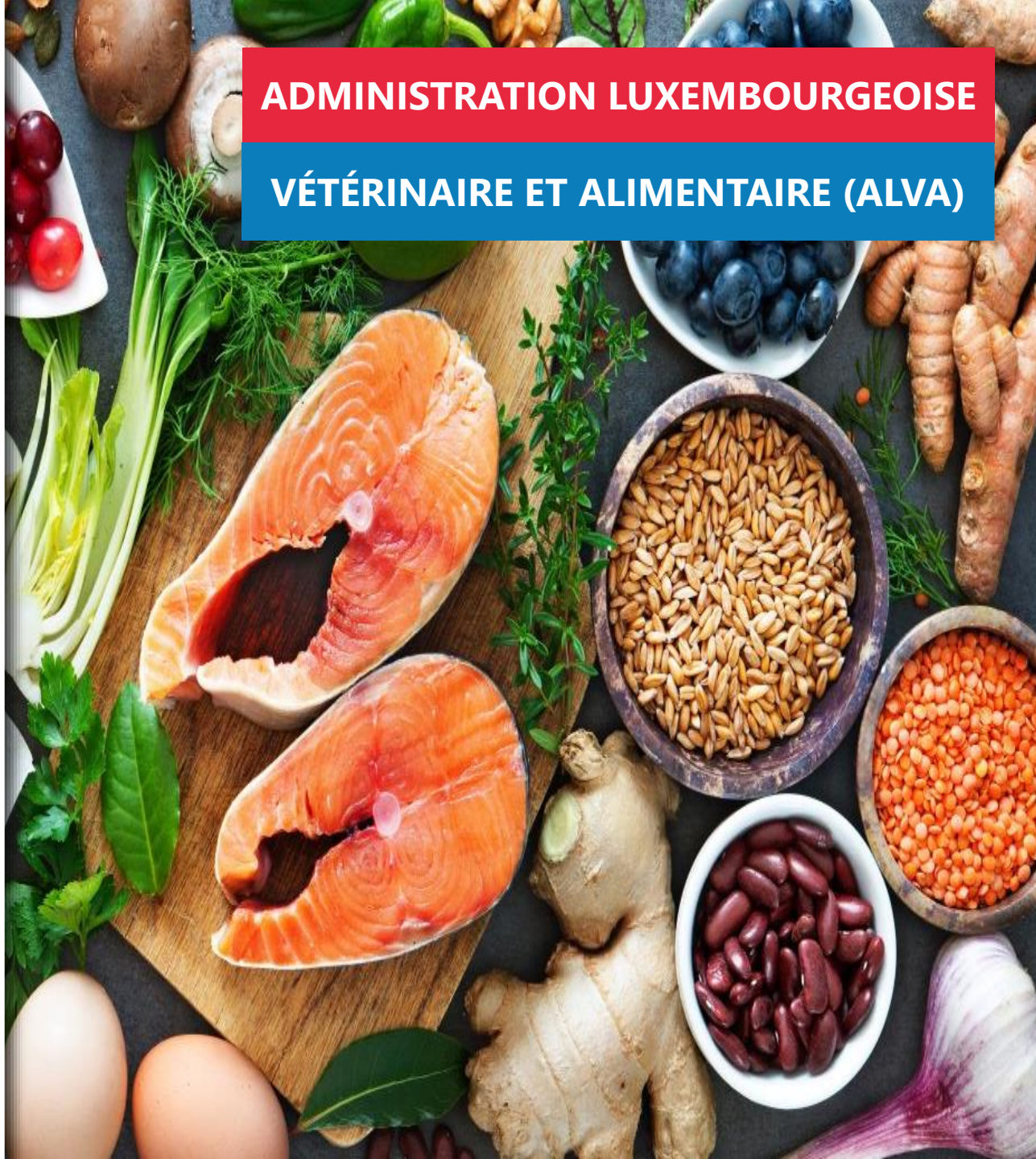
PFAS

PER- AND POLYFLUOROALKYLATED SUBSTANCES

A MARKET REVIEW

LUC SCHULER, PH.D.



