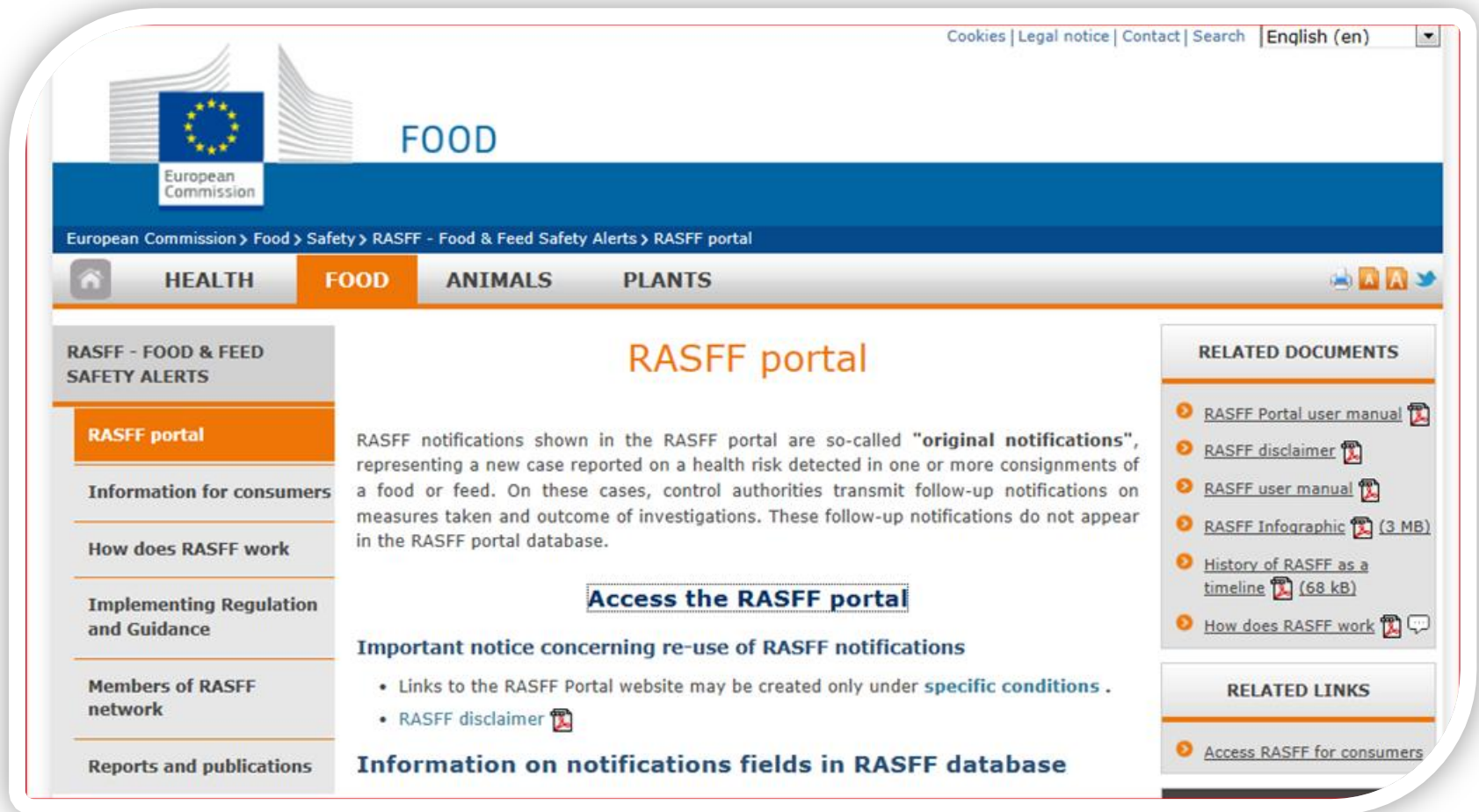
- Targeted approach: single marker
- Untargeted approach: Multiple markers
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■ Text mining approach (MedISys)

■ **Trend analysis** (databases (RASFF, EMA, UPS etc) & **prediction modelling** (agent modelling, **Bayesians network**))

Food fraud is reported in Rapid Alert System for Food and Feed (RASFF)



