



Elaboration of a multiannual sampling plan concerning microbiological hazards in food



Foodborne illness



www.neblettbeardandarsenault.com



“30 % of all emerging infections over the past 60 years were caused by pathogens commonly transmitted through food” (Nature, 2008)

The European Union reported in 2008:
5.332 foodborne outbreaks causing
45.622 human cases, 6.230 hospitalisations and 32 deaths



www.nbafoodadvocate.com



Scope

Elaborating a multiannual sampling plan by the use of
a semi-quantitative risk assessment for
microbiological hazards in food

- Improving the food control system of Luxembourg
- Making luxembourgish food safer
- Reducing the numbers of foodborne illness

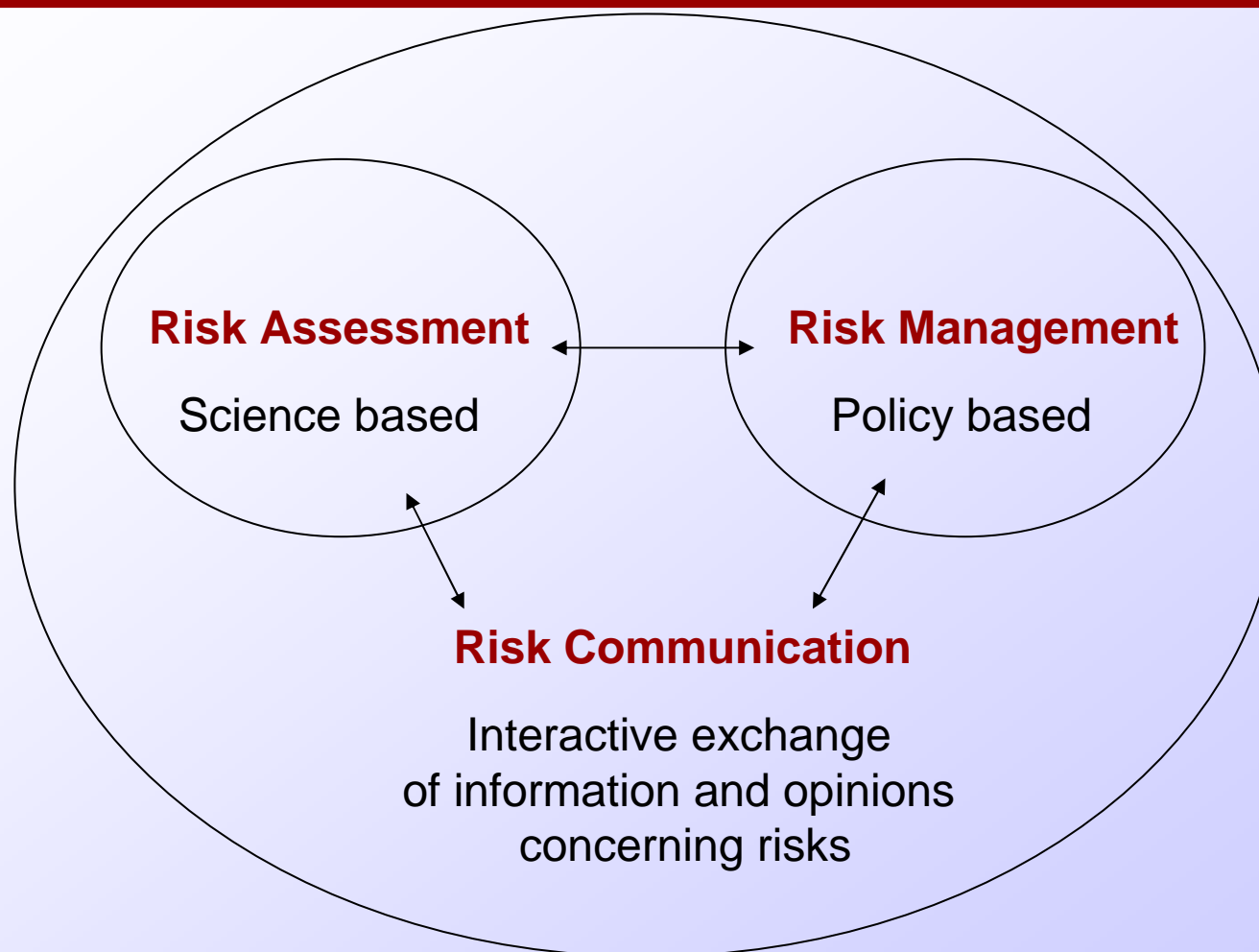


Risk assessment, the method

- Semi-quantitative method
- elaborated by the „Organisme pour la Sécurité et la Qualité de la Chaîne alimentaire“ (OSQCA)
- used so far by the luxembourgish food safety authority (service de la sécurité alimentaire) for the elaboration of multiannual sampling plans concerning food contact materials, additifs, GMO's, pesticides and mycotoxins



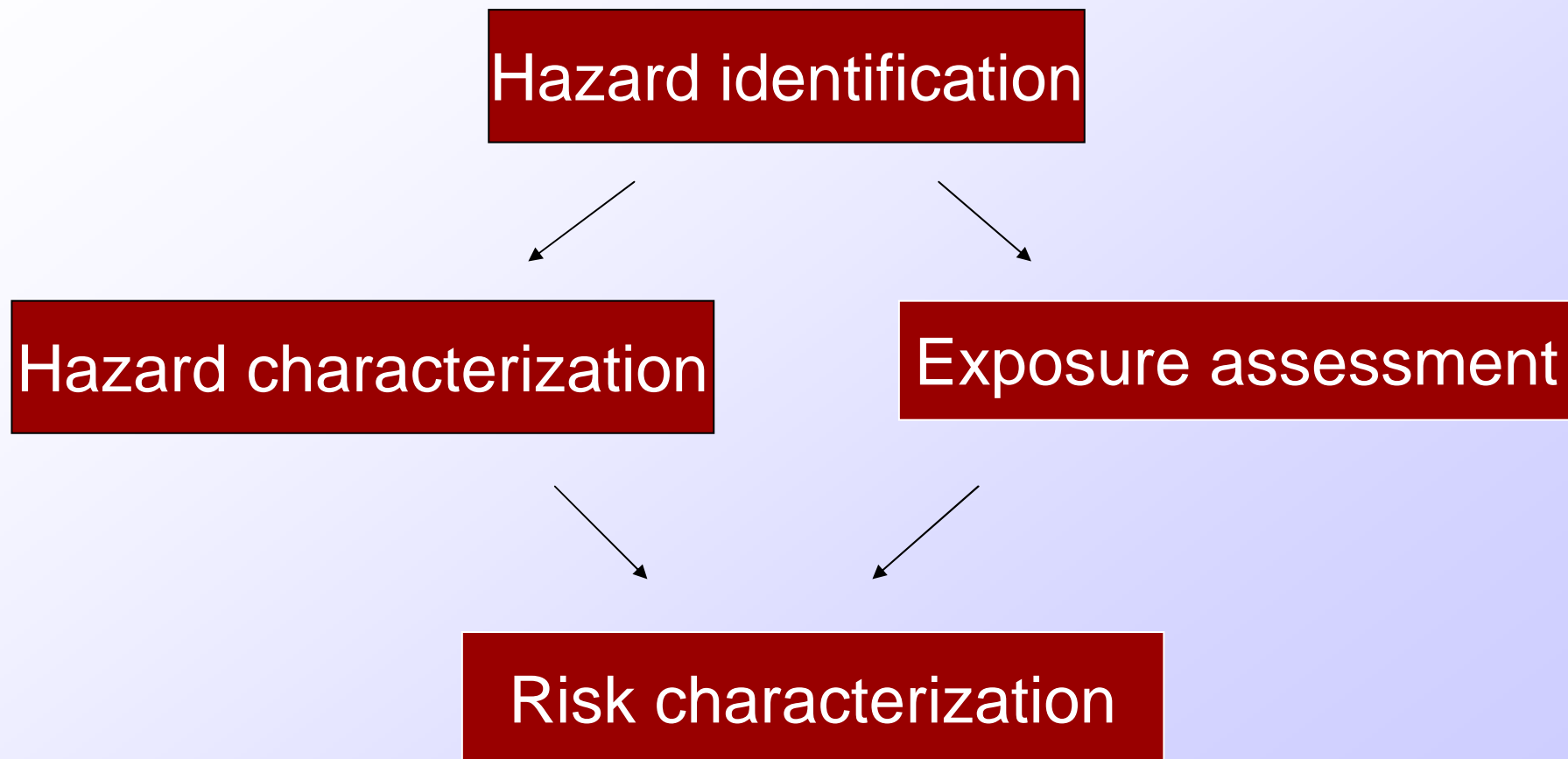
Risk analysis framework*



*defined by the Codex Alimentarius Commission



Risk assessment





Hazard identification

Which pathogenic bacteria provoke foodborne illness?

