

Regulations relating to POPs in foods: Incidents concerning dioxins and food: Applied research to support policy

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Science meets legislation

Requirements to monitor dietary exposure

Conduct research and food surveys

Investigate incidents

Establish legal requirements for food safety

Policy development

Provide advice to public and others



International agreements



Environmental contaminants

‘Stockholm’ POPs

Persistent; Bioaccumulative; Toxic

- Concentrate at higher trophic levels
- Food can be a useful indicator of environmental contamination – an ‘integrative matrix’



Food Regulations – underlying legislation

General Food Law

- Regulation (EC) 178/2002
- Official Controls
 - Regulation (EC) 882/2004
- Procedures for Contaminants in Food
 - Council Regulation (EEC) 315/93

All implemented in the UK through the **2007 Contaminants in Food Regulations** (under consultation)

EU legislation – types

Regulation

Directive

Decision

Recommendation



Setting limits

Why?

- Need for legal tools
- Common EU approach
- Belgian feed crisis late 1990s

- **How?**

1. Existing data (Previous surveys / scientific papers / industry)
2. Call for further data (Decision / Recommendation)
 - Data collated by Commission (Scoop) or EFSA
3. Limits discussed and finalised
 - Agreed at Working Group (health risk, ALARA etc)
 - Put to vote at Standing Committee
 - Usually incorporated through amendment
4. Limits periodically reviewed



Timeline – limits in food

- 2002: First dioxin limits: Council Regulation 2375/2001
 - amending Commission Regulation 466/2001
- 2006: Total TEQ added (to include dioxin-like PCBs): Regulation 199/2006 (non-dioxin-like PCBs added later)
 - further amendment to 466/2001
- 2006: Regulation 1881/2006
 - Consolidation of 466/2001 & 18 existing amendments
- 2008: Regulation 565/2008: limit for fish liver
- 2013: Action levels are defined in Recommendation 2013/711/EU to serve as early warning tool in order to identify possible contamination sources



Commission Regulation (EU) No 1259/2011

- revision of the maximum and action levels for dioxins/furans and dioxin-like PCBs
- Use of WHO 2005 toxicity equivalent factors to (previously WHO-TEF 1998 were used)
- maximum levels for non-dioxin-like PCBs established

In force since 1 January 2012



Dioxin limits (Regulation EC 1259/2011)

	Foodstuffs	maximum levels for the sum of		
		dioxins/furans (WHO-PCDD/F- TEQ) ⁽³²⁾	dioxins/furans and dioxin-like PCBs (WHO-PCDD/F- PCB-TEQ) ⁽³²⁾	PCB 28, PCB 52, PCB 101, PCB 138, PCB 153 und PCB 180 (ICES – 6) ⁽³²⁾
1	Meat and meat products (excluding edible offal) of the following animals ⁽⁶⁾ : - bovine animals and sheep - poultry - pigs	2,5 pg/g fat ⁽³³⁾ 1,75 pg/g fat ⁽³³⁾ 1,0 pg/g fat ⁽³³⁾	4,0 pg/g fat ⁽³³⁾ 3,0 pg/g fat ⁽³³⁾ 1,25 pg/g fat ⁽³³⁾	40 ng/g fat ⁽³³⁾ 40 ng/g fat ⁽³³⁾ 40 ng/g fat ⁽³³⁾
2	Liver of terrestrial animals referred to in 1 ⁽⁶⁾ , and derived products thereof	4,5 pg/g fat ⁽³³⁾	10,0 pg/g fat ⁽³³⁾	40,0 ng/g fat ⁽³³⁾
3	Muscle meat of fish and fishery products and products thereof ^{(25) (34)} , with the exemption of: - wild caught eel - wild caught fresh water fish, with the exception of diadromous fish species caught in fresh water - fish liver and derived products - marine oils The maximum level for crustaceans applies to muscle meat from appendages and abdomen ⁽⁴⁾ . In case of crabs and crab-like crustaceans (<i>Brachyura</i> and <i>Anomura</i>) it applies to muscle meat from appendages.	3,5 pg/g wet weight	6,5 pg/g wet weight	75 ng/g wet weight
4	Muscle meat of wild caught fresh water fish, with the exception of diadromous fish species caught in fresh water, and products thereof ⁽²⁵⁾	3,5 pg/g wet weight	6,5 pg/g wet weight	125 ng/g wet weight
5	Muscle meat of wild caught eel (<i>Anguilla anguilla</i>) and products thereof	3,5 pg/g wet weight	10 pg/g wet weight	300 ng/g wet weight



Dioxin limits (contd.)

6	Fish liver and derived products thereof, with the exception of marine oils referred to in point 7	---	20 pg/g wet weight ⁽³⁸⁾	200 ng/g wet weight ⁽³⁸⁾
7	Marine oils (fish body oil, fish liver oil and oils of other marine organisms intended for human consumption)	1,75 pg/g fat	6,0 pg/g fat	200 ng/g fat
8	Raw Milk ⁽⁶⁾ and dairy products ⁽⁶⁾ , including butter fat	2,5 pg/g fat ⁽³³⁾	5,5 pg/g fat ⁽³³⁾	40 ng/g fat ⁽³³⁾
9	Hen eggs and egg products ⁽⁶⁾	2,5 pg/g fat ⁽³³⁾	5,0 pg/g fat ⁽³³⁾	40 ng/g fat ⁽³³⁾
10	Fat of the following animals: - bovine animals and sheep - poultry - pigs	2,5 pg/g fat 1,75 pg/g fat 1,0 pg/g fat	4,0 pg/g fat 3,0 pg/g fat 1,25 pg/g fat	40 ng/g fat 40 ng/g fat 40 ng/g fat
11	Mixed animal fats	1,5 pg/g fat	2,5 pg/g fat	40 ng/g fat
12	Vegetable oils and fats	0,75 pg/g fat	1,25 pg/g fat	40 ng/g fat
13	Foods for infants and for young children ⁽⁴⁾	0,1 pg/g wet weight	0,2 pg/g wet weight	1,0 ng/g wet weight

