

Probabilistic risk assessment of patulin in apple juice for preschool children in Flanders

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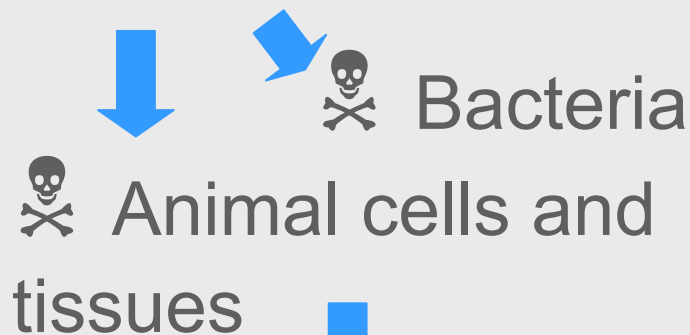
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Patulin

- *Penicillium expansum*
- Apples and apple-based products
- Toxicity

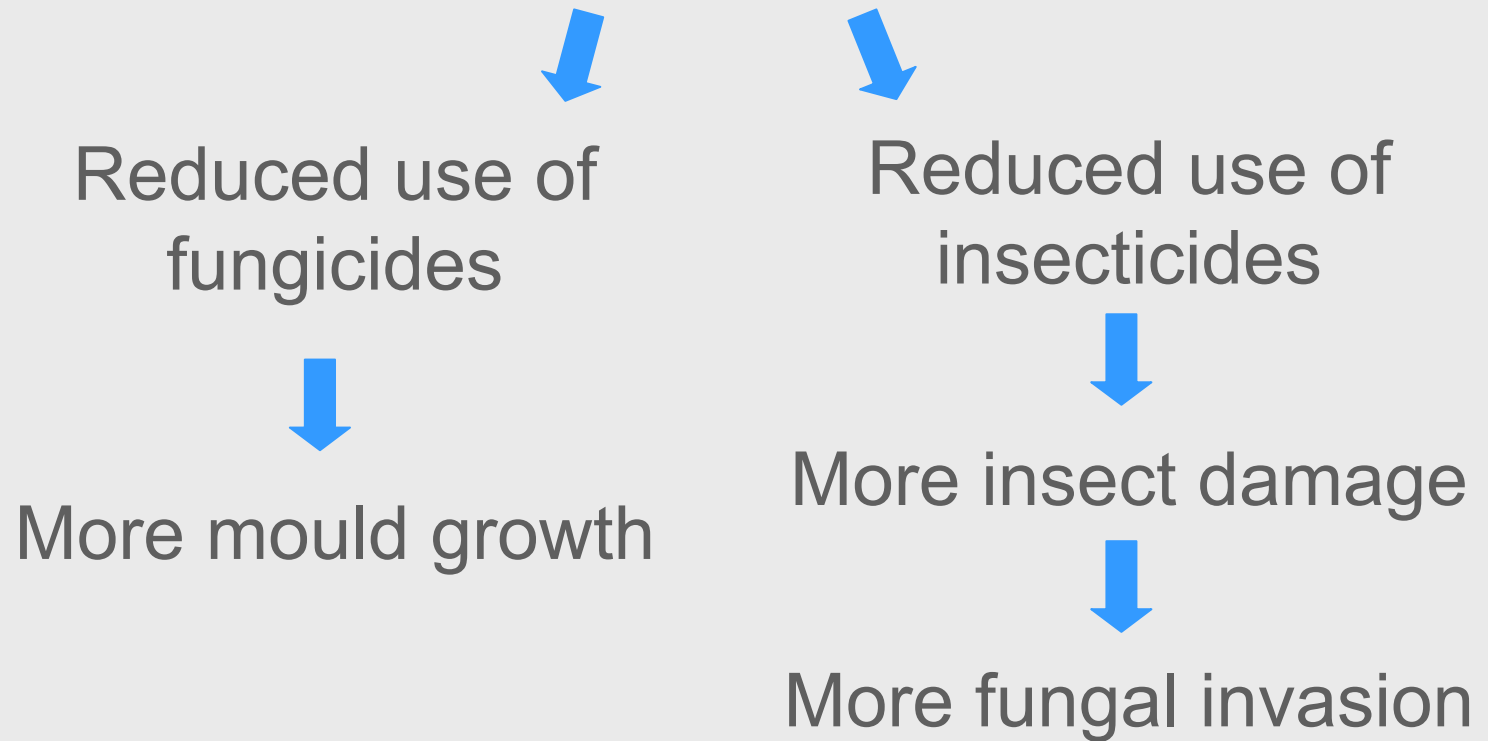


TDI: 0.4 $\mu\text{g}/\text{kg}$ bw/day

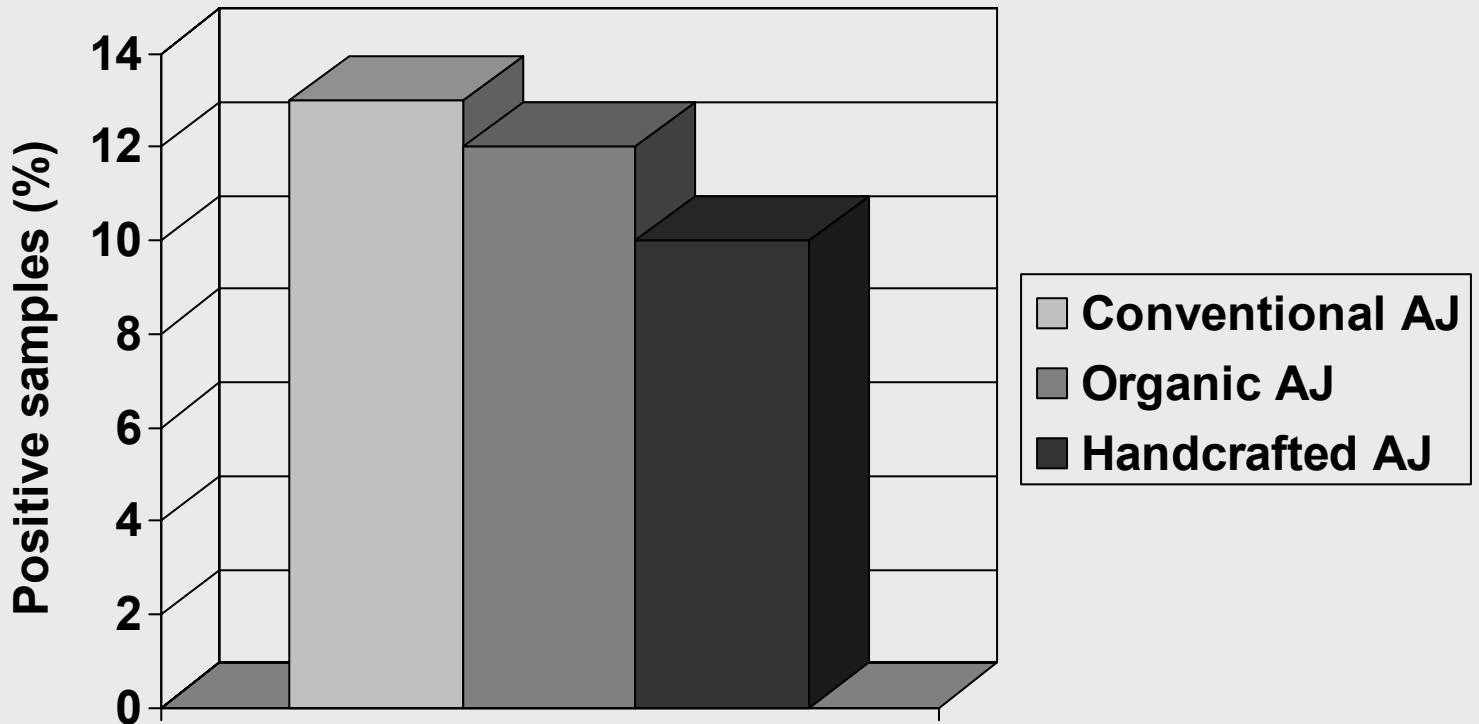


Influence of organic farming on patulin?

