

A Decision Tree for the Legal Classification of Food Supplements in the European Union Based on an Analysis of RASFF Notifications on Food Traded Online

Supplementary Information

Notifications on feed

Twenty-four notifications on feed were submitted by nine notifying countries, most frequently by Germany (8; 33.3%) and Spain (6; 25.0%). The notifications were mainly based on consumer complaints (8; 33.3%) or official controls on the market (11; 45.8%). Concerned products originated from nine countries, including the Netherlands (8; 33.3%), the United Kingdom (UK) (4; 16.7%), and Austria (3; 12.5%). Several notifications reported the unauthorised presence of cannabidiol (CBD) as a feed additive or marketing of CBD oil for pets, also in combination with unauthorised health claims.

Notifications on food contact material

One hundred notifications on food contact material were submitted by 11 notifying countries, often by Germany (28.0%), Belgium (25.0%), Luxembourg (19.0%), and Finland (15.0%), and primarily in 2021 (89.0%). The notifications frequently resulted from monitoring of media (61.0%) and official controls on the market (29.0%). Affected products originated from 11 countries, including China (24.0%), the UK (8.0%), France (7.0%), and Germany (6.0%). In 43 notifications, the origin was unknown or not reported.

Several notifications concerned mugs and drinking cups (31.0%), products for children (22.0%), as well as tableware or kitchenware (63.0%) (multiple entries), mostly due to product composition. For instance, 84 notifications reported the (unauthorised) presence of bamboo or bamboo fibres in food contact material, frequently accompanied by misleading claims. Further notifications reported the presence or migration of melamine (and formaldehyde) (15.0%) as well as the (unauthorised) presence of maize fibres/starch (11.0%) and wheat (fibres) (7.0%) (multiple entries).

Table A.1 Decision bases at international, European, and national levels (using Germany as an example) for the legal classification of hazards reported in RASFF notifications on food traded online

level	decision basis	explanation
EU	2017/2470	Commission Implementing Regulation (EU) 2017/2470 [...] establishing the Union list of novel foods [...]; Annex comprises the Union list of authorised novel foods with conditions of use and further requirements
EU	Novel Food status Catalogue	Online-catalogue including information on the Novel Food status of food products, ingredients, and substances (https://ec.europa.eu/food/food-feed-portal/screen/novel-food-catalogue/search , last accessed on 07.06.2025); described as non-binding and non-exhaustive list that is “based on information provided by the EU Member States” (European Commission, n. d.-c)
EU	2002/46/EC	Directive 2002/46/EC of the European Parliament and of the Council [...] on the approximation of the laws of the Member States relating to food supplements; establishes harmonised rules for food supplements in EU Member States with regard to ingredients (vitamins, minerals, and other substances), labelling and trade; Annex I and II specify authorised (forms of) vitamins and minerals for use in food supplements
EU	EFSA Tolerable Upper Intake Levels	“Upper safe levels (ULs) of vitamins and minerals established by scientific risk assessment” (EFSA NDA Panel et al., 2024, p. 3) used as reference values for “managing the risks of excess nutrient intake” (EFSA NDA Panel et al., 2024, p. 4) (EFSA, 2024)
EU	1925/2006	Regulation (EC) No 1925/2006 of the European Parliament and of the Council [...] on the addition of vitamins and minerals and of certain other substances to food; Annex III lists substances with prohibited (Part A) and restricted (Part B) use in foods including food supplements due to harmful health effects as well as substances under Community scrutiny (Part C) due to possible harmful health effects
EU	432/2012	Commission Regulation (EU) No 432/2012 [...] establishing a list of permitted health claims made on foods [...]; Annex comprises the Union list of permitted health claims with conditions and restrictions of use
EU	EU register of health claims	Online-register including information on authorised and non-authorised health claims (https://ec.europa.eu/food/food-feed-portal/screen/health-claims/eu-register , last accessed on 07.06.2025); described as “search tool [and] for information only” (European Commission, n. d.-a)

level	decision basis	explanation
EU	List of botanical claims on hold	List of botanical-related health claims for which a final assessment is pending (EFSA, n. d.) that may be used under specific circumstances (BVL, n. d.)
DE	BfR recommendations	Non-binding recommendations of maximum levels for vitamins and minerals in food supplements by the German Federal Institute for Risk Assessment (BfR) (BfR, 2024)
DE	Stofflisten	Non-exhaustive lists of botanical substances (plants, mushrooms, algae) classified by recommended non-use in food (Part A), recommended restricted use in food (Part B), or possible harmful health effects (Part C) (similar to Regulation (EC) No 1925/2006); decision aid for stakeholders published by the Federal Office of Consumer Protection and Food Safety (BVL) and the Länder with the participation of German, Austrian, and Swiss experts (BVL, 2025) (BVL, 2020a, 2020b, 2020c)
EU	EFSA Scientific Opinions	Scientific Opinions prepared by the European Food Safety Authority (EFSA), published in the EFSA Journal (https://efsa.onlinelibrary.wiley.com/journal/18314732 , last accessed on 07.06.2025) and/or on the EFSA website (https://www.efsa.europa.eu/en , last accessed on 07.06.2025)
EU	HoA Report	Report published by the Heads of Food Safety Agencies working group “Food Supplements” proposing a list of substances with possible health risks for which an article 8 procedure for inclusion in Annex III Part A, Part B, or Part C of Regulation (EC) No 1925/2006 is recommended (Heads of Food Safety Agencies, 2024)
EU	EFSA Compendium of botanicals	Non-exhaustive online-database (https://www.efsa.europa.eu/en/microstrategy/botanical-summary-report , last accessed on 07.06.2025) of botanicals containing “substances of possible concern for human health” (EFSA, 2021) to support “safety assessment of botanicals and botanical preparations intended for use in food, including supplements” (EFSA, 2021) (EFSA, 2025)
DE	BfR Opinions	Opinions and communications prepared by the BfR, published on the BfR website (https://www.bfr.bund.de/ , last accessed on 07.06.2025)
INT	UN Convention 1961	United Nations Single Convention on Narcotic Drugs, 1961; international treaty on co-operation and control of narcotic drugs in other than medical and scientific uses; Schedules I, II, III, and IV list narcotic drugs or preparations that are subject to control measures and further provisions (yellow list) (UN Office on Drugs and Crime, n. d.)

