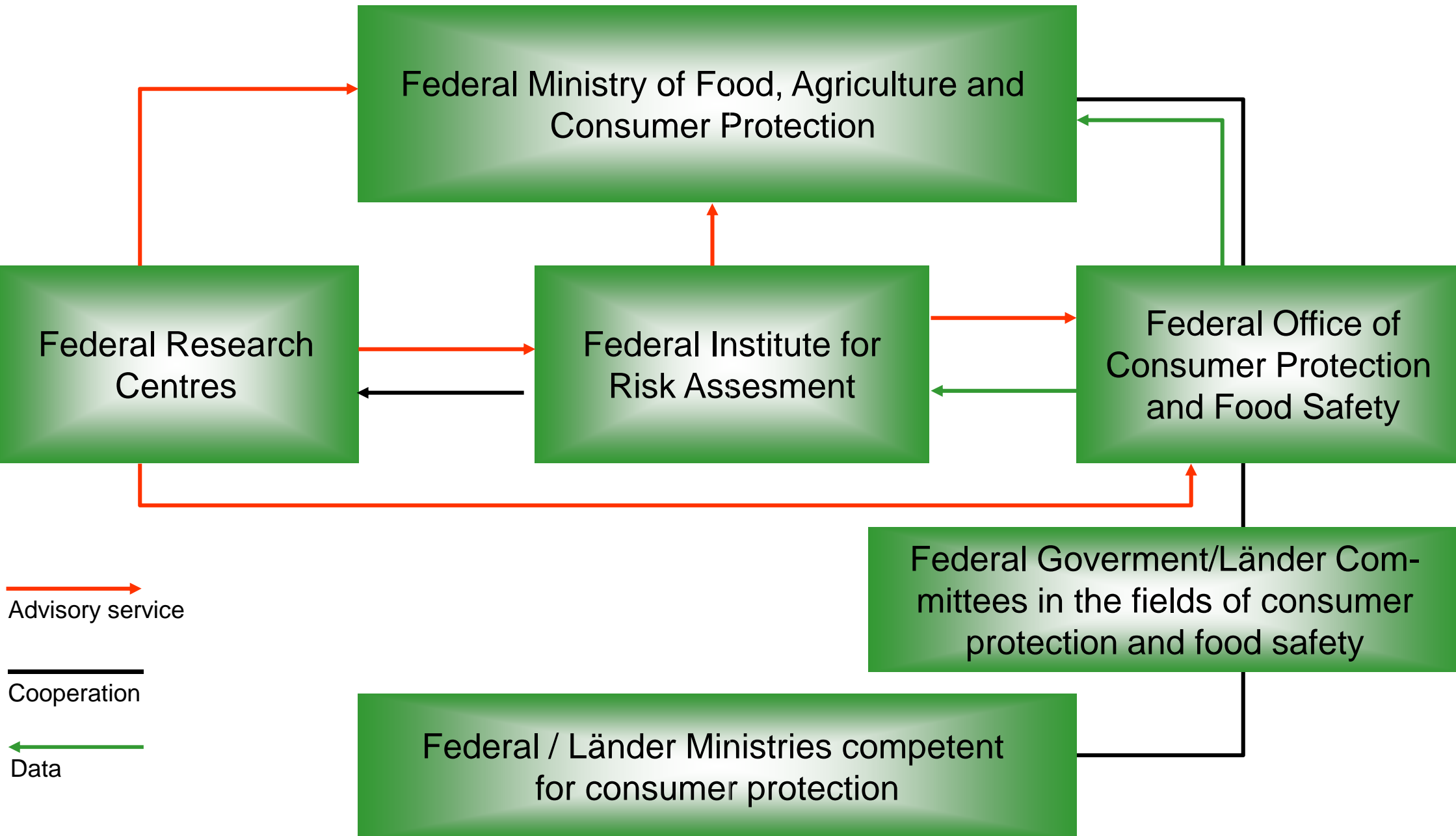


Is food a vector for intentional contamination – BIO-/Agroterrorism?

Bernd Appel, Anja Buschulte, Matthias Filter,
Eva Knoop, Andreas Hensel

Cooperation on Consumer Health Protection in Germany



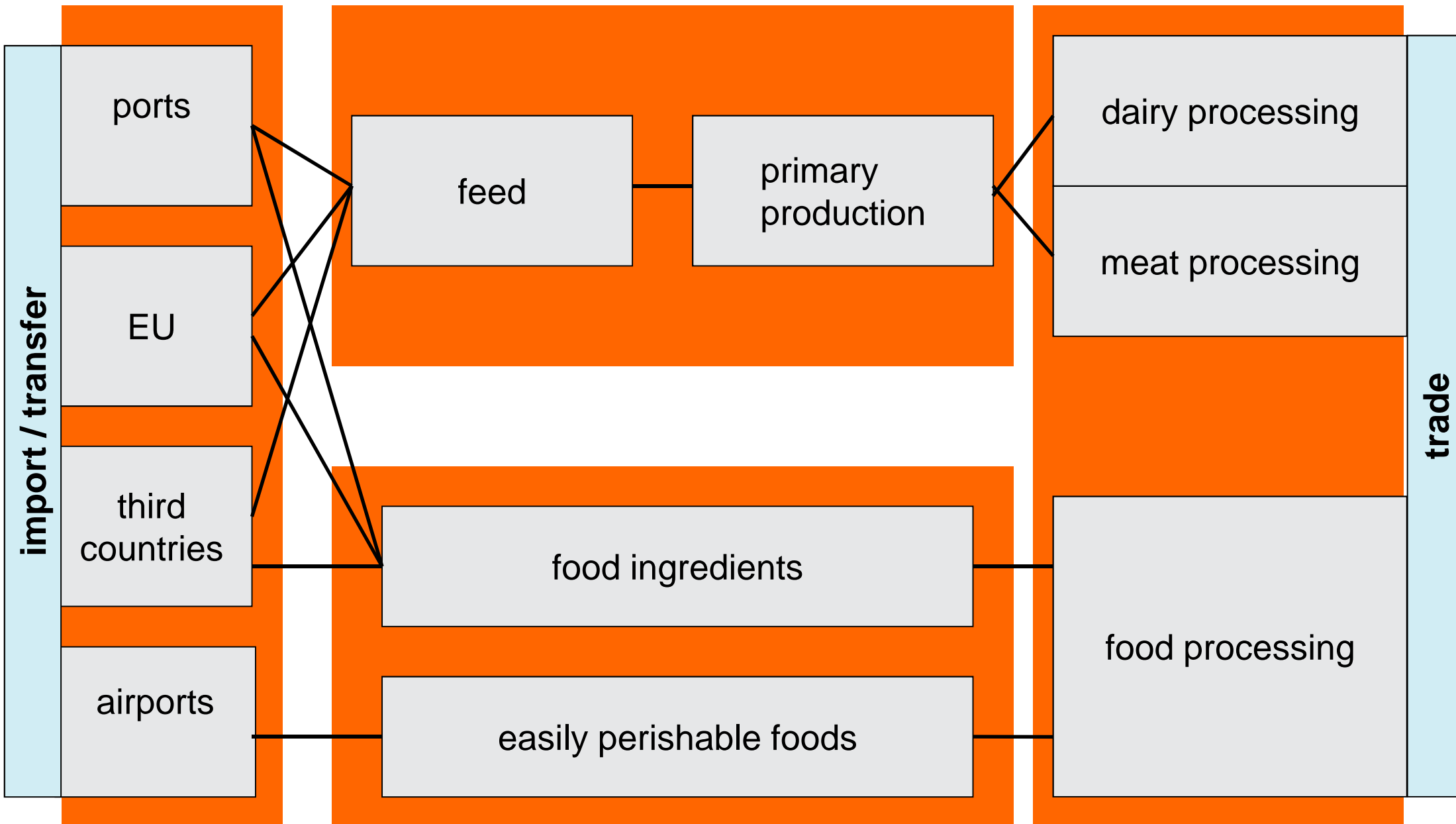
Key Questions

1. Is **food a vector** for intentional contamination?
2. Can we **detect** intentional contamination **in time / at all**?
3. How to **discriminate between natural and intentional** cases?
4. Do we have **examples / experiences** with intentional contamination?
5. What has to be done to **ensure food / feed safety and security**?

