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Chemical Hazards in Food and Feed

Towards an integrated risk assessment

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European Food Safety Objectives
General Food Law: EC 178/2002

From the Farm to the Fork

- Integrated Quality Control
- Integrated Risk Assessment

In the period 2003-2012, the CONTAM Panel published 107 scientific outputs (55 on food, 43 on feed, 9 on food and feed).

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The CONTAM Mandates: Risk Assessment of Contaminants in Food and Feed

- ✓ Persistant organic pollutants
- ✓ Metals, metaloids and other chemical elements
- ✓ Mycotoxins
- ✓ Marine biotoxins
- ✓ Plant toxicants (alkaloids) in food and feed
- ✓ Food process contaminants
- ✓ Feed process contaminants (coccidiostats)

EFSA Journal 2012; 10 (10); s1004

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Risk Assessment of Contaminants in Food

- ✓ **Data sources & data mining**
  - ✓ Scientific literature, official national reports (EU & MS, Codex) AND DCM (EFSA Data Collection and Monitoring)
  - ✓ Human exposure (Comprehensive Food Consumption Database (> 20 MS)

EFSA Journal 2012; 10 (10); s1004

Risk Assessment Principles

Dealing with “unavoidable” substances

Identified by Mode of Action (Hazard Identification)

Health-based guidance value (HBGV)

Reference points:

BMDL (dose response assessment)
(benchmark dose lower confidence limit (95 perc. confidence interval)
NOAEL (LOAEL) & uncertainty factors
ARD acute reference dose (short term - incidental – exposure)
MOE – Margin of exposure (genotoxic and carcinogenic substances)

EFSA Journal 2012; 10 (10); s1004

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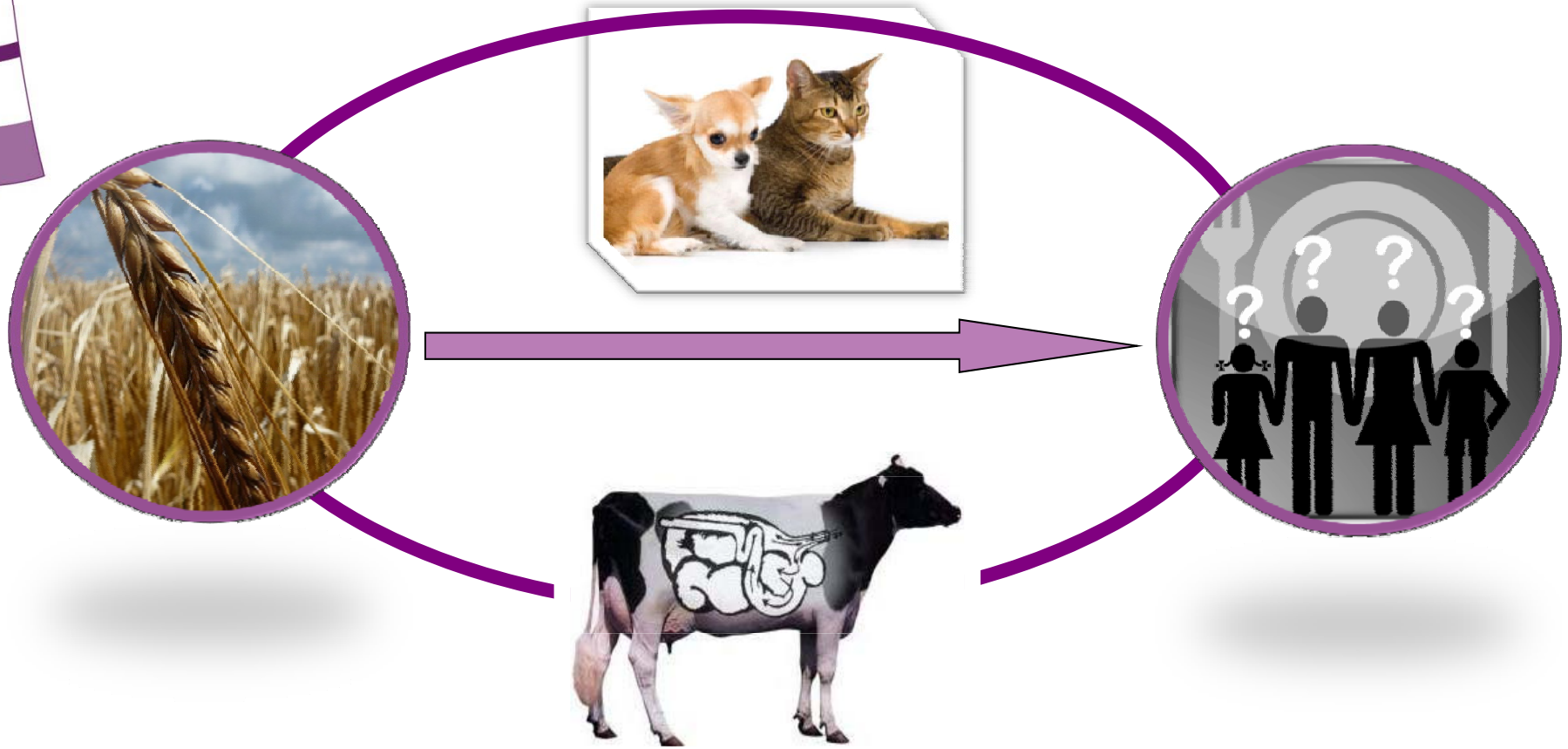
The CONTAM mandate

