

Overdrachtsmodel van ongewenste stoffen van Feed naar Food

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Sectordag GMP+ gecertificeerde bedrijven

TNO | Kennis voor zaken

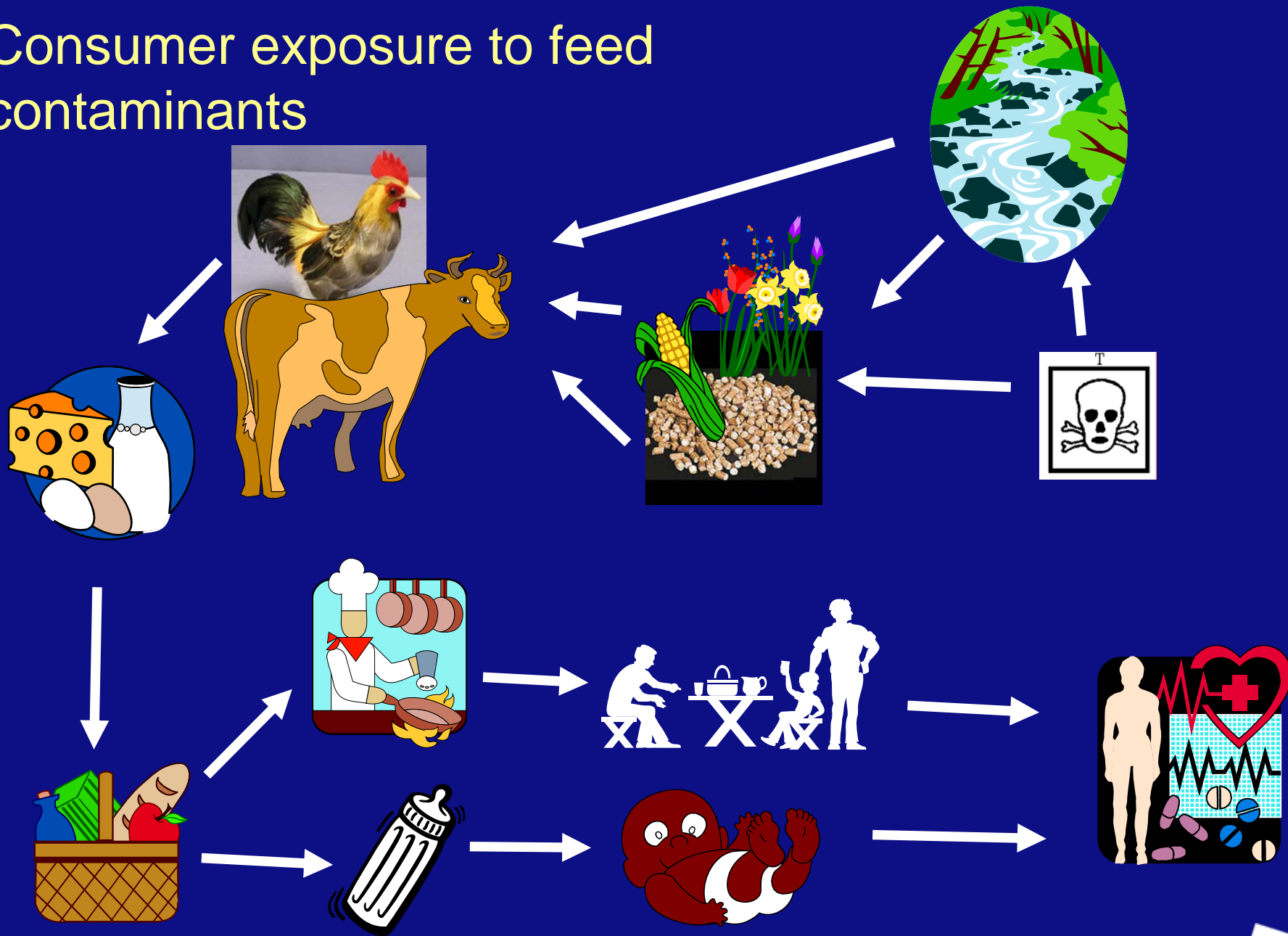


TNO database on transfer of chemicals from feed towards edible animal commodities