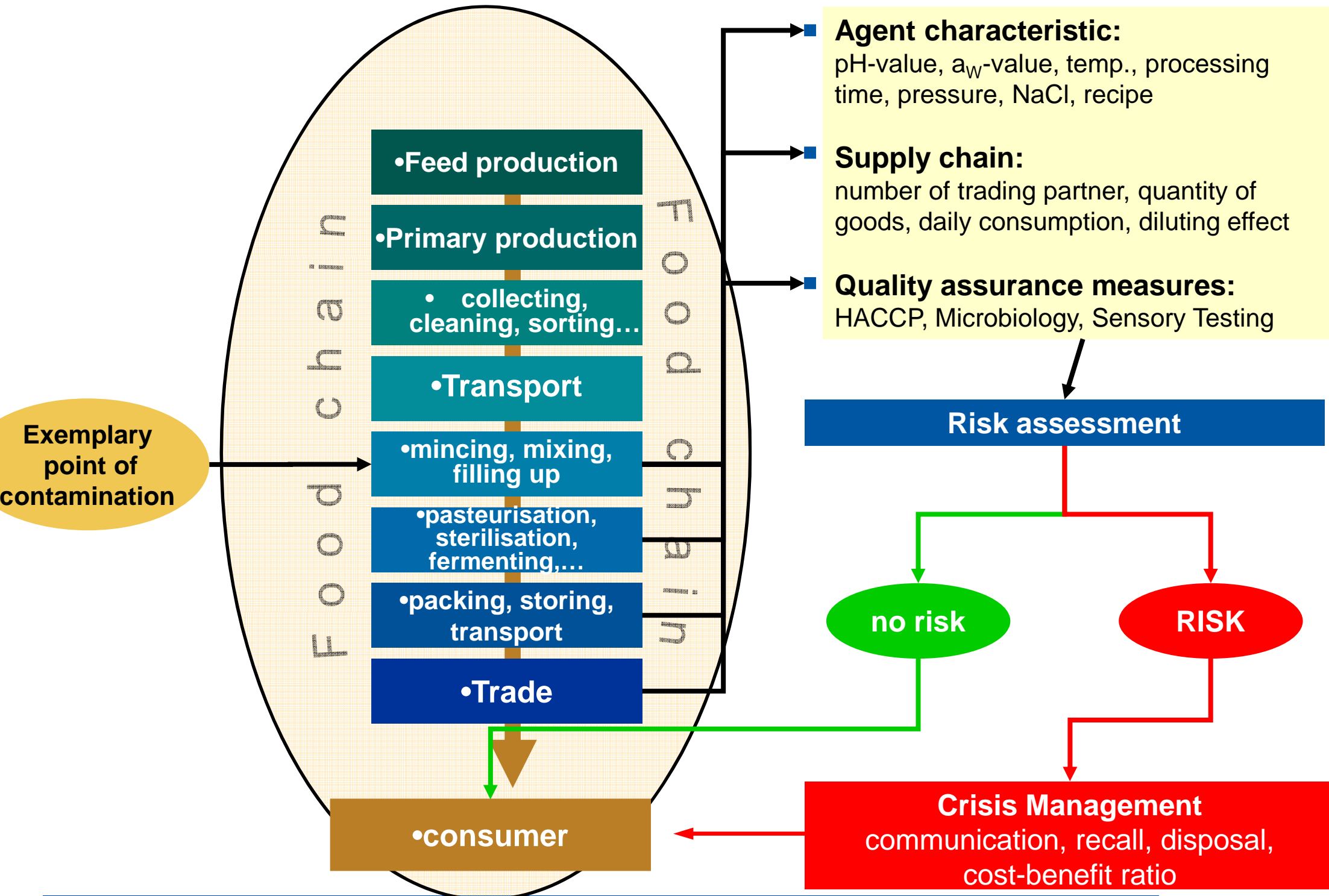
For answers you need: microbiologists, food technologists, vetmeds,
epidemiologists, biomathematicians, programmers AND
BSL laboratories

Supply chains and possible points of contamination

bacteria - viruses – toxins (chemicals)



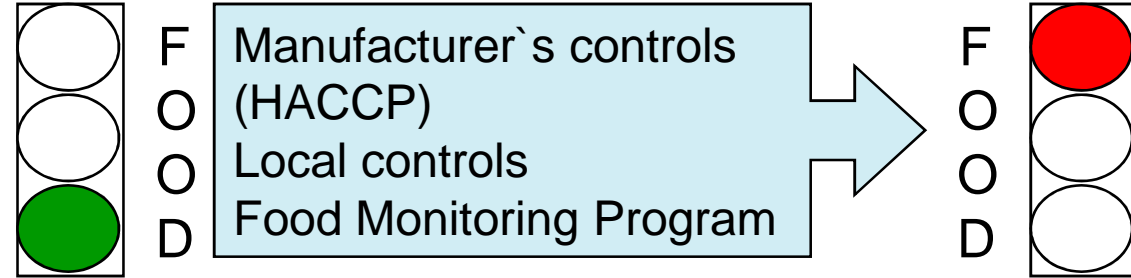
Focus: Intentional contamination of the food supply chain



Differentiating between „natural“ and intentional outbreaks

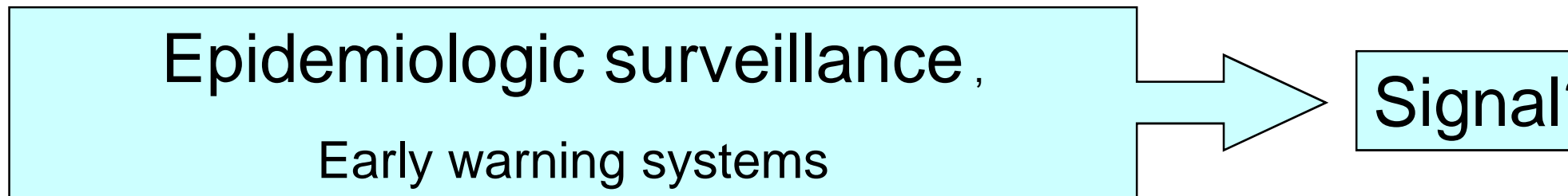
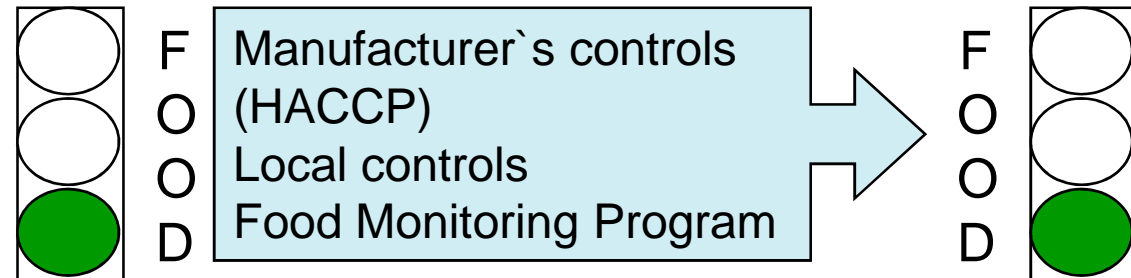
Natural outbreak