level	decision basis	explanation
		(UN, 1984b; UN Office on Drugs and Crime, n. d.)
INT	UN Convention 1971	United Nations Convention on Psychotropic Substances, 1971; international treaty on co-operation and control of psychotropic substances in other than medical and scientific uses; Schedules I, II, III, and IV list psychotropic substances that are subject to control measures and further requirements for manufacture, trade, and distribution as well as import and export provisions (green list) (UN Office on Drugs and Crime, n. d.) (UN, 1984a; UN Office on Drugs and Crime, n. d.)
DE	BtMG	Act on the Trade in Narcotic Drugs (Narcotic Drugs Act); provisions governing the trade in narcotic drugs (e.g., licensing, import, export and transit, prescriptions, monitoring); Annex I lists non-marketable narcotic drugs; Annex II lists marketable narcotic drugs that may not be prescribed; Annex III lists marketable narcotic drugs that may be prescribed
DE	NpSG	Act on New Psychoactive Substances (New Psychoactive Substances Act); prohibition of trade, marketing, manufacturing, transport, possession, or administration of new psychoactive substances; Annex defines the groups of substance groups covered by the provisions of the act
INT	UN Convention 1988	United Nations Convention against Illicit Traffic in Narcotic Drugs and Psychotropic Substances, 1988; international treaty on co-operation and control of substances “used in the manufacture of narcotic drugs and psychotropic substances” (UN, 2001); Annex lists substances that are subject to specific provisions and measures regarding manufacture, trade, and distribution, import and export monitoring (red list) (UN Office on Drugs and Crime, n. d.) (UN, 2001; UN Office on Drugs and Crime, n. d.)
EU	273/2004	Regulation (EC) No 273/2004 of the European Parliament and of the Council [...] on drug precursors [...]; implementation of UN Convention 1988; Annex I lists substances which are subject to specific control and monitoring measures within the EU to prevent illicit manufacture of narcotic drugs or psychotropic substances
EU	111/2005	Council Regulation (EC) No 111/2005 [...] laying down rules for the monitoring of trade between the Union and third countries in drug precursors [...]; implementation of UN Convention 1988; Annex lists substances which are subject to specific provisions regarding trade between Member States and third countries to prevent illicit manufacture of narcotic drugs or psychotropic substances

level	decision basis	explanation
EU	Union Register of medicinal products	Online-register providing information on medicinal products and orphan medicinal products for human use with EU marketing authorisation (https://ec.europa.eu/health/documents/community-register/html/reg_index_inn.htm , last accessed on 07.06.2025); includes an “index of active substances covered by Commission decisions” (European Commission, n. d.-d)
DE	AMIce	Medicinal Products Information System; online-register including approval data on medicinal products (https://portal.dimdi.de/amguifree/termsfuse.xhtml , last accessed on 07.06.2025); public database contains a searchable module in which active substances are listed (BfArM, n. d.)
DE	AMVV	Ordinance on Prescription-Only Medicinal Products; Annex I lists active substances and preparations that are available only on prescription and not over the counter
DE	AMVerkRV	Ordinance on Pharmacy-Only Medicinal Products and Medicinal Products Sold outside Pharmacies; substances and preparations listed in Annex 1a, plants and plant preparations (except those listed in Annexes 1b and 1c), as well as medicinal tea preparations containing plants listed in Annexes 1d and 1e are excluded from the pharmacy obligation; substances and preparations listed in Annex 4, plants and plant preparations listed in Annexes 1b and 1c, as well as medicinal products for diseases or sufferings listed in Annex 3 are (under certain circumstances) subject to the pharmacy obligation
EU	2008/911/EC	Commission Decision [...] establishing a list of herbal substances, preparations and combinations thereof for use in traditional herbal medicinal products [...]; Annex I lists herbal substances and preparations with longstanding medicinal use “not considered to be harmful under normal conditions of use” (European Commission, n. d.-b)
EU	EU herbal monograph	Scientific opinions on herbal substances and preparations for medicinal use prepared by the Committee on Herbal Medicinal Products (HMPC) (EMA, n. d.), published on the website of the European Medicines Agency (EMA) (https://www.ema.europa.eu/en/search?f%5B0%5D=ema_search_categories%3A85&f%5B1%5D=herbal_outcome%3A254 , last accessed on 07.06.2025)
INT	WADA Prohibited List	International standard listing prohibited substances and methods in sport, maintained and published by the World Anti-Doping Agency (WADA) as part of the World Anti-Doping Code (WADA, n. d.) (WADA, 2023)

level	decision basis	explanation
DE	AntiDopG	Act against doping in sport (Anti-Doping Act); Annex lists substances whose acquisition, possession, or transfer for doping purposes in quantities exceeding small amounts (significant quantity) is prohibited
DE	DmMV	Ordinance determining the significant quantity of doping substances; Annex defines the quantities exceeding small amounts for substances covered by the Anti-Doping Act
Abbreviations: INT: international (international level); EU: European Union (European level); DE: Germany (national level)		

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Table A.2 RASFF notifications on food traded online by notification basis (n=786)

notification basis	notifications (%)
monitoring of media	499 (63.5)
official control on the market	169 (21.5)
consumer complaint	101 (12.8)
border control	5 (0.6)
food poisoning	4 (0.5)
company's own check	3 (0.4)
surveillance programme/monitoring sample	3 (0.4)
official control (non-member country)	1 (0.1)
request/information through AAC/FF	1 (0.1)

Table A.3 RASFF notifications on food traded online by notifying country (n=786)

notifying country	notifications (%)
Sweden	171 (21.8)
Belgium	136 (17.3)
United Kingdom	120 (15.3)
Denmark	84 (10.7)
Germany	66 (8.4)
Poland	52 (6.6)
Czech Republic	30 (3.8)
Switzerland	23 (2.9)
Spain	20 (2.5)
Hungary	16 (2.0)
Slovakia	11 (1.4)
Luxembourg	10 (1.3)
Ireland	9 (1.1)
Slovenia	8 (1.0)
France	6 (0.8)
Lithuania	6 (0.8)
Austria	3 (0.4)
Cyprus	3 (0.4)
Italy	3 (0.4)
European Commission	2 (0.3)
Estonia	2 (0.3)
Netherlands	2 (0.3)
Bulgaria	1 (0.1)
Croatia	1 (0.1)
Norway	1 (0.1)