ADMINISTRATION LUXEMBOURGEOISE

VÉTÉRINAIRE ET ALIMENTAIRE (ALVA)

PFAS

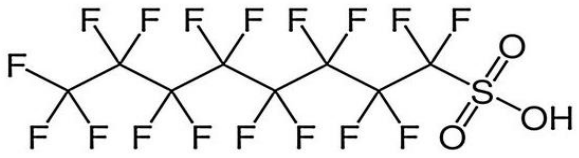
Forever Chemicals

LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Agriculture,
de l'Alimentation et de la Viticulture

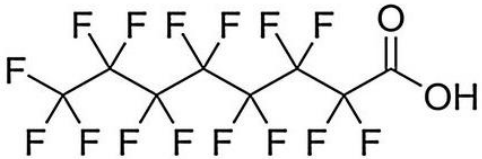
Administration luxembourgeoise vétérinaire
et alimentaire

Per- and polyfluoroalkylated substances

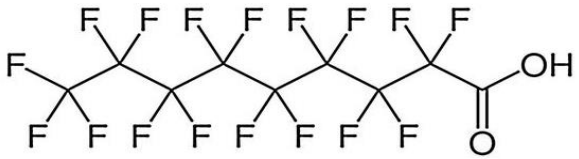
- A very large class of synthetic chemicals in use since the 1930s.
- Chains of carbon (C) atoms surrounded by fluorine (F) atoms, with different terminal ends.
- Thousands of different variations exist in commerce.
- Widely used in industrial processes and in consumer products.
- Mobile via air, water, soil.
- One of the strongest bonds in chemistry, leads to environmental persistence.



