Meat safety research beyond 2006: *Quo vadis*?

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Summary

- Food safety background:
  - International basis
  - Longitudinal and Integrated Safety Assurance ("LISA") approach
  - Food Safety Objectives concept
- EU-FP7 research: What could be in it for meat safety?
  - Theme 2: Food, Agriculture and Biotechnology
  - Activity: Fork to farm – Food, Health and Well-being
  - What should I research?…Example of *E. coli* O157 in beef
  - Potential emerging meat safety risks
  - Identification of research needs: Sources of hints?

Food safety assurance background

WOMAN Mother and baby

Killers in the kitchen

Invisible germs a threat to babies

10 WAYS TO BEAT THE BUGS

International basis of modern food safety assurance

- World Trade Organisation (WTO) principles 1995:
  - No discrimination between imported and locally produced foods
- Codex Alimentarius Commission (CAC; founded 1962) is the reference institution for:
  - International food standards
  - International disagreements on food safety issues
- European Union (EU)
  - Animals and foods included in the EU founding documents
  - "White paper" 2000 – thorough revision of food legislation
  - Regulation (EC) 178/2002 –EFSA founded
  - Novel approach – "risk assessment-based" & "farm-to-fork"

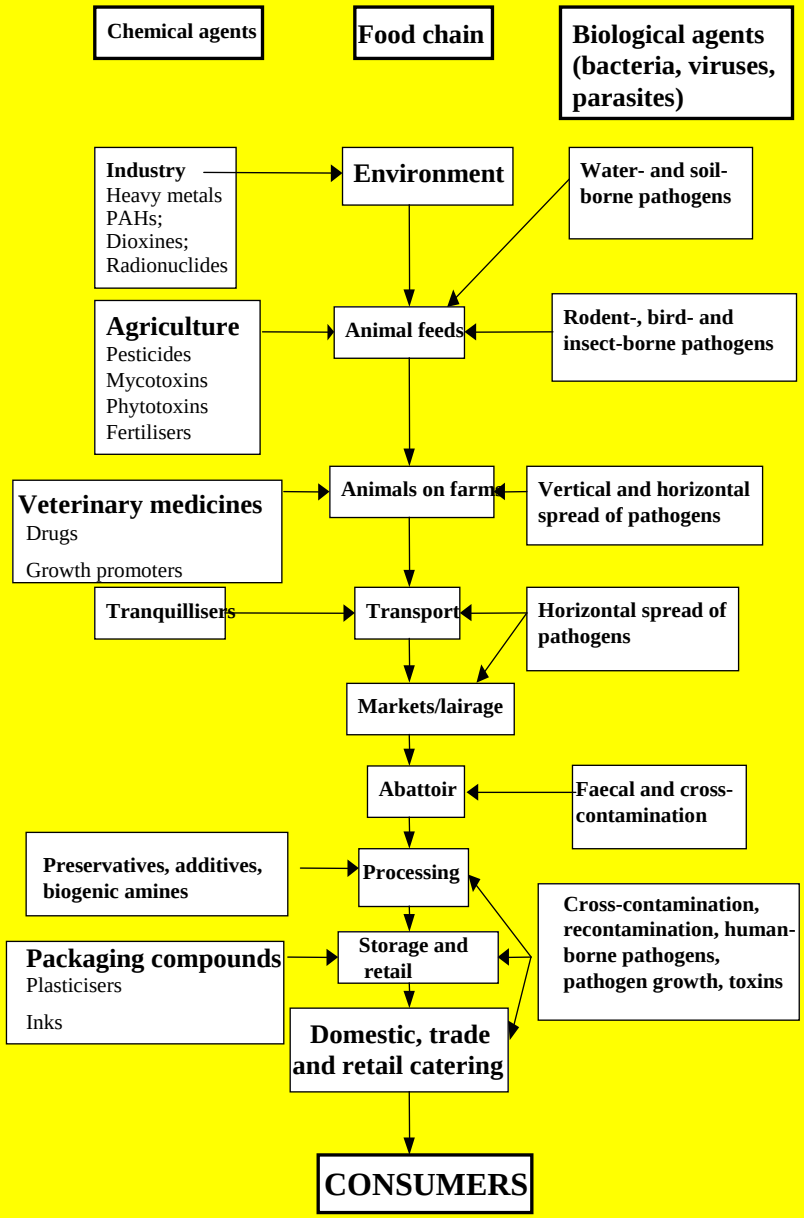
Longitudinal and Integrated Safety Assurance ("LISA") approach: Scientific frame

- Health hazards (harmful agents) enter the food chain at different, sometimes multiple, points
- Events on one point affects the adjacent points of the chain (longitudinal effects)
- Hazards are controlled in a coordinated way
- Reduction of risks where they cannot be totally eliminated
- Using an multidisciplinary and science-based approach