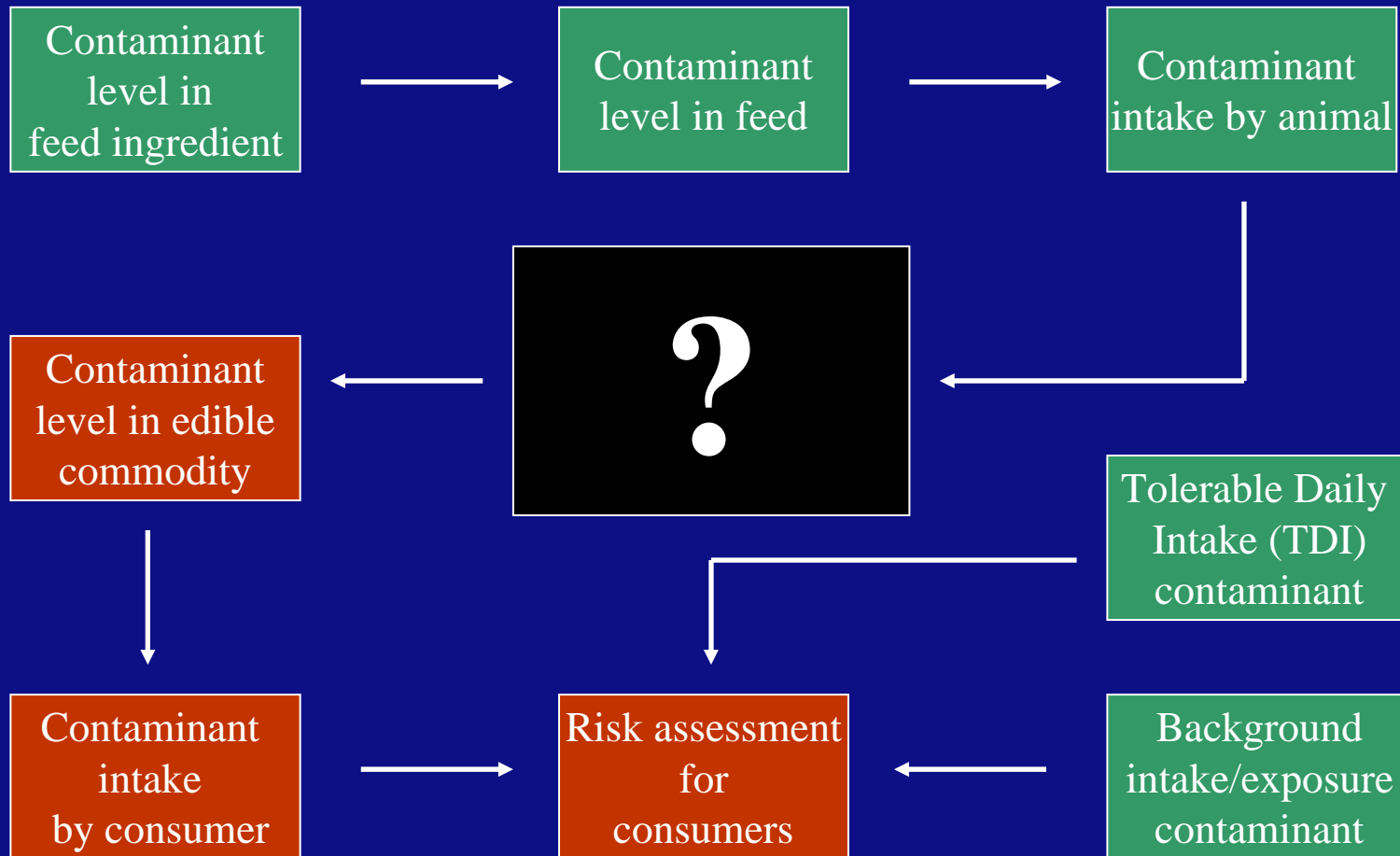
Contents

- Health risk assessment of contaminants in feed
- Transfer database introduction
- Case study: acephate contamination of animal feed
- Current status of the Transfer database
- Conclusions