The screenshot shows the RASFF portal website. At the top, there is a navigation bar with links for Cookies, Legal notice, Contact, Search, and English (en). Below this is a header section with the European Commission logo and the word "FOOD". A breadcrumb trail reads: European Commission > Food > Safety > RASFF - Food & Feed Safety Alerts > RASFF portal. A secondary navigation bar includes links for HEALTH, FOOD (highlighted), ANIMALS, and PLANTS. The main content area is titled "RASFF portal" and contains a paragraph explaining that RASFF notifications are "original notifications" representing new health risk cases. Below this is a button labeled "Access the RASFF portal". To the left is a sidebar with links: RASFF - FOOD & FEED SAFETY ALERTS, RASFF portal (highlighted), Information for consumers, How does RASFF work, Implementing Regulation and Guidance, Members of RASFF network, and Reports and publications. To the right is a "RELATED DOCUMENTS" section listing various manuals and infographics, and a "RELATED LINKS" section with a link to "Access RASFF for consumers".

European Commission

FOOD

European Commission > Food > Safety > RASFF - Food & Feed Safety Alerts > RASFF portal

HEALTH **FOOD** ANIMALS PLANTS

RASFF portal

RASFF notifications shown in the RASFF portal are so-called "**original notifications**", representing a new case reported on a health risk detected in one or more consignments of a food or feed. On these cases, control authorities transmit follow-up notifications on measures taken and outcome of investigations. These follow-up notifications do not appear in the RASFF portal database.

[Access the RASFF portal](#)

Important notice concerning re-use of RASFF notifications

- Links to the RASFF Portal website may be created only under **specific conditions**.
- [RASFF disclaimer](#)