Methods of sampling and performance criteria for method analysis according to the Commission Directive 2002/69/EC. ⁽⁴⁾



Action levels for food

Food	Action level for dioxins and furans (WHO-TEQ) (1)	Action level for dioxin-like PCBs (WHO-TEQ) (1)
Meat and meat products (excluding edible offal) ⁽²⁾ of the following animals ⁽²⁾ :		
- bovine animals and sheep,	1,75 pg/g fat ⁽³⁾	1,75 pg/g fat ⁽³⁾
- poultry,	1,25 pg/g fat ⁽³⁾	0,75 pg/g fat ⁽³⁾
- pigs.	0,75 pg/g fat ⁽³⁾	0,5 pg/g fat ⁽³⁾
Mixed fats	1,00 pg/g fat ⁽³⁾	0,75 pg/g fat ⁽³⁾
Muscle meat of farmed fish and farmed fishery products	1,5 pg/g wet weight	2,5 pg/g wet weight
Raw milk ⁽²⁾ and dairy products ⁽²⁾ , including butter fat	1,75 pg/g fat ⁽³⁾	2,0 pg/g fat ⁽³⁾
Hen eggs and egg products ⁽²⁾	1,75 pg/g fat ⁽³⁾	1,75 pg/g fat ⁽³⁾
Fruit, vegetables and cereals	0,3 pg/g product	0,1 pg/g product



Limits in feed

Figure 1. Maximum values for feed products (value as of 23 November 2017)

Products intended for animal feed	Dioxins (sum of PCDD/Fs): Maximum content in WHO- PCDD/F-TEQ ¹	Sum of dioxins and dioxin-like PCBs (sum of PCDD/Fs and DL- PCBs): Maximum content in WHO-PCDD/F-PCB-TEQ ¹	Non-dioxin-like PCBs: Maximum content ²
	relative to a feed with a moisture content of 12 %		
Feed materials of plant origin with the exception of:	0,75 ng/kg	1,25 ng/kg	10 µg/kg
- vegetable oils and their by- products	0,75 ng/kg	1,5 ng/kg	10 µg/kg
Feed materials of mineral origin	0,75 ng/kg	1,0 ng/kg	10 µg/kg
Feed materials of animal origin:			
- Animal fat, including milk fat and egg fat	1,50 ng/kg	2,0 ng/kg	10 µg/kg
- Other land animal products including milk and milk products and eggs and egg products	0,75 ng/kg	1,25 ng/kg	10 µg/kg
- Fish oil	5,0 ng/kg	20,0 ng/kg	175 µg/kg
- Fish, other aquatic animals, and products derived thereof with the exception of fish oil, hydrolysed fish protein containing more than 20 % fat and crustacea meal	1,25 ng/kg ³	4,0 ng/kg ³	30 µg/kg ³
- Hydrolysed fish protein containing more than 20 % fat	1,75 ng/kg	9,0 ng/kg	50 µg/kg
- Crustacea meal	1,75 ng/kg	4,0 ng/kg	30 µg/kg
Feed additives belonging to the functional groups of binders and anti-caking agents (including functional groups of substances for the control of radionuclide contamination and substances for reduction of the contamination of feed by mycotoxins)	0,75 ng/kg	1,5 ng/kg	10 µg/kg
Feed additives belonging to the functional group of compounds of trace elements.	1,0 ng/kg	1,5 ng/kg	10 µg/kg
Premixtures	1,0 ng/kg	1,5 ng/kg	10 µg/kg
Compound feed with the exception of:	0,75 ng/kg	1,5 ng/kg	10 µg/kg
- compound feed for pet animals and fish	1,75 ng/kg	5,5 ng/kg	40 µg/kg
- compound feed for fur animals	---	---	---



Action limits for feed

Products intended for animal feed	Dioxins (sum of PCDD/Fs): Action threshold in WHO-PCDD/F-TEQ ¹	Sum of dioxin-like PCBs (sum of DL-PCBs): Action threshold in WHO-PCDD/F-PCB-TEQ ¹	Comments and additional information (e.g. nature of investigations to be performed)
	relative to a feed with a moisture content of 12 %		
Feed materials of plant origin with the exception of:	0,5 ng/kg	0,35 ng/kg	2
- vegetable oils and their by-products	0,5 ng/kg	0,5 ng/kg	2
Feed materials of mineral origin	0,5 ng/kg	0,35 ng/kg	2
Feed materials of animal origin:			
- Animal fat, including milk fat and egg fat	0,75 ng/kg	0,75 ng/kg	2
- Other land animal products including milk and milk products and eggs and egg products	0,5 ng/kg	0,35 ng/kg	2
- Fish oil	4,0 ng/kg	11,0 ng/kg	3
- Fish, other aquatic animals, and products derived thereof with the exception of fish oil, hydrolysed fish protein containing more than 20 % fat and crustacea meal	0,75 ng/kg	2,0 ng/kg	3
- Fish protein, hydrolysed, containing more than 20 % fat	1,25 ng/kg	5,0 ng/kg	3
- Crustacea meal	1,25 ng/kg	2,0 ng/kg	3
Feed additives belonging to the functional groups of binders and anti-caking agents	0,5 ng/kg	0,5 ng/kg	2
Feed additives belonging to the functional group of compounds of trace elements	0,5 ng/kg	0,35 ng/kg	2
Premixtures	0,5 ng/kg	0,35 ng/kg	2
Compound feed with the exception of:	0,5 ng/kg	0,5 ng/kg	2
- compound feed for pet animals and fish	1,25 ng/kg	2,5 ng/kg	2
- compound feed for fur animals	---	---	



Enforcement

Analytical criteria are specified in:

- Regulation (EU) 2017/644 for food
- Regulation (EC) No 152/2009 for feed.

