Carry over of PAs to milk and other animal derived products

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BfR-Forum Verbraucherschutz, 3 December 2015

Pyrrolizidinalkaloide in Lebens-und-Futtermitteln – eine unterschätzte Gefahr?

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Human exposure to PAs: food sources

- Cereals and other arable crops
- Honey and related products
- (Herbal) teas and supplements
- Animal derived products
  - Milk and milk products (yoghurt, cheese, pudding)
  - Eggs
  - Meat, liver and meat products

PAs – Animal feed monitoring 2006-2012

Occurrence of PAs in feedstuffs. Classification according to EU regulation 575/2011/EC

Cat.	Commodity	No of samples	% Positive	Average concentration of main PA types (µg/kg)					Maximum (µg/kg)	Percentage	
				Senecionine	Echimidine	Heliotrine	Crotaline	Total		Tertiary amine	N-oxide
1	Cereal grains	14	7.1	0.0	2.1	0.0	0.0	2.1	29.6	100	0
2	Oil seeds and fruits (soya)	71	26.8	3.4	7.8	0.0	0.3	11.5	342.7	37.9	62.1
3	Legume seeds	13	15.4	0.0	0.0	9.8	0.0	9.8	112.6	14.4	85.6
4	Tubers and roots	1	0	0.0	0.0	0.0	0.0	0.0	0.0		
5	Other seeds and fruits	5	40.0	0.0	7.3	8.6	0.0	15.9	43.1	36.1	63.9
6	Forages and roughage (silage, hay, alfalfa)	302	58.9	232.2	37.8	0.0	0.0	269.9	22753	57.1	42.9
7	Other plants (herbal supplements)	32	62.5	26.7	69.4	219.8	0.0	315.9	3209	8.2	91.8
All		438	51.4	162.5	32.5	16.4	0.0	211.5	22753	51.6	48.4

- Forages present largest risk, followed by herbal supplements
- Both PA free bases and PANOs are relevant

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Animal feedstuffs: Alfalfa (lucerne)

	2006	2007	2008	2009	2010	2011	2012	2013	2014
No of samples	6	13	12	17	51	50	51	48	50
Positive	83%	85%	83%	88%	92%	86%	90%	92%	68%
Average content (µg/kg)	1440	225	716	621	225	265	356	1007	157
Max (µg/kg)	3439	1409	6219	4507	2418	2027	4169	15751	1498
Samples >1000 µg/kg	3 (50%)	1 (8%)	1 (8%)	2 (12%)	4 (8%)	4 (8%)	6 (12%)	9 (19%)	2 (4%)

- Lucerne is prone to contamination with PAs
- 85% of PAs is of senecionine type, mostly originating from *Senecio vulgaris*

