Development of a framework for the evaluation and prioritization of food and feed safety hazards and related research needs

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Contents

- Aim
- Problems to resolve
- Proceeding

Relevance for human health

Other scientific criteria

Criteria related to the perception of risk

- The user friendly interface
- Listing and automatic ranking of data sets

Aims

- Prioritization of the different classes of hazards: (micro-) biological, chemical, physical, and nutritional, in foods and feeds
- Prioritization of related research needs
- Simple, fast and easy to use - Tool
- No need to perform complete scientific risk assessment
- Include typical local and national conditions

Problems

- Chemical risks have acute and long term end points
- (Micro-) biological risk estimates concerning illnesses and deaths differ widely
- Comparison of (micro-)biological and chemical risks
- Widely differing estimates for deficient or excessive food intake and imbalanced diet

Proceeding

- Prioritizations are applied to triplets formed by:

Product matrix (food or feed), its processing (with possible change of hazard, the respective hazard

- A basis of measurable descriptors was found either as:

DALYs (Disability Adjusted Life Years) or
Illness and death cases in a population, respectively
Economic cost estimates resulting thereof

Literature (measurable descriptors):

- van Kreijl C.F., Knaap A.G.A.C. and Raaij J.M.A. (Editors-in-Chief). Our food, our health. Healthy diet and safe food in the Netherlands. rivm (national institute for public health and the environment). RIVM report number 270555009, ISBN 90-6960-135-4, ISBN 978-90-6960-135-9, NUR 882. 2006 (available at http://www.rivm.nl/bibliotheek/rapporten/270555009.pdf).
- Siebert. B.D. Natural chemicals and food safety. CSIRO Division of Human Nutrition at the regional Institute Inc., Australia, Glenthorne Laboratory. O'Halloran Hill, SA 5158. 1992 (available at http://www.regional.org.au/au/roc/1992/roc1992055.htm) .
- Mead P.S. et al. Food-Related Illness and Death in the United States. Emerging Infectious Diseases Vol. 5, No. 5, 1999 (available at http://www.cdc.gov/ncidod/eid/Vol5no5/mead.htm).

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Relevance for human health- by far the most important criterion

- The incidence and severity of adverse health effects must show up within the “relevance for human health”- criteria

Hazard	**Netherlands, DALYs based factors**	**USA/Australia, Fatalities/costs based factors**
Unfavorable dietary composition and overweight	1	1
(micro-) biological agents	0.0025 – 0.01	0.05 - 0.3
Chemical contamination: pesticides, naturally occurring chemical compounds, toxins or contaminants including allergens	0.00375 – 0.005	
Allergens alone	0.0025	
Environmental chemicals or natural toxicants	0.00125 – 0.0025	0.001
Pesticide residues or food additives		0.00001

Table 1: Criterion *Relevance for human health* of different food borne hazards at the example of the Netherlands (based on DALYs) and the Example of USA and Australia (based on fatalities and costs).

- spreads the different hazards up to ten-thousand fold

User friendly tool-interface

1 Human Health & 6 Exposure Criteria

Other Legitimate Criteria: relevant for value chain

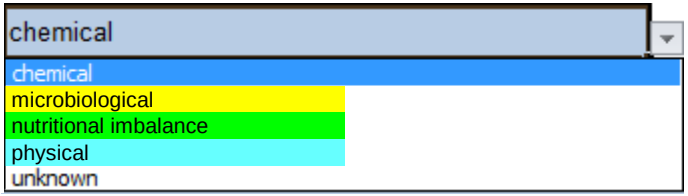
Product x Hazard x Processing -> FLEXIBILITY