Risk assessment on contaminants in the food chain



Objectives:

To perform risk assessment and to identify where appropriate health-base guidance values for food and feed

Feed Safety in Europe: Key issues

Hormones in veal and beef

Dioxins
In poultry meat
NDL PCBs
PBDE's

Heavy metals (fish)

FMD

Swine fever

Avian influenca

Listeria in cheese

Salmonella/ Campylobacter in poultry

Antimicrobial Resistance (MRSA, ESBL)

RISK MANAGEMENT at the community level

Melamine 2010/2011

STEC, 2011

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Directive EC 32/2002
Undesirable substances
(including pesticides, organic pollutants)
in animal feeds

- Establishment of safe exposure levels for the individual animal, sensitive species, or categories (age/production groups)

- Evaluation of the carry-over from feed to foods of animal origin *per* animal species – *per* animal product (milk, meat, eggs, honey)

- **Contribution of residues in animal tissues to total human exposure**

Addressing all animal species, including companion animals (animal health aspects), minor species and farmed fish

Hazard Identification: Feed materials

Formulated feeds
(controlled by EC 32/2002)

- Pasture/roughages
- On-farm preserves

- By-products:
  milling, oilseeds

- Biofuel/biodiesel
  DDG(S)

- Vegetables & new plant varieties

- New technologies

- Emerging (natural) toxins
- Global trade / contaminants

- Estimates of undesirable contaminants

- Accumulation/degradation during processing

- New contaminants/products (glycine, antibiotics)

- PSM, fungal & bacterial toxins (spoilage)

- Nanoparticles

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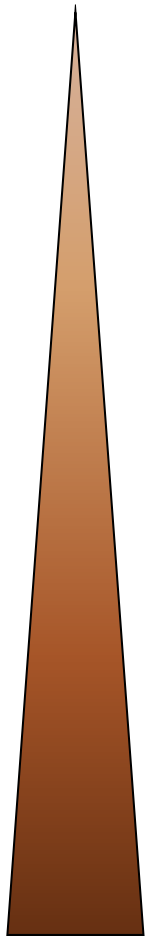

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Exposure assessment

Considerations

Within Europe:
Animal diets are highly variable
- per species / breed
- per age group
- per (production) category