- Literature (books, scientific reports and journals..)
- Epidemiological data of Luxembourg and other european countries
- Rapid alerts concerning food (RASFF)
- Results of food sampling programs of foreign countries



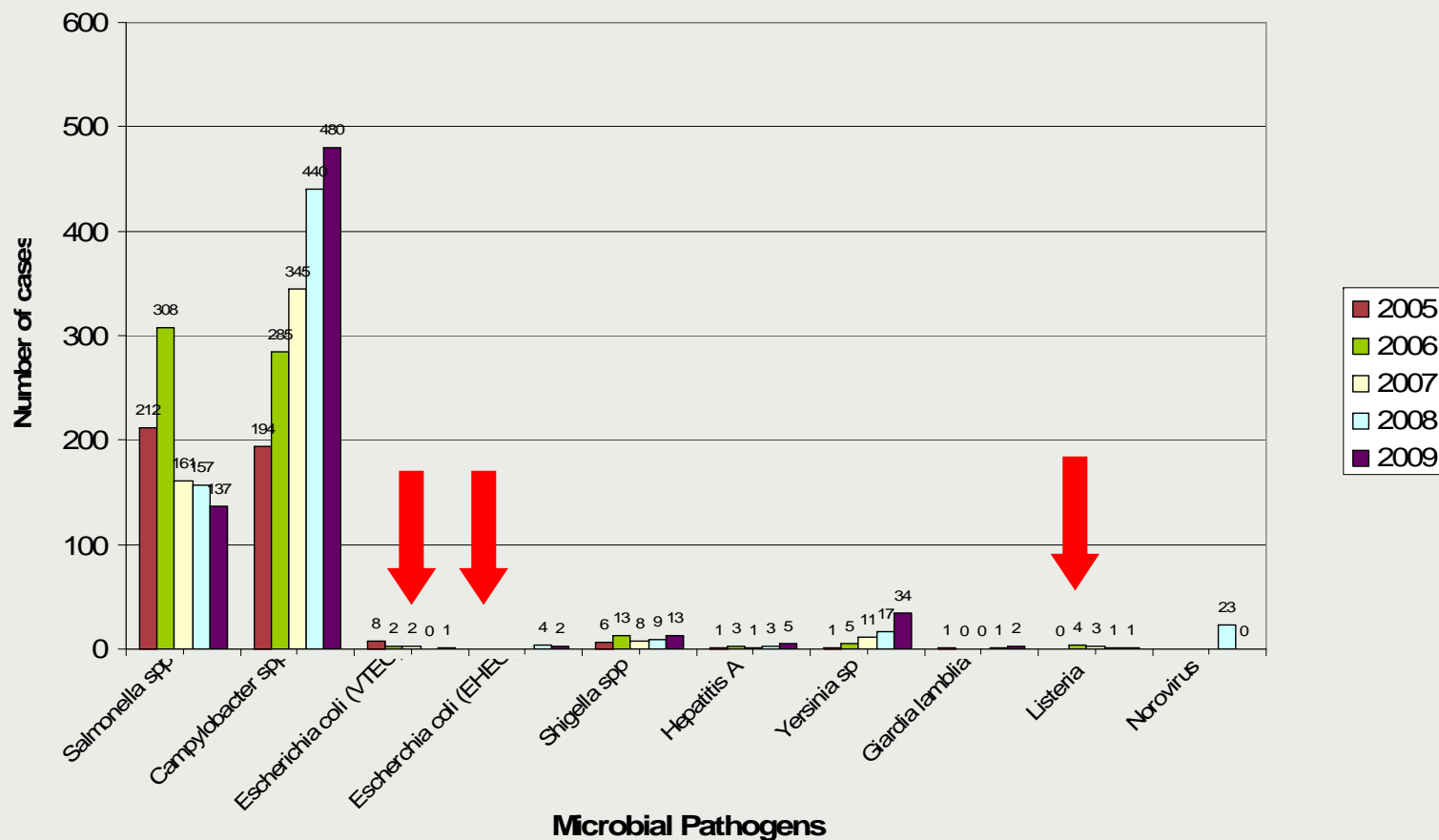
Pathogenic bacteria most found in food (literature)

