

Evaluation of risk based microbiological criteria for *Campylobacter* on broiler meat using TRiMiCri

Workshop:

***Campylobacter* in slaughterhouses and cutting plants:
risks and opportunities for better control**

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Microbiological criterion

The purpose of a microbiological criterion (MC) is to define the acceptability of a food lot based on the results of an analytical test performed on a specified number of samples from the lot.

In a traditional microbiological criterion, the limit has been defined by:

- a number of bacteria (m)
- a number of sampled units (n)
- a number of analytical units (c) out of (n) that contain more than a critical
- concentration of bacteria (m)

$$\begin{array}{c} \text{Microbiological criteria (MCs)} \\ + \\ \text{Quantitative Microbiological Risk Assessment (QMRA)} \\ = \\ \text{Risk-based Microbiological Criteria} \end{array}$$

Recently **two approaches** in the establishment of **Risk-based MCs** have been proposed

1. Microbiological Limit MC (ML-MC)

(Nauta et al., 2012. Risk based microbiological criteria for *Campylobacter* in broiler meat in the European Union. Int. J. Food Microbiol. 158, 209–217)

- defined by m , n and c ,
- well known and easy to communicate
- requires n **quantitative samples per batch (I)**
- traditionally do not require QMRA, but if risk-based **QMRA (III)** is needed
- does not require a baseline data

2. Relative Risk Limit MC (RRL-MC)

(Christensen et al., 2013. Case-by-case risk assessment of broiler meat batches: An effective control strategy for *Campylobacter*. Food Control 31, 485–490)

- defined by n and RR_{crit}
- relatively new and less easy to communicate
- requires n **quantitative samples per batch**
- **QMRA (III)** is required
- requires a **baseline data (II)**

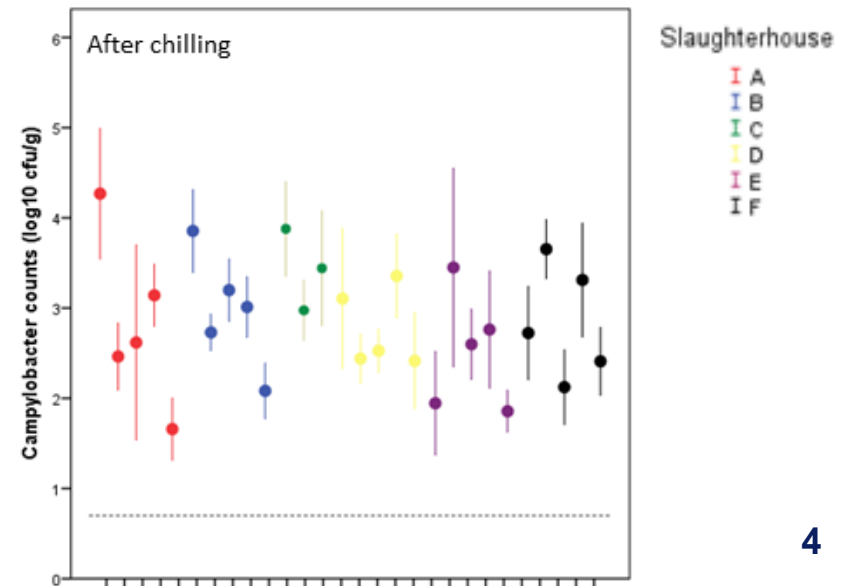
More information:

Nauta et al., 2015. Risk-based microbiological criteria for *Campylobacter* in broiler meat: A comparison of two approaches. Food Control 53, 177–184.

Quantitative samples per batch (I)

Part of data (only carcasses after chilling) presented by Prof. Lieven De Zutter
(Part 1 - *Campylobacter* carcass contamination throughout the slaughter process of *Campylobacter*-positive broiler batches)

- 6 Belgian slaughterhouses
- 28 *Campylobacter* positive batches
- 5 batches per slaughterhouse except for slaughterhouse C (3 batches)
- Breast skin from 6 carcasses per batch



Campylobacter baseline data (II)

The survey was executed in accordance with the requirements for a European Union-wide baseline survey on *Campylobacter* contamination in broiler carcasses.

- 9 Belgian slaughterhouses
- 389 carcasses after chilling were sampled; one carcass per batch
- Breast and neck skin samples were collected
- *Campylobacter* enumeration and detection were performed according to the ISO 10272:2006 methods

| n _{obs} | n _{pos} | p _{obs} | m _{obs} | sd _{obs} | Frequency of quantitative data | | | | |
|------------------|------------------|------------------|---------------------------|---------------------------|--------------------------------|---------|------------|--------------|---------|
| | | | (log ₁₀ cfu/g) | (log ₁₀ cfu/g) | < 10 | 10 -100 | 101 - 1000 | 1001 - 10000 | > 10000 |
| 389 | 202 | 51.9 | 2.78 | 0.86 | 10 | 37 | 77 | 65 | 13 |

Data were adopted from:

Habib et al., 2012. *Campylobacter* contamination in broiler carcasses and correlation with slaughterhouses operational hygiene inspection. Food Microbiol. 29, 105–12.