Information on notifications fields in RASFF database

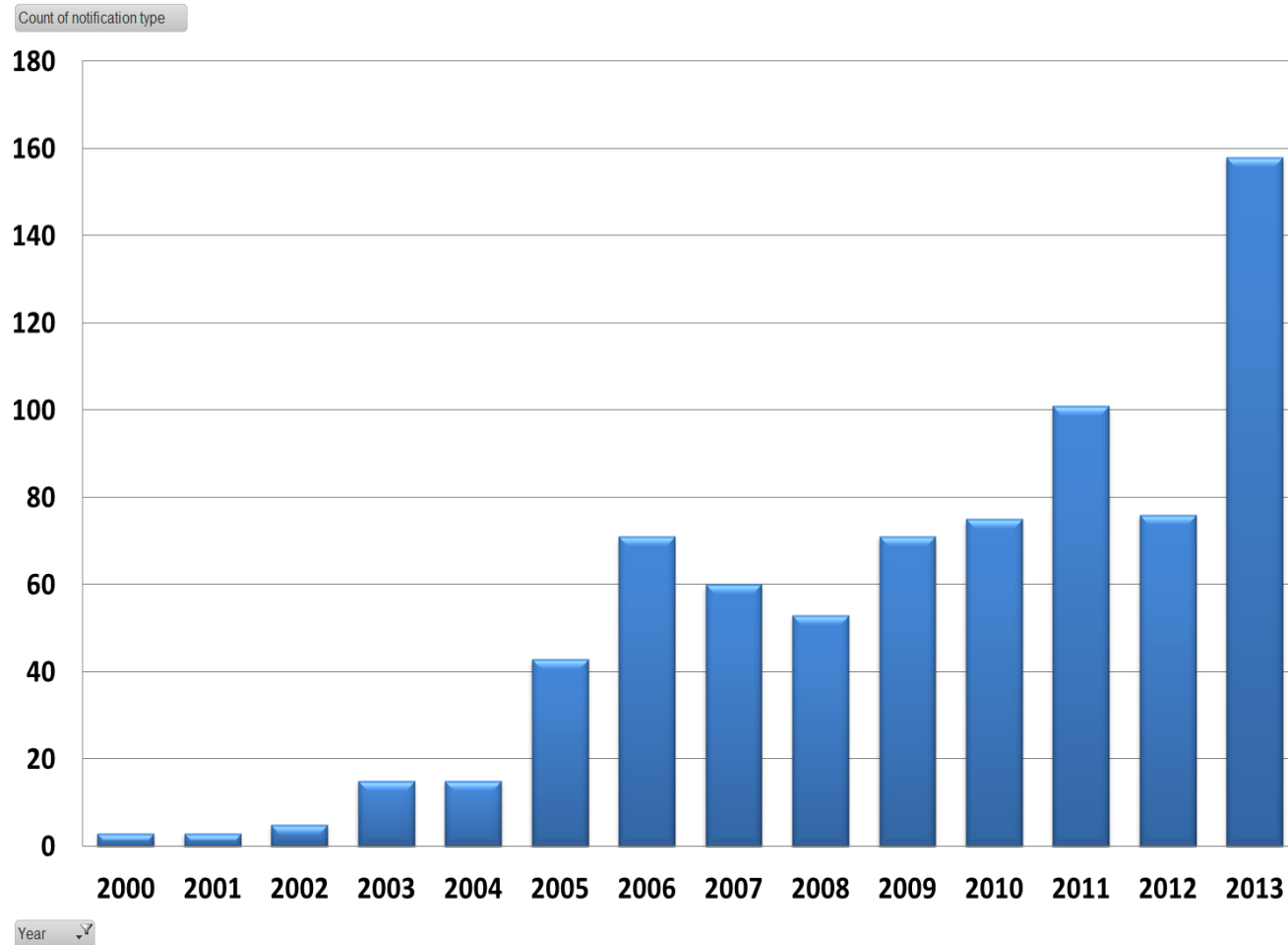
RELATED DOCUMENTS

- [RASFF Portal user manual](#)
- [RASFF disclaimer](#)
- [RASFF user manual](#)