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Animal transfer study

S jac

+

S inq

S vul

E vul

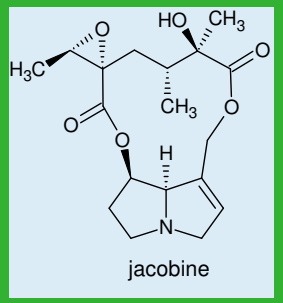
Feed

Rumen content

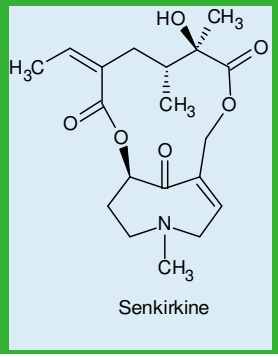
Urine, faeces

Milk

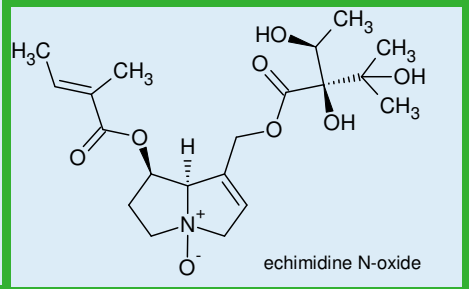
Yoghurt, cheese



jacobine



Senkirkine



echimidine N-oxide

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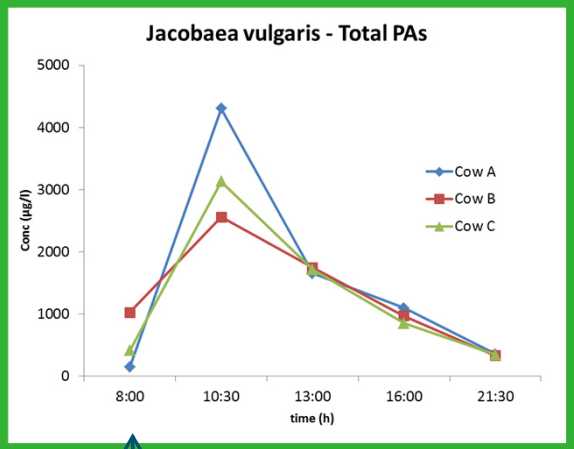
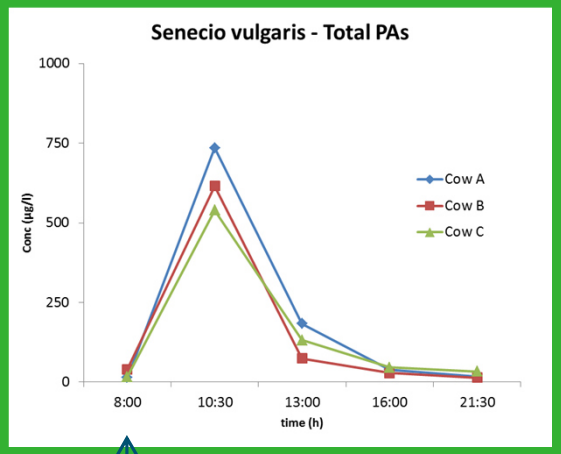
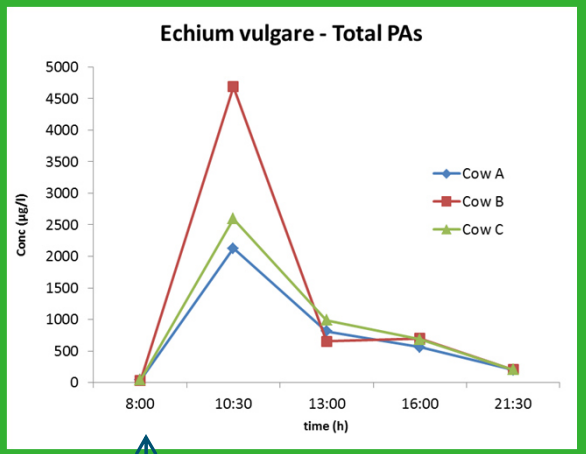
Effect of the rumen

- Levels decrease quickly in the rumen
  - Efficient extraction of PA-plant material
  - Fast transfer to the intestinal tract
- Fast reduction (or transfer/degradation) of PANOs (<1% 2.5 h after administration)







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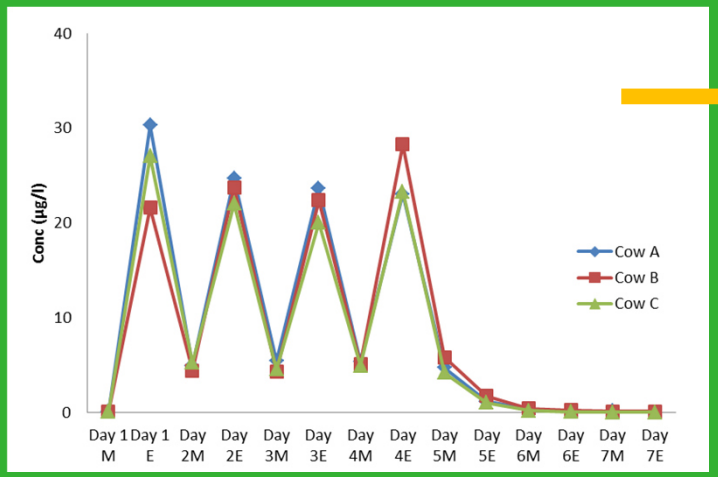
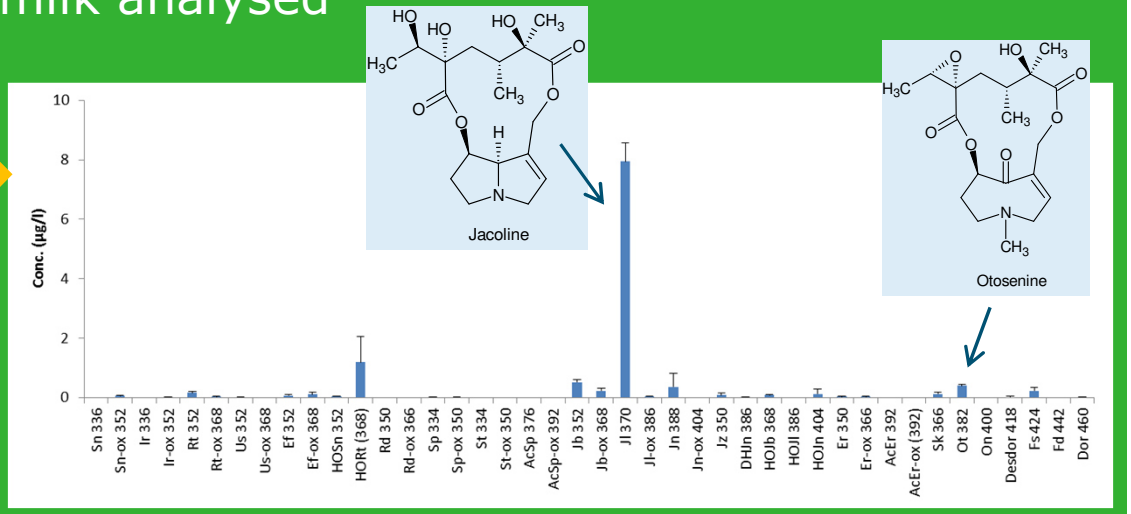
Dosing