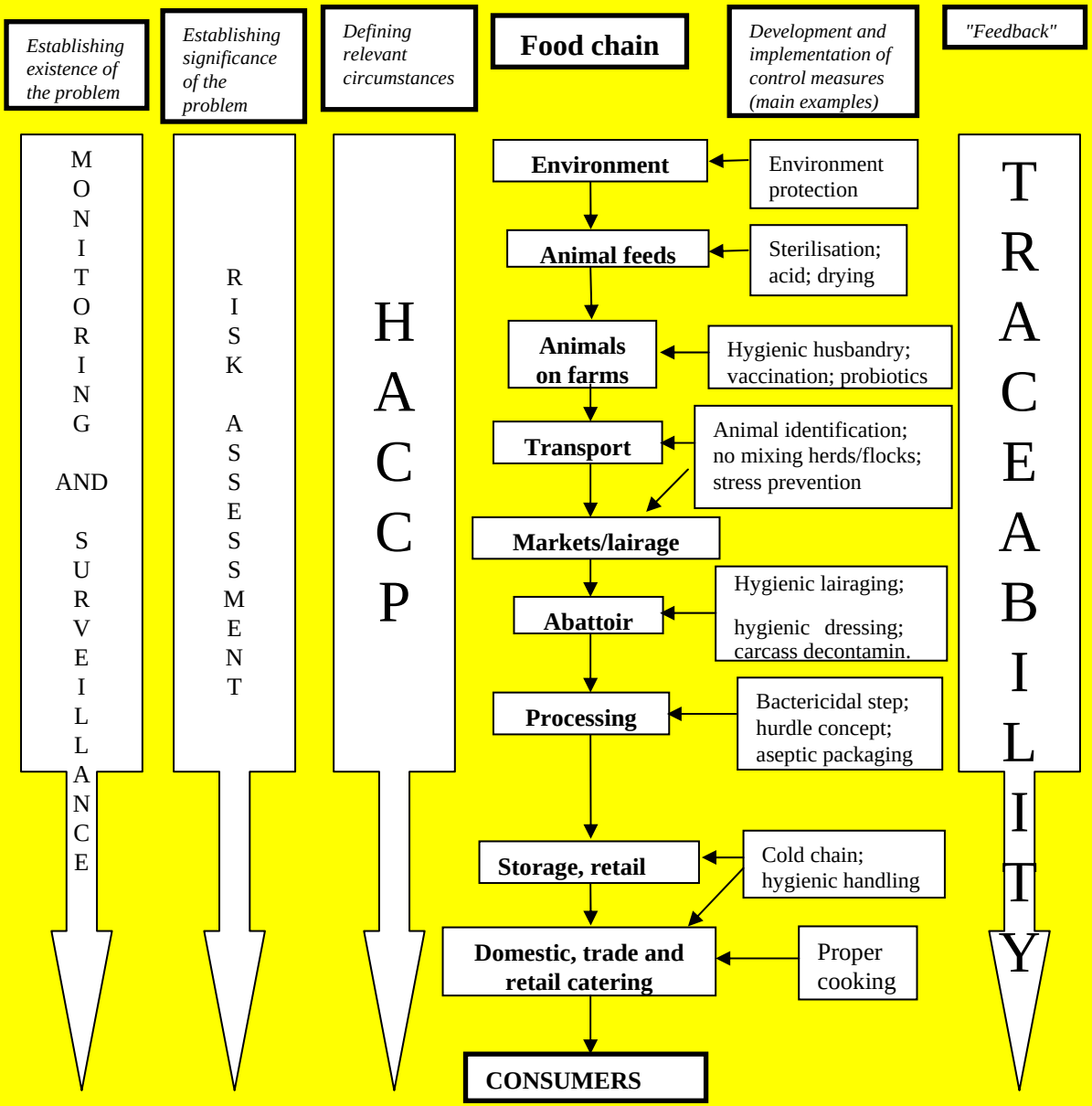
Longitudinal and Integrated Safety Assurance (LISA): Commercial frame

- Vertical integration of production operations farm-to-market
- Examples of good vertical commercial integration :
  - Poultry meat chain
  - Milk/dairy product chain
- Main commercial engines are large, often multinational, retailer chains (e.g. Tesco, Wal-Mart)