2 possible impacts

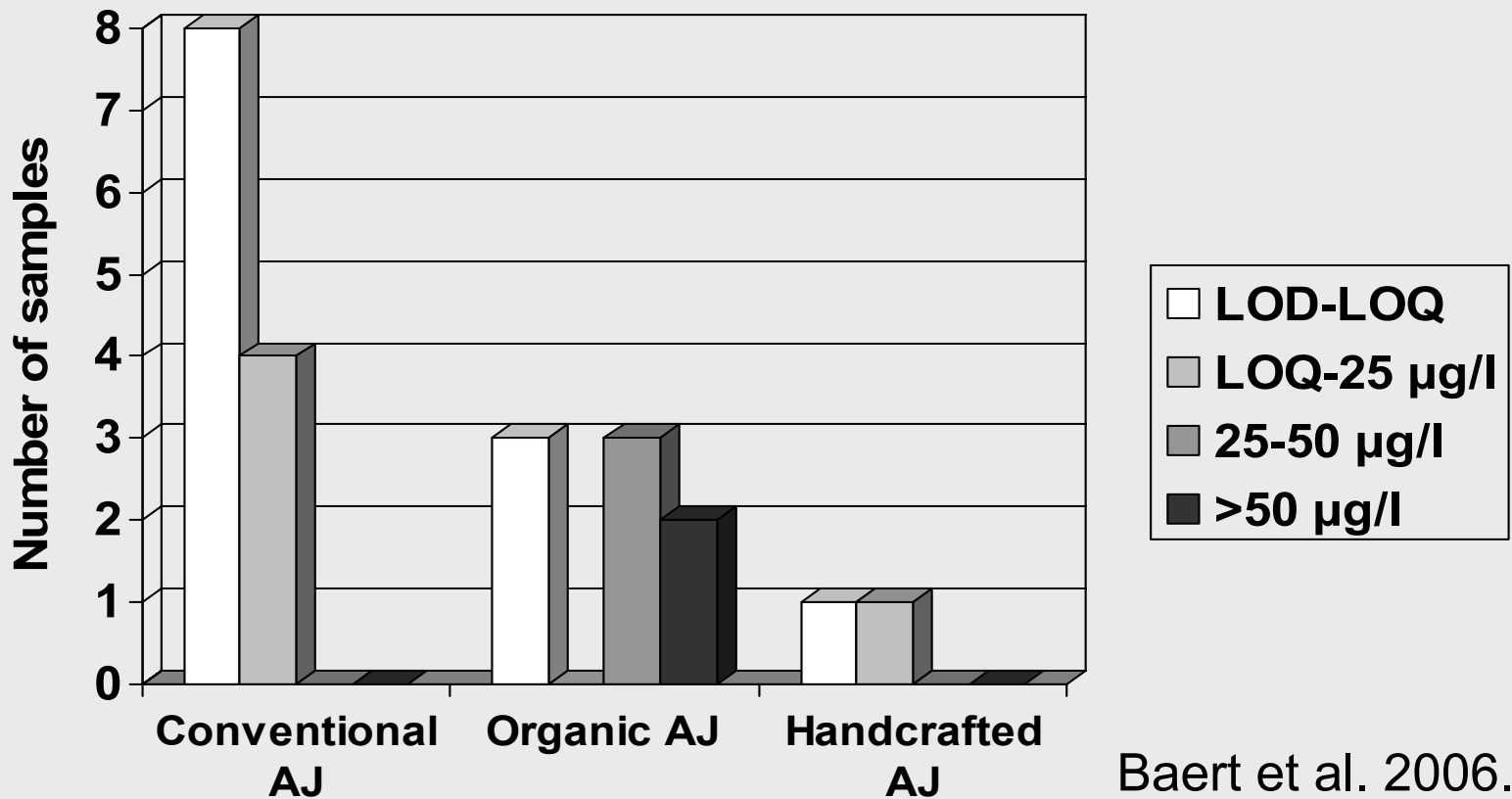


Occurrence of patulin in apple juice (AJ) in Belgium



Baert et al. 2006.

Patulin levels in contaminated samples



Mean ($\mu\text{g/l}$): 10.2

43.1

10.5

Baert et al. 2006.

Objectives

- Evaluate influence of patulin levels on public health



Focus: small children and apple juice

- Evaluation of lowering regulatory limit
- Evaluation of lowering AJ consumption

Exposure assessment

Contamination
($\mu\text{g pat/g AJ}$)

Consumption
(g AJ/kg bw/day)

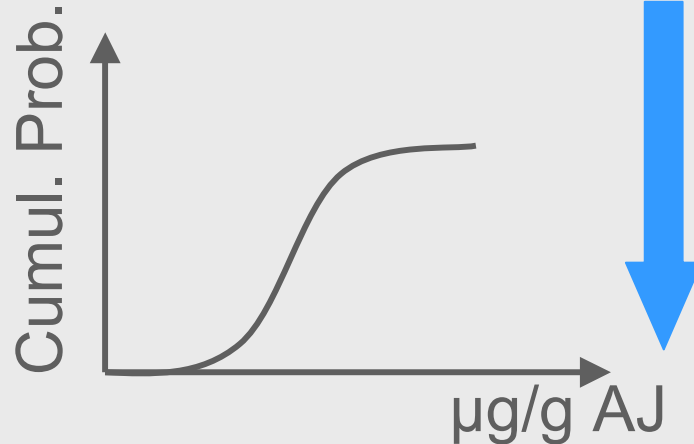


Contamination x Consumption = Intake

Exposure assessment

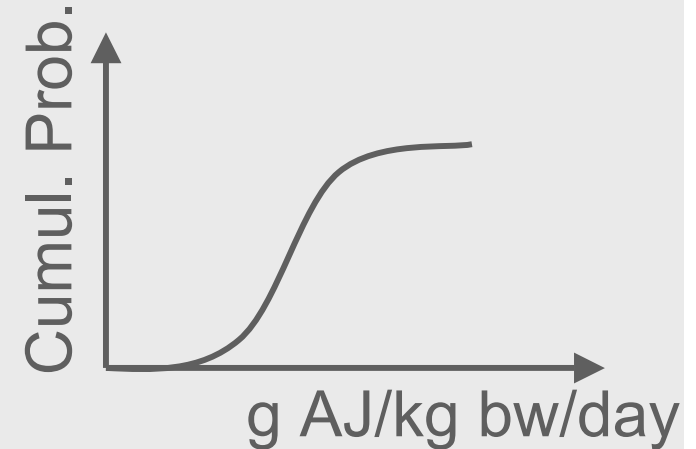
Contamination

($\mu\text{g pat/g AJ}$)



Consumption

(g AJ/kg bw/day)