Consumer exposure to feed contaminants



Consumer health risk assessment for feed contaminants

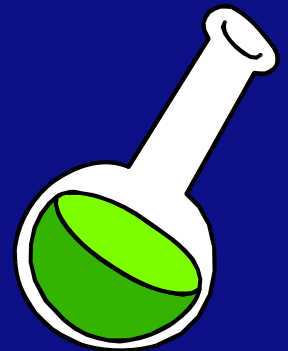


Residue transfer through livestock animals

- Various kinetic processes determine the **qualitative** and **quantitative** outcome of transfer of contaminants/residues from feed to edible commodities:
 - absorption
 - distribution
 - metabolism
 - excretion

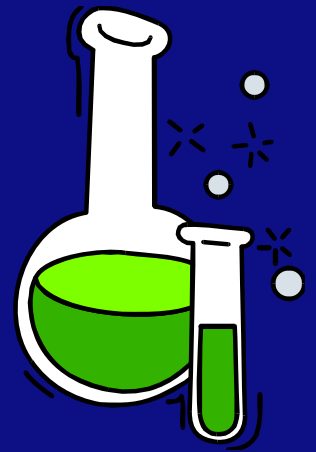
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- **Qualitative outcome:**
 - nature of contaminants/residues in edible commodities



Residue transfer through livestock animals

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 - absorption
 - distribution
 - metabolism
 - excretion
- **Qualitative outcome:**
 - nature of contaminants/residues in edible commodities
- **Quantitative outcome:**
 - levels of contaminants/residues in edible commodities



Studies on residue transfer through livestock animals

- nature of contaminants/residues in edible commodities
 - usually radio tracer studies

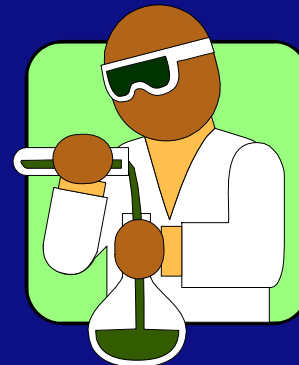
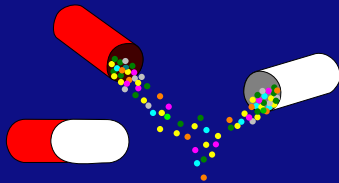


Studies on residue transfer through livestock animals

- nature of contaminants/residues in edible commodities
 - usually radio tracer studies



- levels of contaminants/residues in edible commodities
 - feeding studies under field-like conditions



History: Information on contaminant/residue transfer through livestock animals

Emergency Response activities

- Information not available for every possible residue/contaminant
- often: dedicated chemical-specific studies needed
 - expensive
 - time consuming
- It is not feasible to generate chemical-specific information for every contaminant for every situation at any moment.

Transfer remains a black box in many cases (to a certain extent)

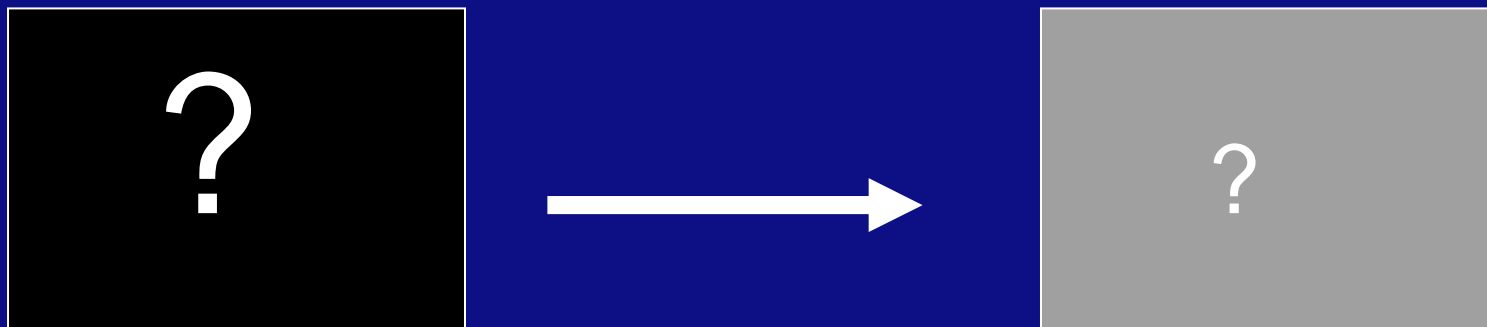


Information on contaminant/residue transfer through livestock animals

TNO database on transfer of chemicals from feed towards edible animal commodities