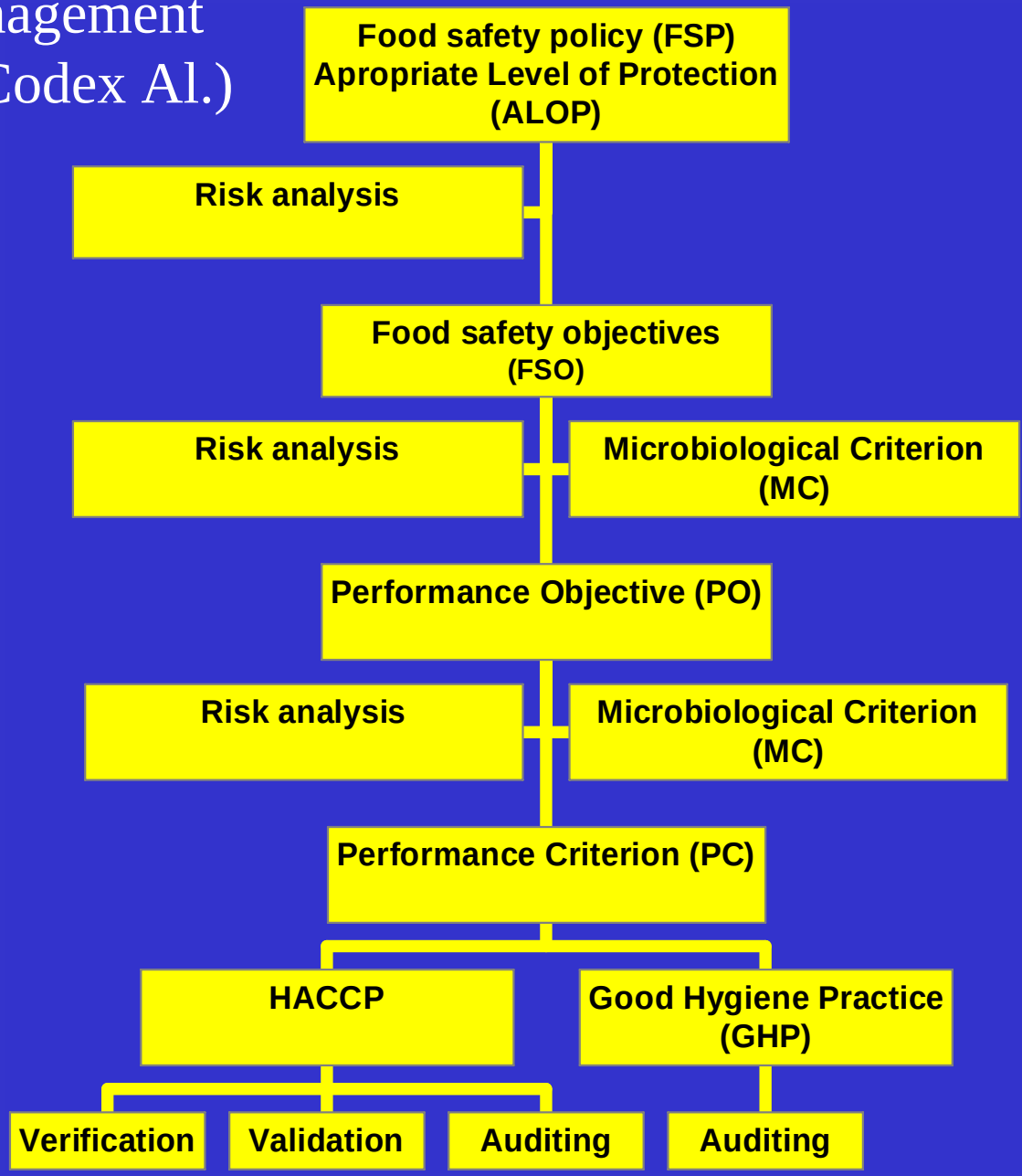
TRANSFER OF MAIN HEALTH HAZARDS ALONG THE MEAT CHAIN