Table A.4 RASFF notifications on food traded online by country of origin (n=786)

country of origin	notifications (%)
United States	194 (24.7)
unknown	104 (13.2)
Netherlands	80 (10.2)
United Kingdom	73 (9.3)
China	45 (5.7)
Germany	40 (5.1)
Spain	25 (3.2)
Turkey	17 (2.2)
several	16 (2.0)
Czech Republic	16 (2.0)
Switzerland	14 (1.8)
France	12 (1.5)
Sweden	12 (1.5)
Austria	11 (1.4)
Poland	9 (1.1)
Australia	8 (1.0)
Canada	8 (1.0)
Italy	8 (1.0)
Bulgaria	7 (0.9)
India	7 (0.9)
Hong Kong	6 (0.8)
Malaysia	6 (0.8)
Slovakia	6 (0.8)
Slovenia	6 (0.8)
Denmark	5 (0.6)
Portugal	5 (0.6)
Russia	5 (0.6)
Lithuania	4 (0.5)
Estonia	3 (0.4)
Thailand	3 (0.4)
Hungary	2 (0.3)

country of origin	notifications (%)
Iceland	2 (0.3)
Ireland	2 (0.3)
Norway	2 (0.3)
South Korea	2 (0.3)
Ukraine	2 (0.3)
Belgium	1 (0.1)
Cyprus	1 (0.1)
Dominican Republic	1 (0.1)
Ecuador	1 (0.1)
Egypt	1 (0.1)
Finland	1 (0.1)
Indonesia	1 (0.1)
Kuwait	1 (0.1)
Latvia	1 (0.1)
Luxembourg	1 (0.1)
Malta	1 (0.1)
Moldova	1 (0.1)
Monaco	1 (0.1)
Panama	1 (0.1)
Philippines	1 (0.1)
Romania	1 (0.1)
Sri Lanka	1 (0.1)
United Arab Emirates	1 (0.1)
Uzbekistan	1 (0.1)

Table A.5 RASFF notifications on food traded online by product category (multiple entries) (n=786). Notifications reported one or several products of the same or different categories. Therefore, the sum of notifications reporting on the product categories (796 notifications) differs from the total number of notifications (786 notifications). Notifications reporting different products of the same category were counted once

product category	notifications (%)
dietetic foods, food supplements and fortified foods	707 (89.9)
thereof food supplements	689 (87.7)
cocoa and cocoa preparations, coffee and tea	21 (2.7)
other food product/mixed	14 (1.8)
unknown	9 (1.1)
fruits and vegetables	8 (1.0)
food additives and flavourings	7 (0.9)
nuts, nut products and seeds	7 (0.9)
confectionery	5 (0.6)
fats and oils	5 (0.6)
herbs and spices	4 (0.5)
cereals and bakery products	3 (0.4)
non-alcoholic beverages	2 (0.3)
prepared dishes and snacks	2 (0.3)
alcoholic beverages	1 (0.1)
meat and meat products (other than poultry)	1 (0.1)

Table A.6 RASFF notifications on food traded online by hazard category (multiple entries) (n=786). Notifications reported one or several hazards of the same or different categories. Notifications reporting different hazards of the same category or subcategory were counted once. Therefore, the total number of notifications reporting hazards in a category may differ from the sum of notifications reporting hazards in the subcategories. The subcategory “other” includes unauthorised marketing/sale, other non-compliance, and recall from consumers

hazard category	notifications (%)
presence	159 (20.2)
unauthorised/prohibited substance/ingredient	449 (57.1)
thereof Novel Food	266 (33.8)
(possibly) unsafe substance/ingredient	84 (10.7)
presence of certain substances/ingredients (total)	645 (82.1)
high content/intake/levels/amount	119 (15.1)
(risk of) overdosage	9 (1.1)
high content/intake, (risk of) overdosage (total)	126 (16.0)
insufficient labelling	13 (1.7)
undeclared ingredient	3 (0.4)
unauthorised health claim	25 (3.2)
non-compliant labelling and unauthorised health claims (total)	38 (4.8)
adverse reaction/side effects, food poisoning	12 (1.5)
microbiological hazard	10 (1.3)
physical hazard	4 (0.5)
other	76 (9.7)
other (total)	100 (12.7)

Table A.7 Hazards reported in RASFF notifications on food traded online (multiple entries) (n=786). The 786 notifications reported a total of 210 hazards in 1,002 entries. 764 notifications reported a specific hazard. 22 notifications reported no specific hazard; 16 notifications reported the hazard as “-“ and 10 notifications reported the hazard as “unknown” (4 duplicates)

hazard	presence of certain substances/ingredients	high content/intake, (risk of) overdose	non-compliant labelling and unauthorised health claims	other	notifications (%)
2,4-dinitrophenol (DNP)	x			x	108 (13.7)
Cannabidiol (CBD)	x	x	x	x	103 (13.1)
Yohimbine	x		x	x	73 (9.3)
<i>Pausinystalia johimbe</i> (yohimbe)	x		x	x	38 (4.8)
Monacolin K (Lovastatin)		x			28 (3.6)
<i>Withania somnifera</i> (ashwagandha)	x		x	x	28 (3.6)
1,3-Dimethylamylamine (DMAA)	x			x	26 (3.3)
<i>Artemisia annua</i>	x		x		17 (2.2)
<i>Mitragyna speciosa</i> (kratom)	x			x	17 (2.2)
Caffeine	x	x	x		16 (2.0)
<i>Eurycoma longifolia</i> (tongkat ali)	x				16 (2.0)
Agmatine sulphate	x				15 (1.9)
Sodium chlorite	x			x	15 (1.9)
Sildenafil	x				13 (1.7)
Tetrahydrocannabinol (THC)	x	x			13 (1.7)
Vitamin B6		x			13 (1.7)
5-Hydroxytryptophan (5-HTP)	x		x		12 (1.5)
<i>Ephedra</i>	x			x	11 (1.4)
<i>Epimedium</i>	x				11 (1.4)
<i>Epimedium grandiflorum</i>	x				10 (1.3)
Huperzine A	x				10 (1.3)
Zinc		x	x		10 (1.3)
<i>Aristotelia chilensis</i> (maqui) (berries) (powder)	x			x	9 (1.1)