- Confirmatory methods provide unequivocal identification and quantification of PCDD/Fs and PCBs providing full information on congener basis
- Screening methods identify samples with levels of PCDD/Fs and dioxin-like PCBs exceeding legal limits



Historic legislation

Commission Recommendation

2004/705/EC on the monitoring of background levels of dioxins and dioxin-like PCBs in foodstuffs



Commission Recommendation

2006/88/EC on the reduction of the presence of dioxins, furans and PCBs in feedingstuffs and foodstuffs

Commission Decision 2008/352/EC - imposing special conditions governing guar gum originating in or consigned from India due to contamination risks of those products by pentachlorophenol and dioxins



Best limits to use

- Fat-based limit for liver set in 2002
 - 6 pg WHO-TEQ/g fat (7 samples!)
- Some indications of problem during FMD outbreak
- Survey for dioxins in offal published July 2006
 - 10/10 venison liver samples > limit
 - 9/21 lamb's liver samples > limit, 2/21 > 'action' level
 - all samples assessed as low risk to health (low fat)
- At UK request, Commission changed to whole weight limits



Guidance documents

LOD / LOQ

Sampling

Measurement Uncertainty

Guidance Document on Measurement Uncertainty for Laboratories performing PCDD/F and PCB Analysis using Isotope Dilution Mass Spectrometry


CODEX ALIMENTARIUS RECOMMENDED METHODS OF ANALYSIS AND SAMPLING
INTERNATIONAL FOOD STANDARDS

 Food and Agriculture Organization of the United Nations  World Health Organization


CXS 234-1999¹
Adopted in 1999.


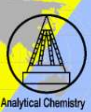
E-mail: codex@fao.org - www.codexalimentarius.org

Guidance Document on Measurement Uncertainty for Laboratories performing PCDD/F and PCB Analysis using Isotope Dilution Mass Spectrometry



EURL POPs
Analysis of POPs in Foods, York UK, Jan 2022



Eurachem  **CITAC** 
Co-Operation on International Traceability in Analytical Chemistry

EURACHEM / CITAC Guide CG 4

Quantifying Uncertainty in Analytical Measurement

Third Edition

Chinese regulations

GB standards: e.g. National Food Safety Standard for Maximum Levels of Contaminants in Foods (GB 2762-2017)

4.11 Polychlorinated biphenyl

4.11.1 Please refer to Table 11 for polychlorinated biphenyl limits in foods.

Table 11 Polychlorinated biphenyl limits in foods

Food Category (Name)	Limit P ^{aP} mg/kg
Aquatic animal and its products	0.5

^a Polychlorinated biphenyl is calculated by total of PCB28, PCB52, PCB101, PCB118, PCB138, PCB153 and PCB180.

4.11.2 Testing methods: using methods provided in GB 5009.190.



Incidents involving dioxins

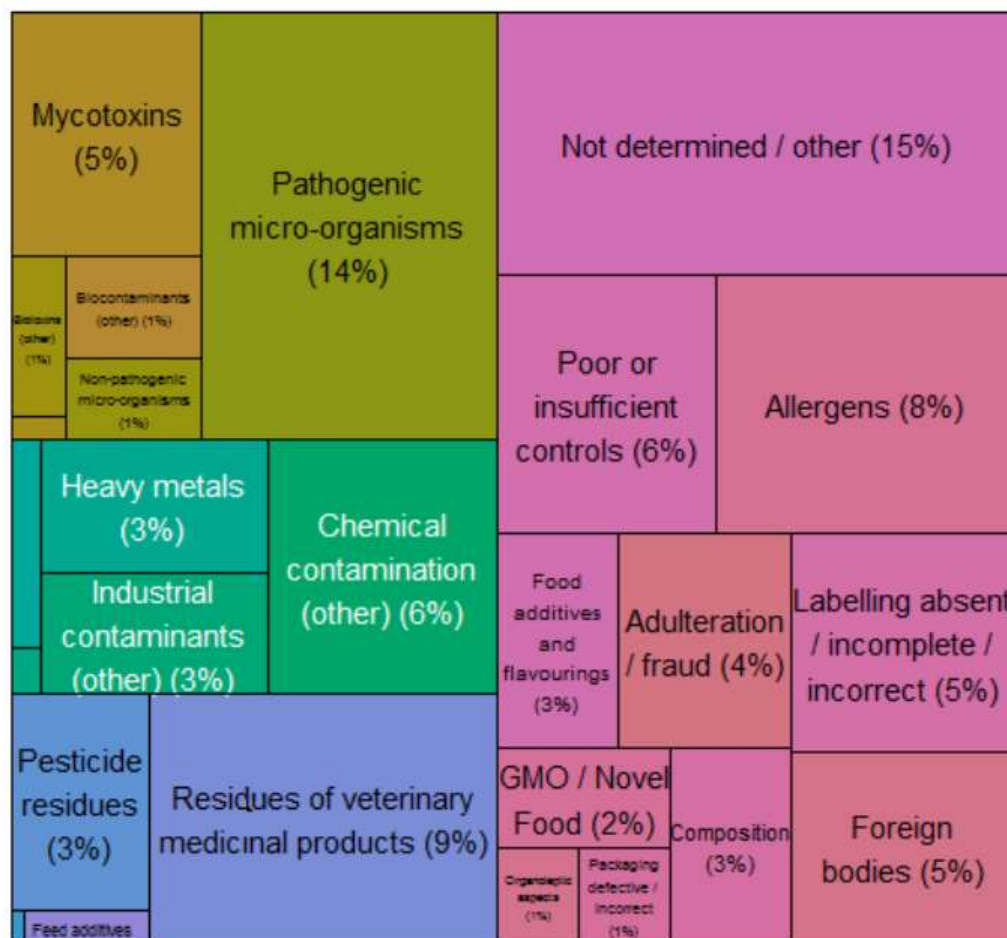


Summary of incidents - UK

Published by FSA as annual report until 2017 – now live database
<https://www.food.gov.uk/>