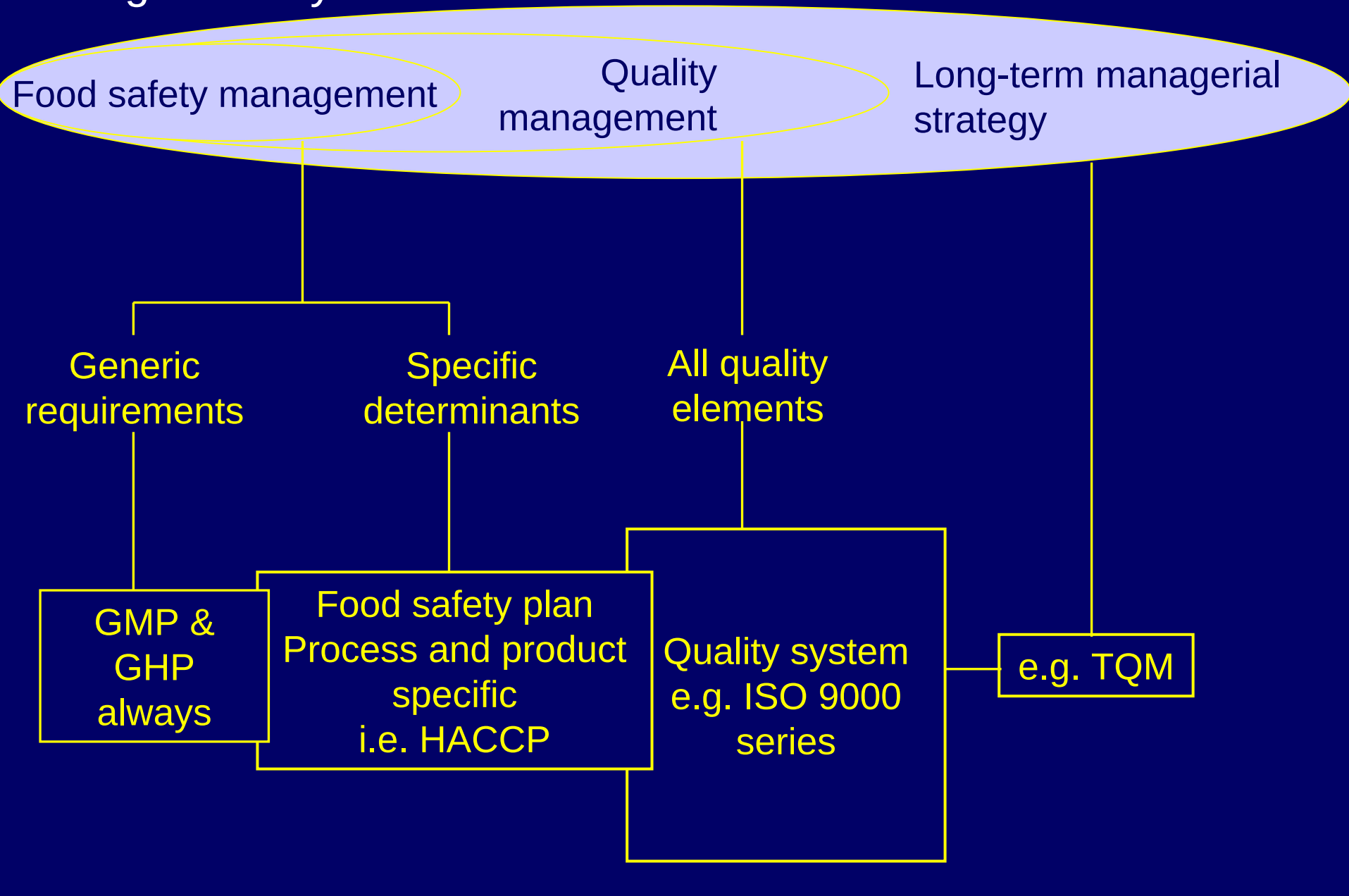
OPERATIVE ASPECTS OF INTEGRATED FOOD SAFETY ASSURANCE



Risk management targets (Codex Al.)

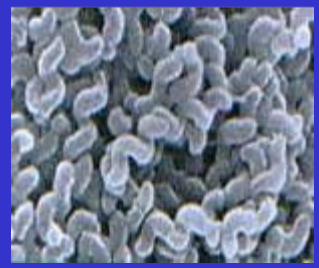


Relation between food safety management and food quality management systems



EU-FP7 research:

What could be in it for meat safety?



FP7-Theme 2:
Food, Agriculture and Biotechnology

- Activity: Sustainable production and management of biological resources (land, forest, aquatic)
- Activity: Fork to farm - Food, health and well being
- Activity: Responding to emerging needs and unforeseen policy aspects

Activity: Fork to farm - Food, health and well being (1)

- Consumer aspects:
  - Novel foods?
  - Dietetic-nutritional foods?
  - Traditional-local foods?

Activity: Fork to farm - Food, health and well being (2)

- Food industry innovation:
  - Animal feeds towards safe foods?
  - Improved-advanced, “ecological” food technologies?
  - “Sophisticated” process controls?
  - Functional foods?
  - “Active” and “Intelligent” packaging?
  - Safe use of wastes and by-products?

Activity: Fork to farm - Food, health and well being (3)

- Safety and quality of foods:
  - Microbial ecology?
  - Detection and quantification methods?
  - Risk analysis: practical aspects of its use?
  - Modelling of integrated food chain?

Activity: Fork to farm - Food, health and well being (4)

- Environmental aspects:
  - Food contaminants-Human health link?
  - Food-feed industries-Environment protection link?
  - Related modelling?