Pathogen	Food at risk	Sources of contamination	Disease	Infective dose
Listeria monocytogenes	meat (raw), vegetables, smoked fish, some soft cheeses (unpasteurized milk)	contamination during processing steps, postprocessing contamination	Listeriosis (gastroenteritis, meningitis...) Mortality rate: 20-30%!	unknown, probably ~1000 cells
Campylobacter spp.	meat (poultry, pigs, cows, sheep...), vegetables, shellfish and water	contamination during processing steps, crosscontamination	Campylobacteriosis (inflammatory enteric infection) 2,4 million cases/year in US	500-10.000 organisms
EHEC (O157:H7)	Raw meat (filet américain), vegetables (crosscontamination), fruits, uncooked sausages..	contamination during processing steps, animal-to-person contact, person-to-person contact, crosscontamination	Bloody diarrhea, hemolytic uremic syndrome (HUS) via lethal Shiga-like toxins, bacteria are acid-resistant --> pass through the stomach unharmed	50-100 cells
Bacillus cereus	Pasta, rice, sauces, soups, vegetables, milk, infant formulas,	endospores that germinate after cooking	Emetic toxin: nausea, vomiting after 1-6h after ingestion Diarrheagenic toxin: diarrhea, nausea, abdominal cramping, watery stools after 8-16h of ingestion	10 ⁵ -10 ⁶ viable cells or spores/g
Salmonella spp.	Poultry (major source), eggs, cheese, ice cream, vegetables (crosscontamination)	contamination during processing steps, animal-to-animal and human-to-human contact	three forms of disease: Typhoid fever, gastroenteritis and bacteremia	1 to 10 ⁹ cfu/g
Yersinia enterocolitica (serotypes O:3, O:4)	Raw porc meat and products thereof, water, vegetables and milk (crosscontamination)	contamination during processing steps (slaughterhouse, pigs), crosscontamination, animal-to-human contact	Yersiniosis: gastroenteritis with diarrhea and/or vomiting	unknown
Clostridium perfringens	Meat and meat products (multiply to food poisoning levels during cool down and storage of prepared foods after they had been cooked)	endospores that germinate after cooking	Perfringens poisoning: intense abdominal cramps and diarrhea 8-22 hours after consumption of contaminated food Necrotic enteritis (rare but often fatal): necrosis of the intestines and septicemia	> 10 ⁸ cells
.....				



Epidemiological data of Luxembourg

Cases of diarrheal diseases provoked by microbial pathogens in Luxembourg





Rapid alerts for potentially pathogens in food (2000-today)





Hazard characterization

Collecting data about selected foodborn pathogens:

- Infective dose
- Adverse health effects
- Susceptible population
- Short and longterm consequences
- Routes of transmission



Hazard characterization

Choose between 4 levels to define the expected prevalence (EP) of the selected pathogen:

Level 1: rather harmless pathogen (EP 10%)

Level 2: probably harmful pathogen (EP 5%)

Level 3: harmful pathogen (EP 1,5%)

Level 4: very harmful pathogen (EP 1%)



Exposure assessment

Is determined by 2 factors:

Prevalence of the pathogen in a selected food (Level 1-4)

→ defined by the results of sampling programs of foreign countries
or the number of rapid alerts

Contribution of the selected food to the contamination (Level 1-4)

→ defined by the frequency and the quantity selected food is
consumed by Luxembourgish population



Exposure assessment

Determination of the confidence level:

Level of confidence =
hazard characterization (level 1-4) +
(level of prevalence x level of contribution)

If score between 2 and 6	→ level of confidence 90%
If score between 7 and 12	→ level of confidence 95%
If score between 13 and 20	→ level of confidence 99%



Risk characterization

Determination of population size:

How many different trademarks of the product at risk exist on the market in Luxembourg?