- [RASFF Infographic](#) (3 MB)
- [History of RASFF as a timeline](#) (68 kB)
- [How does RASFF work](#)

RELATED LINKS

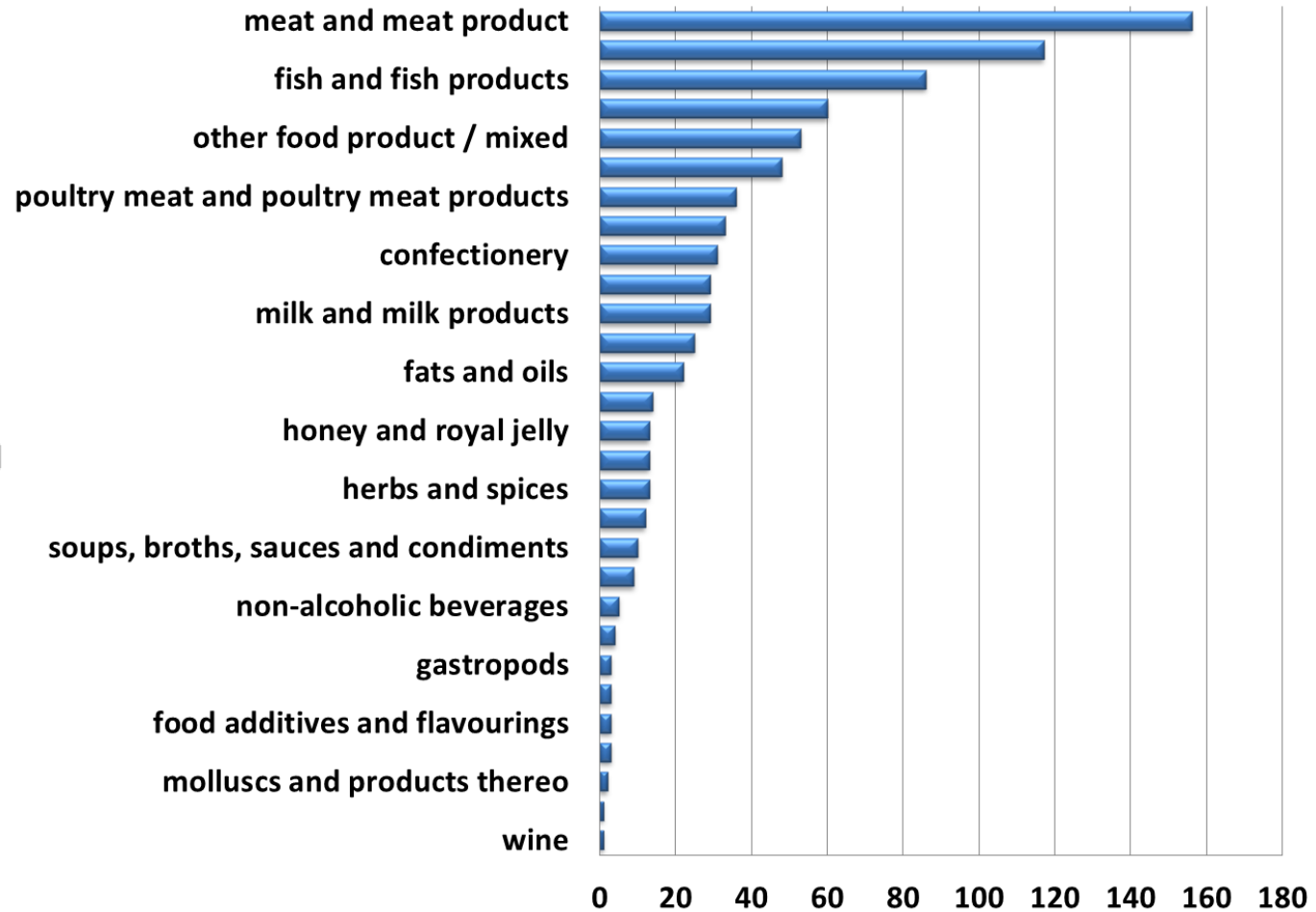
- [Access RASFF for consumers](#)