hazard	presence of certain substances/ingredients	high content/intake, (risk of) overdose	non-compliant labelling and unauthorised health claims	other	notifications (%)
<i>Epimedium sagittatum</i>	x				9 (1.1)
Colloidal silver	x				8 (1.0)
Melatonin	x	x		x	8 (1.0)
<i>Rauvolfia tetraphylla</i> (<i>Rauvolfia canescens</i>)	x			x	8 (1.0)
Tadalafil	x				8 (1.0)
<i>Garcinia cambogia</i>	x	x	x	x	7 (0.9)
<i>Lepidium meyenii</i> (maca)	x			x	7 (0.9)
Synephrine	x	x			7 (0.9)
<i>Tribulus terrestris</i>	x		x		7 (0.9)
Amygdalin		x		x	6 (0.8)
Fullerene C60	x		x		6 (0.8)
<i>Hoodia gordonii</i>	x				6 (0.8)
<i>Rauvolfia vomitoria</i>	x				6 (0.8)
Vitamin D		x			6 (0.8)
α -Amylase (genetically modified, GMM)	x				6 (0.8)
2-amino-6-methylheptane (DMHA)	x			x	5 (0.6)
Dimethylethanolamine (DMEA)	x				5 (0.6)
Nicotinic acid		x		x	5 (0.6)
Vitamin A		x		x	5 (0.6)
Vitamin E		x			5 (0.6)
Aluminium		x			4 (0.5)
Berberine	x			x	4 (0.5)
<i>Cnidium monnieri</i>	x				4 (0.5)
Glycerophosphorylcholine (alpha-GPC)	x				4 (0.5)
Ibutamoren (MK-677)	x				4 (0.5)
Ligandrol (LGD-4033)	x				4 (0.5)

hazard	presence of certain substances/ingredients	high content/intake, (risk of) overdose	non-compliant labelling and unauthorised health claims	other	notifications (%)
Magnesium L-threonate	x				4 (0.5)
Piperine		x		x	4 (0.5)
3,3'-diindolylmethane (DIM)	x			x	3 (0.4)
<i>Ajuga turkestanica</i>	x				3 (0.4)
Aloin		x			3 (0.4)
<i>Bacillus cereus</i>				x	3 (0.4)
Beta-alanine	x				3 (0.4)
<i>Cannabis sativa</i> (extract)	x				3 (0.4)
Cardarine (GW1516) (Endurobol)	x				3 (0.4)
<i>Cistanche deserticola</i>	x				3 (0.4)
Enobosarm (MK-2866) (Ostarine)	x				3 (0.4)
Erythrosine (E 127)	x		x		3 (0.4)
Hydrocyanic acid		x			3 (0.4)
Hydroxyanthracene derivatives	x	x		x	3 (0.4)
<i>Hypericum perforatum</i> (St. John's wort)	x		x	x	3 (0.4)
Magnesium in metal form	x				3 (0.4)
<i>Mucuna pruriens</i>	x				3 (0.4)
Nicotinamide mononucleotide (NMN)	x			x	3 (0.4)
Oxilofrine (Methylsynephrine)	x				3 (0.4)
Phenethylamine	x				3 (0.4)
<i>Salmonella</i>				x	3 (0.4)
Sibutramine	x				3 (0.4)
<i>Trametes versicolor</i>	x				3 (0.4)
Vosilasarm (RAD140) (Testolone)	x				3 (0.4)
1,3-dimethylbutylamine (DMBA)	x				2 (0.3)
2-chloroethanol	x				2 (0.3)

hazard	presence of certain substances/ingredients	high content/intake, (risk of) overdose	non-compliant labelling and unauthorised health claims	other	notifications (%)
<i>Acacia rigidula</i>	x				2 (0.3)
<i>Ambrosia artemisiifolia</i>	x				2 (0.3)
<i>Annona muricata</i> (leaves)	x				2 (0.3)
Artemisinin (from <i>Artemisia annua</i>)	x		x		2 (0.3)
<i>Azadirachta indica</i> (neem) (powder)	x			x	2 (0.3)
Cannabigerol (CBG)	x				2 (0.3)
<i>Clitoria ternatea</i>	x				2 (0.3)
Colloidal gold	x				2 (0.3)
Cyanide		x			2 (0.3)
<i>Dendrobium nobile</i>	x				2 (0.3)
Ephedrine	x				2 (0.3)
Ethylene oxide	x			x	2 (0.3)
Gluten	x		x	x	2 (0.3)
Higenamine	x				2 (0.3)
<i>Huperzia serrata</i> (extract)	x				2 (0.3)
<i>Hydrastis canadensis</i> (goldenseal)	x				2 (0.3)
Lead		x			2 (0.3)
N-acetyl-L-cysteine	x				2 (0.3)
Octopamine	x				2 (0.3)
Phenolphthalein	x				2 (0.3)
Polycyclic aromatic hydrocarbons (PAH) (sum of PAH4)	x				2 (0.3)
<i>Pueraria montana</i> var. <i>lobata</i> (kudzu) (root)	x				2 (0.3)
Zeolite	x				2 (0.3)
2-Hydroxypropyl nortadalafil	x				1 (0.1)
4,6-androstadien-17-ol-3-one	x				1 (0.1)

hazard	presence of certain substances/ingredients	high content/intake, (risk of) overdose	non-compliant labelling and unauthorised health claims	other	notifications (%)
4,6-androstadien-3,17-dione	x				1 (0.1)
4,9-estradien-3,17-dione	x			x	1 (0.1)
5-androsten-17-ol-3-one	x				1 (0.1)
<i>Adansonia digitata</i> (baobab) (leaves)	x				1 (0.1)
Aflatoxin B1				x	1 (0.1)
Aflatoxins (sum)				x	1 (0.1)
<i>Agaricus blazei</i>	x				1 (0.1)
Aildenafil (Dimethylsildenafil)	x				1 (0.1)
<i>Akkermansia muciniphila</i>	x		x		1 (0.1)
<i>Andrographis paniculata</i>	x		x		1 (0.1)
Anthraquinone	x				1 (0.1)
<i>Arctostaphylos uva-ursi</i>	x		x	x	1 (0.1)
<i>Argyrea nervosa</i> (Hawaiian baby woodrose)	x				1 (0.1)
Arimistane	x				1 (0.1)
Arsenic	x				1 (0.1)
<i>Bauhinia purpurea</i>	x				1 (0.1)
Benzo(a)pyrene	x				1 (0.1)
<i>Bulbine natalensis</i>	x				1 (0.1)
Cadmium	x				1 (0.1)
Calcium hypochlorite				x	1 (0.1)
Cannabinol (CBN)	x				1 (0.1)
Carrageenan (E 407)	x				1 (0.1)
Cascara (<i>Coffea</i> spp.)	x				1 (0.1)
<i>Cascara sagrada</i> (<i>Rhamnus purshianus</i>)				x	1 (0.1)
Chloramphenicol	x				1 (0.1)
Chlorate	x				1 (0.1)