Risk characterization

[illegible]

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Demonstration

Risk assessement of *Listeria monocytogenes* in smoked fish



www.scientificamerican.com



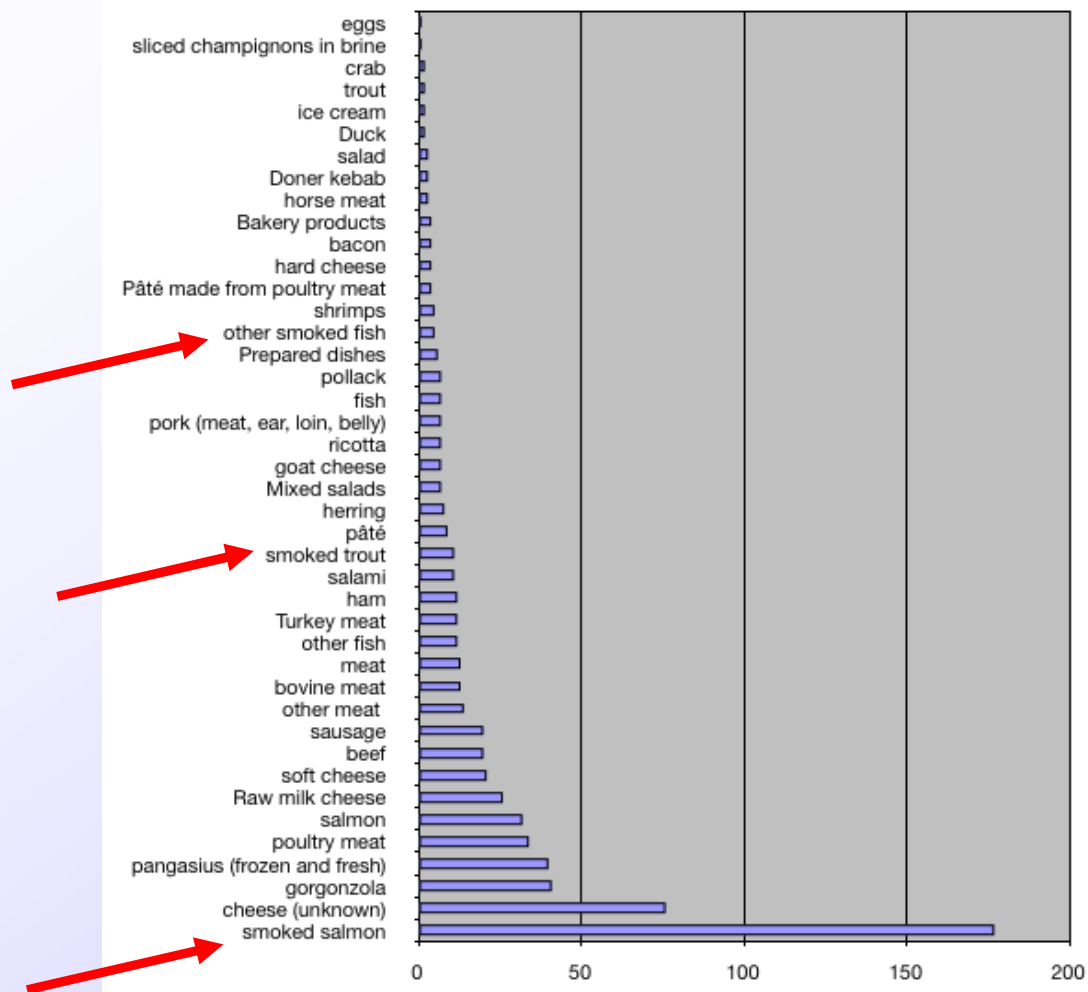
Hazard characterization

- **Illness:** Listeriosis
 - **Mild form:** gastrointestinal symptoms (nausea, vomiting and diarrhea)
 - **Serious form:** septicemia, meningitis, encephalitis and intrauterine or cervical infections in pregnant women
- **Infective dose:** probably low (1000 cells), depends on the strain and the susceptibility of the victim
- **High mortality rate** (20-30%) → France: 304 cases/year, 76 deaths
- **Vulnerable groups:** pregnant women, newborn babies, elderly people and people with an impaired immune system
- **Growth characteristics:** growth at low temperatures (0°C-8°C)!! Survive for long periods in foods, in processing plants, in households and food service establishments, or in the environment, particularly at refrigeration or frozen storage temperatures
- **Food at risk:** raw milk, smoked fish, cheeses particularly made of raw unpasteurized milk, raw meats, fermented raw meat sausages...