Main goals:

- chemical-specific information on transfer
- Scientific/statistical analyses
- (reduce uncertainty in) prediction of degree of transfer



TNO database on transfer of chemicals from feed towards edible animal commodities

Meta-analysis of literature and record in database:

- over 250 references covering 1970 - 2006
- over 3600 transfer factors

- various species
- various categories of chemicals
- range of dose levels and feeding periods
- milk, eggs, meat, fat, edible offal's
- metabolite levels included (if available)

TNO database on transfer of chemicals from feed towards edible animal commodities

Animal species in the database:

	(n*)
• (Dairy) cow	741
• (Laying) hen	633
• Pig	302
• Birds	104 (Pheasant, Turkey, Duck, Quail)
• Sheep	38
• Goat	24
• Rabbit	6

* Total amount of experimental feeding levels per animal species

TNO database on transfer of chemicals from feed towards edible animal commodities

Chemicals in the database:

- Pesticides 41 (new) + 17 (old)
- (Heavy) metals 17 (ca. 100 different compounds)
- Mycotoxins 9
- Dioxins/Furans 22
- PCB/PBB 39
- Nitrosamines 3
- Hormones 2
- Veterinary medicines 48
- Other 12

TNO database on transfer of chemicals from feed towards edible animal commodities

Information in the database:

- Identification: Chemical name, CAS no.
- Physico chemical properties: Molecular weight, Log Po/w, Water solubility (g/l)
- Animal species, Feed level (mg/kg)
- Residue level in eggs, milk, meat, fat and offals (mg/kg)
- Transfer Factors: either calculated from residue and feed level, or directly taken from literature
- Feeding period
- Reference
- Remarks (eg. Metabolite name, indication of plateau levels)

TNO database on transfer of chemicals from feed towards edible animal commodities

Verbinding	CAS nr.	MW	Log Po/w	Wateropl. (g/l)	Cat	Dier soort	Voer gehalte mg/kg	Residu gehalte					Transfer Factor				
								Eieren	Melk	Vlees	Vet	Orgaan vlees	Eieren	Melk	Vlees	Vet	Orgaan
								mg/kg	mg/kg	mg/kg	mg/kg	mg/kg					
Bestrijdingsmiddelen																	
Acephate	30560-19-1	183,2	-0,85	818	B	kip	3	0,01			0,02	0,02	0,003			0,007	0,007
Acephate	30560-19-1	183,2	-0,85	818	B	kip	10	0,09	0,01		0,02	0,02	0,009		0,001	0,002	0,002
Acephate	30560-19-1	183,2	-0,85	818	B	kip	30	0,19		0,02	0,02	0,02	0,006		0,0007	0,0007	0,0007
Acephate	30560-19-1	183,2	-0,85	818	B	kwartel	10	0,19		0,01	0,06	0,01	0,019		0,0010	0,0060	0,0010
Acephate	30560-19-1	183,2	-0,85	818	B	kwartel	30	0,34		0,04	0,03	0,01	0,011		0,0013	0,0010	0,0003
Acephate	30560-19-1	183,2	-0,85	818	B	rund	3		0,06	0,03	0,02	0,03		0,020	0,010	0,007	
Acephate	30560-19-1	183,2	-0,85	818	B	rund	10		0,31	0,08	0,03	0,21		0,031	0,008	0,003	
Acephate	30560-19-1	183,2	-0,85	818	B	rund	30		0,68	0,28	0,13	0,57		0,023	0,009	0,004	
Acephate	30560-19-1	183,2	-0,85	818	B	rund	15		0,22	0,11	0,1	0,26		0,015	0,007	0,007	
Acephate	30560-19-1	183,2	-0,85	818	B	rund	30		0,44	0,16	0,15	0,4		0,015	0,005	0,005	
Acephate	30560-19-1	183,2	-0,85	818	B	rund	60		0,98	0,4	0,4	0,85		0,016	0,007	0,007	
Acephate	30560-19-1	183,2	-0,85	818	B	varken	3			0,05	0,02	0,04		0,017	0,007		
Acephate	30560-19-1	183,2	-0,85	818	B	varken	10			0,15	0,07	0,17		0,015	0,007		
Acephate	30560-19-1	183,2	-0,85	818	B	varken	30			0,48	0,1	0,42		0,016	0,003		