Activity: Responding to emerging needs and unforeseen policy aspects

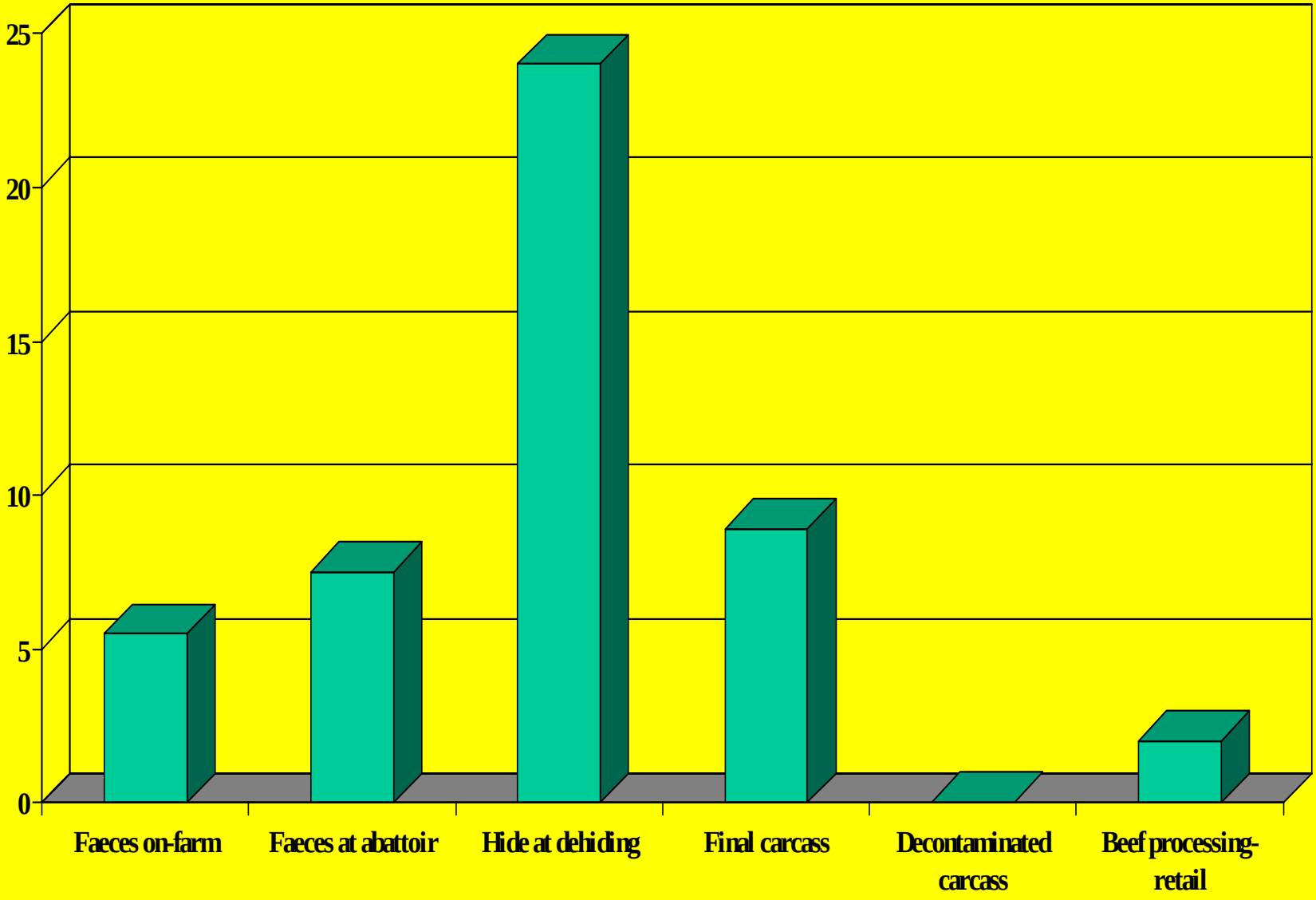
- New concepts:
  - Emerging hazard identification?
  - Rapid responses?
  - New controls-technologies?
  - Management of food safety crisis?

What should I research:

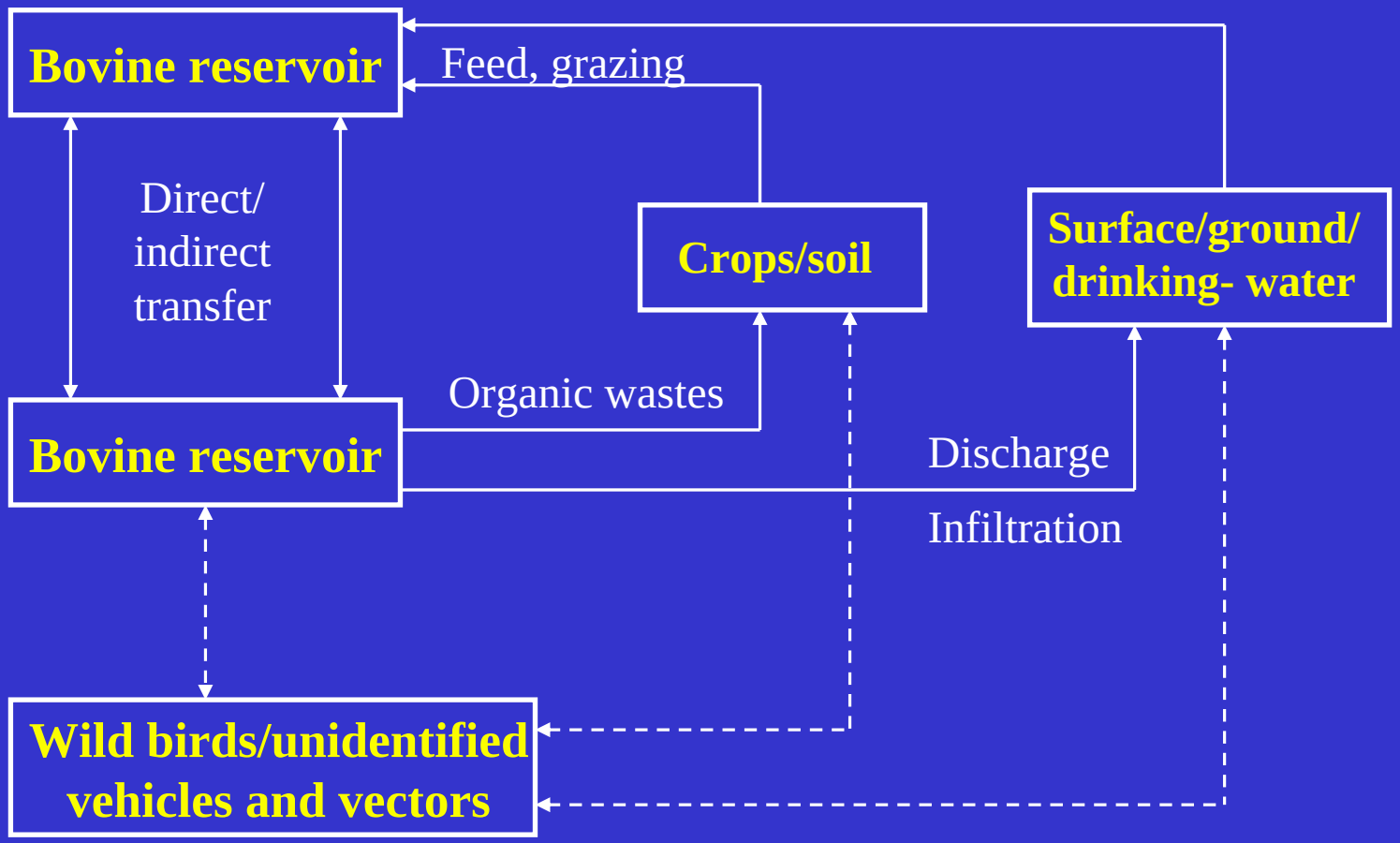
???????