→ **Level 4: very harmful (EP 1%)**



Rapid alerts *Listeria monocytogenes*





Food safety criteria for *Listeria monocytogenes* in food products placed on the market during their shelf-life

EC regulation 2073/2005

of 15 November 2005 on microbiological criteria for foodstuffs

RTE foods intended for infants and for special medical
purposes: absence in 25g

- RTE food able to support the growth of *L. monocytogenes* other than those intended for infants and for special medical purposes: limit 100 CFU/g
- RTE food unable to support the growth of *L. monocytogenes* other than those intended for infants and for special medical purposes: limit 100 CFU/g



Exposure assessment

■ Contribution of smoked fish to the contamination

Consumption of fish and fish products in France (AFSSA, 2007):

- Children (boys and girls) 3 to 14 years → 19 g/day
- Adults 18-79 years → 30 g/day

- **Prevalence:** France: 2% (hot smoked fish)
25% (cold smoked salmon)

Germany: 4,2% (smoked salmon)
13,6% (smoked trout, end of shelf-life)



Exposure assessment

- Contribution to the contamination: level 3
because fish consumption is mean high
- Prevalence: is high (level 4)
- ⇒ Score 16: Level of confidence: 99%



Risk characterization

44 different trademarks of smoked fish in Luxembourg
→ Population size: 44



Determination of the sample size

Population size: 44

Expected prevalence: → 1% (very harmful)

Accepted error: 1%

Level of confidence: 99%

WinEpiscope: Sample size: 42 samples to collect



Multiannual sampling plan

Danger	Effet néfaste	Population concernée	Matrices 2010	Matrices 2011	Matrices 2012	Lieu de prélèvement	Calcul: En+(PxC)	Niveau de confiance (%)	Niveau de prévalence à calculer (%)	Nombre de lots dans la population
Salmonella spp.	4	Champignons séchés et/ou congelés			45	Supermarchés, restaurants chinois	10	95	1	50
		Légumes-feuilles (salades 4ième gamme, épinards, rucola) et germes		116		Grossistes, supermarchés	8	95	1	166
		Herbes fraîches: Basilic, persil, estragon	51			Grossistes, supermarchés	8	95	1	58
		Thé aux herbes, de préférence à base d'anis, fenouil, cumin et de préférence thé pour bébés	37			Supermarchés	16	99	1	40
		Sésame et produits à base de sésame (de préférence venant de l'Inde ou de la Chine)	30			Supermarchés, grossistes, restios et supermarchés chinois	7	95	1	31
		Epices		49		Supermarchés, grossistes	8	95	1	56
		Viande de pita	100			Döner Kebab	12	95	1	135
EHEC (O157:H7)	4	Filet américain	92	92	92	Restos, traiteurs, stations de service, supermarchés	8	95	1	120
	4	Fruits et légumes précoupés vendus dans les supermarchés			34	Supermarchés, stations de service	20	99	1	35
Listeria monocytogenes	4	Poisson fumé (emballé, sous vide)	42			Supermarchés	16	99	1	44
Bacillus cereus	3	Tofu	20			Supermarchés	7	95	2,5	23
Cronobacter sakazakii	4	Lait et préparations en poudre pour bébés	42	42	42	Supermarchés	12	95	1	44
Histamine	2	Thon	64			Restos, (pizzerias), traiteurs	10	99	5	130
		Anchois		56		Restos, (pizzerias), traiteurs	18	99	5	100

Formateur: L. Kunsch

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Results so far

Listeria monocytogenes

2/ 8 samples of smoked salmon >100 CFU/g

8 samples of other smoked fish negative

Histamines in fish

37 samples of tuna < limit 200 mg/kg (EC 2073/2005)

1/ 18 samples of anchovy: > 1800 mg/kg (limit 400 mg/kg!! EC 2073/2005)

EHEC in filet américain

27 samples negative but high plate counts of E. coli and aerobic mesophilic bacteria