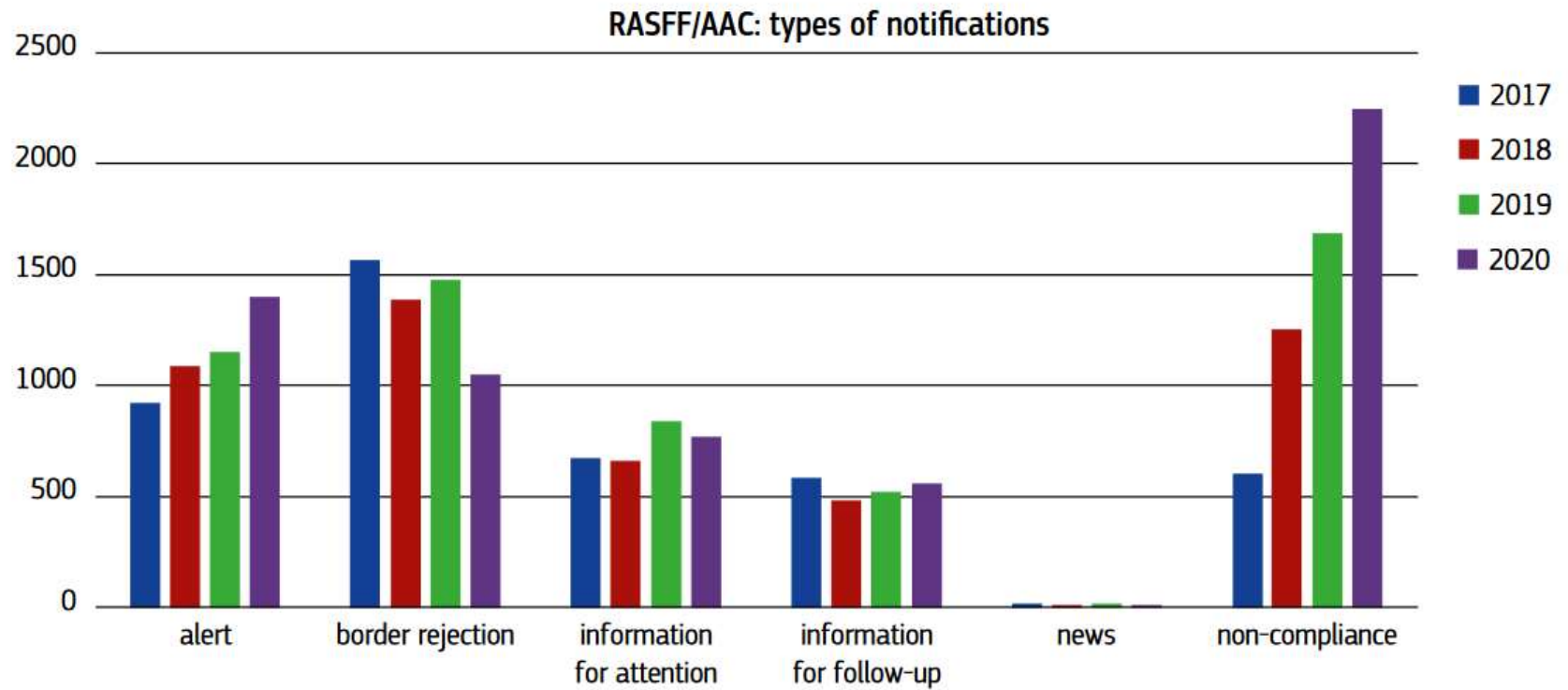
Figure 2: Relative numbers of incidents by suspected or actual concern (Hazard type): UK, 2016/17 ¹



RASFF – The Rapid Alert System for Food and Feed (EU)

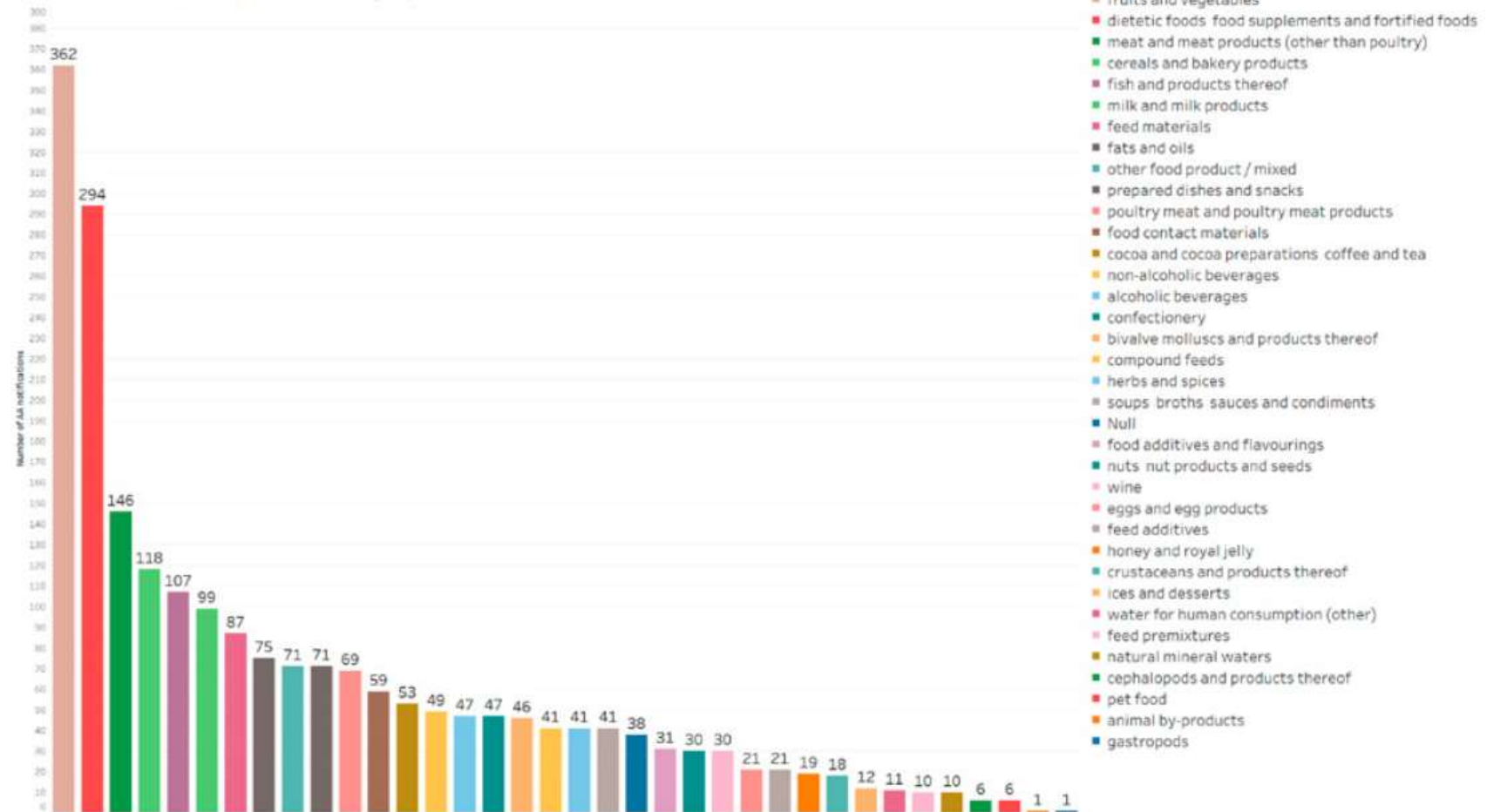
https://ec.europa.eu/food/safety/rasff-food-and-feed-safety-alerts_en