Consensus

Average animal feed composition based on nutritional needs
(CONTAM 2011/2012) →
Quantitative exposure assessment

Remaining challenges: current trends in animal nutrition

- Replacement of animal proteins in petfood
- Dietary requirements of farmed fish
- Feed additives
- Global trade in feed materials (new feed materials)

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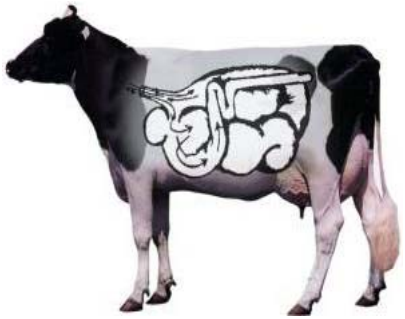
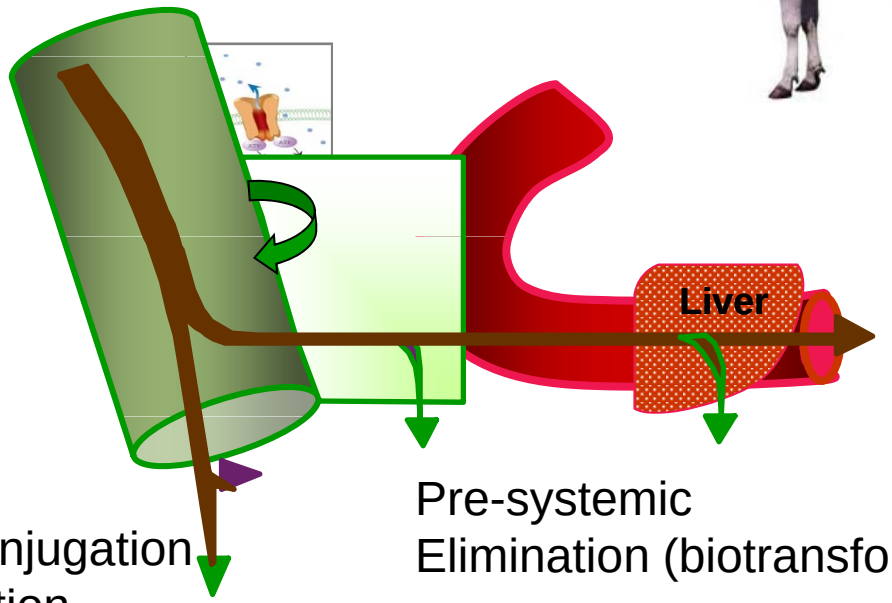
Dose-response assessment: Oral bioavailability

Hazard Characterisation

Pre-systemic elimination in the rumen



Genetic polymorphisms



Systemic circulation

Effect

De-conjugation
Excretion

Pre-systemic
Elimination (biotransformation)

Concentrations in feed materials *vs* internal (biologically active) dose

Species differences!

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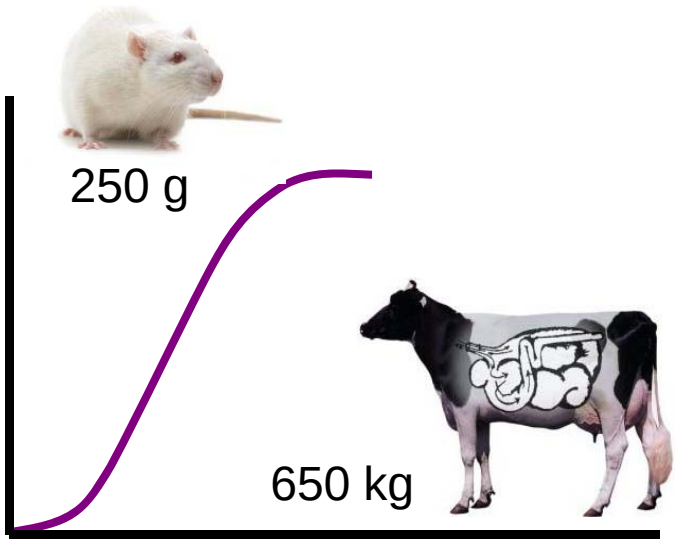
Risk characterization