hazard	presence of certain substances/ingredients	high content/intake, (risk of) overdose	non-compliant labelling and unauthorised health claims	other	notifications (%)
Chlorine dioxide (E 926)	x				1 (0.1)
Chromium		x			1 (0.1)
<i>Cimicifuga racemosa</i> (black cohosh) (extract)	x				1 (0.1)
<i>Cirsium oligophyllum</i>	x				1 (0.1)
<i>Coix lacryma-jobi</i>	x				1 (0.1)
<i>Coptis chinensis</i> (Chinese goldthread) (root) (extract)	x				1 (0.1)
Creatine ethyl ester	x				1 (0.1)
Curcumin		x			1 (0.1)
Dehydroepiandrosterone (DHEA)	x				1 (0.1)
Desmethyltadalafil	x				1 (0.1)
<i>Dipteryx odorata</i> (tonka) (beans)	x			x	1 (0.1)
Emodin	x				1 (0.1)
Epigallocatechin gallate (EGCG)	x				1 (0.1)
<i>Epimedium brevicornum</i>	x				1 (0.1)
<i>Escherichia coli</i> (shigatoxin producing)				x	1 (0.1)
Ginsenosides		x			1 (0.1)
Glucosamine	x				1 (0.1)
<i>Griffonia simplicifolia</i> (extract)	x		x	x	1 (0.1)
<i>Grifola frondosa</i>	x				1 (0.1)
<i>Gymnema sylvestre</i> (leaves) (extract)	x				1 (0.1)
Harmaline	x				1 (0.1)
Harmine	x				1 (0.1)
<i>Hericium erinaceus</i> (lion's mane)	x				1 (0.1)
Hexahydrocannabinol (HHC)	x				1 (0.1)
Hordenine	x				1 (0.1)

hazard	presence of certain substances/ingredients	high content/intake, (risk of) overdose	non-compliant labelling and unauthorised health claims	other	notifications (%)
Huperzine	x			x	1 (0.1)
Icariin	x				1 (0.1)
<i>Ilex guayusa</i>	x				1 (0.1)
Iodine		x			1 (0.1)
Iron		x			1 (0.1)
<i>Larrea tridentata</i> (chaparral) (leaves)	x			x	1 (0.1)
Lipoic acid		x			1 (0.1)
<i>Listeria monocytogenes</i>				x	1 (0.1)
Locust bean gum (E 410)	x				1 (0.1)
<i>Lycium barbarum</i> (leaves)	x				1 (0.1)
Magnesium aspartate	x				1 (0.1)
Magnesium creatine chelate	x				1 (0.1)
Magnesium orotate	x	x			1 (0.1)
Mercury	x				1 (0.1)
Monacolin (from red rice)		x			1 (0.1)
N,N-dimethylethanolamine bitartrate	x				1 (0.1)
N-acetyl-L-tyrosine	x				1 (0.1)
Nicotine	x	x			1 (0.1)
Norvaline	x			x	1 (0.1)
Ochratoxin A				x	1 (0.1)
<i>Ocimum tenuiflorum</i> (<i>Ocimum sanctum</i>) (holy basil)	x		x		1 (0.1)
Palmitoylethanolamide	x				1 (0.1)
Pancreatin				x	1 (0.1)
<i>Phyllanthus emblica</i> (<i>Emblica officinalis</i>)	x		x		1 (0.1)
Phyllophaga (June beetle)	x				1 (0.1)

hazard	presence of certain substances/ingredients	high content/intake, (risk of) overdose	non-compliant labelling and unauthorised health claims	other	notifications (%)
<i>Rauvolfia</i> (extract)	x				1 (0.1)
Reindeer antlers	x				1 (0.1)
<i>Rhynchophorus ferrugineus</i> (palm worm)	x				1 (0.1)
<i>Salmonella</i> Give				x	1 (0.1)
<i>Santalum album</i>	x		x		1 (0.1)
<i>Scutellaria lateriflora</i> (blue skullcap) (extract)	x				1 (0.1)
Selenium		x			1 (0.1)
Selenium amino acid chelate	x				1 (0.1)
<i>Serenoa repens</i> (extract)	x				1 (0.1)
Serratiopeptidase	x				1 (0.1)
Sildenafil thiono analogue	x				1 (0.1)
Silver	x				1 (0.1)
<i>Smilax scobinicaulis</i>	x				1 (0.1)
Soy			x		1 (0.1)
Stanozolol	x				1 (0.1)
Sulfites	x				1 (0.1)
<i>Terminalia arjuna</i>	x		x		1 (0.1)
<i>Terminalia bellirica</i>	x		x		1 (0.1)
<i>Terminalia chebula</i>	x		x		1 (0.1)
Testosterone	x				1 (0.1)
Tetrahydroharmine (THH)	x				1 (0.1)
Theacrine	x				1 (0.1)
<i>Tinospora cordifolia</i>	x		x		1 (0.1)
Titanium dioxide (E 171)	x				1 (0.1)
Toluene	x				1 (0.1)
Tri-creatine malate	x				1 (0.1)

hazard	presence of certain substances/ingredients	high content/intake, (risk of) overdose	non-compliant labelling and unauthorised health claims	other	notifications (%)
<i>Turnera diffusa</i>	x				1 (0.1)
Vitamin C		x	x		1 (0.1)
Vitamin K		x			1 (0.1)
<i>Vitex agnus-castus</i>	x		x	x	1 (0.1)
<i>Xanthoparmelia scabrosa</i>	x				1 (0.1)
Xylene	x				1 (0.1)
YK-11	x				1 (0.1)
Zopiclone	x		x	x	1 (0.1)