Created in 1979, RASFF enables information about food safety concerns and non-compliances to be shared efficiently

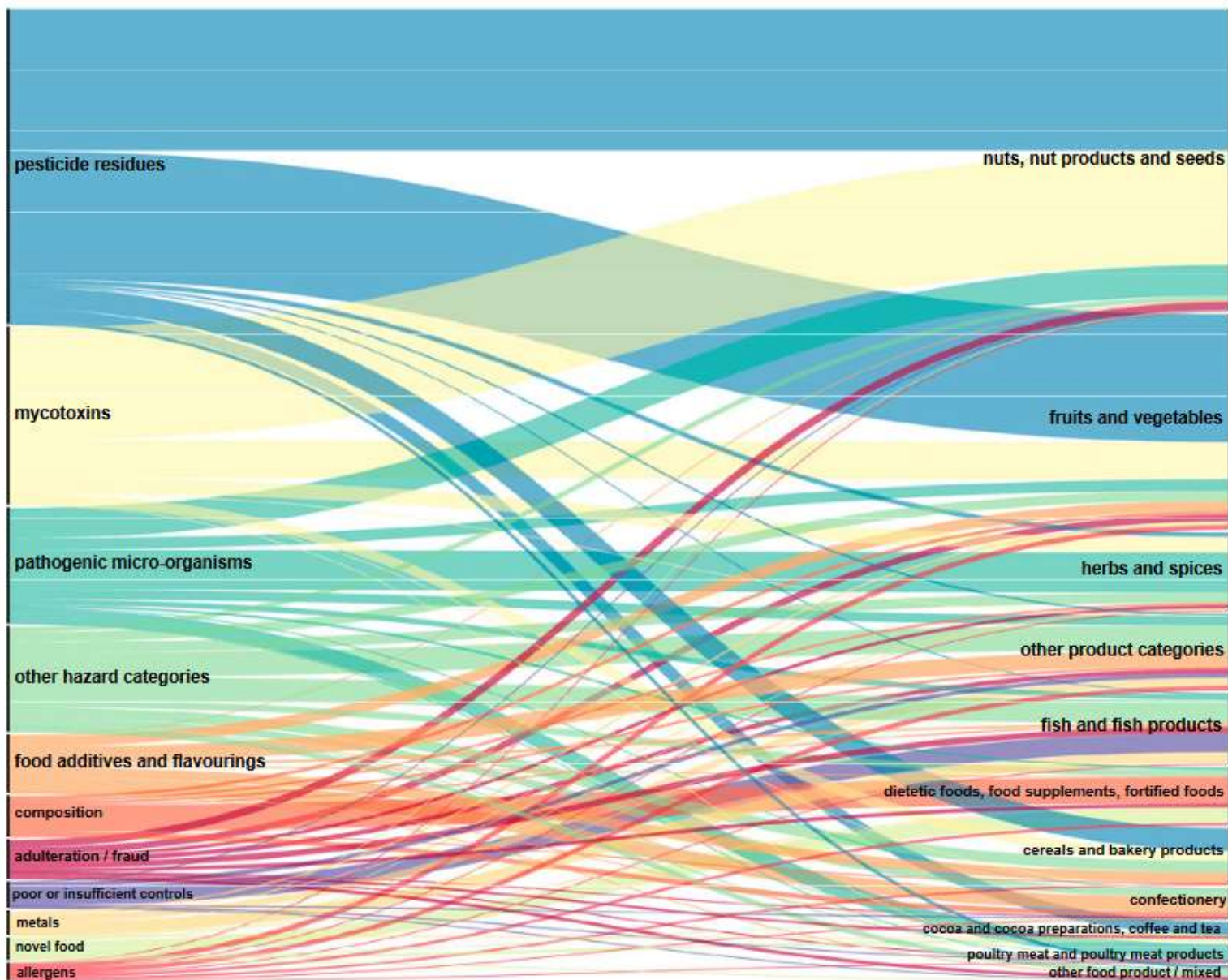


RASFF (2)

AAC notifications per product category



2020 top 10 hazard and product categories on food products originating from non-member countries



Incidents with dioxins and food / feed

Ron Hoogenboom, Wim Traag, Alwyn Fernandes and Martin Rose

European developments following incidents with dioxins and PCBs in the food and feed chain.