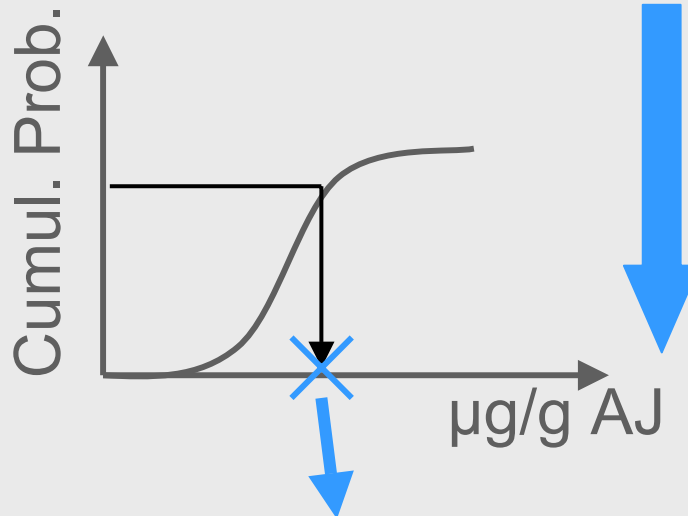


Contamination x Consumption = Intake

Exposure assessment - Probabilistic

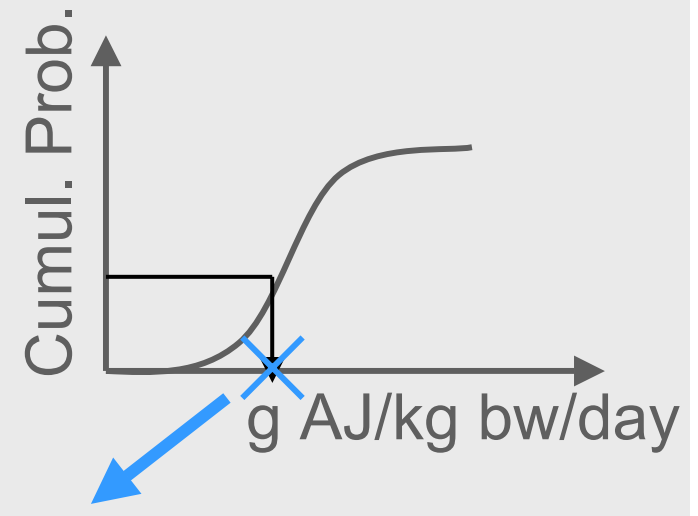
Contamination

($\mu\text{g pat/g AJ}$)



Consumption

(g AJ/kg bw/day)



Contamination x Consumption = Intake

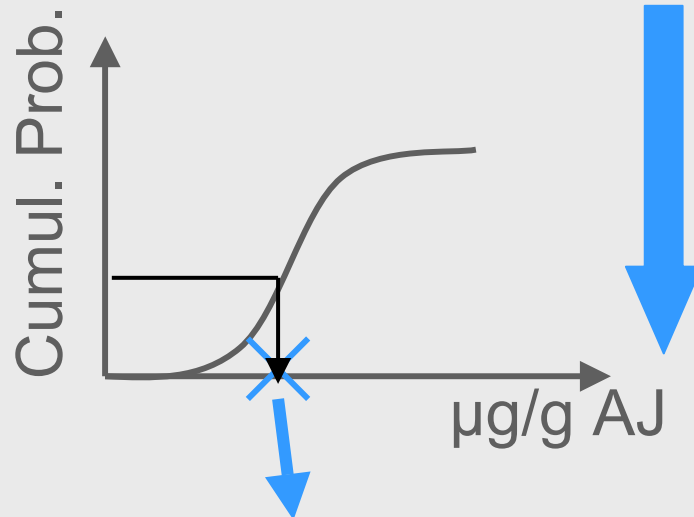


X_1

Exposure assessment - Probabilistic

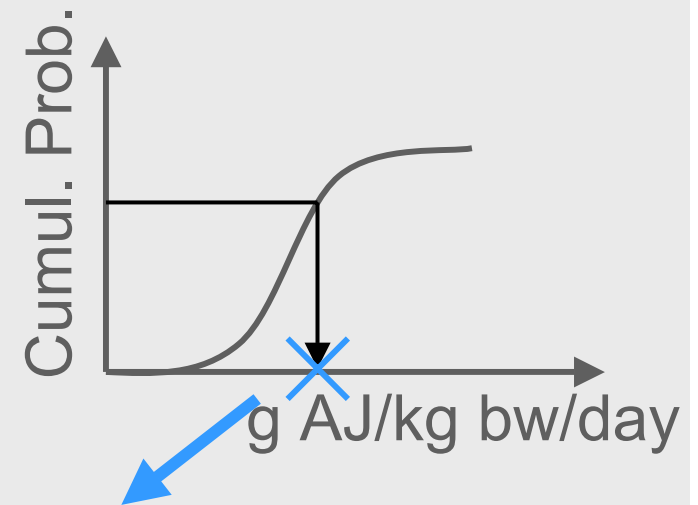
Contamination

($\mu\text{g pat/g AJ}$)



Consumption

(g AJ/kg bw/day)