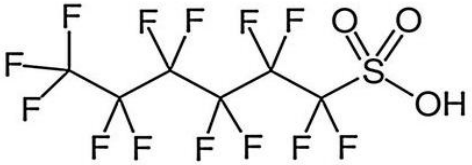
PFOS



PFOA



PFNA



PFHxS

PFAS

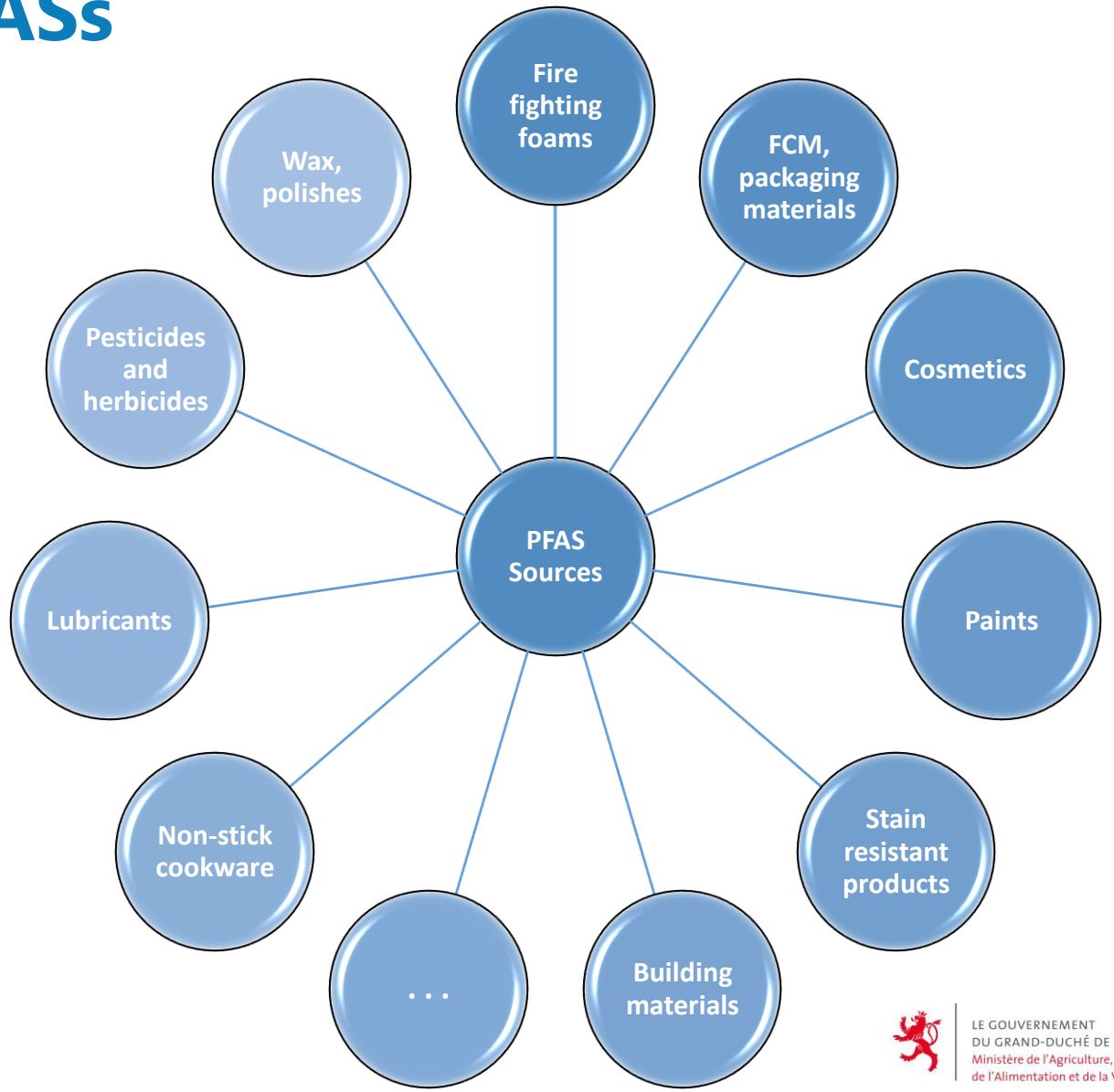
Products that contain PFASs

LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Agriculture,
de l'Alimentation et de la Viticulture

Administration luxembourgeoise vétérinaire
et alimentaire

Products that contain PFASs

https://en.wikipedia.org/wiki/Polytetrafluoroethylene



LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Agriculture,
de l'Alimentation et de la Viticulture