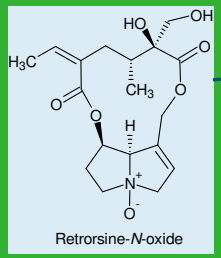
Dosing

PAs in milk – Ragwort (*Jacobaea vulgaris*)

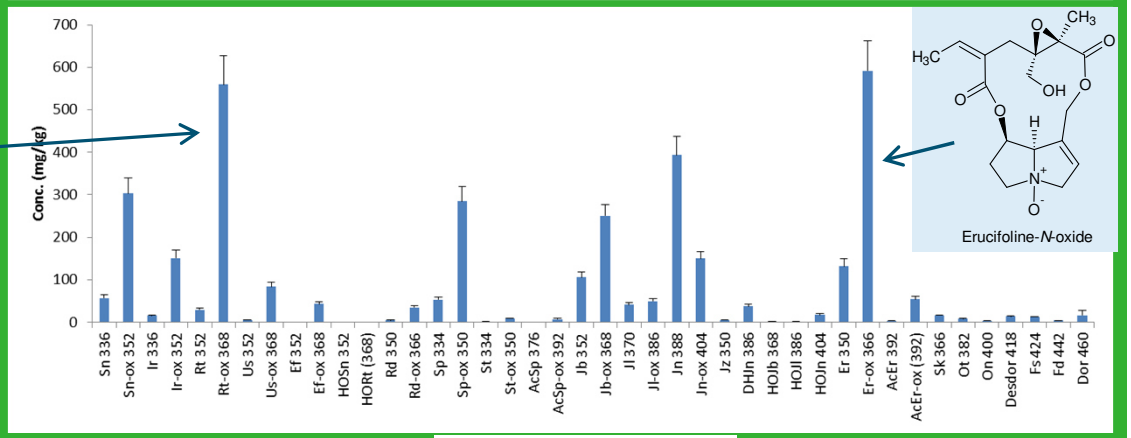
- 3 Cows fed by gavage
  - 4 Days 200 g dried material (1% of feed intake) in the morning
  - Morning and evening milk analysed