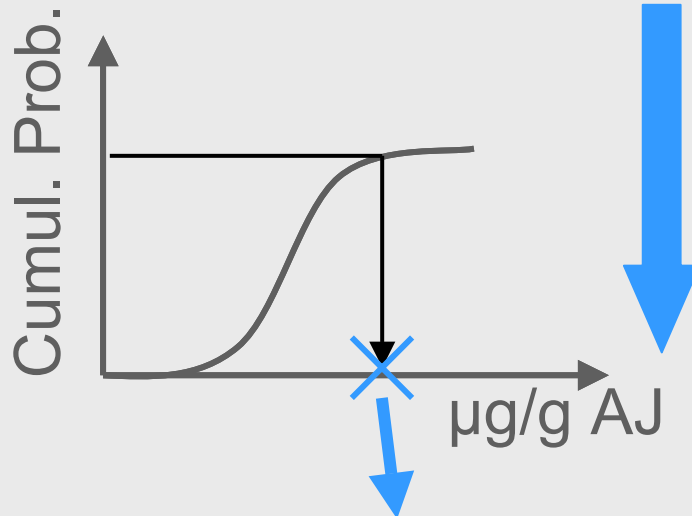
Contamination x Consumption = Intake

X_1, X_2

Exposure assessment - Probabilistic

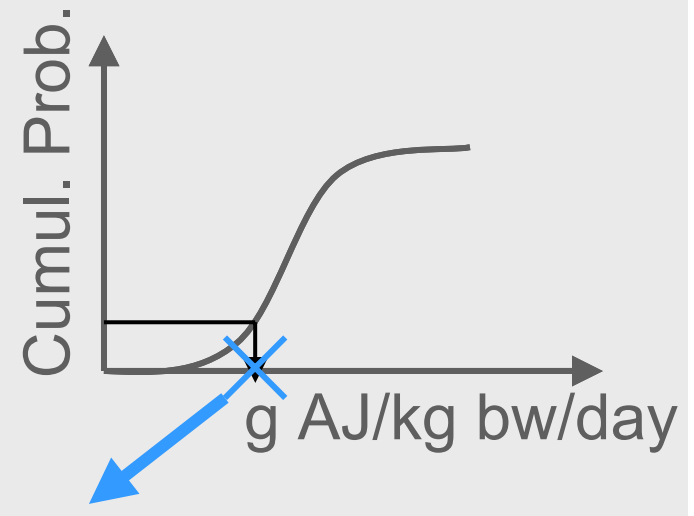
Contamination

($\mu\text{g pat/g AJ}$)



Consumption

(g AJ/kg bw/day)



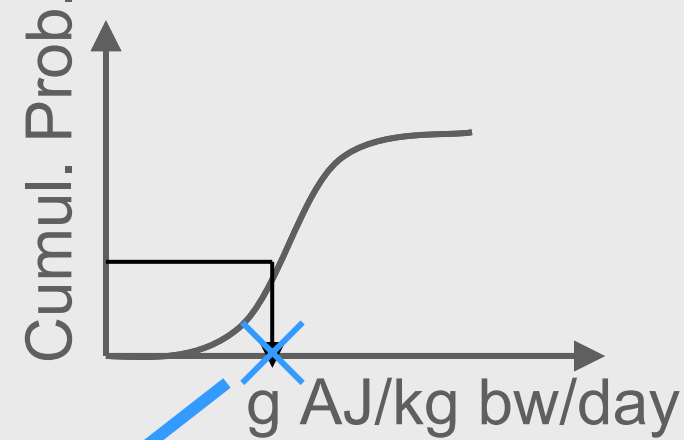
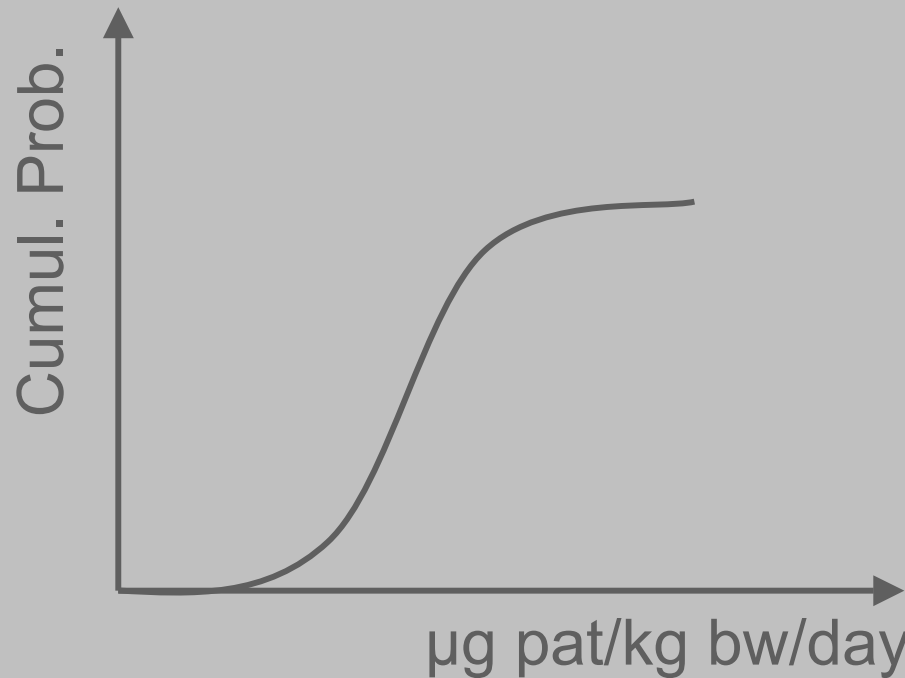
Contamination x Consumption = Intake

Exposure assessment - Probabilistic

Contamination
($\mu\text{g pat/g AJ}$)

Consumption

(g AJ/kg bw/day)