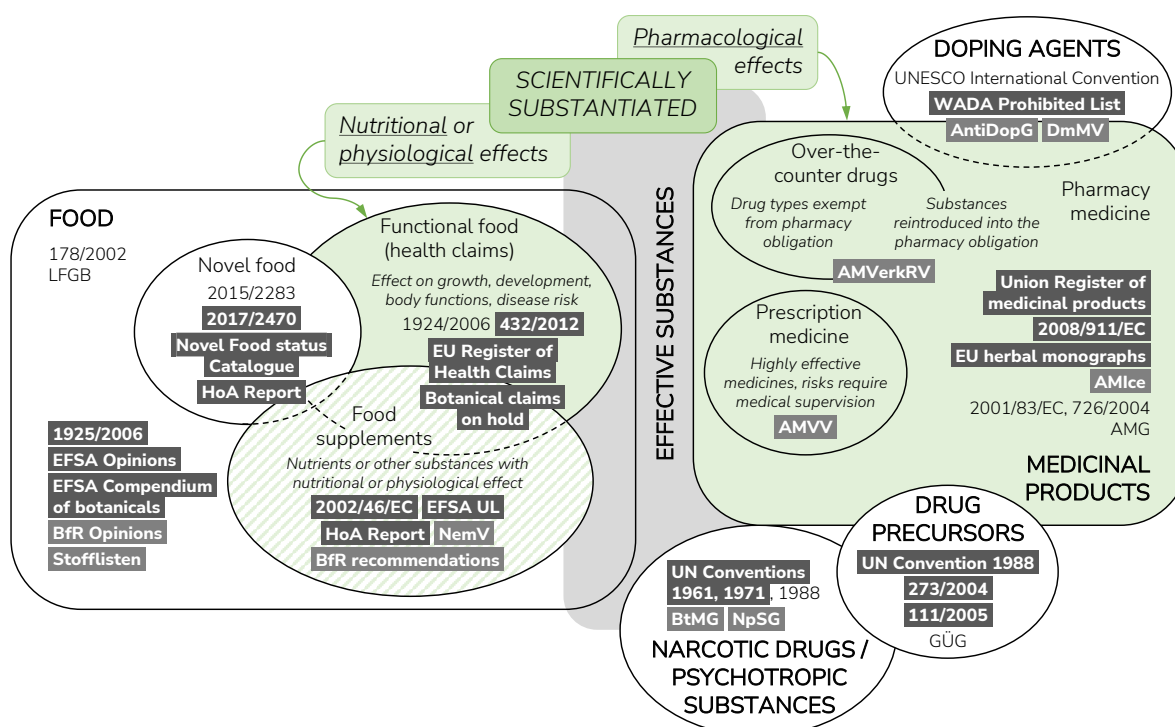


Fig. A.1 Legal framework for mapping hazards reported in RASFF notifications on food traded online (based on legislation and Fuhrmann et al. (2020), Holle et al. (2018), Körner et al. (2022)). Legislation and decision bases at international, European, and national levels (using Germany as an example) were reviewed. Important decision bases are highlighted in dark grey (international and European levels) and light grey (national level). Abbreviations are explained in the list of abbreviations and/or in Table A.1. 178/2002: Reg. (EC) No 178/2002 (General Food Law); 2015/2283: Reg. (EU) 2015/2283 (Novel Food); 1924/2006: Reg. (EC) No 1924/2006 (health claims); 2001/83/EC: Directive 2001/83/EC (medicinal products for human use); 726/2004: Reg. (EC) No 726/2004 (authorisation and supervision of medicinal products for human and veterinary use)

Abbreviations: **AMG**: Medicinal Products Act [Gesetz über den Verkehr mit Arzneimitteln (Arzneimittelgesetz)]; **AMIce**: Medicinal Products Information System [Arzneimittelinformationssystem]; **AMVerkRV**: Ordinance on Pharmacy-Only Medicinal Products and Medicinal Products Sold outside Pharmacies [Verordnung über apothekenpflichtige und freiverkäufliche Arzneimittel]; **AMVV**: Ordinance on Prescription-Only Medicinal Products [Verordnung über die Verschreibungspflicht von Arzneimitteln (Arzneimittelverschreibungsverordnung)]; **AntiDopG**: Act against doping in sport (Anti-Doping Act) [Gesetz gegen Doping im Sport]; **BfR**: German Federal Institute for Risk Assessment [Bundesinstitut für Risikobewertung]; **BtMG**: Act on the Trade in Narcotic Drugs (Narcotic Drugs Act) [Gesetz über den Verkehr mit Betäubungsmitteln (Betäubungsmittelgesetz)]; **DmMV**: Ordinance determining the significant quantity of doping substances [Verordnung zur Festlegung der nicht geringen Menge von Dopingmitteln]; **EFSA**: European Food Safety Authority; **GÜG**: Drug Precursor Monitoring Act [Gesetz zur Überwachung des Verkehrs mit Grundstoffen, die für die unerlaubte Herstellung von Betäubungsmitteln missbraucht werden können (Grundstoffüberwachungsgesetz)]; **LFGB**: German Food and Feed Code [Lebensmittel-, Bedarfsgegenstände- und Futtermittelgesetzbuch]; **NemV**: Ordinance on Food Supplements [Verordnung über Nahrungsergänzungsmittel (Nahrungsergänzungsmittelverordnung)]; **NpSG**: Act on New Psychoactive Substances (New Psychoactive Substances Act) [Neue-psychoaktive-Stoffe-Gesetz]; **UL**: Tolerable Upper Intake Level; **UN**: United Nations; **UNESCO**: United Nations Educational, Scientific and Cultural Organization; **WADA**: World Anti-Doping Agency

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- Körner, H. H., Patzak, J., Volkmer, M., & Fabricius, J. (2022). Betäubungsmittelgesetz: Betäubungsmittel-Verschreibungsverordnung, Arzneimittelgesetz, Neue-psychoaktive-Stoffe-Gesetz, Anti-Doping-Gesetz, Grundstoffüberwachungsgesetz [Narcotics Act: Narcotic Drugs Prescription Ordinance, Medicinal Products Act, New Psychoactive Substances Act, Anti-Doping Act, Drug Precursor Monitoring Act] (10 ed.). C. H. Beck.