Dose-response assessment



Anecdotal evidence
of toxicity misses
dose accuracy

Physiological differences
(multi-species assessments)

Limited availability of professional dose-response data

Identification of threshold of toxicological concern (TTC equivalent)

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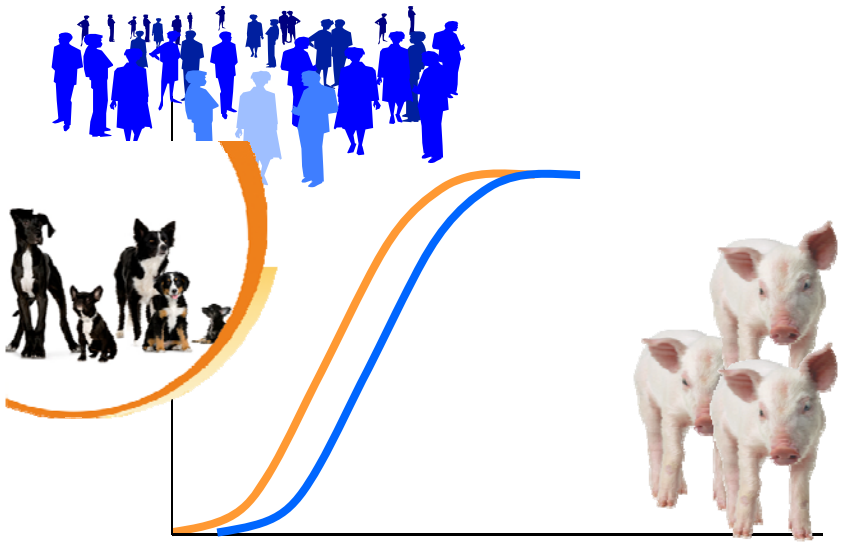
Risk characterization

Dose-response assessment: toxicological endpoints of concern



Long-term effects (cancer)
Developmental toxixity
Endocrine effects

Health and productivity
-Weight gain & feed utilization
-Milk-meat-egg production
-Reproductive capacity
-Immune-competence
-Organ-specific lesions

Identification of a threshold of toxicological concern (TTC equivalent)

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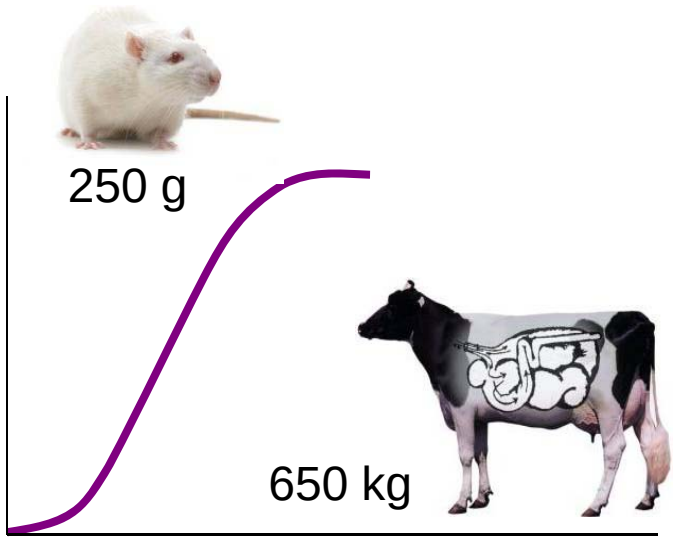
Risk characterization

Dose-response assessment: supportive parameters (TK)



ADME(T)

Allometric scaling

-**A**bsorption
- Rumen barrier function
- Intestinal barrier
- Efflux transporters
- Pre-systemic elimination