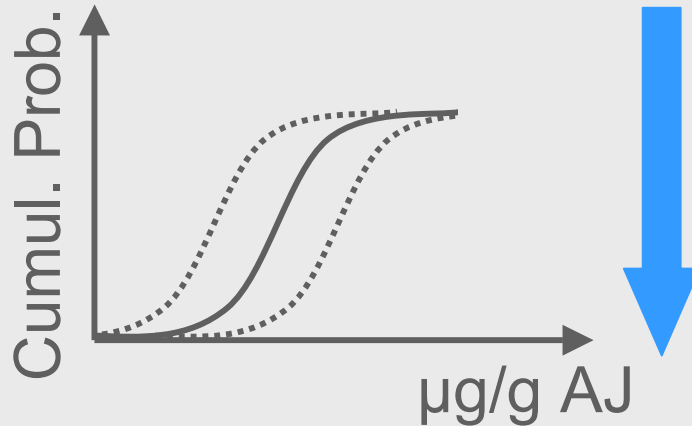
Consumption = Intake

$X_1, X_2, X_3, X_4, X_5, \dots$

Probabilistic

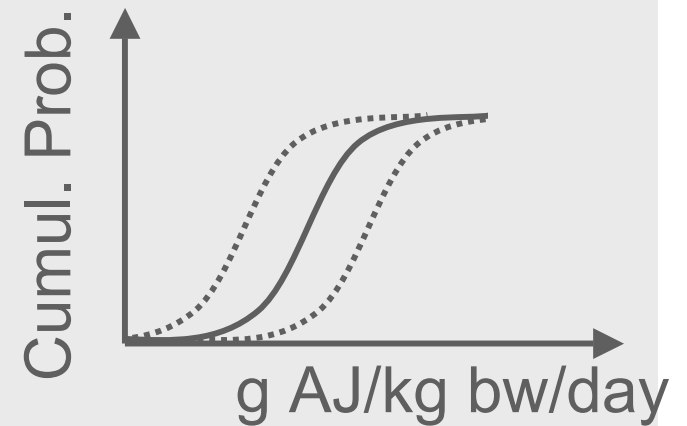
Contamination

($\mu\text{g pat/g AJ}$)



Consumption

(g AJ/kg bw/day)



Contamination x Consumption = Intake

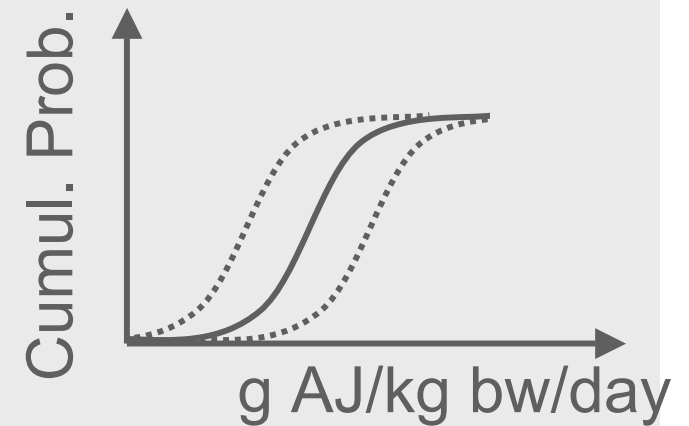
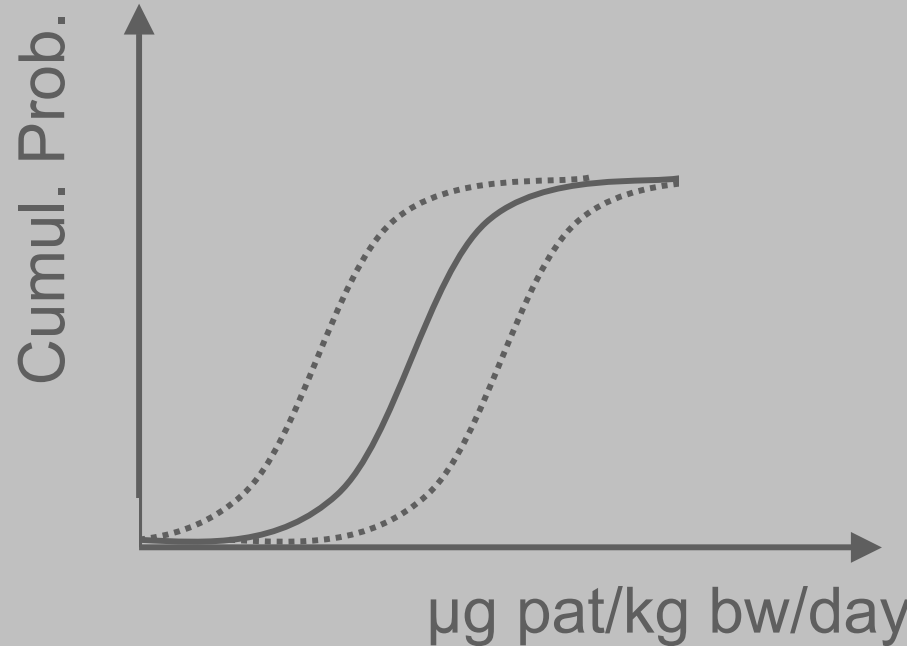


Exposure assessment - Probabilistic

Contamination
($\mu\text{g pat/g AJ}$)

Consumption

(g AJ/kg bw/day)



Consumption = Intake

$X_1, X_2, X_3, X_4, X_5, \dots$

Exposure assessment

Contamination

($\mu\text{g pat/g AJ}$)

Apple juices were analysed on patulin content
(Baert et al., 2006)

Consumption

(g AJ/kg bw/day)

Epidemiological study on nutritional habits of preschool children in Flanders (2.5-6.5 years)
(Huybrechts et al., 2006)

Assumptions:

- A consumer will only drink one type of apple juice
- Consumption pattern of 3 types of AJ is the same