- naturally in food occurring agent
- common agent – food combination

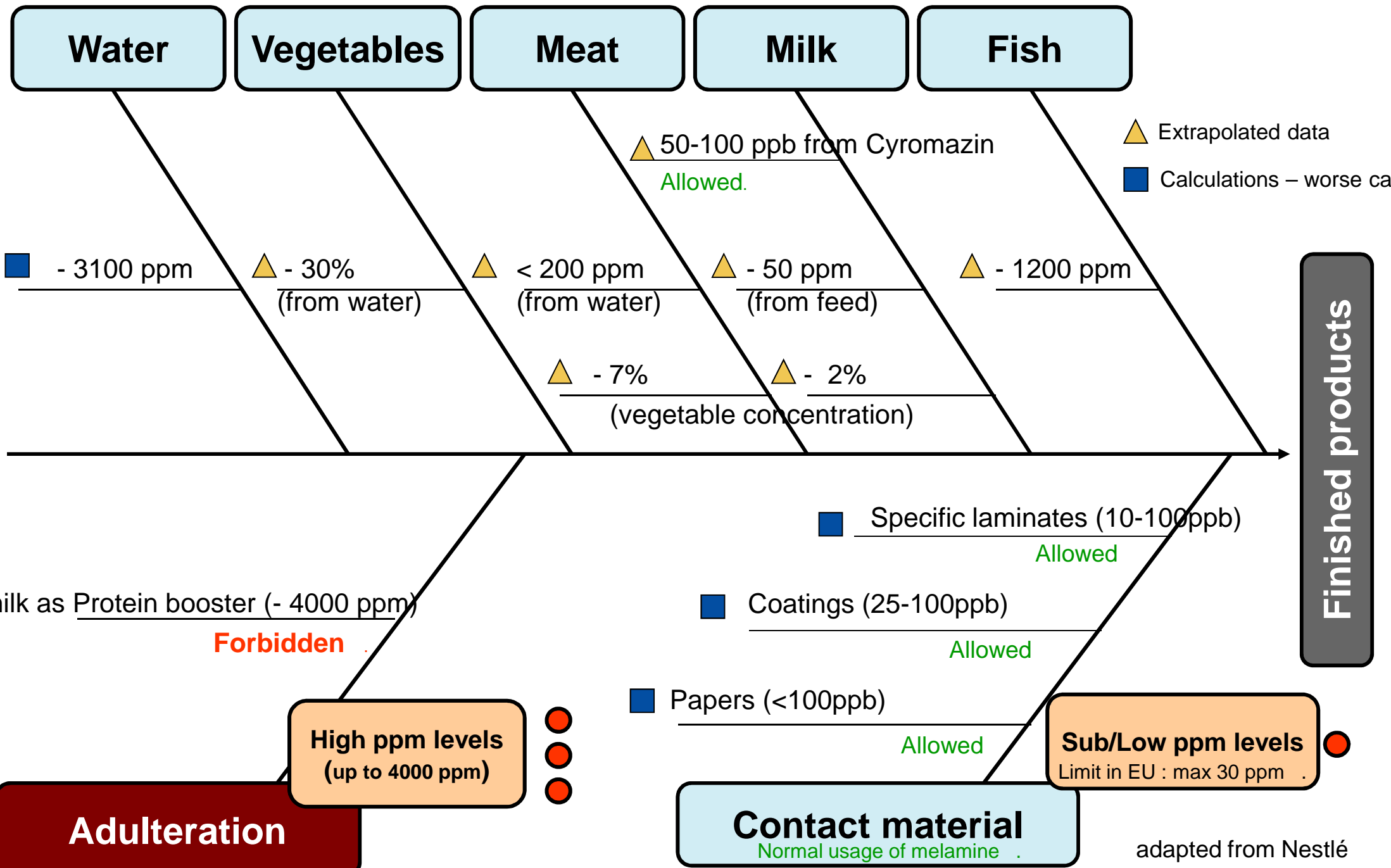


Intentional outbreak

- unusual/atypical agent
- unusual food – agent combination
- genetically modified agents



Possible entry points of Melamin in the food chain



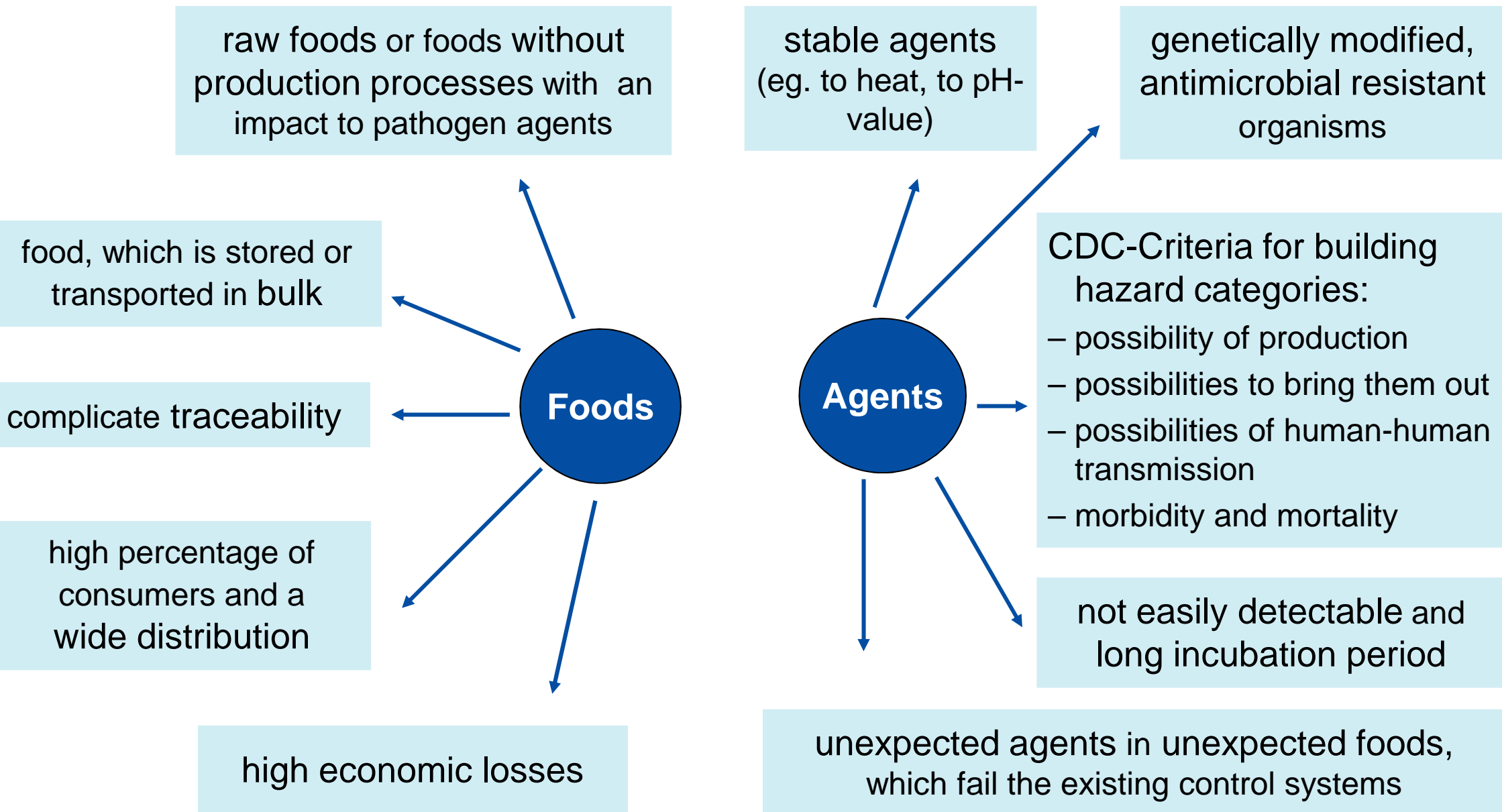
Food - a target for terrorist attacks?

Type of outbreak	Agent and food	Region and year	Infected people	Point of contamination	Time for identification causing food
deliberate	Salmonella typhimurium in salad bars	USA, 1984	751	service	1 week, but arrest 1y later
unintentional	Salmonella typhimurium in pasteurized milk	USA, 1985	170.000	plant (after pasteurization)	< 1 month
unintentional	Salmonella enteritides in pasteurized ice cream	USA, 1994	224.000	transport	about 2 months
unintentional	Escherichia coli O157:H7 in radish sprouts	Japan, 1996	7.000 (including some deaths)	service (at school)	about 1 month
unintentional	EHEC in spinach	USA, 2006	>200	agricultural production	< 1 week

Questions that need to be answered

1. What are the **most vulnerable food chains** ?
 - in respect to consequences for consumer health
 - in respect to safeguard the food supply chain
 - in respect to economical consequences
2. What are the **microbiological agents with highest concern** to the public?
 - considering food processing and food consumption profiles
 - considering the consequences of contamination during production
 - considering the accessibility and ease of production
3. What are the **best methods to detect intentional contaminations**?
 - considering the given legal framework for monitoring systems
 - considering the sensitivity / specificity of detection methods
 - considering the costs
4. In the case of a bioterroristic event: **how to response adequately**?
 - considering all possible preventive and reactive actions
 - considering the cost–benefit relation
 - considering available decontamination technology

What kind of food and biological or chemical agents are in special focus?