Administration luxembourgeoise vétérinaire
et alimentaire

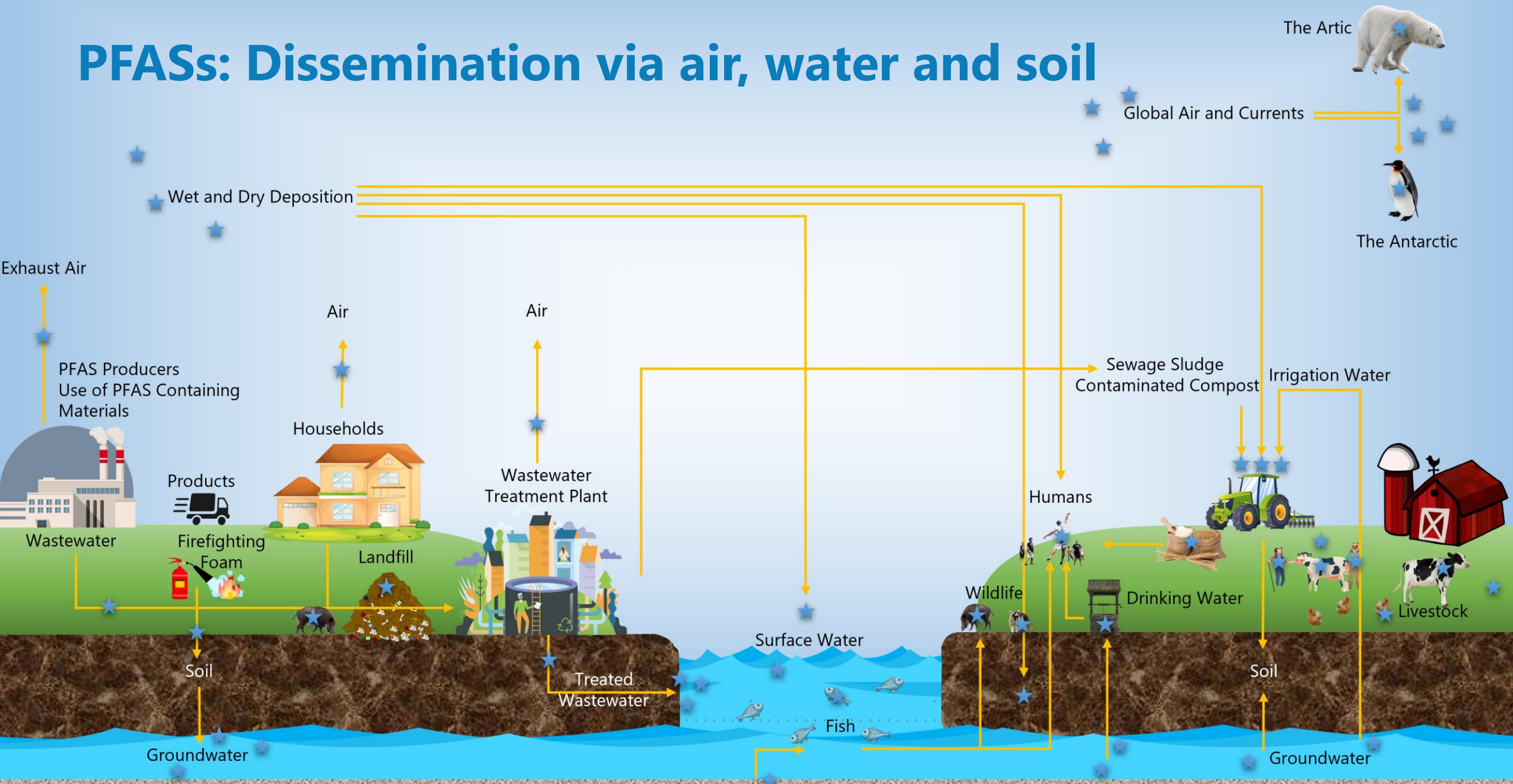
PFAS Fate and Transport

Dissemination via air, water and soil

LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Agriculture,
de l'Alimentation et de la Viticulture

Administration luxembourgeoise vétérinaire
et alimentaire

PFASs: Dissemination via air, water and soil



After Brunn *et al. Environmental Sciences Europe* 2023, **35**(1):20 *(modified)*