Let's imagine an example…
E. coli O157 in beef

Summary of *E. coli* O157:H7 prevalences (%) in cattle from farm to fork



E. coli O157 cycle in the farm environment



On-farm controls of *E. coli* O157:H7

Prevention of the pathogen's recycling
- Land management (animal wastes)
- Vectors (rodents, wildlife...)
- Animal husbandry (GHP)

Prevention of the ingestion of the pathogen:
- Feed treatments
- Water treatments
- Animal interactions (suckling, licking)

Suppresion of the ingested pathogen:
- Dietary manipulation
- Probiotics
- Phage therapy

Modifications of the host responses
- Vaccination

Other controls?

Transport-lairage (pre-dressing) controls of *E. coli* O157:H7

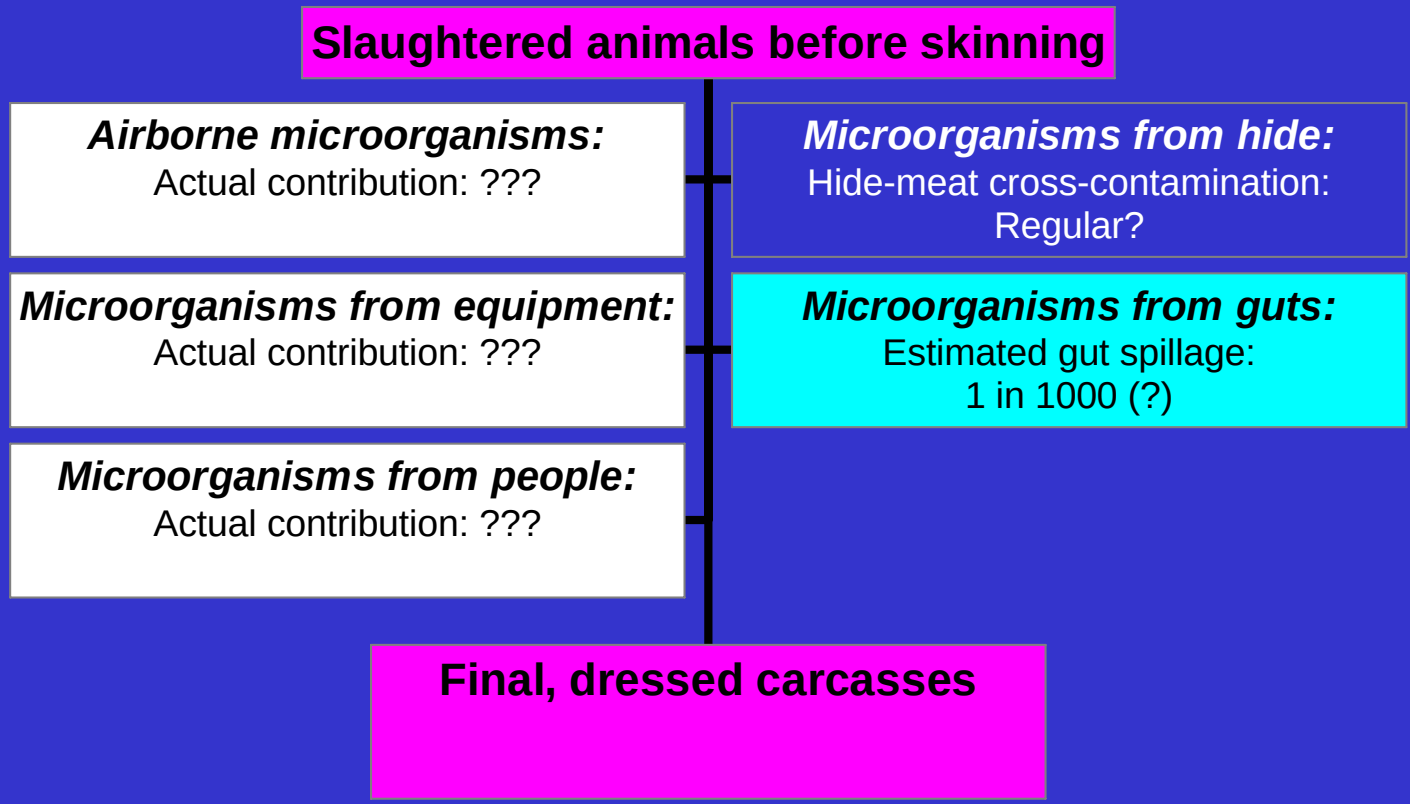
Avoid livestock markets:
- Mixing of animals from different farms
- Environment-mediated cross-contamination