Avg content:
12.1 µg/L
0.05%



Plant material

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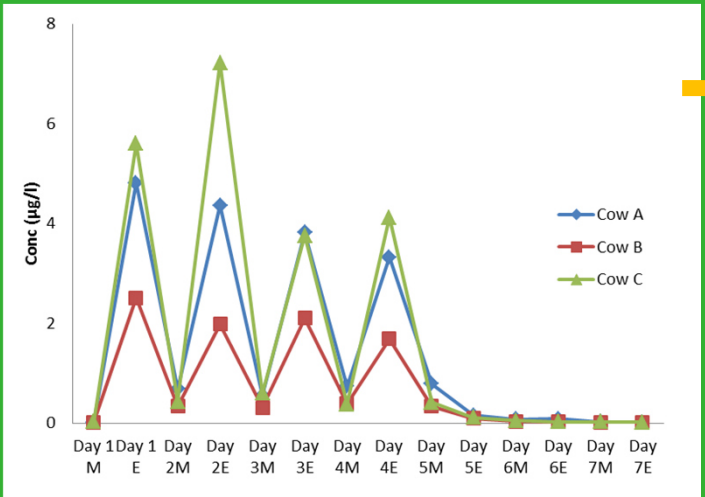
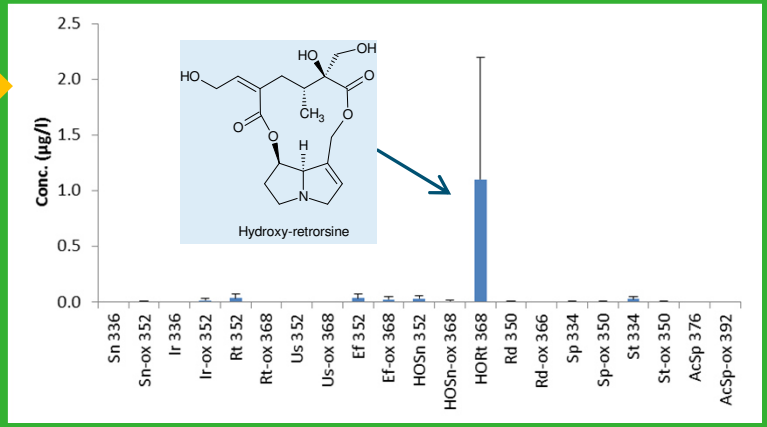
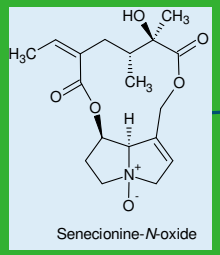
PAs in milk – Common groundsel (*Senecio vulgaris*)

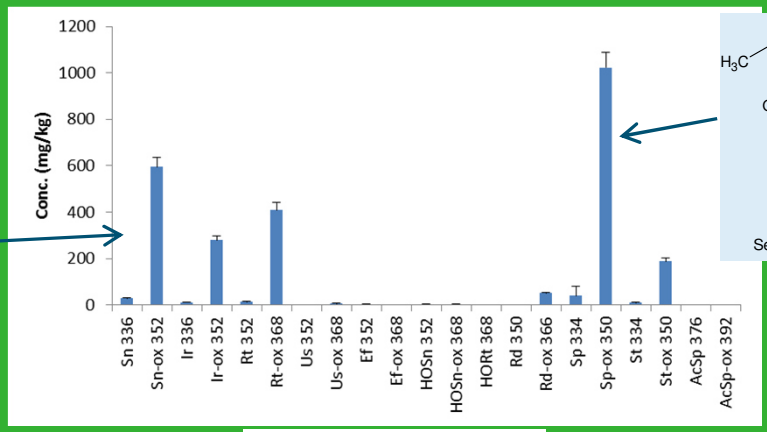
- 4 Days: 200 g dried material (1% of feed intake) in the morning
- Morning and evening milk analysed