Food fraud notifications in RASFF (2000 to 2013).



Products related to food fraud in RASFF

Count of reference



Product Category

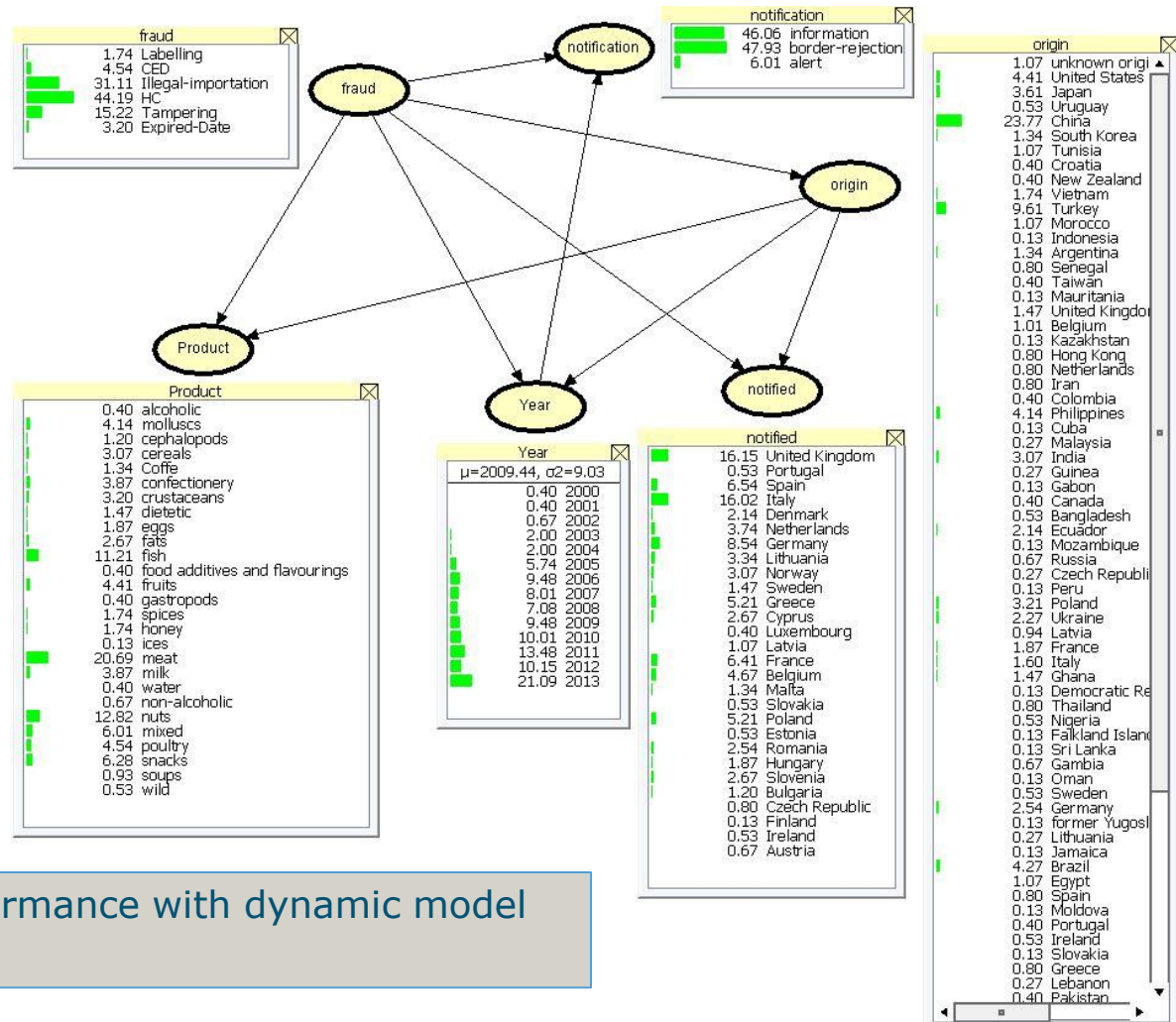
Modelling of Fraud in RASFF using Bayesians network