Miminimise lairaging time:
- Accumulation of the excreted pathogen
- Environment-mediated cross-contamination
- Lying on contaminated floor

Minimise between-batches transfer:
- Efficient sanitation of pens
- Sanitation of stun-box after each animal?

Hide decontamination:
-After death but before skinning

Main sources/routes of microbial contamination of carcasses during dressing



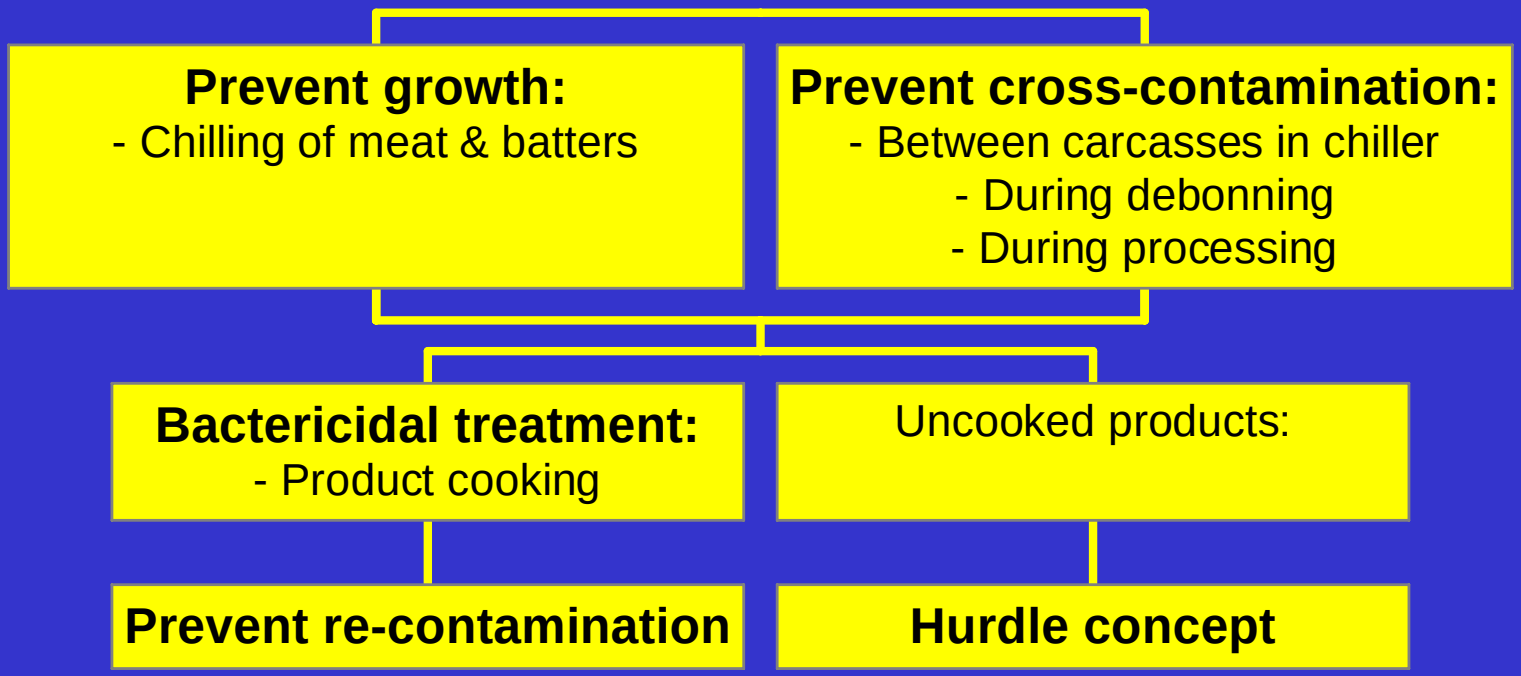
Controls of *E. coli* O157:H7 during dressing