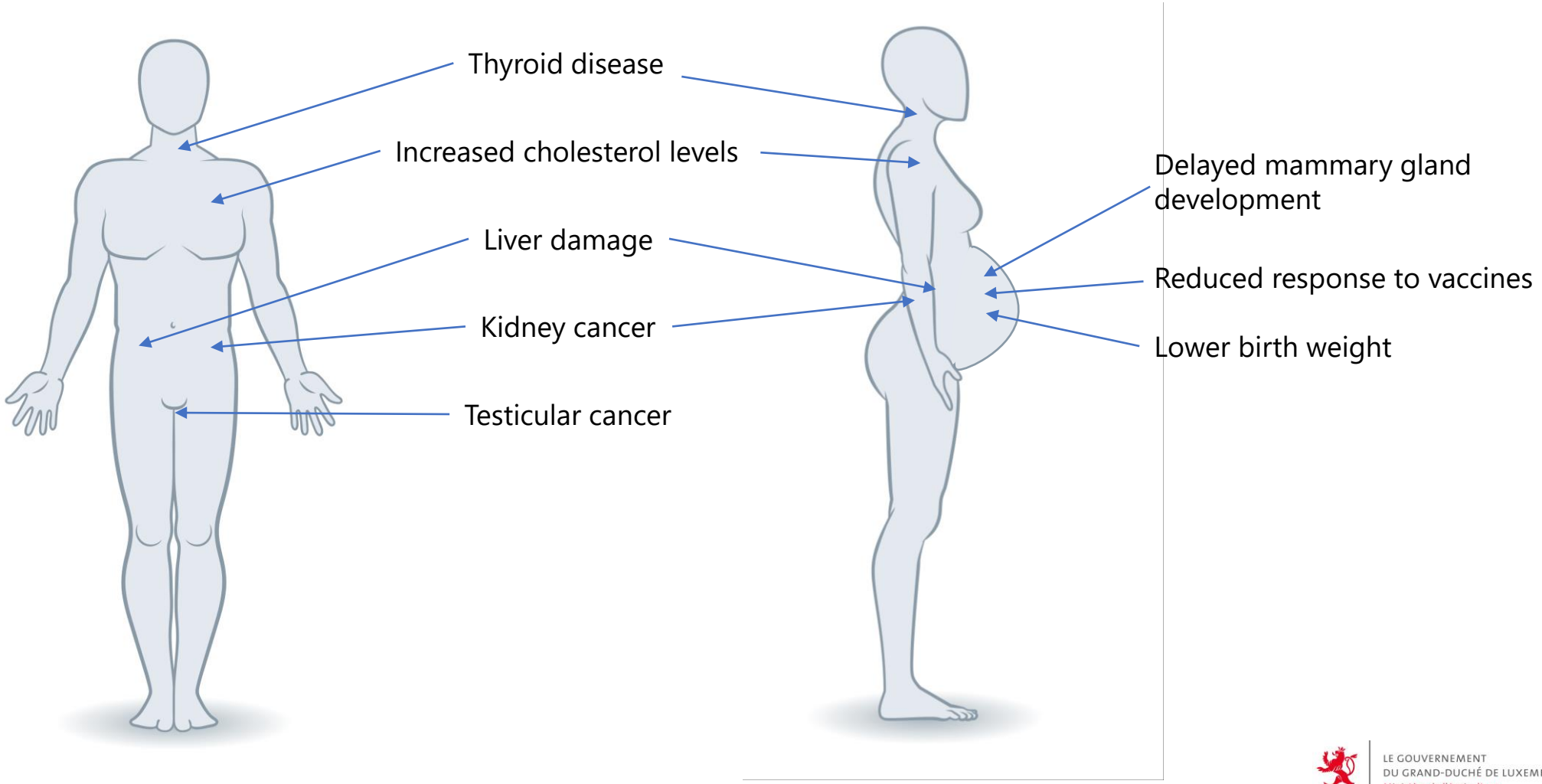
PFAS

Health Effects

LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Agriculture,
de l'Alimentation et de la Viticulture

Administration luxembourgeoise vétérinaire
et alimentaire

PFAS related Health Effects



After S.E. Fenton *et al.* Environmental Toxicology and Chemistry, 2021;40:606–630 *(modified)*

LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Agriculture,
de l'Alimentation et de la Viticulture
Administration luxembourgeoise vétérinaire
et alimentaire

EU Regulations

Maximum permitted levels

LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Agriculture,
de l'Alimentation et de la Viticulture

Administration luxembourgeoise vétérinaire
et alimentaire

EU Regulations

- Regulation (UE) 2023/915
  - Setting ML for the 4 PFASs (PFOS, PFOA, PFNA, PFHxS) and their Sum for products of animal origin:
  - Meat, offal, fish, crustaceans, bivalve molluscs and eggs.
- Commission Recommendation (UE) 2022/1431
  - Monitoring of a wide variety of foodstuffs reflecting consumption habits, including fruits, vegetables, starchy roots and tubers, seaweed, cereals, nuts, oilseeds, food for infants and young children, food of animal origin, non-alcoholic drinks, wine and beer.
  - Further investigation of the causes of the contamination:
    a) 0,010 µg/kg for PFOS, 0,010 µg/kg for PFOA, 0,005 µg/kg for PFNA and 0,015 µg/kg for PFHxS in fruits, vegetables, starchy roots and tubers;
    b) 1,5 µg/kg for PFOS, 0,010 µg/kg for PFOA, 0,005 µg/kg for PFNA and 0,015 µg/kg for PFHxS in wild fungi;
    c) 0,020 µg/kg for PFOS, 0,010 µg/kg for PFOA, 0,050 µg/kg for PFNA and 0,060 µg/kg for PFHxS in milk;
    d) 0,050 µg/kg for PFOS, 0,050 µg/kg for PFOA, 0,050 µg/kg for PFNA and 0,050 µg/kg for PFHxS in baby food.

Market Review

Results

LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Agriculture,
de l'Alimentation et de la Viticulture

Administration luxembourgeoise vétérinaire
et alimentaire

Animal and non-animal origin (2023 – 2024 ongoing)

Food Commodity	N	< LOD	> LOD
Cereals and cereal products	***5***	***3***	***2***
Breakfast cereals	4	3	1
Breakfast muesli	1		1
Follow-on formula	***5***		***5***
Oilseeds	***15***	***11***	***4***
Chia seeds	2	2	
Linseeds	3		3
Peanuts	5	4	1
Sesame seeds	2	2	
Sunflower seeds	3	3	
Vegetables	***2***	***1***	***1***
Courgette	1	1	
Cucumber	1		1

Products of animal origin	***37***	***31***	***6***
Bovine	***13***	***11***	***2***
Milk	8	7	1
Muscle	5	4	1
Honey	***10***	***9***	***1***
Ovine	***1***	***1***	
Porcine	***1***	***1***	
Poultry	***5***	***5***	
Egg	2	2	
Muscle	3	3	
Rabbit	***2***	***2***	
Wild Game	***5***	***2***	***3***
Processed Product	5	2	3
Total	***64***	***46***	***18***