B-agents: Bacteria / toxins with food relevance (1)

- **Category A (CDC)**
- Anthrax (*Bacillus anthracis*)
- Botulism
(*Clostridium botulinum* toxin)
- Plague (*Yersinia pestis*)
- Tularemiae
(*Francisella tularensis*)
- **Relevance if taken up by food**
- ***Bacillus anthracis*** can be infectious if taken up by food
- ***Clostridium botulinum*** can occur naturally in certain foods
- ***Yersinia pestis***, cases of food-borne infections reported
- ***Francisella tularensis*** Infections rare, but reported for hare meat

Classification of agents in category I

bacteria	toxin	virus
categorie I		
<i>Bacillus anthracis</i>	Botulinumtoxin	<i>Hepatitis E-Virus</i>
<i>Salmonella Typhi</i>	Ricin	<i>Krim-Kongo-Haemorrhagic-fewer-Virus</i>
<i>Brucella spp.</i>		
<i>Vibrio cholerae</i>		
Enterohaemorrhagic <i>Escherichia coli</i>		
<i>Francisella tularensis</i>		
<i>Shigella dysenteria</i>		

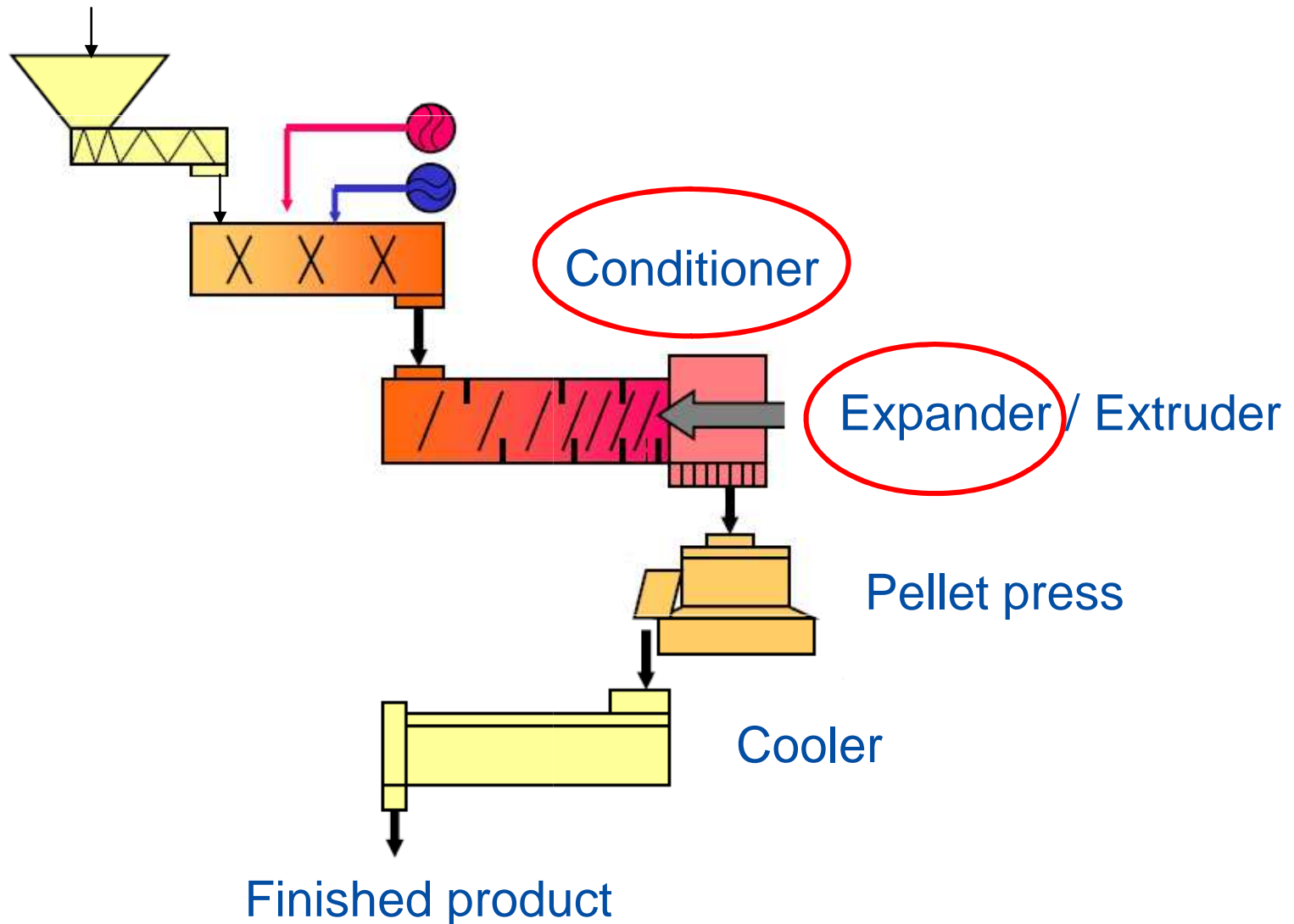
Food which could be easily contaminated

- milk, milk products
- meat products
- minced meat/seasoned minced meat
- salads/catering food
- Some fresh fruits
- non-aerated, low pH water (soda)
- fruit juices with low pH
- cereals
- chocolate bars
- frozen imported food
- ice-cream
- food additives, spices