- Process hygiene (GHP-, HACCP-principles)
- Efficient cleaning-sanitation of the slaughter-hall environment (biofilms!)
- Final carcass decontamination
  - *E. coli* O157 reductions: 0.3-2 logs

E. coli O157:H7 behaviour during meat processing-storage phase

- Generally, related behaviour similar to other Gram-negative pathogens e.g. *Salmonella*, with respect to:
  - Growth inhibition temperature: roughly <7^{o}C
  - Heat inactivation: reliable 71^{o}C kill
  - Effects of salt and nitrites: can survive in fermented meats!
- Strain diversity when growing at abusive temperatures?

Controls of *E. coli* O157:H7 during processing-storage

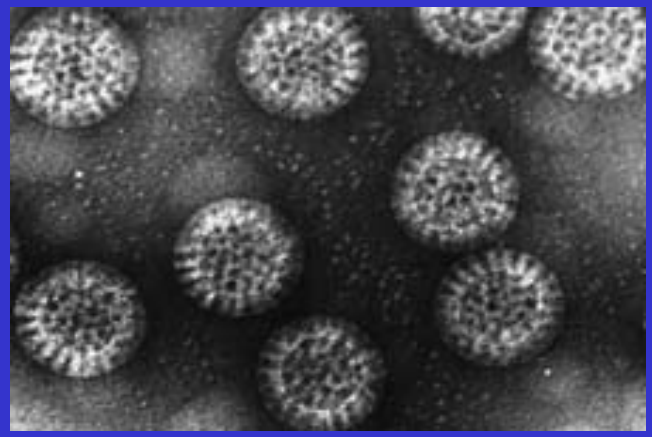


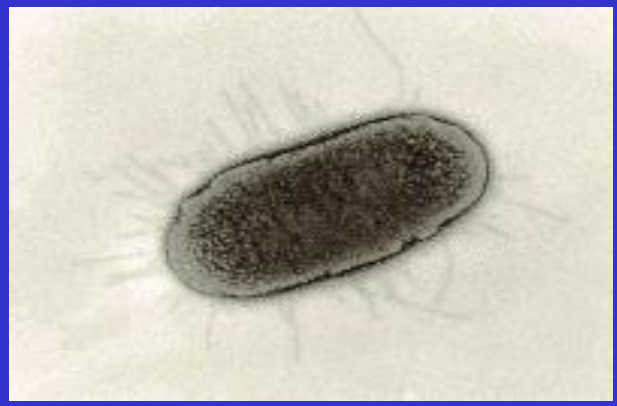
Controls of *E. coli* O157:H7 during retail-consumer phase

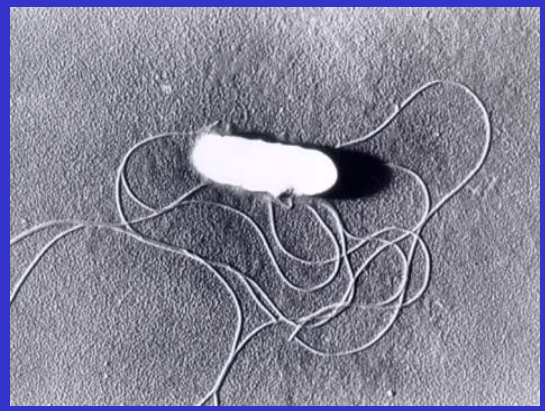
Strain diversity-characterisation of *E. coli* O157 and the food chain

- Genotypes and "natural selection":
  - PFGE types
  - Ribo-types
  - Combined PFGE-Ribo-types
  - Micro-array
  - Other?
- Phenotypes and "natural selection":
  - Phage-typing
  - VT typing
  - Growth kinetics
  - Inactivation kinetics
  - Other?

Potential emerging food safety risks?







Novel risks?

Chemical:

- New chemical products (additives, preservatives)?
- Phytotoxins?
- New medicines?
- Wastes-food chain?
- Domestic chemicals?
- Uncertainties?

Biological:

- Enteroviruses?
- Antimicrobial resistance?
- Arthropod vectors?
- People-food mobility?
- Prion-related?
- GMO-GMF?
- Uncertainties?

Further identification of meat safety research needs:

- *What are the main sources?* -

Where to start to look for hints?

- Scientific reviews in leading journals
  (i.e. gaps in present knowledge…)
- EFSA scientific opinions (free on the Web)
  (i.e. recommendations for further research…)
- Ongoing EU projects' outcomes
  (i.e. follow-up)
- Scientific networks
- Own imagination (balanced!)

Thank you!

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