TNO database on transfer of chemicals from feed towards edible animal commodities

Inhoud gehalte					Transfer Factor					Feeding		Refs	Opmerkingen
Eieren	Melk	Vlees	Vet	Orgaan vlees	Eieren	Melk	Vlees	Vet	Orgaan vlees	period	Orgaan vlees		
mg/kg	mg/kg	mg/kg	mg/kg	mg/kg						(days)			
			0,02	0,02	0,003			0,007	0,007	92		JMPR, 2003	
0,09		0,01	0,02	0,02	0,009		0,001	0,002	0,002	92		JMPR, 2003	
0,19		0,02	0,02	0,02	0,006		0,0007	0,0007	0,0007	92		JMPR, 2003	
0,19		0,01	0,06	0,01	0,019		0,0010	0,0060	0,0010	148		JMPR, 2003	
0,34		0,04	0,03	0,01	0,011		0,0013	0,0010	0,0003	148		JMPR, 2003	
	0,06	0,03	0,02	0,03		0,020	0,010	0,007	0,010	30	kidney higher than liver	JMPR, 2003	plateau milk ca 12 days
	0,31	0,08	0,03	0,21		0,031	0,008	0,003	0,021	30	kidney higher than liver	JMPR, 2003	plateau milk ca 12 days
	0,68	0,28	0,13	0,57		0,023	0,009	0,004	0,019	30	kidney higher than liver	JMPR, 2003	plateau milk ca 12 days
	0,22	0,11	0,1	0,26		0,015	0,007	0,007	0,017	28	kidney higher than liver	JMPR, 2003	plateau milk ca 4 days
	0,44	0,16	0,15	0,4		0,015	0,005	0,005	0,013	28	kidney higher than liver	JMPR, 2003	plateau milk ca 4 days
	0,98	0,4	0,4	0,85		0,016	0,007	0,007	0,014	28	kidney higher than liver	JMPR, 2003	plateau milk ca 4 days
		0,05	0,02	0,04			0,017	0,007	0,013	30	kidney higher than liver	JMPR, 2003	
		0,15	0,07	0,17			0,015	0,007	0,017	30	kidney higher than liver	JMPR, 2003	
		0,48	0,1	0,42			0,016	0,003	0,014	30	kidney higher than liver	JMPR, 2003	

TNO database on transfer of chemicals from feed towards edible animal commodities

Among others: record of transfer factors

Transfer factor (TF) =

$$\frac{\text{concentration of a chemical in animal product}}{\text{concentration of the chemical in animal feed}}$$

- concentration in milk, egg, meat, fat, or edible offal:
in mg/kg, wet weight basis
- concentration in feed:
in mg/kg, dry weight basis

TNO database on transfer of chemicals from feed towards edible animal commodities

Example: chemical in dairy cattle feed: 4 mg/kg dry weight
milk: 0.05 mg/kg wet weight

Transfer factor (TF) =

$$\frac{\text{concentration of a chemical in animal product (mg/kg ww)}}{\text{concentration of the chemical in animal feed (mg/kg dw)}}$$

$$\text{Transfer factor (TF)} = \frac{0.05 \text{ mg/kg}}{4 \text{ mg/kg}} = 0.0125$$

TNO database on transfer of chemicals from feed towards edible animal commodities

Transfer factors for all chemicals together

Matrix	N	GM	GSD	P90	P95	Max
Milk	516	0.10	0.18	0.33	0.50	1.4
Eggs	268	0.27	0.60	0.96	1.5	5.5
Meat	868	0.12	0.60	0.21	0.39	11.6
Offals	1016	0.86	2.8	2.3	3.9	51.7
Fat	538	3.4	0.11	12.0	15.4	180