Food Control 50 670-683

TABLE 4

Incidents with PCDD/Fs and dl-PCBs in the feed and food chain, the sources and an indication of the highest levels reported. Also the discovery and the laboratory involved is indicated.

Country	Year	Source	Highest levels ^a (food in pg TEQ/g fat, feed (ingredients) in ng TEQ/kg)	Discovered by	Reference
US	1957	Feed fat, cow hides, chlorophenols		Effects, authorities	Schmittle et al., 1958, Sanger et al., 1958, Higgenbotham et al., 1968, Firestone, 1973
US	1969	Water, chlorophenols		Effects	Firestone, 1973
Japan	1968	Rice oil; PCB-oil		Effects	Kuratsune et al., 1972
Taiwan	1979	Rice oil; PCB-oil		Effects	Hsu et al., 1985
Netherlands	1989	Waste incinerators	Grass; milk 14	Authorities	Liem et al., 1991
US	1996	Ball clay, feed, chickens, cat fish	Feed 61, cat fish 43 (lw), eggs	Authorities	Cooper et al. 1995, Hayward et al., 1999, Ferrario and Byrne, 2000
Germany	1997	Brazilian citrus pulp, lime, PVC	Pulp 10; milk 4.9; beef 4.3	Authorities	Malisch, 2000, Carvalhaes et al., 2002, Malisch & Kotz, 2014
Belgium	1999	Feed fat, PCB-oil	Feed 2000; eggs 2000; chicken meat 3000; pork	Effects, private	Bernard et al., 1999, Van Larebeke et al., 2001, De Bont et al., 2004, Traag et al., 2006
Austria	1999	Kaolinic clay	Clay 1132	Authorities	Jobst & Aldag, 2000
Germany, Spain	2000	Choline chloride, sawdust, PCP	Choline chloride 122, feed 0.34	Authorities	Llerena et al., 2003
Italy	2001–2004	Mozzarella, waste incineration	Mozzarella (buffalo) 21, sheep milk 30	Authorities	Diletti et al., 2008
Germany	2003	Dried bakery waste, waste wood	Bakery waste 12, pork 2.2	Private	Hoogenboom et al., 2004
Italy	2004	Wood shavings, PCP	Wood shavings 51, eggs 88	Authorities	Diletti et al., 2005, Brambilla et al., 2009
Netherlands	2004	Potato peels, kaolinic clay	Peels 44, Milk 20	Private	Hoogenboom et al., 2010
Netherlands	2006	Feed fat, gelatine, HCl	Feed fat 440, feed 8, pork 3	Authorities	Hoogenboom et al., 2007
Switzerland	2007	Guar gum	Guar gum 480	Private	Wahl et al., 2008
Chile	2008	Feed, zinc oxide	Zinc oxide 17,148; feed 14, pork 37	Authorities	Kim et al., 2011
Ireland	2008	Dried bakery waste, PCBs in fuel	Bakery waste 8500; Pork 600, Beef, 1000 pig liver 16,000	Private, authorities	Heres et al., 2010, Tlustos et al., 2012, Marnane, 2012
Netherlands, Germany	2010	Organic corn, unknown	Corn 2.7; eggs 11	Private, authorities	RASFF 2010.0519
Germany	2010	Industrial fatty acids, chlorophenols	Feed 1.5; eggs, meat	Private	Abraham et al., 2011

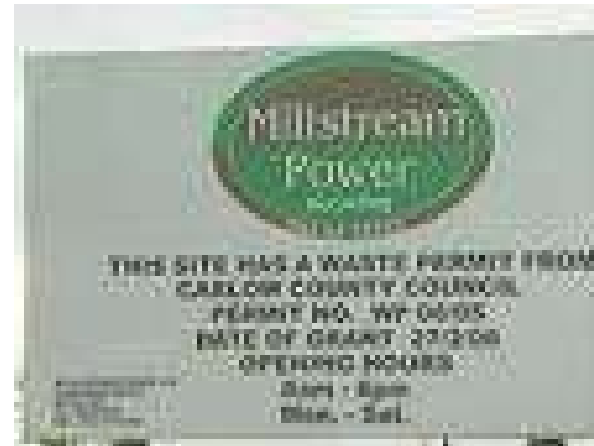


Examples - 'Irish' incident 2008-9

December 2008 – routine screening of pork fat in Irish Republic finds high levels of PCBs

- Contamination traced to recycled biscuit/cake crumb
- PCB-contaminated fuel oil used for direct product drying
- Distinctive congener profile

Full dioxin analysis of pork fat shows up to 400 pg/g (limit 1)



- No feed to NI pig farms but ROI pigs went to NI processors
- Limited traceability

All pork products from Irish Republic and Northern Ireland withdrawn from the market



'Irish' incident 2008-9 (contd.)

Feed also went to beef & dairy farms on both sides of border

Milk blocked on 2 dairy farms

5-6,000 NI beef cattle placed under restriction (8 farms)

12,000 tonnes of slurry tested before use/disposal

- Major cull of cattle
- Need to minimise further impact
- Limited positive release

Land already spread with slurry also tested

Clear lessons to be learned

- Risks of direct drying
- Need for greater awareness of dioxins
- Importance of testing



All pork is recalled after toxin find in pigs

Consumers told not to eat pork and bacon after dioxins found in feed and fat samples

Total recall of pork and bacon after health scare

Consumers told not to eat pork and bacon after dioxins found in feed and fat samples



WHAT YOU SHOULD DO

Routine tests triggered huge recall



No cause for health concerns, says watchdog

by Ray Ryan
Agriculture Correspondent

Chief executive, Alan Hill, said data used to assess health risk showed no cause for concern.