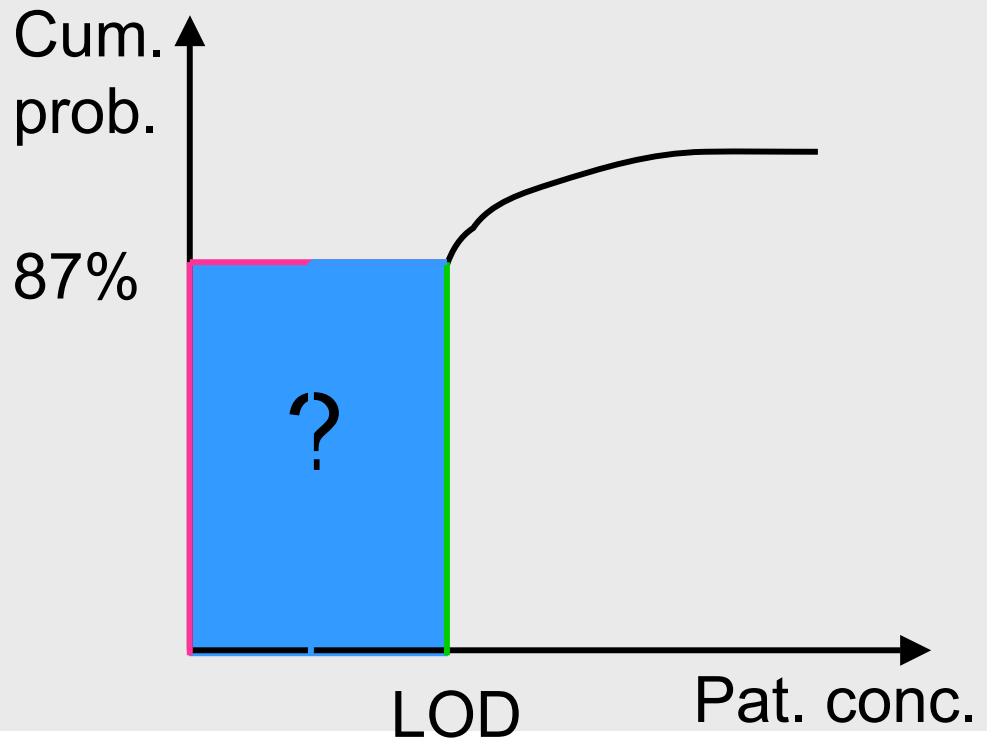
Values below LOD?

Between 10 and 13% of the data \geq LOD ➔

H1: LOD

H2: LOD/2

H3: 0



Values below the LOD? - exposure ($\mu\text{g}/\text{kg}$ bw/day) for organic apple juice

	LOD	LOD/2	0
P50*	0 [0-0]**	0 [0-0]	0 [0-0]
P90	0.085 [0.077-0.094]	0.043 [0.039-0.047]	0 [0-0]
P97.5	0.216 [0.181-0.312]	0.125 [0.096-0.197]	0 [0-0.183]
P99	0.408 [0.261-0.815]	0.341 [0.155-0.782]	0.316 [0-0.775]
P99.5	0.601 [0.351-1.442]	0.617 [0.213-1.442]	0.627 [0.161-1.442]
P99.9	1.449 [0.533-3.068]	1.443 [0.506-3.246]	1.445 [0.522-3.245]

* 50th percentile

** [90% confidence interval]

Values below LOD?

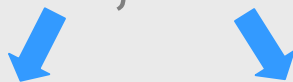
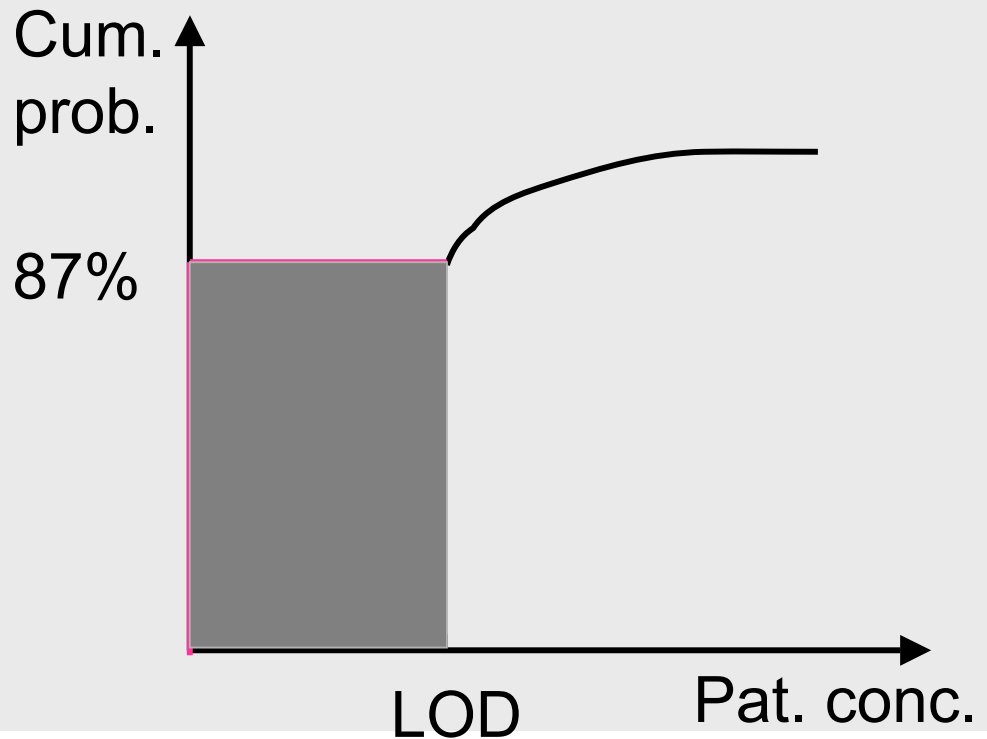
Between 10 and 13% of the data \geq LOD \rightarrow