QMRA (III) using TRiMiCri



TRiMiCri (Tool for Risk-based Microbiological Criteria) is a freely available software tool that applies the QMRA model and allows the user to analyze the performance of their batches of broiler meat against user defined MCs using both approaches ML-MC and RRL-MC if desired.

TRiMiCri has three main functionalities:

1. Quantitative concentration data found in samples taken from a food lot can be evaluated for compliance against user-defined MCs.
2. Semi-quantitative concentration data found in representative samples can be entered to define a “baseline” risk that is needed for the evaluation of RRL-MCs.
3. Evaluation of the expected effect of setting specific microbiological criteria in terms of effect on consumer health risk and the percentage of non-complying food lots.

1. Evaluation of Quantitative concentration data against user-defined MCs

- Data input might be performed manually or by importing *.csv files.
- No assumptions are made on the distributions of concentrations
- The user has to define a transition factor (τ) - the difference in concentration on the sample taken (e.g. a skin sample) and the meat

For the assessment of relative risks of batches, TRiMiCri uses a QMRA model that calculates the probability of illness for consumption of a meal with meat with a sampled concentration.

Consumer phase model

the transmission of *Campylobacter* from raw meat to a chicken salad
(Nauta et al. 2008)



Dose response model

(Teunis and Havelaar 2000)

2. Assessment of the baseline risk

The baseline risk, is assessed with the same QMRA model and it is:

- a Danish baseline, which is calculated on the basis of a representative data set obtained at Danish retail 2007-2009, or
- a custom baseline, defined by the user, derived from representative data entered in TRiMiCri by means of the “baseline” option.

3. Evaluation of the expected effect of setting specific MC

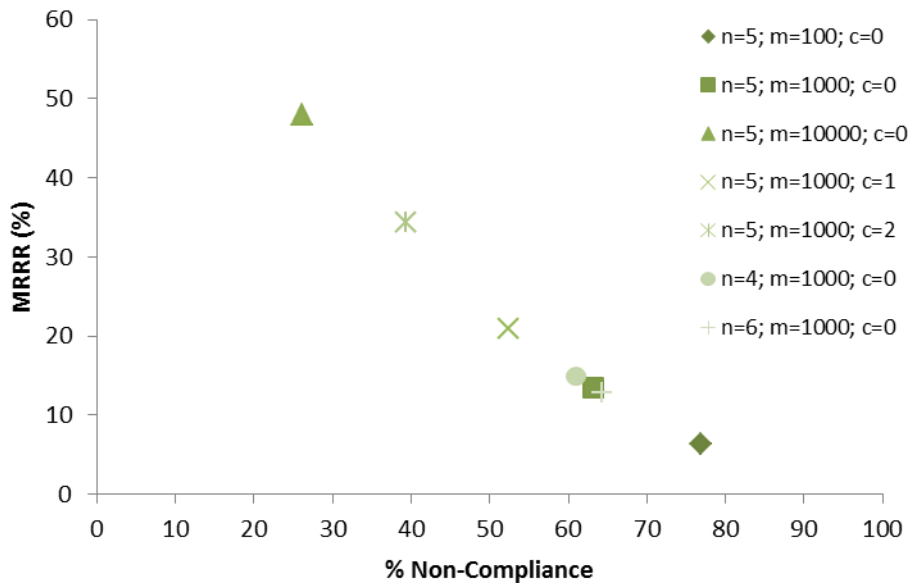
The suitability of criteria is evaluated on the basis of:

- the expected percentage of batches that is not complying with the MC (NC) and
- the minimum relative residual risk (MRRR).