Table A.8 Legal classification of hazards reported in RASFF notifications on food supplements traded online. Hazards in bold could not be classified using the described procedure

hazard	food										drugs	medicinal products				doping agents
	information on Novel Food status	vitamin or mineral	UL/maximum level	prohibited or restricted	national recommendation	Scientific Opinion	EFSA Compendium	HoA Statement	Health claims	other non-compliance	narcotic drug/psychotropic substance/drug precursor	active substance	herbal medicinal product	prescription medicine	information on pharmacy obligation	doping agent
2,4-Dinitrophenol (DNP)						x BfR						x DE				x WADA
Cannabidiol (CBD)	x NF					x EFSA						x EU, DE		x		
Yohimbine												x DE		x		
<i>Pausinystalia johimbe</i> (yohimbe)				x prohibited	x Part A	x EFSA, BfR	x					x DE	x		x pharmacy obligation	
Monacolin K (Lovastatin)				x restricted		x EFSA, BfR			x [non-authorised]			x DE		x		
<i>Withania somnifera</i> (ashwagandha)	x -				x Part B	x BfR		x Prio	x [on hold]							
1,3-Dimethylamylamine (DMAA)						x BfR										x WADA
<i>Artemisia annua</i>	x NF				x		x		x [on hold]							
<i>Mitragyna speciosa</i> (kratom)					x Part A	x BfR	x									

Caffeine						x EFSA, BfR			x [non- authorised] [on hold]			x DE				
<i>Eurycoma longifolia</i> (tongkat ali)	x NF					x EFSA	x									
Agmatine sulphate	x NF															
Sodium chlorite						x BfR						x EU, DE				
Sildenafil												x EU, DE		x		
Tetrahydrocannabinol (THC)	x NF					x EFSA, BfR					x	x EU				x WADA
Vitamin B6		x	x UL, max. level			x EFSA, BfR			x [authorised] [non-authorised]			x EU, DE				
5-Hydroxytryptophan (5-HTP)	x NF								x [non- authorised]							
<i>Ephedra</i>				x prohibited	x Part A	x EFSA, BfR	x		x [on hold]			x DE	x	x	x pharmacy obligation	
<i>Epimedium</i>																
<i>Epimedium grandiflorum</i>	x NF				x		x					x DE				
Huperzine A	x -							x								
Zinc		x	x UL, max. level			x EFSA, BfR			x [authorised] [non-authorised]			x EU, DE		x	x	
<i>Aristotelia chilensis</i> (maqui) (berries) (powder)	x -				x Part C	x EFSA										
<i>Epimedium sagittatum</i>	x NF				x		x									
Colloidal silver	x -					x EFSA, BfR										

Melatonin	x -					x BfR		x Prio	x [authorised] [non-authorised]			x EU, DE		x		
<i>Rauvolfia tetraphylla</i> (<i>Rauvolfia canescens</i>)							x					x DE	x	x	x pharmacy obligation	
Tadalafil												x EU, DE		x		
<i>Garcinia cambogia</i>	x -				x Part C		x		x [on hold]			x DE				
<i>Lepidium meyenii</i> (maca)	x -				x	x BfR	x	x Prio	x [on hold]							
Synephrine	x -					x BfR		x Prio				x DE				
<i>Tribulus terrestris</i>	x -				x Part C	x BfR	x	x Prio	x [on hold]			x DE				
Amygdalin						x EFSA						x DE				
Fullerene C60																
<i>Hoodia gordonii</i>	x NF				x		x		x [on hold]							
<i>Rauvolfia vomitoria</i>	x NF						x					x DE	x	x	x pharmacy obligation	
Vitamin D		x	x UL, max. level			x EFSA, BfR			x [authorised] [non-authorised]			x EU, DE		x	x pharmacy obligation	
α -Amylase (genetically modified, GMM)										x						
2-Amino-6-methylheptane (DMHA)												x DE				x WADA
Dimethylethanolamine (DMEA)												x DE		x		
Nicotinic acid		x	x UL, max. level			x EFSA, BfR			x [authorised] [non-authorised]			x EU, DE				

Vitamin A		x	x UL, max. level			x EFSA, BfR			x [authorised] [non-authorised]			x EU, DE		x	x pharmacy obligation	
Vitamin E		x	x UL, max. level			x EFSA, BfR			x [authorised] [non-authorised]			x EU, DE				
Aluminium						x EFSA, BfR				x						
Berberine	x -								x [on hold]							
<i>Cnidium monnieri</i>	x NF															
Glycerophosphorylcholine (alpha-GPC)	x NF											x DE				
Ibutamoren (MK-677)												x DE				x WADA, DE
Ligandrol (LGD-4033)																x WADA, DE
Magnesium L-threonate	x NF	x not listed				x EFSA										
Piperine	x -							x Prio	x [non- authorised]							
3,3'-Diindolylmethane (DIM)	x NF															
<i>Ajuga turkestanica</i>																
Aloin				x prohibited		x EFSA, BfR			x [on hold]			x DE			x pharmacy obligation	
<i>Bacillus cereus</i>										x						
Beta-alanine	x -								x [non- authorised]			x DE				
<i>Cannabis sativa</i> (extract)	x NF						x				x	x DE				

Cardarine (GW1516) (Endurobol)																x WADA, DE
<i>Cistanche deserticola</i>	x NF															
Enobosarm (MK-2866) (Ostarine)												x DE				x WADA, DE
Erythrosine (E 127)						x EFSA				x		x DE				
Hydroxyanthracene derivatives				x prohibited		x EFSA						x DE				
<i>Hypericum perforatum</i> (St. John's wort)	x -				x Part B		x	x Prio	x [on hold]			x DE	x	x	x pharmacy obligation	
Magnesium in metal form		x not listed										x DE				
<i>Mucuna pruriens</i>					x Part A		x		x [on hold]			x DE				
Nicotinamide mononucleotide (NMN)	x NF	x not listed										x EU				
Oxilofrine (Methylsynephrine)												x DE				x WADA
Phenethylamine									x [on hold]		x	x DE			x pharmacy obligation	x WADA
<i>Salmonella</i>										x						
Sibutramine											x	x EU, DE		x		x WADA
<i>Trametes versicolor</i>	x NF				x											
Vosilasarm (RAD140) (Testolone)												x DE				x WADA, DE
1,3-Dimethylbutylamine (DMBA)																x WADA
2-Chloroethanol						x EFSA				x						
<i>Acacia rigidula</i>	x NF						x									

<i>Ambrosia artemisiifolia</i>	x NF											x DE				
<i>Annona muricata</i> (leaves)	x NF				x Part A	x BfR	x									
Artemisinin (from <i>Artemisia annua</i>)												x DE				
<i>Azadirachta indica</i> (neem) (powder)					x Part A		x		x [on hold]							
Cannabigerol (CBG)	x NF															x WADA
Colloidal gold												x DE				
<i>Dendrobium nobile</i>	x NF															
Ephedrine									x [on hold]		x	x DE				x WADA
Ethylene oxide										x						
Gluten										x						
Higenamine																x WADA
<i>Huperzia serrata</i> (extract)							x		x [on hold]							
<i>Hydrastis canadensis</i> (goldenseal)					x Part A		x		x [on hold]			x DE	x	x	x pharmacy obligation	
Lead						x EFSA				x						
N-Acetyl-L-cysteine	x -					x EFSA		x	x [non-authorised]			x EU, DE		x		
Octopamine												x DE				x WADA
Phenolphthalein												x DE			x pharmacy obligation	
Polycyclic aromatic hydrocarbons (PAH) (sum of PAH4)						x EFSA				x						