Perfluorooctanoic acid (PFOA),

Perfluorooctane sulfonate (PFOS),

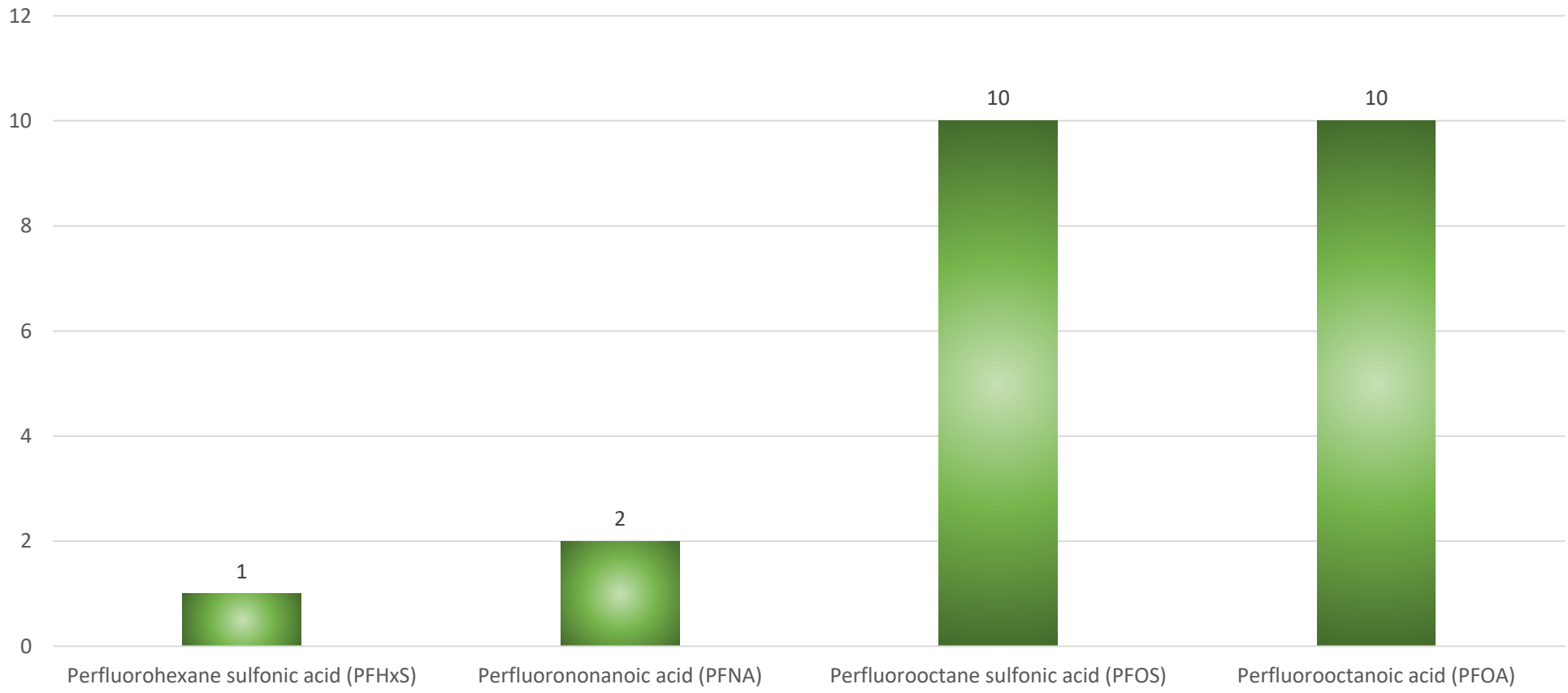
Perfluorohexane sulfonic acid (PFHxS).

Perfluorononanoic acid (PFNA),

LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Agriculture,
de l'Alimentation et de la Viticulture
Administration luxembourgeoise vétérinaire
et alimentaire

Animal and non-animal origin (2023 – 2024 ongoing)

Detection frequency of different PFASs



LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Agriculture,
de l'Alimentation et de la Viticulture

Administration luxembourgeoise vétérinaire
et alimentaire

Tolerable weekly intake (TWI)