Avg content:
1.5 µg/L
0.01%





Plant material

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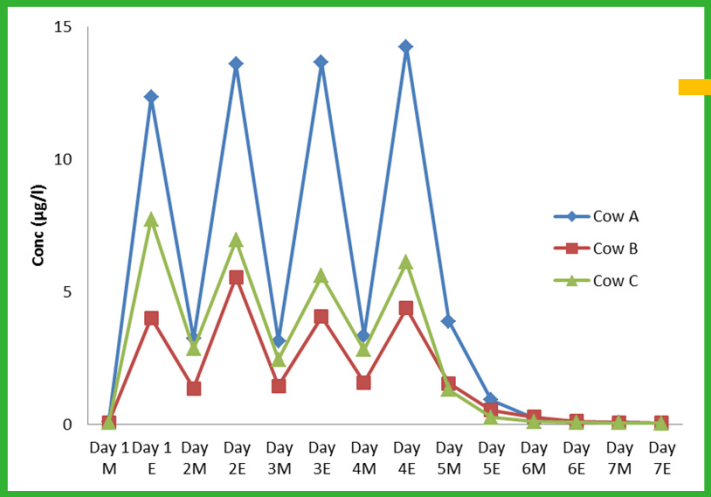
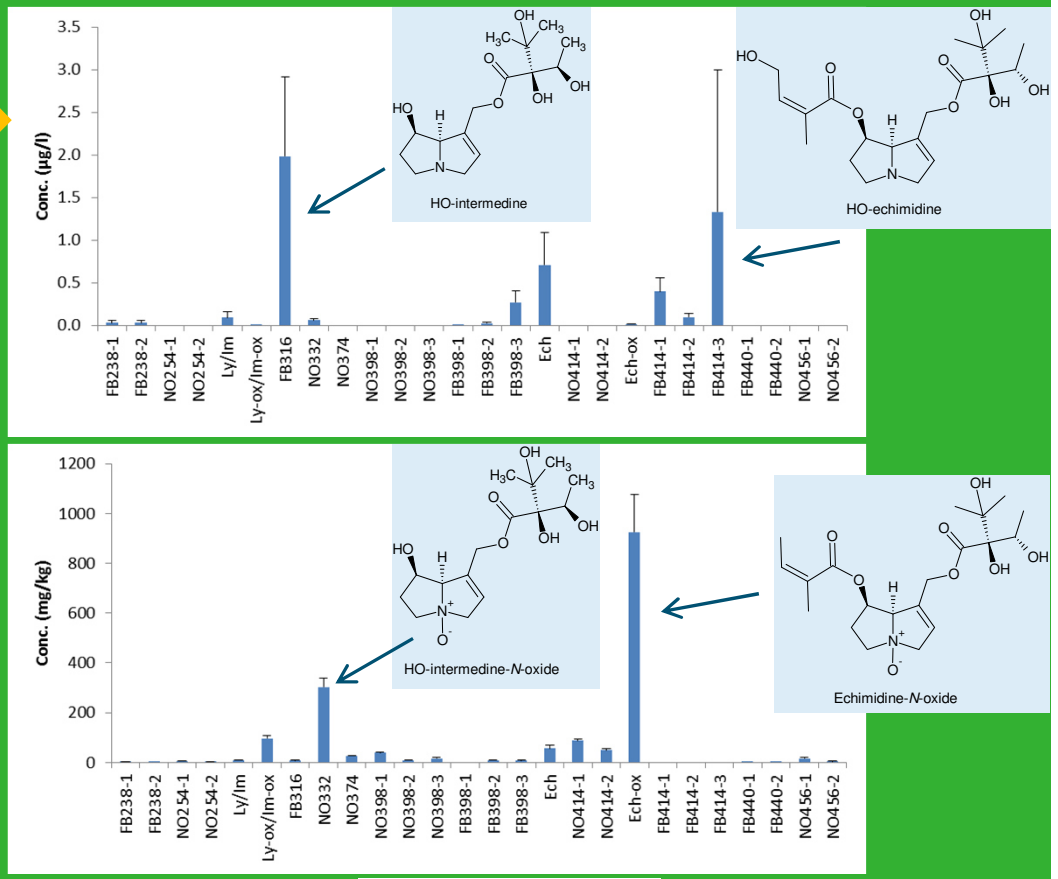
PAs in milk – Vipers bugloss (*Echium vulgare*)

- 4 Days: 200 g dried material (1% of feed intake) in the morning
- Morning and evening milk analysed





Avg content:
5.1 µg/L
0.05%

Plant material

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Mass balance PAs

Treatment (n=3)	PAs consumed (mg)	PAs excreted (mg)				Excreted (%)
		Milk	Urine	Faeces	Total	Total
Ragwort	753±78	0.37±0.11	21.3±3.9	12.2±1.8	33.9±4.4	4.5%
Common groundsel	558±33	0.05±0.05	12.5±2.0	3.4±1.2	16.0±3.1	2.9%
Vipers bugloss	335±39	0.16±0.09	6.6±2.0	12.5±2.4	19.3±0.9	5.8%

- Only small part of PAs is recovered
- Excretion is fast: in urine max conc <5 h
- Hydroxylated compounds formed
- Milk and faeces: only PA FBs, urine: 80% PANOs