<i>Pueraria montana</i> var. <i>lobata</i> (kudzu) (root)	x NF				x	x EFSA, BfR						x DE				
Zeolite	x NF								x [non- authorised]							
2-Hydroxypropyl nortadalafil																
4,6-Androstadien-17-ol-3-one																x WADA, DE
4,6-Androstadien-3,17-dione																x WADA, DE
4,9-Estradien-3,17-dione																x WADA, DE
5-Androsten-17-ol-3-one																x WADA, DE
<i>Agaricus blazei</i>	x NF				x				x [on hold]							
Aildenafil (Dimethylsildenafil)																
<i>Akkermansia muciniphila</i>	x NF+					x EFSA										
<i>Arctostaphylos uva-ursi</i>					x Part B		x		x [on hold]			x DE	x		x	
<i>Argyreia nervosa</i> (Hawaiian baby woodrose)	x NF*				x Part A		x					x DE				
Arimistane																x WADA, DE
Arsenic						x EFSA				x						
<i>Bauhinia purpurea</i>																
Benzo(a)pyrene						x EFSA				x						
<i>Bulbine natalensis</i>	x NF															
Calcium hypochlorite																

Cannabinol (CBN)	x NF											x DE				x WADA
<i>Cascara sagrada</i> (<i>Rhamnus purshianus</i>)					x Part A	x EFSA	x		x [on hold]			x DE	x		x pharmacy obligation	
Chloramphenicol						x EFSA, BfR				x		x DE		x		
Chlorate						x EFSA, BfR				x						
Chlorine dioxide (E 926)												x DE				
Chromium		x	x max. level			x EFSA, BfR			x [authorised] [non-authorised]			x DE				
<i>Cimicifuga racemosa</i> (black cohosh) (extract)	x -				x Part A			x Prio	x [on hold]			x DE	x			
<i>Cirsium oligophyllum</i>																
<i>Coptis chinensis</i> (Chinese goldthread) (root) (extract)							x					x DE				
Creatine ethyl ester																
Curcumin	x NF					x BfR		x Prio	x [non-authorised] [on hold]			x DE				
Dehydroepiandrosterone (DHEA)												x EU, DE		x		x WADA, DE
Desmethyltadalafil																
Emodin				x prohibited		x EFSA						x DE			x pharmacy obligation	
Epigallocatechin gallate (EGCG)	x NF+			x restricted		x EFSA			x [non-authorised]			x DE		x		
<i>Epimedium brevicornum</i>	x NF				x											

Ginsenosides									x [on hold]			x DE				
Glucosamine						x EFSA, BfR			x [non- authorised]			x DE				
<i>Griffonia simplicifolia</i> (extract)	x -						x	x	x [on hold]							
<i>Grifola frondosa</i>	x NF				x				x [non- authorised]							
<i>Gymnema sylvestre</i> (leaves) (extract)					x Part A	x BfR			x [on hold]							
Harmaline																
Harmine																
<i>Hericium erinaceus</i> (lion's mane)	x NF				x											
Hexahydrocannabinol (HHC)	x NF					x BfR					x					x WADA
Hordenine												x DE				
Huperzine																
Iodine		x	x UL, max. level			x EFSA, BfR			x [authorised] [non-authorised]			x DE				
Iron		x	x max. level			x EFSA, BfR			x [authorised] [non-authorised]			x EU, DE				
<i>Larrea tridentata</i> (chaparral) (leaves)					x Part A		x									
Lipoic acid						x EFSA			x [non- authorised]			x DE				
Magnesium aspartate		x not listed				x EFSA						x DE				
Magnesium creatine chelate																

Magnesium orotate		x not listed				x EFSA						x DE				
Mercury						x EFSA				x						
Monacolin (from red rice)				x restricted		x EFSA, BfR										
N,N-Dimethylethanolamine bitartrate												x DE				
N-Acetyl-L-tyrosine												x DE				
Norvaline																
Palmitoylethanolamide												x DE				
Pancreatin									x [non-authorised]			x EU, DE				
<i>Rauvolfia</i> (extract)												x DE	x	x	x pharmacy obligation	
Reindeer antlers	x -								x [non-authorised]			x DE				
<i>Salmonella</i> Give										x						
<i>Scutellaria lateriflora</i> (blue skullcap) (extract)												x DE				
Selenium		x	x UL, max. level			x EFSA, BfR			x [authorised] [non-authorised]			x EU, DE		x		
Selenium amino acid chelate		x not listed				x EFSA						x DE		x		
<i>Serenoa repens</i> (extract)					x Part B		x		x [on hold]			x EU, DE	x			
Serratiopeptidase	x NF											x DE		x		
Sildenafil thiono analogue																

Silver						x EFSA				x						
<i>Smilax scobinicaulis</i>												x DE				
Stanozolol												x DE		x		x WADA, DE
Testosterone												x EU, DE		x		x WADA, DE
Tetrahydroharmine (THH)																
Theacrine																
Titanium dioxide (E 171)						x EFSA, BfR				x						
Toluene										x						
Tri-creatine malate																
<i>Turnera diffusa</i>	x -				x				x [on hold]			x DE				
Vitamin C		x	x max. level			x EFSA, BfR			x [authorised] [non-authorised]			x EU, DE			x	
Vitamin K		x	x max. level			x EFSA, BfR			x [authorised] [non-authorised]			x DE				
<i>Vitex agnus-castus</i>					x Part B		x		x [on hold]			x DE	x			
<i>Xanthoparmelia scabrosa</i>	x NF															
Xylene										x						
YK-11																x WADA, DE
Zopiclone												x DE		x		

Abbreviations/explanation: NF: Novel Food; EU: European Union; DE: Germany; information on Novel Food status ("x NF"=information available, Novel Food / "x NF+"=information available, authorised Novel Food / "x -"=information available, not novel); prohibited or restricted: prohibition or restriction according to Regulation (EC) No 1925/2006; national recommendation: recommendation made in the Stofflisten ("Part A"=recommendation of non-use in food / "Part B"=recommendation of restricted use in food / "Part C"=identification of possible harmful health effects); HoA statement ("x"=substance included in the HoA report / "x Prio"=substance prioritised in the HoA report); active substance: registration as active substance at European (EU) or national (DE) levels