-**D**istribution
- physico-chemical data
- biological barriers

-**M**etabolism / Biotransformation
- Inter- / intra-species variability
- Genetic polymorphisms

-**E**xcretion
- renal capacity
- urinary pH

Integration of information from other sources
Example: R & D veterinary medicinal products

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Additional Risk Assessment Tools

Mode of Action (MoA) based approach

- Facilitates cross-species risk characterization
- Uses mechanistic information from *in vitro* studies
- Uses recent progress in molecular and systems biology
- Identifies biomarkers of exposure and effect
- Supports comparison of experimental data with epidemiological observations

Meeting forthcoming challenges:
Assessment of multiple exposure and long-term health outcomes

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Major achievements

- Identification of risks associated with foods from animal origin and their contribution of overall human exposure
- Stratified and transparent approach in RA for all major animal species
- **Establishing prerequisites for a quantitative risk assessment (i.e. exposure assessment)**
- **Identification of uncertainties and research needs**

Meeting the objectives of General Food Law: EC 178/2002

Integration of Food and Feed Risk Assessment

Mode of Action (MoA) based approaches:

In vitro data:
Qualitative analysis of a toxicological effect
ADME(T) information
Species differences

Toxicogenomics / metabolomics / -omics
Characterization of effects
Biomarkers of effect – monitoring tools (population analyses)

Assessing the **o**verall **r**isk **p**robability (**ORP**) under real life conditions of multi-source exposure to multiple chemical substances

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Conclusions

The risk assessment of contaminants in the food chain
- is a non-static process
- is a multi-disciplinary task
- needs to be flexible (see emerging risks) without losing consistency

Recent toxicological paradigms make use of

- physiological data (TD/TK)
- integrated approaches using new technologies and models

Forthcoming analyses will include
- the assessment of multiple substance-exposure scenarios
- the integration of health indicators (pre-existing disease that may influence the long-term health outcomes)

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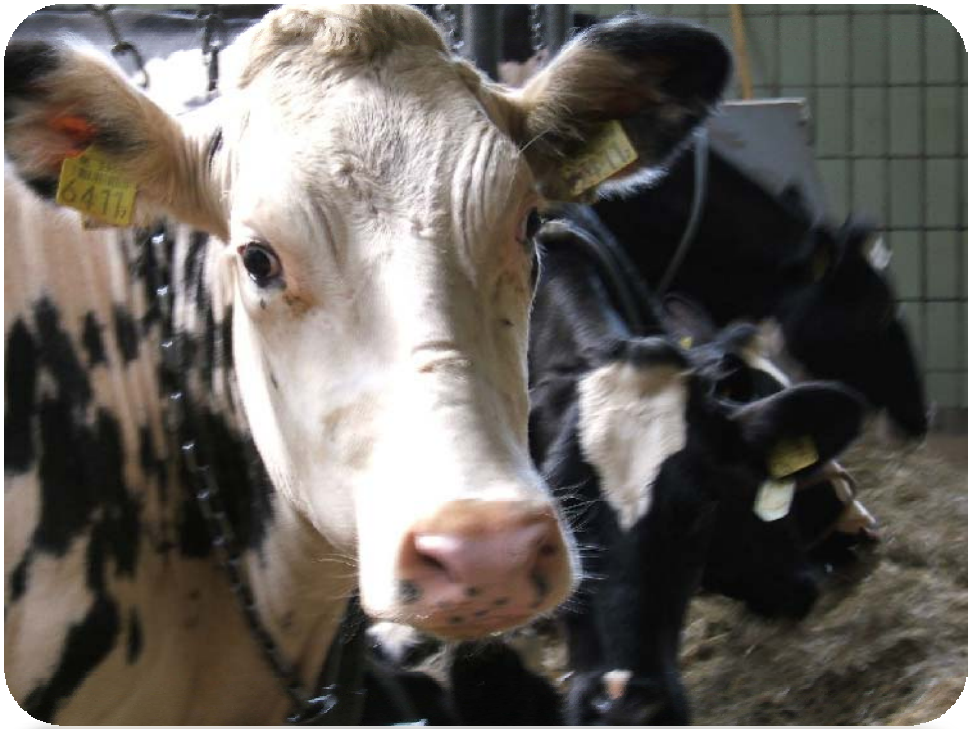
Food Safety & Food Security