Other: Clostridium perfringens, Staphylococcus coagulase positive and Listeria monocytogenes but < limit

Salmonella spp. in doner kebab meat

25 samples negative but high plate counts of Enterobacteria and aerobic mesophilic bacteria

Salmonella spp. in tea and sesame

All samples negative

Cronobacter sakazakii in infant formulae

34 samples negative

Bacillus cereus in tofu

All samples negative



Multiannual sampling plan

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Perspectives

→ using quantitative risk assessment for microbiological hazards in food with mathematical models like

- Calculation of the dose at the time of consumption
- Probability of contamination of one serving
- Dose-response relationship

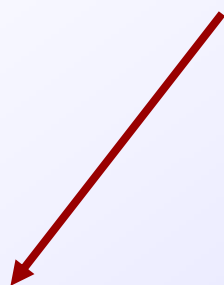
but more data needed



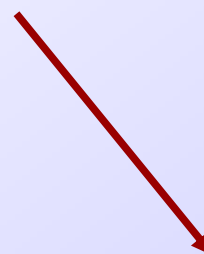
Thank you for your attention



Microbiological quality control of food



Routine control
RTE food collected in
bakery stores, catering
services, supermarkets and
service stations



Sampling plan
Samples collected within the
framework of the sampling
plan



Win Episcopo

- Win Episcopo is software for quantitative veterinary epidemiology
- The determination of the sample size is based on a statistical approach, the binomial law
- It has been developed by different universities:
 - Facultad de Veterinaria, Zaragoza, SPAIN
 - Agricultural University, Wageningen, NETHERLANDS
 - University of Utrecht, NETHERLANDS
 - University of Edinburgh, UNITED KINGDOM



Risk assessment types

Quantitative risk assessment

- Can be either deterministic or probabilistic
- Uses statistical models

Semi-quantitative

- Provides an intermediary level between the textual evaluation of qualitative risk assessment and the numerical evaluation of quantitative risk assessment by evaluation risks with a score
- Does not require the same mathematical skills as quantitative risk assessment, nor does it require the same amount of data → can be applied to risk and strategies where precise data are missing

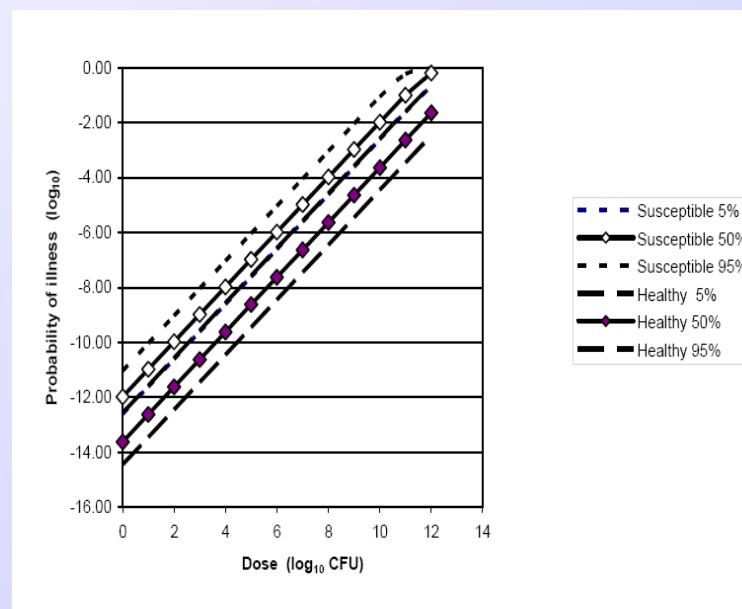
Qualitative risk assessment

- Based in numerical data for exposure assessment and hazard characterization
- Of a descriptive or categorical nature
- Is commonly used for screening risks to determine wheter they merit further investigation



Quantitative risk assessment

- Hazard identification
- Exposure assessment
 - Calculation of the dose at the time of consumption
 - Probability of contamination of serving
- Hazard characterization
 - Dose-response relationship
- Risk characterization
 - Exposure assessment outputs and dose-response relationships are combined to calculate the probability of contracting the illness



Comparison of the dose-response curve for susceptible and healthy populations (WHO/FAO 2004)