Pork products recalled after toxin found in pig carcasses

Ken Foss
Public Affairs Correspondent

THE government and the Food Safety Authority of Ireland (FSAI) have recalled all pork products from pigs produced in the Republic following the discovery of dioxins in animals at several farms.



Public given assurances over dioxin health threat

by Ray Ryan
Agriculture Correspondent

What not to eat

A wide range of products... Shelves empty... Massive probe into tainted meat

PORK BANNED

All pig meat recalled by safety checks in toxic meat scare



Food safety authority's helpline gets 'unprecedented' number of calls

EUROPEAN BUSINESS

A HELPLINE set up by the Food Safety Authority of Ireland at the wake of the recall of Irish pork products last Saturday has...

number of queries related to the issue of recalls on purchased products.

Many consumers and people in the industry also say the helpline was set up to answer questions...

EU food authority has few concerns over Irish pork

EUROPEAN BUSINESS

Consumers eating large amounts of meat with highest level of dioxins pose no risk.

EU food safety officials said they had no concerns over Irish pork products, despite the recall of the meat.

FEARS ENGINE OIL WAS PUT IN PIGS' FEED

EUROPEAN BUSINESS

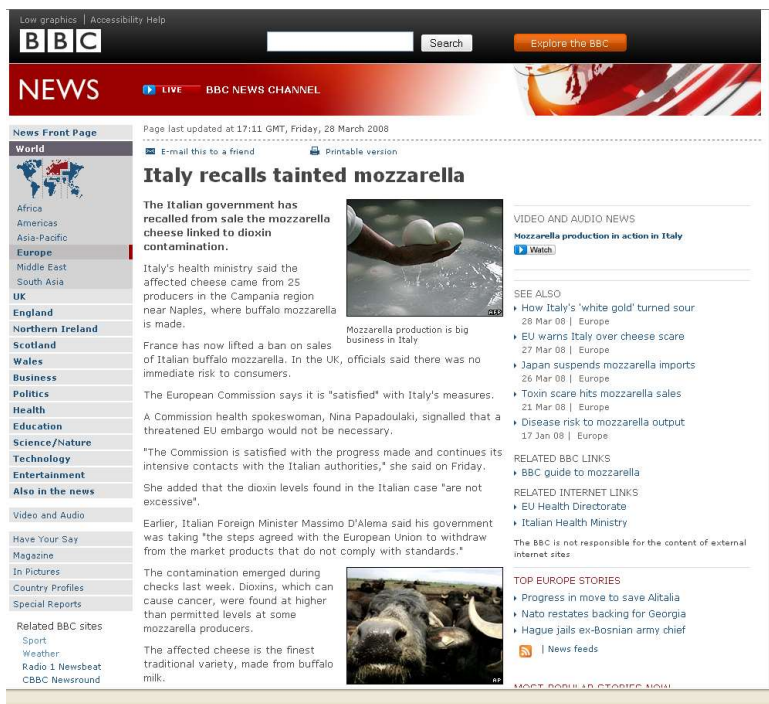


Pig feed toxins 'were off the scale'

EUROPEAN BUSINESS



Examples - Illegal waste disposal



January 2008 – widespread reports of dioxins in mozzarella cheese from the area around Naples (Campania – PDO)

Threats from several countries to place complete ban on imports of Italian mozzarella

Commission advised Italian authorities on detailed monitoring programme

Results for some samples found at several times the limit. Several dozen farms closed as a result

Contamination associated with illegal disposal of hazardous waste and widespread burning of domestic waste



Dioxins in guar gum



1. RASFF re. very high dioxin in guar gum (24/7/07)
2. Letter from Commission to MS - all incoming guar to be tested (1/08/07).
3. Investigations started in Switzerland and India (August/Sept)

Investigations

- Tracking down contaminated guar batches (all MS)
- Ensuring analytical methods available to L.A.s/industry
- Verifying what limits to work to (legal / safety)
- Testing final products (numerous trade withdrawals)
- Incoming guar from all suppliers tested at Border Posts
- Results reported to Commission on regular basis



4. FVO mission to India October 2007
5. Agreed at Standing Committee 5/10/07 to relax test requirements
6. FVO preliminary report to Working Group 23/11/07
7. Final conclusions due December 2007



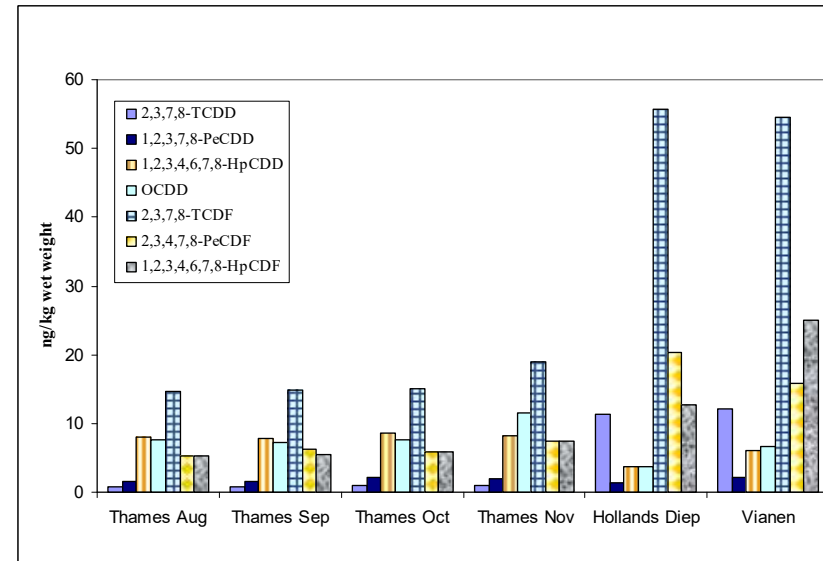
Applied research - examples



Mitten crabs



- Invasive species
- Originate from China
- Cause damage to river bank
- Culinary delicacy
- Control population by harvesting for consumption?