Model developed with RASFF data up to 2013

Model validated with RASFF data of 2014

Model performance:

- 82% correct prediction of fraud type
- 51% prediction of new fraud combinations
- static



Higher performance with dynamic model approach

Application of BNs to predict food fraud

- (Bouzembrak and Marvin, 2016) used BNs prediction model to aid the border inspector to detect the type of food fraud.

Food Control 61 (2016) 180–187



Prediction of food fraud type using data from Rapid Alert System for Food and Feed (RASFF) and Bayesian network modelling



Yamine Bouzembrak, Hans J.P. Marvin*

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Bayesian networks

Food fraud type prediction

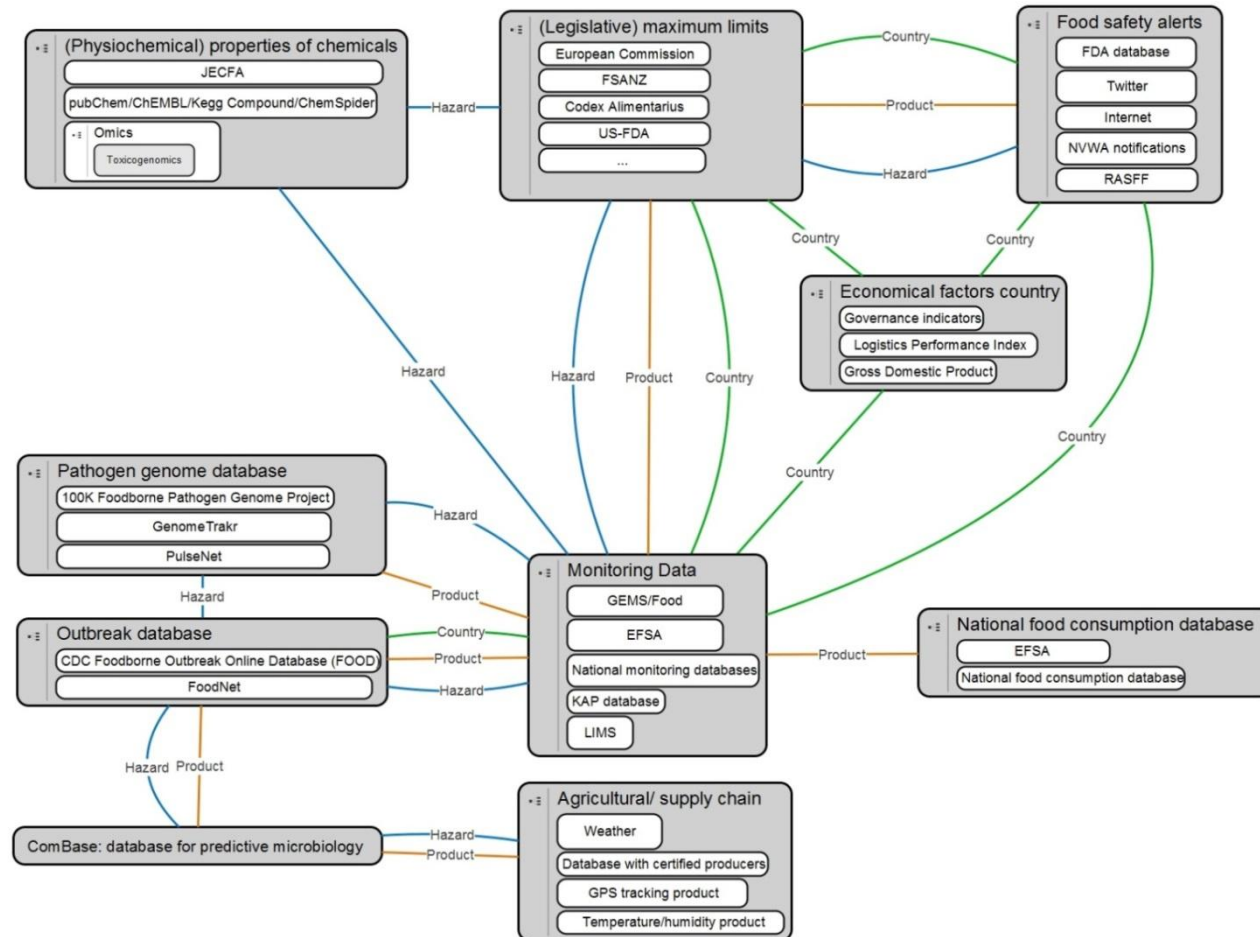
RASFF

ABSTRACT

Because food fraud can harm human health and erode consumer trust, it is imperative that it is detected at an early stage. Therefore the aim of this study was to predict the expected food fraud type for imported products for which the product category and country of origin are known in order to target enforcement activities. For this purpose we used a Bayesian Network (BN) model that was developed based on adulteration/fraud notifications as reported in the Rapid Alert System for Food and Feed (RASFF) in the period 2000–2013. In this period 749 food fraud notifications were reported and were categorised in 6 different fraud types (i) improper, fraudulent, missing or absent health certificates, (ii) illegal importation, (iii) tampering, (iv) improper, expired, fraudulent or missing common entry documents or import declarations, (v) expiration date, (vi) mislabelling. The data were then used to develop a BN model. The constructed BN model was validated using 88 food fraud notifications reported in RASFF in 2014. The proposed model predicted 80% of food fraud types correctly when food fraud type, country and food

Bayesian Networks (BNs) modelling in Big Data research

BN is able to combine data from different nature and location



Application of BNs to predict food fraud

Prediction of food fraud using multiple data sources and expert knowledge

- Identify parameters relevant for food fraud (\Rightarrow nodes in BN model)
- Determine the relationships between these parameters (expert knowledge, literature)
- Identify data sources of these parameters
- Develop the BN model
- Validate the BN model

Application of BNs to predict food fraud

Parameters relevant for food fraud (some examples)

Economic parameters:

- Prices of the fraudulent product at the time of detection
- Price spike around the period of detection
- Trade volumes of the product between the country of detection and country of origin
- Complexity of the food chain

Parameters of the country of origin & detection

- Indices: corruption index, food safety index, governance index, legal system index, press index, human development index and technology index.