Process line in a feed mill

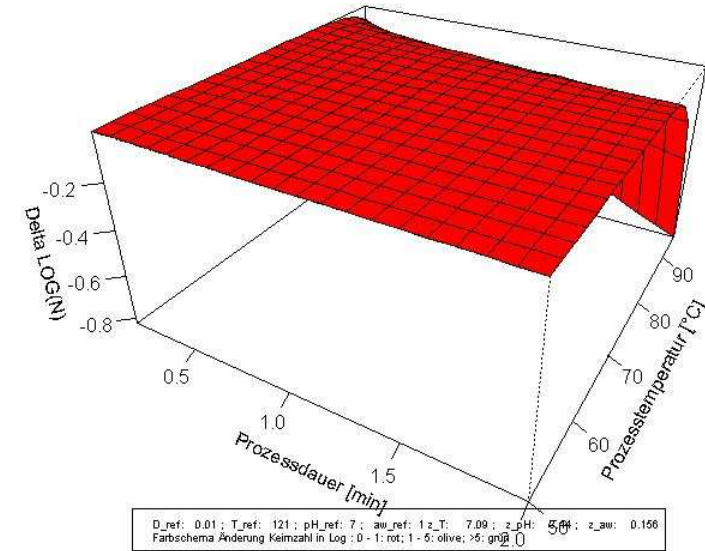
Raw material



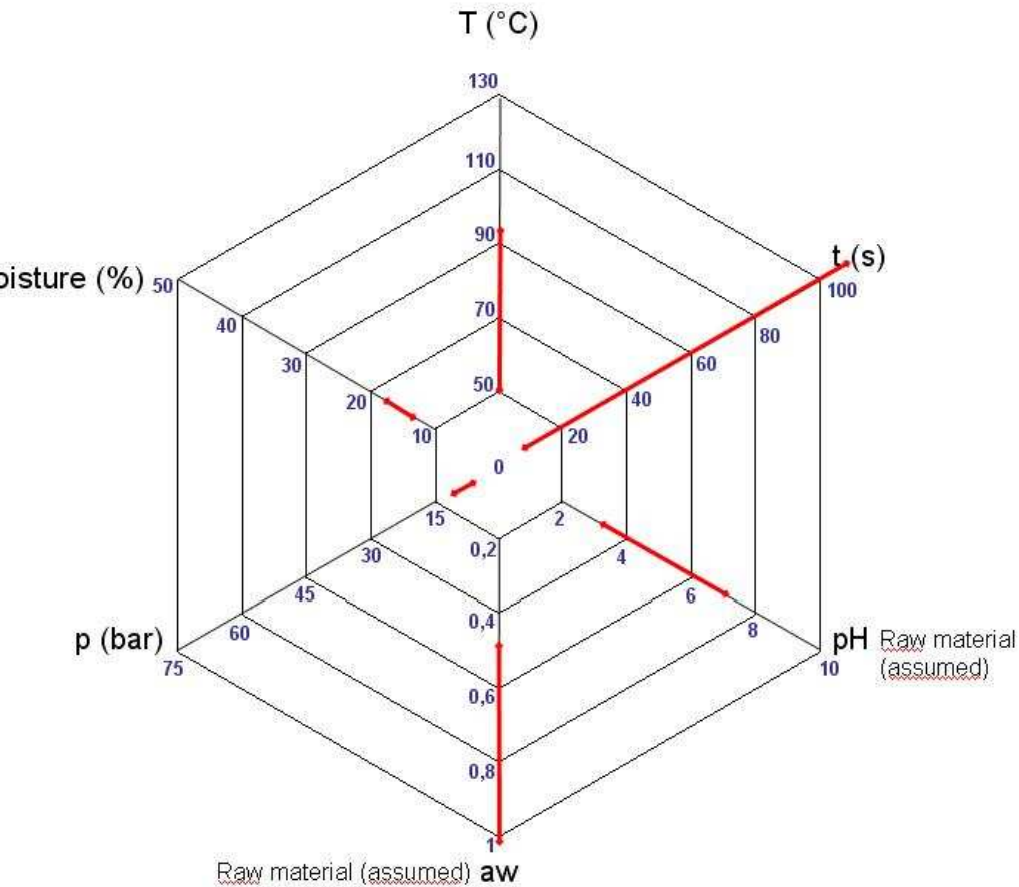
Parameter influence to inactivation

Influence of processing time (t) and temperature (°C) to inactivation

set values: aw 0,8; pH 7

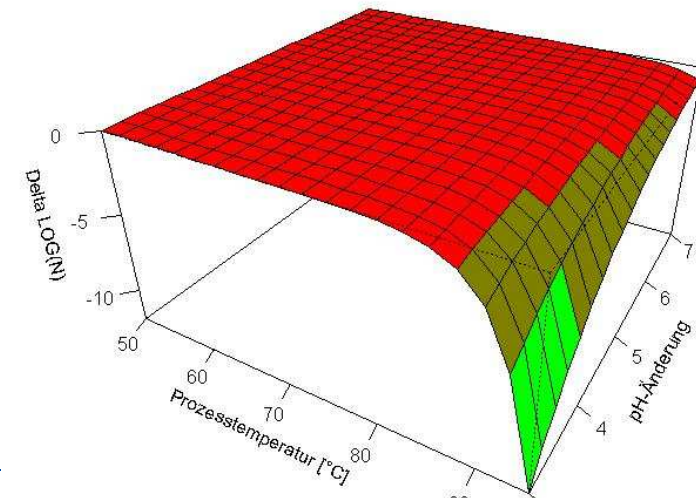


Value Ranges Conditioner Process



Influence of pH and t(°C) to inactivation

set values: aw 0,8; t(min) 2

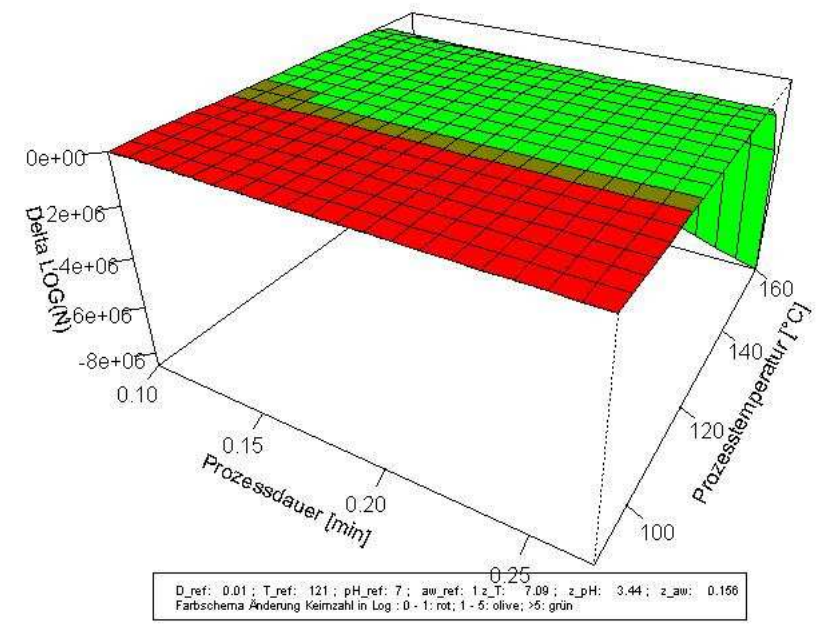
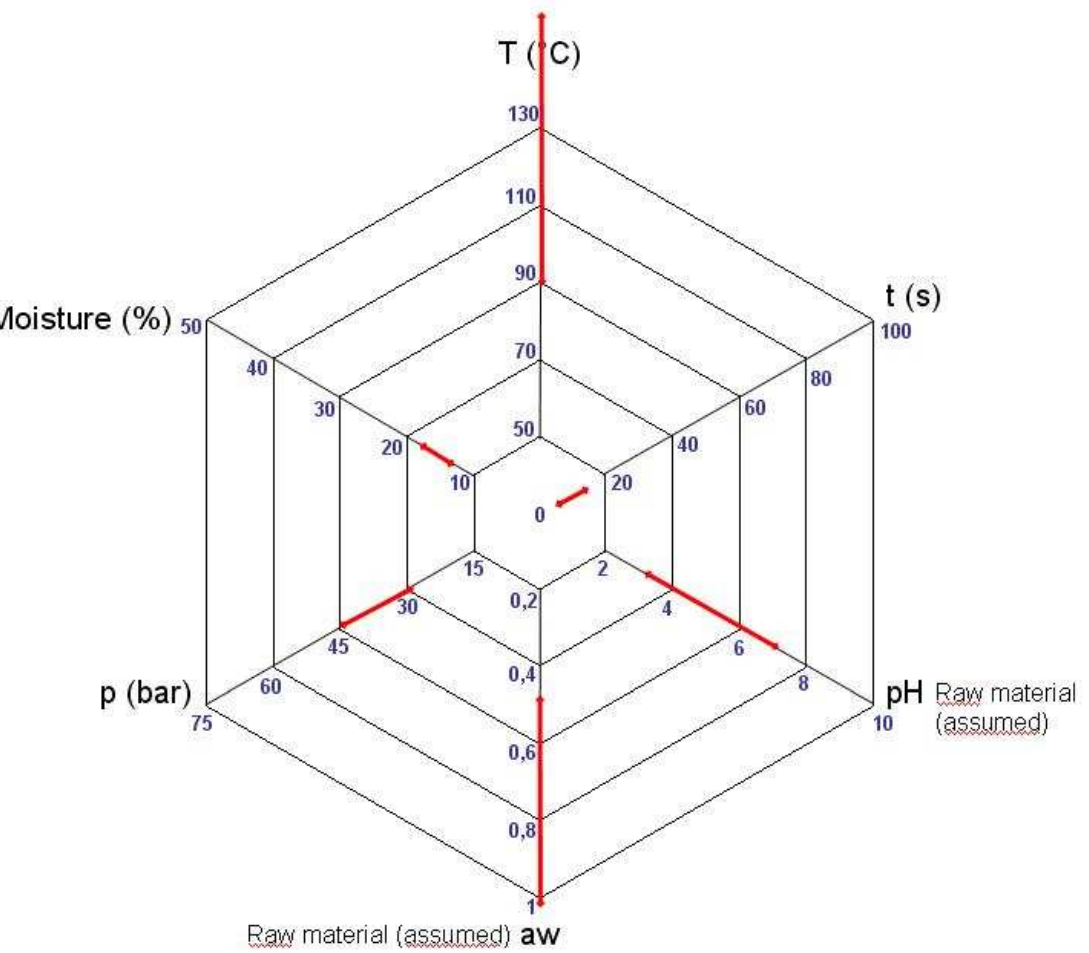


Selected surrogat/strain: **B.cereus ADQP 407**; parameter data Leguerinel et al (2005)