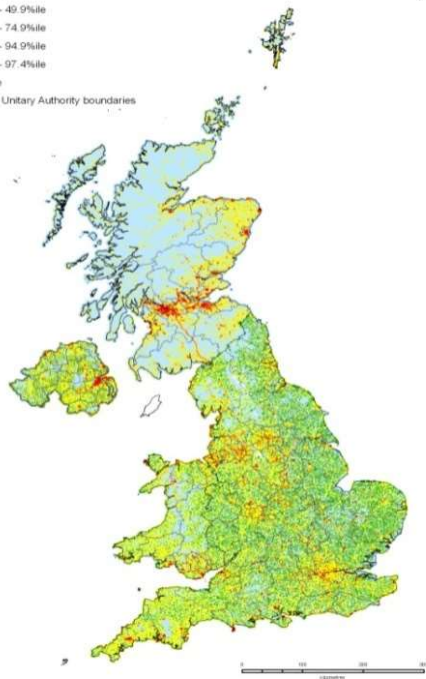
Analysis of POPs in Foods, York UK, Jan 2022



Consumption of fish by anglers

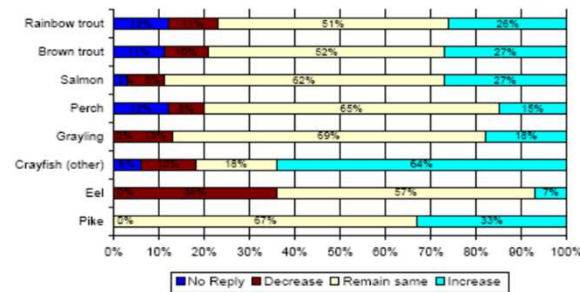
Organic Pollutants from Urban Diffuse

- <24.8%ile
- 25.0%ile - 49.9%ile
- 50.0%ile - 74.9%ile
- 75.0%ile - 94.9%ile
- 95.0%ile - 97.4%ile
- >97.5%ile
- County & Unitary Authority boundaries



- GIS - identify polluted waterways
- Socio-economic study; market research
- Sampling and analysis
- Exposure assessment
- Advice to anglers and consumers

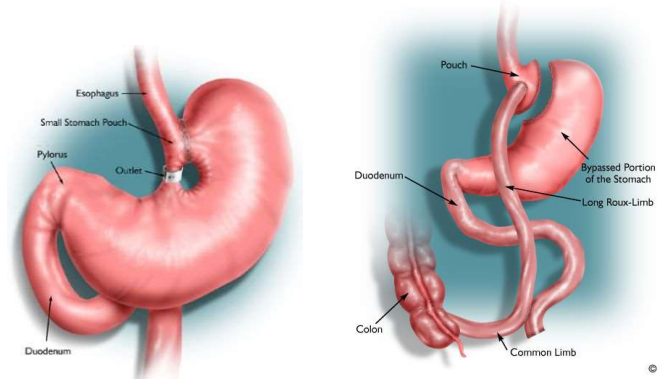
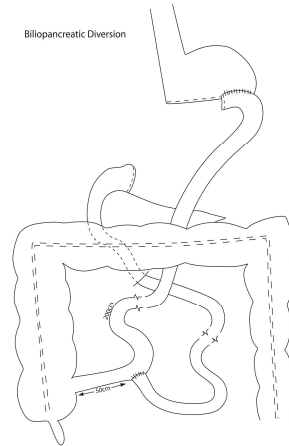
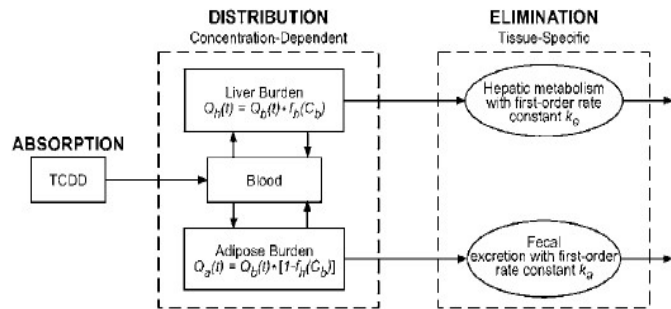
Figure 15: Q16 For all the Types of Fish you have caught then Eaten in the Last 12 Months, do you think the Number of Fish you eat will Increase, Decrease or Stay the Same?



Base 1168



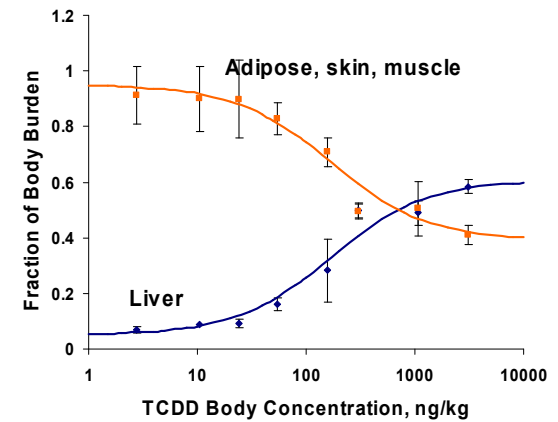
Dioxin body burden following rapid weight loss: implications for risk assessment



Distribution based on

- Lipophilicity,
- Binding to inducible hepatic CYP1A2 protein
 - Dose-dependent
 - CONGENER-SPECIFIC!!

Liver sequestration regarded as negligible at “background” levels



Contaminants in recycled waste materials used in agriculture: implications for food production



www.euchinasafe.eu



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 727864 and from the Chinese Ministry of Science and Technology (MOST).

Disclaimer: The content of this presentation does not reflect the official opinion of the European Commission and/or the Chinese government. Responsibility for the information and views expressed therein lies entirely with the author(s).