Matrix	Origin	Σ PFAS (µg/kg)	TWI (ng/kg body weight)			
			Infants	Adolescents	Adults	Elderly
Breakfast cereals	EU/Non EU	0,047	0,082	0,444	0,241	0,210
Breakfast muesli	EU/Non EU	0,006	0,032	0,056	0,035	0,028
Linseeds A	India	0,002	N/A	0,001	0,005	0,004
Linseeds B	Non EU	0,009	N/A	0,006	0,025	0,020
Linseeds C	Non EU	0,010	N/A	0,006	0,027	0,022
Honey	Luxembourg	0,003	0,005	0,014	0,011	0,012
Follow-on formula A	Germany	0,014	0,392	N/A	N/A	N/A
Follow-on formula B	Unknown	0,004	0,112	N/A	N/A	N/A
Follow-on formula C	Unknown	0,009	0,252	N/A	N/A	N/A
Follow-on formula D	EU/Non EU	0,006	0,168	N/A	N/A	N/A
Follow-on formula E	Unknown	0,007	0,196	N/A	N/A	N/A
Peanuts	Egypt	0,003	N/A	0,016	0,020	0,017
Wild boar Paté	Luxembourg	0,083	N/A		3181	
Wild boar sausage A	Luxembourg	0,489	N/A		540	
Wild boar sausage B	Luxembourg	0,260	N/A		1015	
Cucumber	Luxembourg	0,004	0,056	0,042	0,031	0,038
Bovine Milk	Luxembourg	0,026	N/A	1,647	0,993	0,768
Bovine Muscle	Luxembourg	0,057	0,550	0,895	0,829	0,764

In 2020, EFSA established a TWI of 4,4 ng/kg of body weight per week for the sum of the four PFASs.

Tolerable weekly intake (TWI):

$$\frac{\text{Compound Concentration x Consumption}}{\text{Body Weight}}$$

LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Agriculture,
de l'Alimentation et de la Viticulture
Administration luxembourgeoise vétérinaire
et alimentaire

Fluorinated Pesticides

Results

LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Agriculture,
de l'Alimentation et de la Viticulture

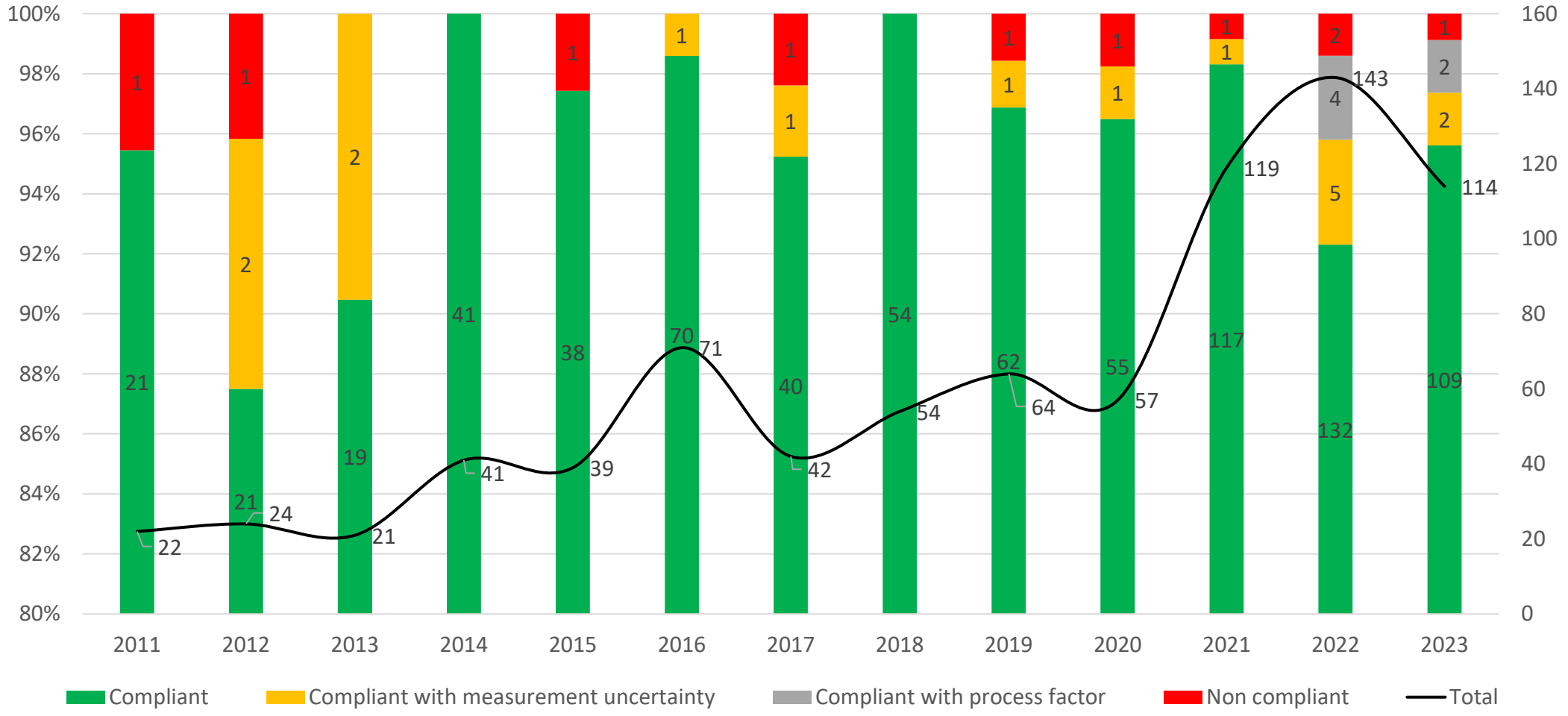
Administration luxembourgeoise vétérinaire
et alimentaire