H1: LOD

H2: LOD/2

H3: 0

H4: uniform
(min, max)



Uniform (0, LOD)

Uniform (0, LOD)

Values below the LOD? - exposure ($\mu\text{g}/\text{kg}$ bw/day) for organic apple juice

	LOD/2	Uniform
P50*	0 [0-0]**	0 [0-0]
P90	0.043 [0.039-0.047]	0.039 [0.014-0.069]
P97.5	0.125 [0.096-0.197]	0.135 [0.053-0.229]
P99	0.341 [0.155-0.782]	0.350 [0.143-0.822]
P99.5	0.617 [0.213-1.442]	0.615 [0.249-1.472]
P99.9	1.443 [0.506-3.246]	1.471 [0.526-3.066]

* 50th percentile ** [90% confidence interval]

Assessment of patulin exposure ($\mu\text{g}/\text{kg}$ bw/day)

	Organic AJ	Convent. AJ	Handcraft. AJ
P83*	0 [0-0]**	0 [0-0]	0 [0-0]
P97.5	0.135 [0.053-0.229]	0.095 [0.057-0.133]	0.102 [0.047-0.151]
P99	0.350 [0.143-0.822]	0.156 [0.106-0.206]	0.150 [0.084-0.229]
P99.5	0.615 [0.249-1.472]	0.202 [0.141-0.287]	0.195 [0.109-0.290]
P99.9	1.471 [0.526-3.066]	0.328 [0.210-0.548]	0.298 [0.156-0.460]

*83th percentile ** [90% confidence interval]

Percentage of the population exceeding the TDI

Organic AJ	Convent. AJ	Handcraft. AJ
0.9%	0.1%	0%
[0.3-1.8%]*	[0-0.3%]	[0-0.2%]

* [90% confidence interval]

Risk management measure: Lowering the regulatory limit

European legislation Nr. 1425/2003

- fruit juices and fruit nectar: $50 \mu\text{g kg}^{-1}$



Effect on exposure when only apple juice with $<50 \mu\text{g pat/kg}$ is available

Risk management measure: Lowering the regulatory limit

European legislation Nr. 1425/2003

- fruit juices and fruit nectar: $50 \mu\text{g kg}^{-1}$
- future: new evaluation



Effect on exposure when only apple juice with $<50 \mu\text{g pat/kg}$ is available

Effect on exposure when limit would be $25 \mu\text{g kg}^{-1}$

Lowering the regulatory limit: patulin exposure ($\mu\text{g}/\text{kg}$ bw/day) for organic apple juice

	Current sit.	<50 $\mu\text{g}/\text{kg}$	<25 $\mu\text{g}/\text{kg}$
P50*	0 [0-0]**	0 [0-0]	0 [0-0]
P97.5	0.135 [0.053-0.229]	0.118 [0.045-0.186]	0.099 [0.036-0.157]
P99	0.350 [0.143-0.822]	0.226 [0.107-0.443]	0.154 [0.066-0.222]
P99.5	0.615 [0.249-1.472]	0.379 [0.173-0.647]	0.196 [0.100-0.303]
P99.9	1.471 [0.526-3.066]	0.682 [0.320-1.402]	0.309 [0.171-0.491]

* 50th percentile ** [90% confidence interval]



Lowering the regulatory limit: Percentage of pop. exceeding TDI

Current sit.	<50µg/kg	<25µg/kg
0.9%	0.5%	0%
[0.3-1.8%]*	[0.1-1.2%]	[0-0.3%]

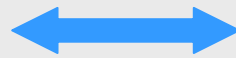
* [90% confidence interval]

Due to high apple juice
consumption: up to 1.2l/day

Risk management measure: Lowering apple juice consumption

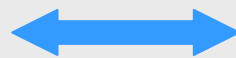
Fruit juice:

less fibres



fresh fruit

more sugar



mineral water



Advised: limit fruit juice consumption to ± 200 ml a day

Lowering apple juice consumption: Percentage of pop. exceeding TDI

Organic AJ

Current sit.	AJ cons. <200ml/day
0.9%	0.8%
[0.3-1.8%]*	[0.2-1.7%]

Lowering apple juice consumption: Percentage of pop. exceeding TDI

Organic AJ

Current sit.	AJ cons. <200ml/day	AJ contam. <25µg/kg
0.9% [0.3-1.8%]*	0.8% [0.2-1.7%]	0% [0-0.3%]

Conventional AJ

Current sit.	AJ cons. <200ml/day
0.1% [0-0.3%]*	0% [0-0%]

Conclusion

- A proper treatment of data $< \text{LOD}$ is not be underestimated
- A uniform distribution with uncertain bounds can be used to handle data $< \text{LOD}$
- Children consuming organic AJ: 0.9% [0.3-1.8%] exceed TDI
- \downarrow regulatory limit to 25 $\mu\text{g}/\text{kg}$: 0% [0-0.3%] exceed TDI
- Reduction of AJ consumption was less effective to reduce patulin exposure