Campylobacter: food safety aspects and interventions

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Outline

- *Campylobacter*: introduction
- Control options in primary production
- Control options in processing stage
- Success stories
- Future approach to reduce the human *Campylobacter* burden
- Instructions for the consumer
Questionnaire: how is *Campylobacter* ranking?
Campylobacter

- Sensitive for heat, dryness, disinfection,...
  - *C. jejuni* (92% of gastro-intestinal infections)
  - *C. coli* (5% of gastro-intestinal infections)

- Many (all?) animal species are asymptomatic carrier of *Campylobacter*
The importance of *Campylobacter*

- *Campylobacter jejuni/coli* is the most common cause of bacterial intestinal disease in Europe
  - Estimated at 10 million cases per year in EU (costs: 2.4 billion)

- Serious outcome
  - 35-45 per 100,000 ill (EU); 3.5-4.0 hospitalized; 0.15-0.30 fatal

- 1999 CDC estimated 2.4 million cases annually in US
  - 13,000 hospitalizations and 120 deaths

- Sequelae
  - Guillain Barré Syndrome, Irritable Bowel Syndrome, Reactive Arthritis

- Largest part of the world: no data
Campylobacteriosis: sources of infection

- Poultry meat
- Contaminated drinking water
- Travelling
- Raw milk
- Direct animal contact
- Cross-contamination
Source attribution

Can we estimate the attribution from the sources for human campylobacteriosis?
Source attribution based on different approaches

- Case control studies and outbreaks: 24-29% attributed to poultry meat
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- Intervention studies: 40% attributed to poultry meat
Campylobacteriosis incidence in Belgium

- Registered cases
- April, May, June, July
- 1998 vs 1999

Dioxin crisis

Data: Dr. Frank van Loock
Source attribution based on different approaches

- Case control studies and outbreaks: 24-29% attributed to poultry meat
- Intervention studies: 40% attributed to poultry meat
- Microbial subtyping (MLST): 50-80% attributed to poultry
Campylobacter in poultry
Colonisation of *Campylobacter* in broilers

- newly hatched chicks are *Campylobacter* free
- colonisation < 14 days rare - maternal immunity?
- colonisation is age dependent (organic production)
- up to $10^9$ cfu per gram cecal contents
- asymptomatic and lifelong for broilers, slight decline in older birds
- almost 100% of birds in a flock become positive within a few days
Campylobacter and poultry meat

- Contamination of carcasses during processing
- 40% of EU carcasses > $10^3$ cfu per g neck/breast skin
- Organisms don’t grow but survive well to retail
- Cross contamination of other foods is common
- A single drop of fluid from a positive bird can contain ~$10^6$ cfu
Interventions in the poultry meat production chain
What are we aiming for?

- Preferably absence
- If colonization cannot be prevented in primary production, the processing plant is in charge
- Eliminate the heavily contaminated carcasses

Quantitative risk assessment models indicate that “the incidence of campylobacteriosis associated with consumption of chicken meals could be reduced 30 times by introducing a 2 log reduction of the number of Campylobacter on the chicken carcasses”
Risk factors for farms to be *Campylobacter* positive
(input for intervention)

**Increased**
- Thinning
- Other animals
- Other poultry houses
- Age
- Water supply

**Decreased**
- Implementation of biosecurity measures
On-farm interventions: 3 approaches

- Prevent *Campylobacter* entering broiler houses during primary production
- Increase resistance of broiler chickens to colonisation
- Reduce the concentration of *Campylobacter* in chicken intestines before slaughtering
Prevention of introduction of *Campylobacter*: biosecurity

poultry farm
Prevention of introduction of *Campylobacter* farm
Prevention of introduction of *Campylobacter*

25 gram cecal content \( \times 10^9 \) x 50,000 broilers = \( 10^{15} \) campylobacters/day

1 broiler can be become colonised with 50 campylobacters
On-farm interventions

- Biosecurity (including fly screens)
  - Thinning, consistently & rigorously applied, only indoor!

- Feed and water additives (acids, competitive exclusion, probiotics)

- Vaccination

- Phage therapy

- Genetic resistance

- Bacteriocines
On-farm interventions

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Quantitative effect of interventions

Study by European Food Safety Authority

- Description of risk factors and interventions (based on literature review and EU baseline study)
- Estimation of effect of interventions on risk reduction of human campylobacteriosis and ranking (based on quantitative mathematical model)
- Description of advantages and disadvantages of potential interventions and time scale for availability
Selected interventions to be analysed by mathematical model

- Biosecurity
- Fly screens
- Discontinued thinning
- Reduction of slaughter age
- Reducing colonization by different approaches
- Decontamination
Conclusions on interventions (1)

Based on results of QMRA based on data from four countries:

- 100% risk reduction by reduction of carcass concentration by 
  > 6 log_{10} units
  
  …..can be achieved by irradiation/cooking

- > 90% risk reduction by reduction of carcass concentrations by 
  > 2 log_{10} units,
  
  …..can be achieved by freezing for 2-3 weeks or reduction of the 
  concentration in intestines at slaughter by > 3 log units;

- 50-90% risk reduction by reduction of carcass concentrations 
  by 1-2 log_{10} units,
  
  ……can be achieved by freezing for 2-3 days, hot water or 
  chemical carcass decontamination with lactic acid, acidified 
  sodium chlorite or trisodium phosphate
Conclusions on interventions (2)

- 50-90% risk reduction by an equivalent reduction of flock prevalence
  - *fly screens* (based on data from Denmark only)

- Up to 50% risk reduction by modifications of primary production,
  - *restriction of slaughter age* to a max 28 days (only indoor flocks)
  - *discontinued thinning*

- The risk reduction associated with interventions in primary production is expected to vary considerably between countries.

Success stories
Verified human *Campylobacter* cases

Iceland

Freezing campy pos carcasses
New Zealand data

Data Sources: ESR Ltd notification data; NZHIS hospitalisation data (filtered – thanks to Nigel French, Rob Lake and A. Sears)
Future control options for *Campylobacter*

EU: targets (counts per gram product)
What *Campylobacter* control programmes are in place in Asia?
Take home messages

- *Campylobacter* is the leading cause of bacterial enteric illness and associated with considerable morbidity.
- Up to 80% is poultry derived with 20-40% through poultry meat.
- Options for intervention in primary production are still (economically) limited and restricted to indoor production (animal welfare conflicting with food safety!)
- Aiming for *Campylobacter* negative flocks arriving at slaughterhouse; if not, go for the low counts per gram.
- The public health benefits of controlling *Campylobacter* in primary broiler production are expected to be greater than control later in the chain (due to non-poultry meat transmission routes).
Instructions for the consumer!!!
Dr. Henk van der Zee, Food Inspectorate, the Netherlands