Influence of processing time (t) and temperature (°C) to inactivation

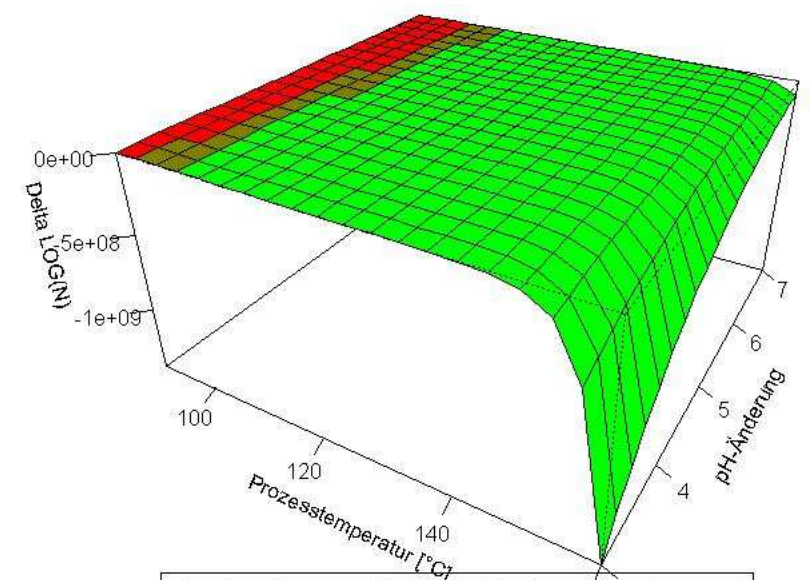
set values: aw 0,8; pH 7

Value Ranges Expander Process



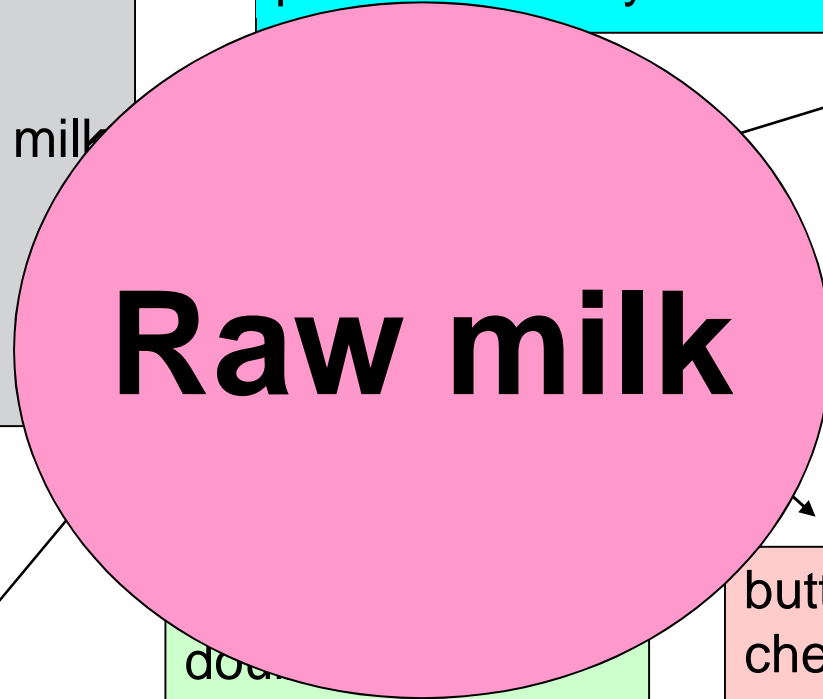
Influence of pH and t(°C) to inactivation

set values: aw 0,8; t(min) 0,16



Selected surrogat/strain: **B.cereus ADQP 407**; parameter data Leguerinel et al (2005)

Diversity of Milk Products



condensed skimmed milk
Condensed milk
extended shelf-life milk
fresh whole milk
lowfat milk
part-skim condensed milk
pasteurized milk
skimmed milk
sterilized milk
UHT milk

powdered milk
powdered skimmed milk
powdered whey

brined cheese
cream cheese
fresh cheese
hard cheese
mascarpone
pasta filata
semi-hard cheese
semi-soft cheese
soft cheese
soft ripened cheese
sour milk cheese
whey cheese

sour whey
sweet whey

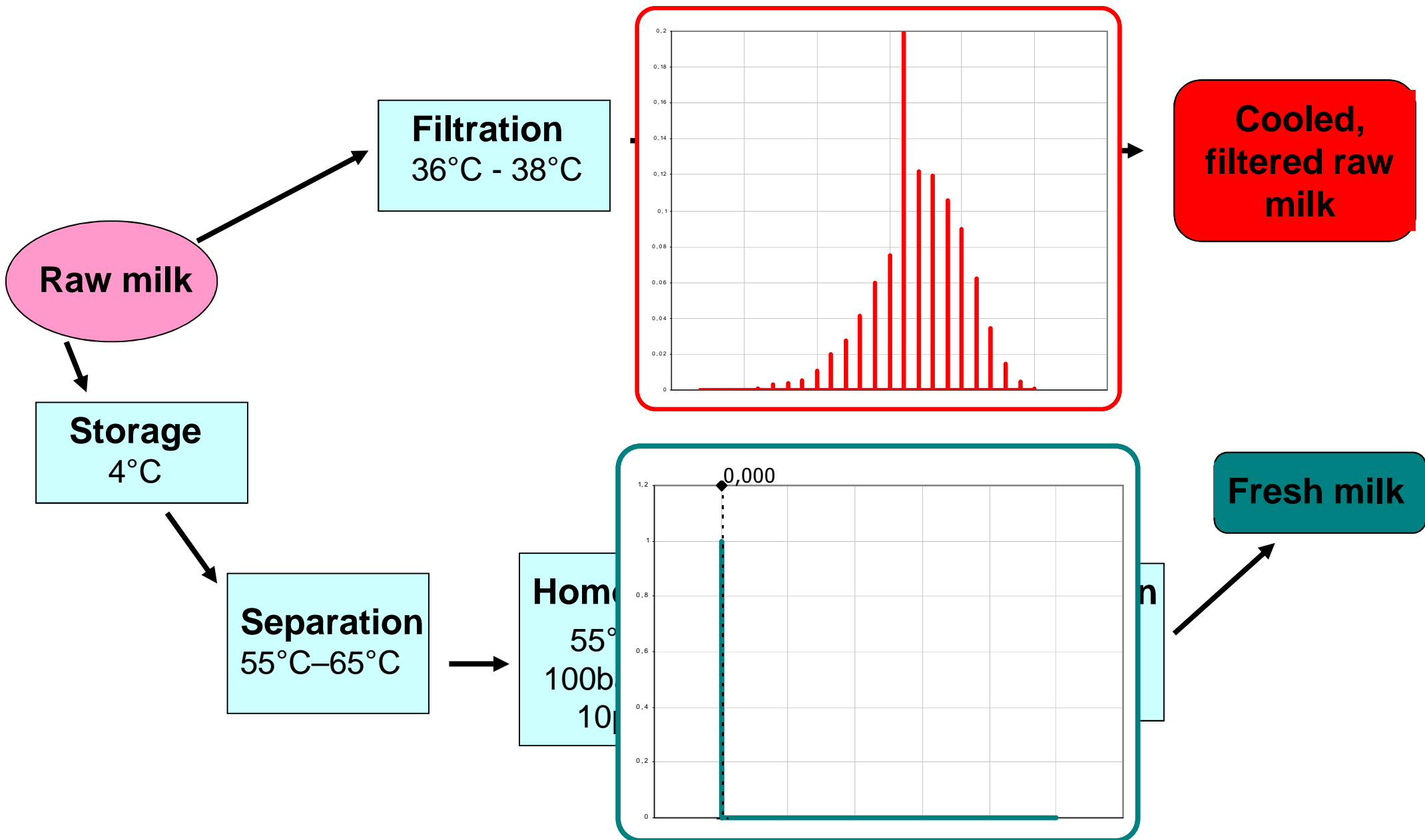
butterfat
clarified butter
cultured butter
mild cultured butter
raw cream butter
sweet cream butter
whey butter

double cream
half and half
pasteurized cream
schmand
sour cream
soured cream
table cream
whipping cream

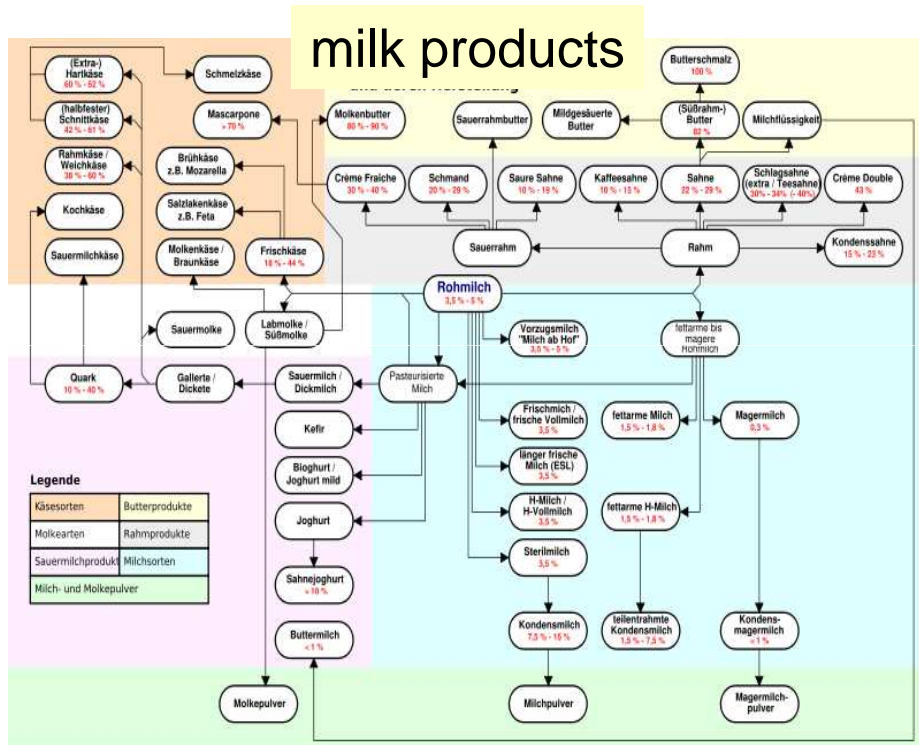
buttermilk
cheese curd
cream yoghurt
kefir
mild yoghurt
organic yoghurt
quark
soured milk
yoghurt