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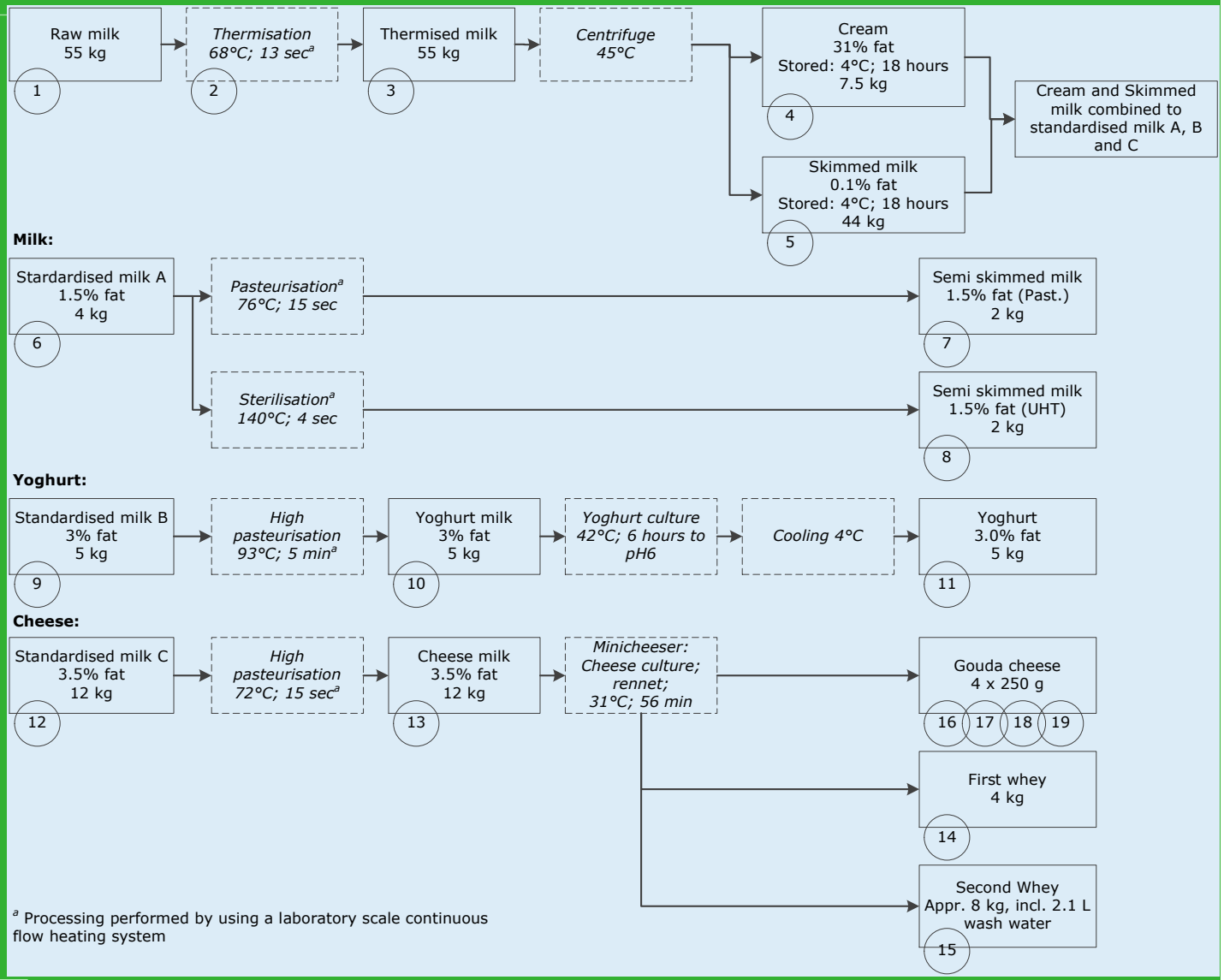
Effect of processing: Dairy production

- NIZO pilot facilities, Ede, the Netherlands
- Ragwort contaminated milk
- Samples from intermediate and end products