FAO-19-12-2011

Intensive production holds key to feeding growing cities, but improvements in natural resource use and environmental performance are crucial

By 2050 an expanded world population will be consuming two thirds
more animal protein than it does today,
bringing new strains to bear on the planet's natural resources.
Populations and income growth are fueling an ongoing trend towards greater per capita consumption
of animal protein in developing countries..
Meat consumption is projected to rise nearly 73 percent by 2050;
dairy consumption will grow 58 percent over current levels.

Cows in Bangladesh. In poor countries, livestock products boost household economic and food security and nutrition.
Much of the future demand for livestock production - in particular in the world's burgeoning cities,
where most population growth is occurring - will be met by large-scale, intensive animal-rearing operations.
"As it stands, there are no technically or economically viable alternatives to intensive production for providing
the bulk of the livestock food supply for growing cities," FAO's report says.

Increases in production will need to come from improvements in the efficiency of
livestock systems in converting natural resources into food and reducing waste.
This will require capital investment and a supporting policy and regulatory environment.

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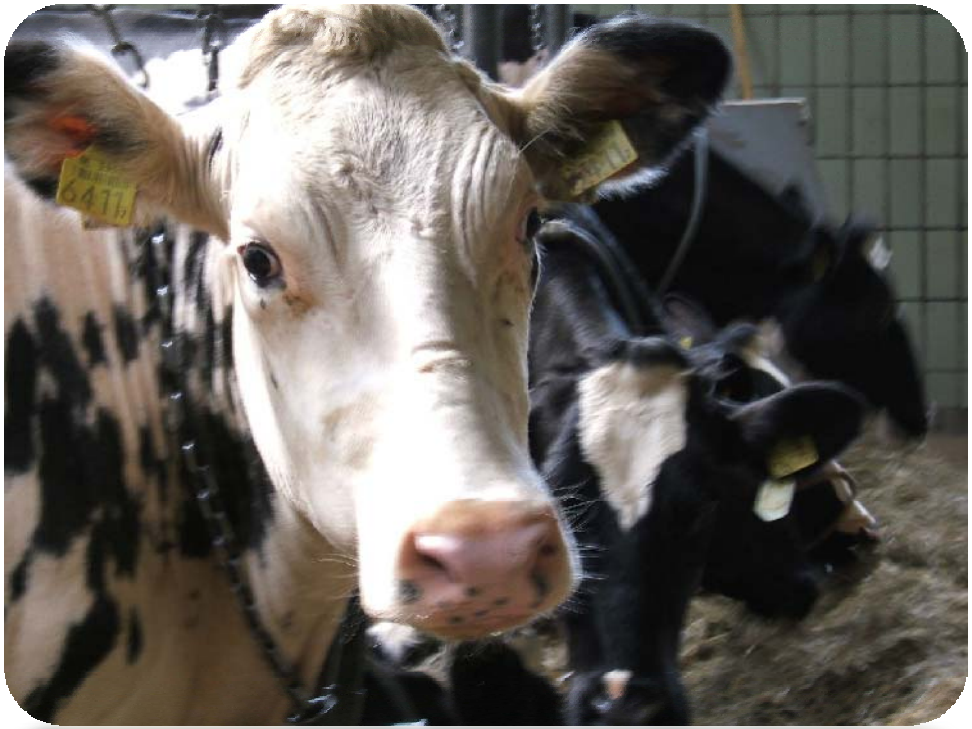
Food Safety & Food Security



Thank you for your attention!