PhD Thesis by
N. Schoene

Example: Pasteurized milk and raw milk



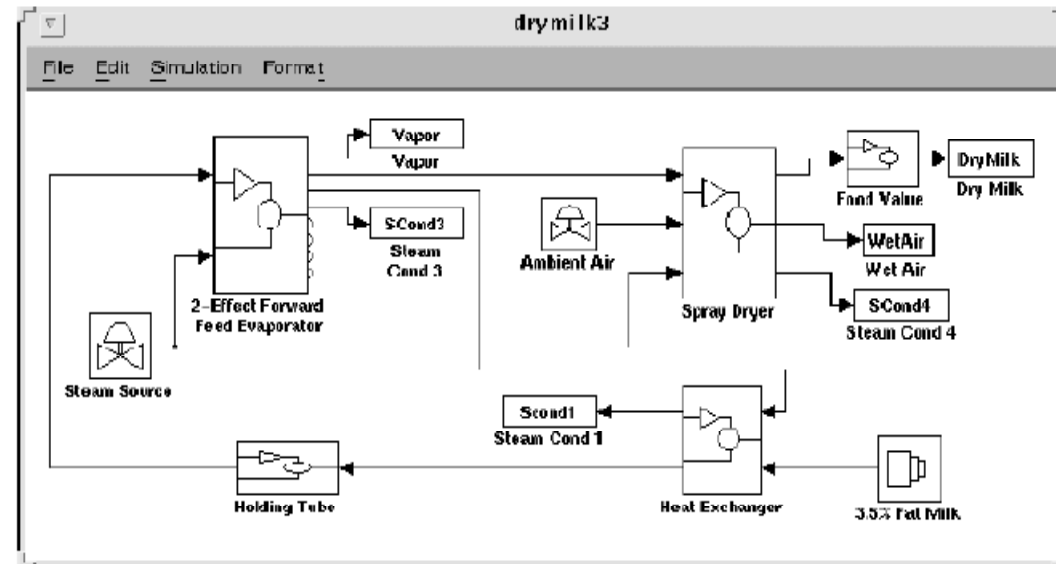
Modeling the processing of food



- Defined number of different products
- Defined number of processing steps
- **Unlimited** number of processing parameter combinations

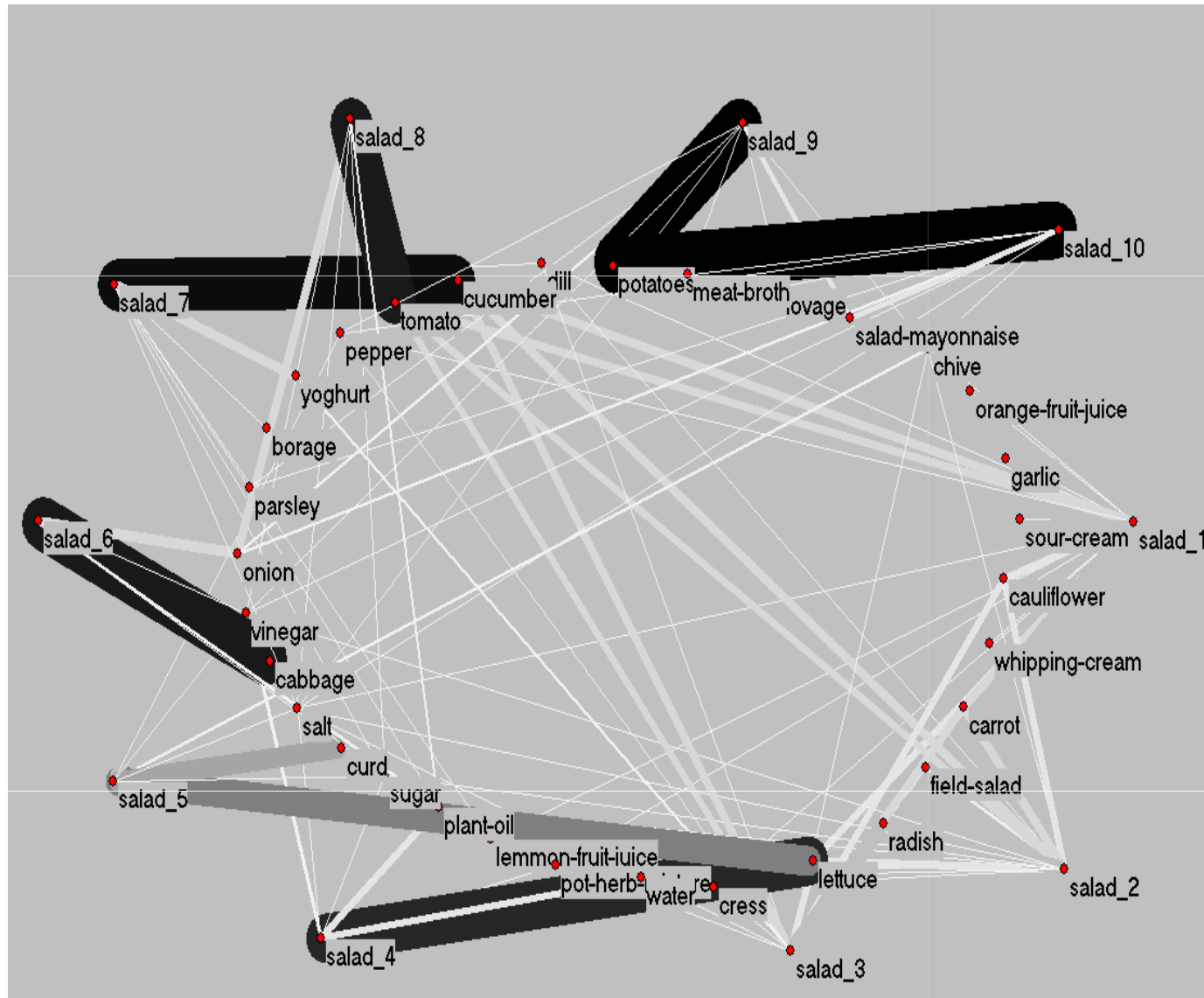
Work in progress:

Development of a modular system block library for food processes



Diefes, H. A., M. R. Okos, und M. T. Morgan. 2000. Computer-aided process design using Food Operations Oriented Design System Block Library. Journal of Food Engineering 46(2):99-108.

Knowledge on food ingredients



TOP 10 salads
raw-vegetable-salad cream-dressing
raw-vegetable-salad vinaigrette
raw-vegetable-salad yoghurt-dressing
lettuce salad vinaigrette
lettuce-curd-salad cheese-dressing
cabbage-salad dressing-with-onions
cucumber-salad yoghurt
tomatosalad vinaigrette-with-onions
potato-salads
potato-salad salad-cream

Ingredient network in salads in Germany

TOP 10 consumed salads

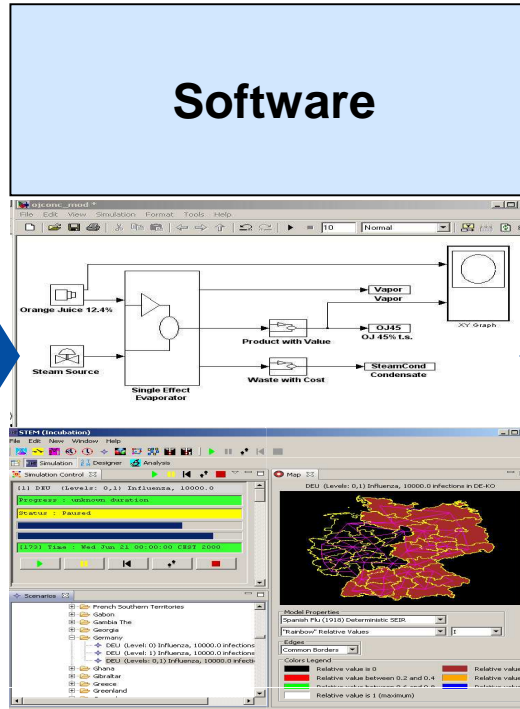
Vision: building block system for risk assessment

risk assessment modeling toolbox

database on food

matrix properties
consumption data
portion size
food processing
transportation

Software



database on agents

agent properties
e.g. growth,
inactivation,
survival,
detection methods,
infectious dose etc.