Transfer factors and physical-chemical properties

Distribution of transfer factors using Log Po/w

Log Po/w	Egg P ₉₅ (N)	Milk P ₉₅ (N)	Meat P ₉₅ (N)	Fat P ₉₅ (N)	Edible Offal P ₉₅ (N)	All Matrices P ₉₅ (N)
<0	0.05 (29)	0.02 (25)	0.02 (72)	0.01 (54)	0.03 (80)	0.02 (260)
0 to 1	0.08 (7)	0.03 (15)	0.07 (9)	0.02 (7)	0.74 (9)	0.10 (47)
1 to 2	0.01 (34)	0.03 (24)	0.00 (102)	0.01 (59)	0.01 (129)	0.01 (348)
2 to 3	0.03 (18)	0.01 (29)	0.02 (61)	0.02 (45)	0.08 (63)	0.03 (216)
3 to 4	1.18 (26)	0.36 (45)	0.01 (46)	14.2 (74)	0.15 (52)	2.00 (243)
4 to 5	0.04 (13)	0.02 (18)	0.03 (65)	0.58 (58)	0.07 (61)	0.12 (215)
5 to 6	2.65 (20)	0.43 (43)	0.03 (31)	17.6 (69)	0.14 (29)	14.0 (192)
6 to 7	1.60 (44)	0.52 (100)	0.33 (32)	31.8 (111)	2.62 (39)	14.1 (326)
7 to 8	0.75 (22)	0.90 (49)	0.33 (30)	18.3 (20)	2.75 (30)	2.73 (151)
>8	0.22 (12)	0.17 (23)	0.04 (8)	0.33 (17)	0.08 (8)	0.23 (68)
Accumulating metals	0.17 (30)	0.15 (54)	1.46 (219)	0.74 (10)	9.62 (290)	5.03 (603)
Non-accumulating metals	0.00 (2)	0.06 (58)	0.03 (189)	0.11 (7)	0.71 (224)	0.50 (480)

Case study:

Long term acephate contamination of dairy cow feed

Level maximally 5 mg/kg (dry weight basis)

Will this contamination pose a relevant risk for consumers?

Acceptable Daily Intake of 0.01 mg/kg bw/day (JMPR, 2002) exceeded?



Case study: contamination of dairy cow feed with acephate

Predicted transfer factor *

	Reasonable worst case (?)	Data base max. pesticides	Data base P95 pesticides	Data base Log Po/w < 0	Data base P95 acephate
Milk	0.8	0.044	0.024	0.02	0.029
Muscle	0.6	0.50	0.046	0.02	0.016
Offals	20-74	0.79	0.16	0.03	0.020
Fat	20	0.50	0.19	0.01	0.007

* Transfer factor (TF) =

concentration of a chemical in animal product (mg/kg ww)

concentration of the chemical in animal feed (mg/kg dw)

Case study: contamination of dairy cow feed with acephate

Intake as % of ADI

	Reasonable worst case (?)	Data base max. pesticides	Data base P95 pesticides	Data base Log Po/w < 0	Data base P95 acephate
Milk	1000	55	30	25	36
Muscle	150	125	12	5	4
Liver	1667	66	13	2.6	1.7
Kidney	3083	33	6.7	1.2	0.8
Fat	833	21	7.9	0.4	0.3

Other examples of application of the database

- Identification of the most vulnerable animal product.
- Evaluation of the health risk as a result of transport of certain chemicals with follow-up transport of feed (ingredients).
-

Current status of the Transfer database

- Adopted by the VWA, VWS and LNV as a tool to predict consumer risks of incidents with feed
 - Participants in the Dutch risk assessment procedure:
 - RIVM Kinetic and PBPK models
 - ASG/RIKILT Exponential models
 - TNO Transfer database
- Internet portal interface operational
- Part of routine TNO services incl. 24/7 ERS
- Maintenance, extension and improvement ongoing

Conclusions

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Conclusions

- The use of database-derived transfer factors enables more realistic risk assessment;
- Even if little information is available, scientifically founded transfer factors can be derived using the data for comparable chemicals (chemical group and/or physico-chemical properties);
- In cases where contaminated feed products are found, those products of animal origin most susceptible to contamination can be identified;
- Rapid risk management decision making and/or intervention is possible using the transfer factor database;

For more information:

Transfer of chemicals from feed to animal products:

www.feedtofoodtransfer.nl

The use of transfer factors in risk assessment

Leeman *et al.*, *Food Additives and Contaminants* (2007)
Volume 24(1) 1-13.

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