Date	21.01.2013		
Assessor	mum		
Product	Raw milk		
Contaminant	EHEC 0157		
Intended use / processing	Production of raw milk cheese		
…actor		**Weighting**	
Quality of agent	microbiological		
Agent impact on human health	Microbial contaminants	0.01	
Dissemination of hazard / biological and chemical agents	high impact (virulence or infectivity) in human and animal	5	
Entry to food chain	farm & processing	2	
Importance of food / feed ingestion	normal food/feed, weekly to monthly consumption	2	low infection dose
Changes due to food processing	basic food/feed, daily to weekly consumption normal food/feed, weekly to monthly consumption speciality, monthly to yearly consumption	0.1	
Expansion of hazard / risk	international (import / export)	3	substantial amount exported
Regulatory concern and internal status	ongoing (inter-) national cooperation	3	
		0.18	
Other legitimate criteria			
media interest (extrapolation)	medium, normal information	2	no cases of illness known
consumer control of hazard	no	3	
familiarity of specalists with hazard	basic knowledge, medium need for research	2	research needed for optimisation of production process
affected groups of population	all, entire population	3	
		36	
	Total priority points TPP	**6.48**	Rating transfer in data base

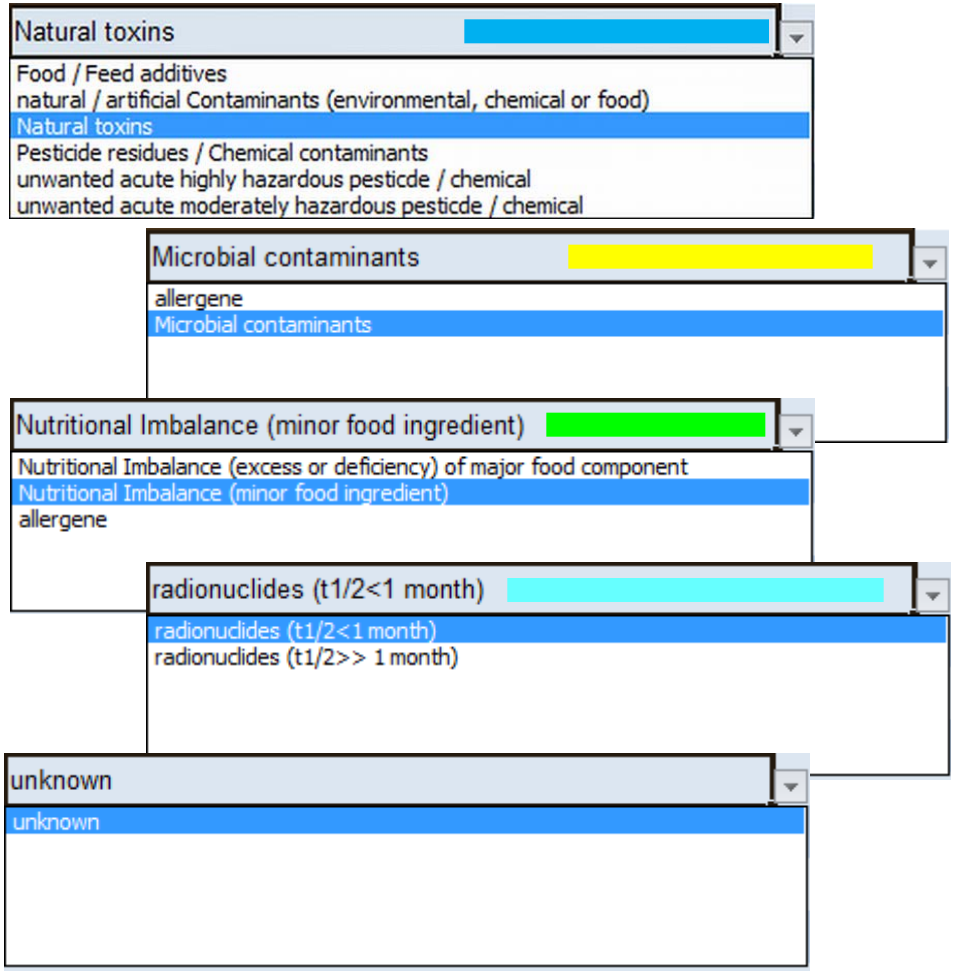
For final rating, sub-criteria are given a numerical value according to the respective importance. These values are multiplied to the final rating value, which is is automatically classified by colors

Type of agent defines the impact on human health

The chosen type of agent



defines the set of criteria describing the resulting impact on human health:



The other scientific criteria (I)

- The other scientific criteria together modulate from a minimal reduction factor of 0.1 to a maximal multiplication factor of 3240.
- Quality of agent:

might be used to switch on or off the appropriate criteria selection for separate food and feed hazard prioritization.