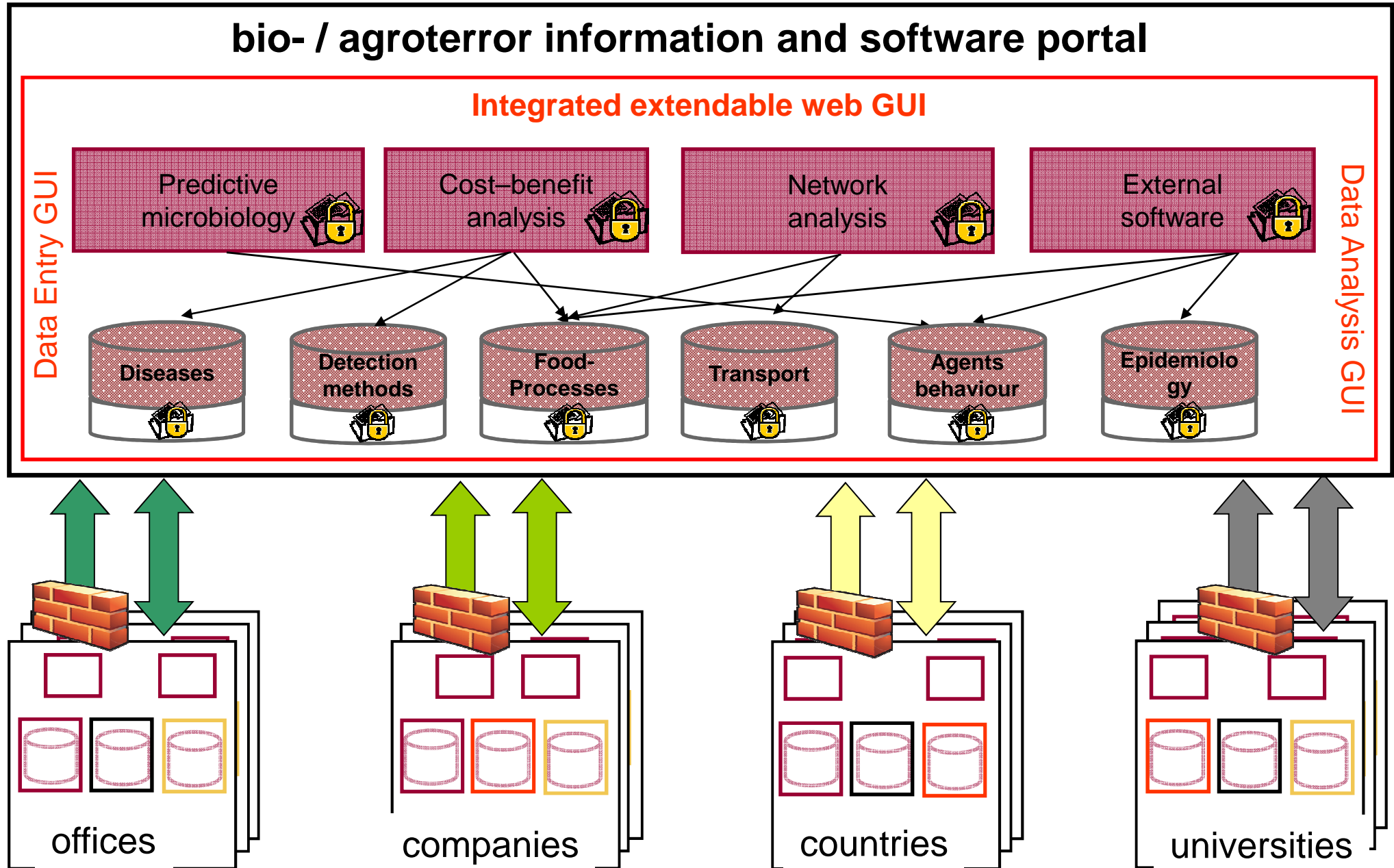
Process data from
companies

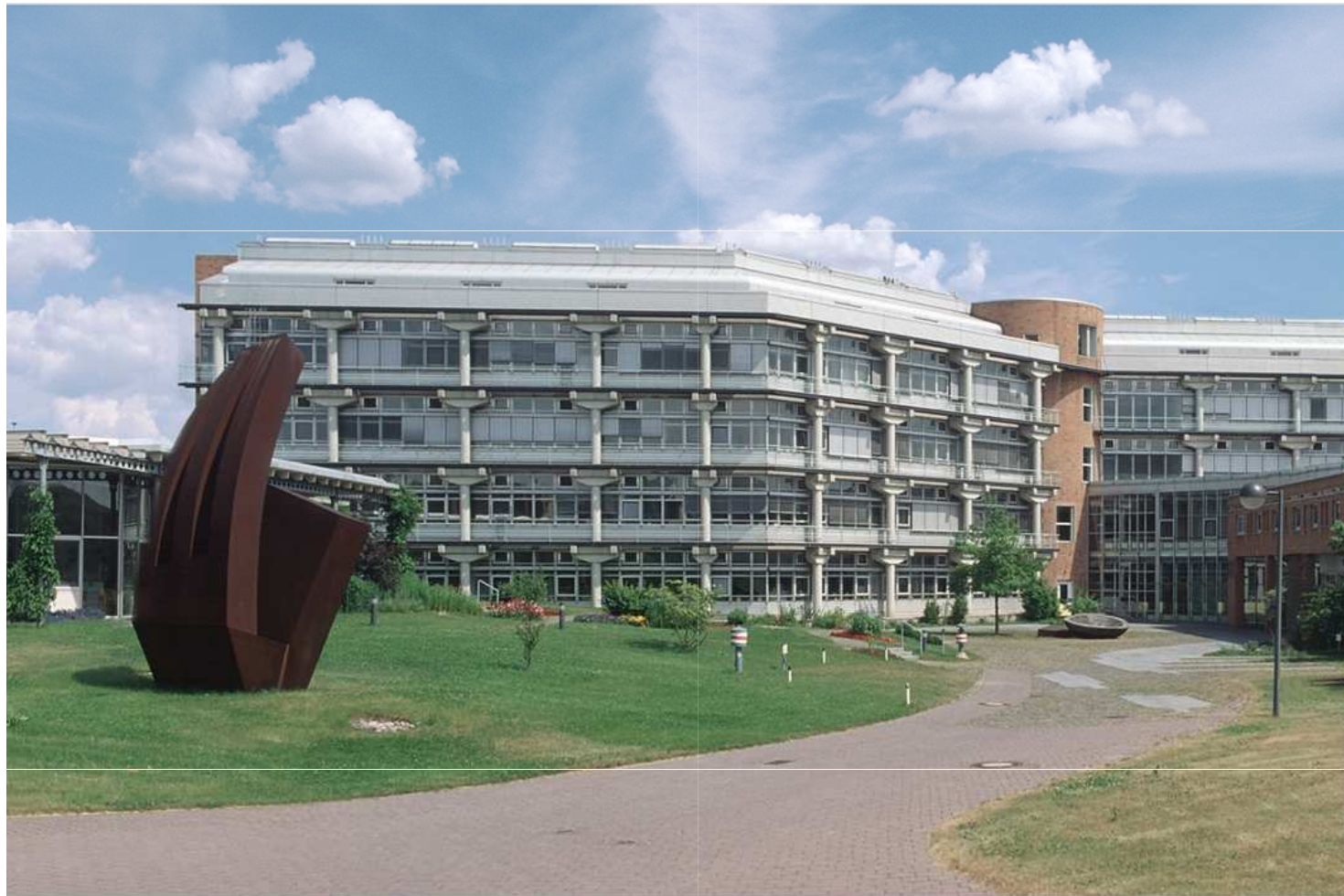
Consumption survey data
Retail data

In-house
experiments

Scientific literature /
public scientific
databases

Vision: web based information and software portal





Thank you for your attention

Professor Dr. Bernd Appel
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