Detected food fraud cases

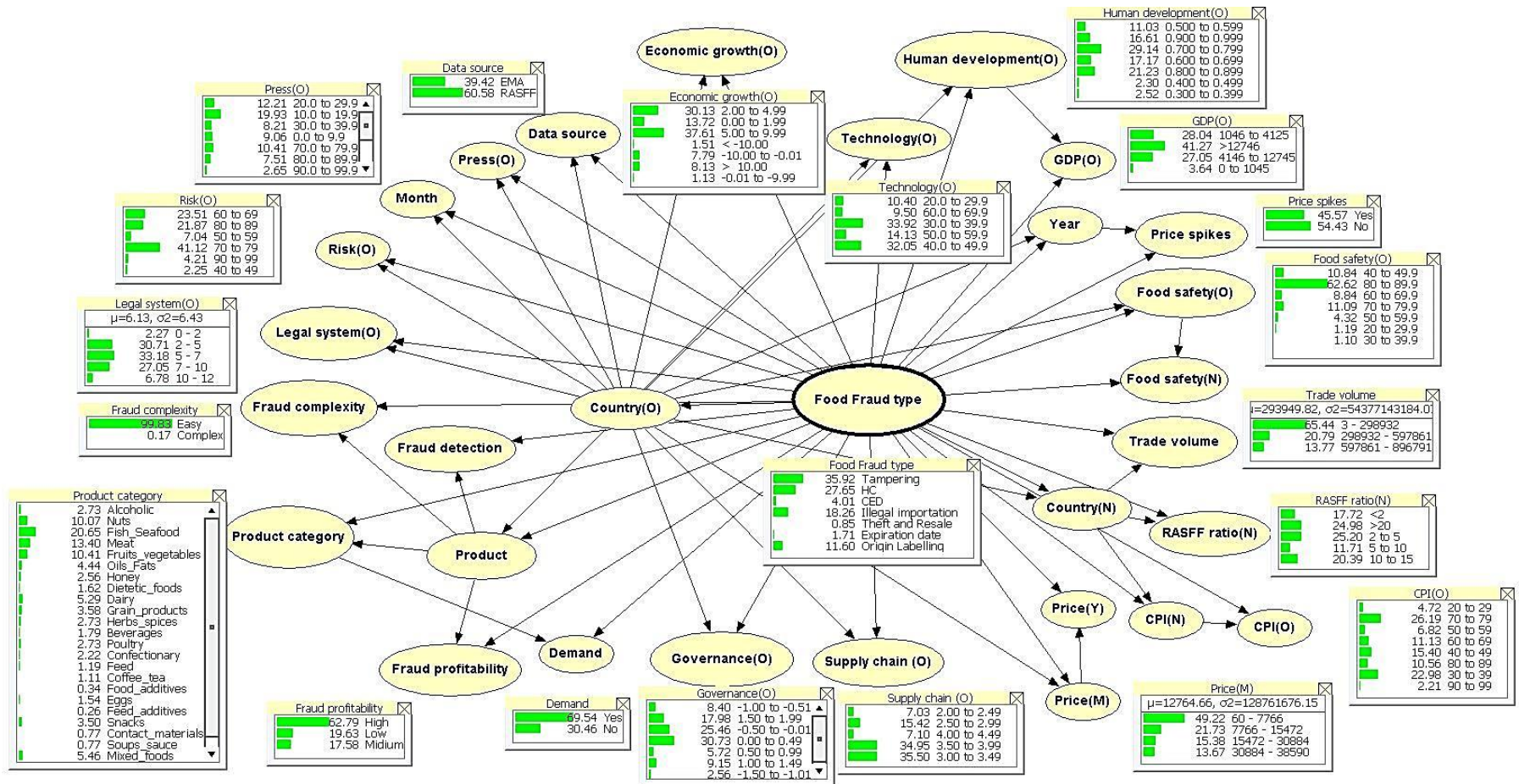
- RASFF and EMA

BN model to predicting food fraud

linking 36 data sources (18 databases and 8 expert judgements)