- Type of agent:

if the hazard is of chemical, microbiological, physical or nutritional nature, selects the appropriate sets of sub-criteria for the selected type of hazard.

- Dissemination:

describes the agent`s capacity of reaching living beings (humans, animals).

The other scientific criteria (II)

Criterion	Sub-criteria
Entry to food chain	Retail and consumer
	Farm and processing
	Environment and field
Importance of food / feed ingestion	Basic food/feed, daily to weekly consumption
	Normal food/feed, weekly to monthly consumption
	Speciality, monthly to yearly consumption
Changes due to food processing	Accumulation
	Unknown
	No change
	Reduction
Spread of the hazard	International (import/export)
	National
	Local
Control options	New and not regulated
	Known but not regulated
	Known and regulated

Explanation (Exposition)

- Entry to the food chain:

assumes contaminations to be more hazardous when present in the food or feed near consumption because there remains less possibility for its detection and minimization.

- Importance of food or feed ingestion:

associates the probability of ingestion with the ingested amount. The criteria changes due to food processing informs about the amount of hazard expected in the final product.

- Spread of the hazard:

defines the area of influence (local, national, import/export).

- known and regulated (and controlled) hazards:
- imply a reduction of hazards present in foods and feeds towards acceptable levels.

The criteria related to the perception of risk

- The 4 criteria related to the perception of risk modulate a maximal multiplication factor of 72

Criterion	Sub-criteria
Media interest (extrapolation)	Headline coverage (i.e. due to fraud, political debate, scandal)
	Little or medium coverage
	No coverage
Consumer control over hazard	no
	yes
Data gaps	No knowledge and high research need
	Basic knowledge and medium research need
	Good knowledge and no research need
Affected persons	General population
	Subpopulations (YOPI)*
	Sensitive individuals

Thus, the factors separating the principal categories of food hazards may be passed or changed.

Explanation (other legitimate criteria)

- Risk communication learnt us: factors different to science influence the perception of risk
- Perception of risk depend on:

individual risk estimations and evaluations

- Media coverage:

appreciation when trying to avoid scandals e.g. due to fraud or insufficient controls and when trying to avoid loss of trust

- Consumers may show increased risk tolerance:

when they exert personal control over a risk, when the risk is voluntarily taken, when it is familiar or when there exists institutional control by a confident institution

- It is important, how many and what persons are affected: i.e. appealing persons like children or mothers (Lit:Renn,O.Univ.Stuttgart,2008)

Examples: microbiological agent (I)

Date	21.01.2013		
Assessor	mum		
Product	Raw milk		
Contaminant	EHEC 0157		
Intended use / processing	Production of raw milk cheese		
		Clear contents	
Factor		**Weighting**	**Comments, remarks**
Quality of agent	microbiological		
Agent impact on human health	Microbial contaminants	0.01	
Dissemination of hazard / biological and chemical agents	high impact (virulence or infectivity) in human and animal	5	
Entry to food chain	farm & processing	2	
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Listing and ranking of input sets

Ranking	TPP	scientific factor	Factor "Other legitimate criteria"	Product	Contaminant	Intended use / processing	Assessor	Date of ranking
3	4.320	0.2400	18	Flour	Aflatoxin B1	Production of bread	test	16.07.2012
1	6.480	0.1800	36	Raw milk	EHEC 0157	Production of raw milk cheese	mum	21.01.2013
2	5.830	0.2160	27	Milk	Aflatoxin M1	Production of cheese	BLK	04.02.2013

- Data records are automatically ranked after insertion into data base
- Optical discrimination of ranking by color gradient
- Indicator function for fraud

Further development

- Criteria dealing with both, food and feed hazards, should be separated
- Normalization of sub-criteria
- Separate weighting of problematic constellations
- Incorporation of existing data on food and feed contamination incidence
- Define and discriminate uncertainty
- Validation
- Computation of tool / data base in Access

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Goodbye everybody!

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