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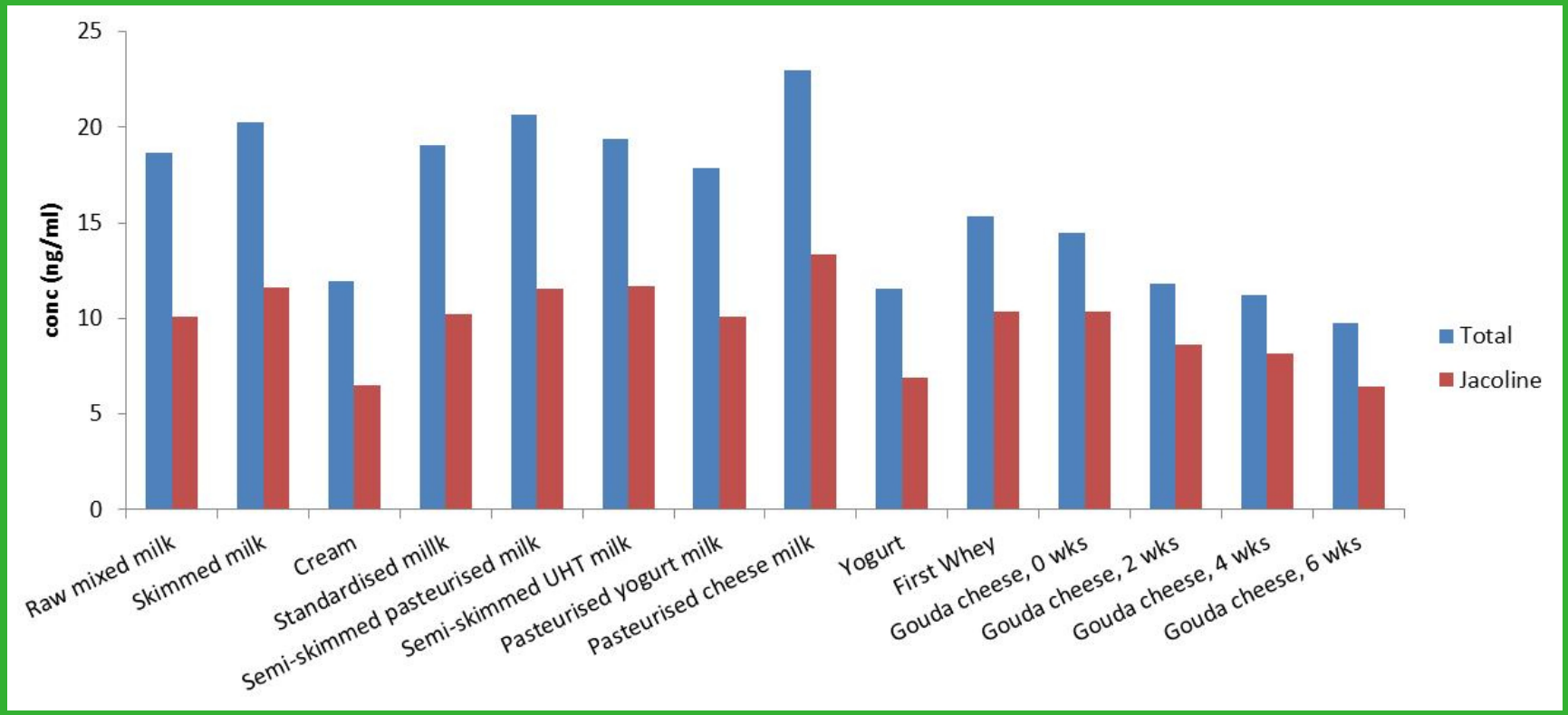
Ragwort PAs: transfer to cheese and yoghurt



- PAs stable during pasteurisation/UHT process
- Cheese and yogurt production: ca. 50% reduction of PAs

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Conclusions transfer studies

- Carry-over rate to milk
  - 0.05% for ragwort, vipers bugloss
  - 0.01% for common groundsel
- PAs containing hydroxyl groups are preferably transferred
  - Jacoline: 5 % based on presence in ragwort
  - Only PA FBs, no PANOs
- PAs are relatively stable during dairy processing and cheese production

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EFSA supporting publication 2015:EN-859

EXTERNAL SCIENTIFIC REPORT

Occurrence of Pyrrolizidine Alkaloids in food[1]

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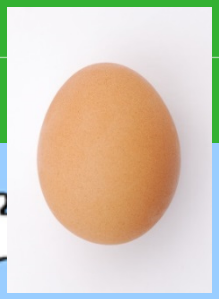
Sampling of animal-derived products



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BfR
Risiken erkennen – Gesundheit schützen