Fluorinated Pesticide Residues

Since 2011 ALVA has analysed 2656 samples for pesticide residues:

- 811 samples (30.5%) contained residues of fluorinated pesticides (ECHA list),
- 10 of the 811 analysed samples (1.2%) were exceeding the maximum limit,
- 16 samples were compliant taking into account the analytical uncertainty,
- 6 samples were compliant considering the process factor.

Fluorinated Pesticide Residues



LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Agriculture,
de l'Alimentation et de la Viticulture

Administration luxembourgeoise vétérinaire
et alimentaire

Fluorinated Pesticide Residues

Matrix	N	Value (mg/kg)	MRL (mg/kg)	Year	% ARfD (for children)	Origin	Action
Coffee / Tea	**2**						
Tea	2					Taiwan	
Lambda-cyhalothrin		0,064	0.01	2023	2 %		***Border rejection, RASFF notification***
Tetraconazole		0,087	0.02	2015	0.3 %		Withdrawal from the market
Fruits	**1**						
Guava	1					Brazil	
Bifenthrin		0,05	0.01	2020	4 %		Withdrawal from the market
Aromatic herbs	**2**						
Thyme	1					Luxembourg	
Lambda-cyhalothrin		3,60	1	2017	27.2 %		Withdrawal from the market
Thyme	1					Unknown	
Tetraconazole		0,66	0.02	2012	0.08 %		Withdrawal from the market

Fluorinated Pesticide Residues

Matrix	N	Value (mg/kg)	MRL (mg/kg)	Year	% ARfD (for children)	Origin	Action
Vegetables	**5**						
Celery	1					Italy	
Lambda-cyhalothrin		0,55	0.20	2022	412 %		***Recall, RASFF notification***
Tomatoes	2					Italy	
Chlorfenapyr		0.140	0.01	2019	54 %		Withdrawal from the market
Chlorfenapyr		0.045	0.01	2022	17 %		Withdrawal from the market
Potatoes	1					Netherlands	
Fluazinam		0,65	0.02	2011	143 %		***Recall, RASFF notification***
Bell peppers	1					Morocco	
Tetraconazole		0,21	0.10	2021	25 %		Withdrawal from the market

LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Agriculture,
de l'Alimentation et de la Viticulture
Administration luxembourgeoise vétérinaire
et alimentaire

Conclusions

Take-Home messages

LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Agriculture,
de l'Alimentation et de la Viticulture

Administration luxembourgeoise vétérinaire
et alimentaire

Conclusions

- Due to the extreme persistence of PFAS substances, impacts on the environment and human health are likely to increase over time.
- These results underline the necessity to regulate the use of PFASs in order to protect consumers' health.
- Continued surveillance is critical to assessing their presence in food and environmental matrices in order to detect new emerging risks.
- Monitoring these substances enables long-term risk-based management of PFAS exposure in humans, livestock, and game.
- By monitoring the presence of PFASs and PFAS-like pesticides in food, ALVA actively contributes to the setting of MLs.

LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Agriculture,
de l'Alimentation et de la Viticulture
Administration luxembourgeoise vétérinaire
et alimentaire

MERCI

DE VOTRE ATTENTION

LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Agriculture,
de l'Alimentation et de la Viticulture

Administration luxembourgeoise vétérinaire
et alimentaire