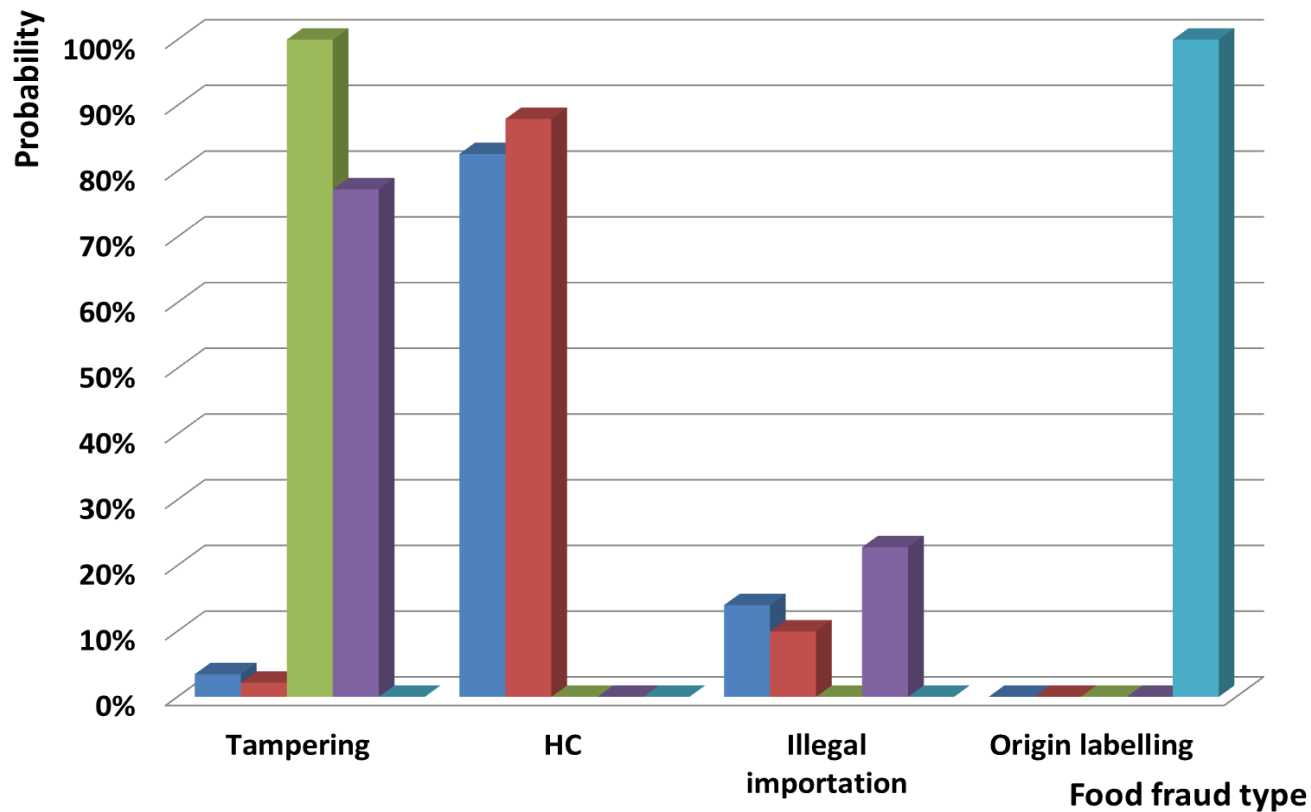


BN model to predict food fraud



Results: 91.5 % correct prediction of food fraud type

The effect of country of origin on the type of food fraud for meat in the low price category originating from Brazil (dark blue), Argentina (red), Poland (green), Canada (purple) and Belgium (light blue).



Application of BNs to predict food fraud

- (Marvin *et al*, 2016) A holistic approach to food safety risks: Food fraud as an example.



A holistic approach to food safety risks: Food fraud as an example

Hans J.P. Marvin*, Yamine Bouzembrak, Esmée M. Janssen, H.J. van der Fels- Klerx, Esther D. van Asselt, Gijs A. Kleter

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ABSTRACT

Production of sufficient, safe and nutritious food is a global challenge faced by the actors operating in the food production chain. The performance of food-producing systems from farm to fork is directly and indirectly influenced by major changes in, for example, climate, demographics, and the economy. Many of these major trends will also drive the development of food safety risks and thus will have an effect on human health, local societies and economies. It is advocated that a holistic or system approach taking into account the influence of multiple "drivers" on food safety is followed to predict the increased likelihood of occurrence of safety incidents so as to be better prepared to prevent



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Conclusions

- The food fraud filter in MedISys, as developed by RIKILT, is useful to collect publications in the media on food fraud
- The food fraud coverage in the media differ greatly between countries
- There is an increasing trend in the number of fraud incidents, as reported in RASFF
- Meat & meat products and fish & fish products are the food categories with the highest number of reports
- BN models are suitable to predict the food fraud category

Thank you

Acknowledgement

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