IRTA
RECERCA I TECNOLOGIA AGROALIMENTARIES
Generalitat de Catalunya

- Total: 746 samples
- 16% organic

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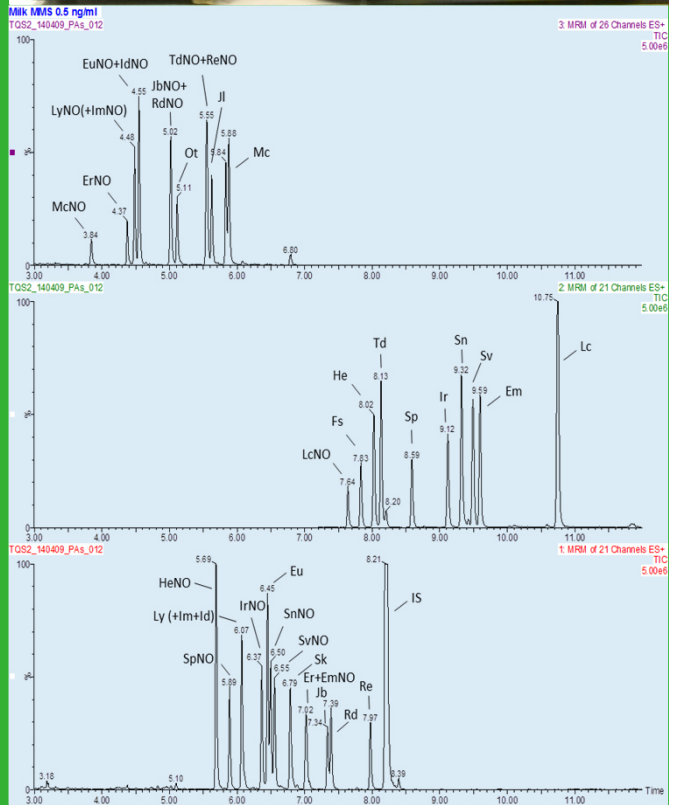
Requirements

- Very low LOQs
  - 0,05-0,1 µg/L in milk
  - 0,25-0,5 µg/kg in meat, egg, yoghurt, cheese
  - 0,25-1 µg/kg in liver

- In-house validated methods
  - Broad scope: 35 PAs
  - MMS calibration
  - Cheese and liver samples were done with std addition



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Survey results: Animal derived products

	Samples analysed	Samples > LOQ	% > LOQ	Highest conc. (µg/kg)
All animal-derived food products	746	13	1.7	0.17
Milk and milk products	268	11	4.1	0.17
Pasteurised and UHT milk	182	11	6.0	0.17
Fermented milk products	27	0		
Cheese	34	0		
Milk powder (infant formula)	25	0		
Fresh eggs	205	2	1.0	0.12
Meat and meat products	273	0	0.0	<0.1
Beef meat	80	0		
Pork meat	79	0		
Poultry meat (chicken breast)	83	0		
Liver (beef, pork, chicken)	31	0		

- Only limited exposure to PAs

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Survey results: Animal derived products

Sample	Origin	Description	Organic/ Non-organic	Pyrrolizidine alkaloid	Conc. (µg/L)
FB14/0204	Germany	Semi-skimmed milk, past.	Non-organic	Senkirkine	0.05
FB14/0210	Germany	Skimmed milk, past.	Non-organic	Otosenine	0.08
FB14/0211	Germany	Semi-skimmed milk, past.	Organic	Otosenine	0.06
FB14/0235	Germany	Semi-skimmed milk, past.	Organic	Otosenine	0.11
IRTA 510	Greece	Skimmed milk, UHT	Non-organic	Senkirkine	0.16
IRTA 514	Greece	Whole milk, UHT	Non-organic	Senkirkine	0.06
IRTA 652	Spain	Goat milk, UHT	Non-organic	Retrorsine	0.11
IRTA 153	Spain	Semi-skimmed milk, UHT	Organic	Jacoline	0.06
RIK M21	Netherlands	Semi-skimmed milk, past.	Organic	Jacoline	0.05
RIK M20	Netherlands	Whole milk, past.	Non-organic	Lycopsamine	0.12
IRTA 639	Spain	Whole milk, past.	Organic	Lycopsamine Echimidine	0.11 0.06

Possible PA plant sources

S jac

E vul

S off

S aq

S inq

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Conclusions

- Compared to other food sources animal derived products do not strongly attribute to the overall exposure to PAs in food products (compared to consumption of tea and herbal supplements)

- Nevertheless efforts should be made to reduce the contamination of milk products by PAs
  - Good Agricultural Practices
  - Better product control

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Questions?

Please contact me at:

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