MRRR

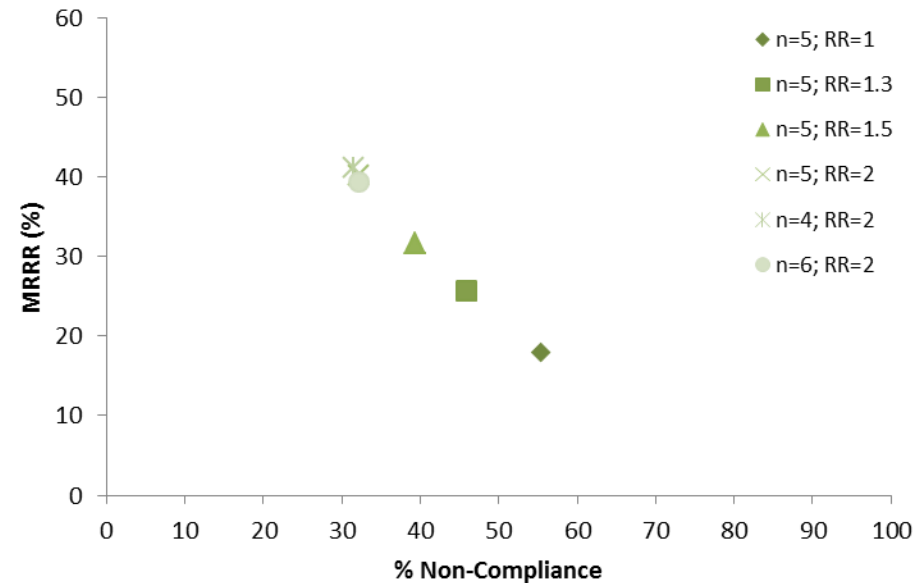
Assuming that all batches are tested and that all batches that are not compliant to the MC are replaced by *Campylobacter* free batches (for example because they receive a treatment that eliminates *Campylobacter*), it represents the remaining risk from the compliant batches, expressed as a fraction of the risk before implementing the MC.

Results



Results for seven ML-MC scenarios.

Symbols show the relationship between the estimated percentage on non-complying batches (NC) and minimum relative residual risk (MRRR).



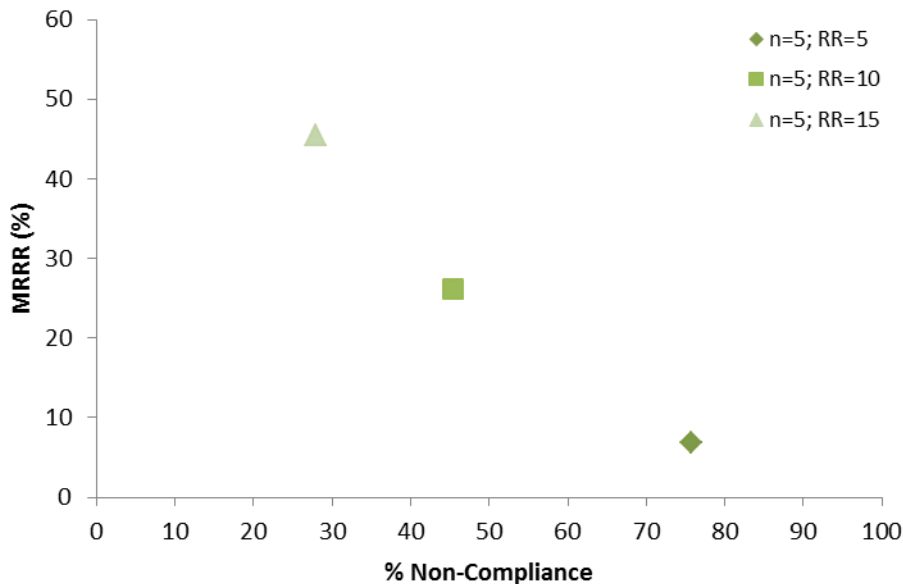
Results for six RRL-MC scenarios.

Results

- Approximately 60% of *Campylobacter* positive broiler batches slaughtered in Belgium would not comply with the ML-MC based on: $n = 5$; $m = 1000$; $c = 0$ and RRL-MC with $n = 5$; $RR = 1$. Assuming *Campylobacter* prevalence at the level ranging from 30 to 50% (depends on the season), up to one-third of all broiler batches produced in Belgium would not comply with these MCs.
- On the other hand, implementation of such a MCs would provide a high public health benefit (MRRR=13 and 18% for ML-MC and RRL-MC, respectively).
- An optimum criterion would combine a low MRRR, understood as the maximum achievable public health benefit, with a low percentage of non-complying batches (NC) that can be translated into low cost for the producers. The selection of the fit for purpose MC is a risk manager decision.
- The changes in the number of observations (n) have only little effect on both MRRR and NC.

Results

Evaluation of broiler batches produced in Belgium against Danish baseline risk



About one-fourth of broiler meat batches positive for *Campylobacter* would not comply with a RRL-MC criterion applied by Danish authorities if $RR_{crit} = 15$

Danish baseline is more stringent than that in Belgium and that the correct estimation of the baseline risk used is crucial for the implementation of RRL-MC.

If the baseline risk represents the current mean annual risk, it should be updated periodically and locally, and in the case of reduction over time it can force gradually stricter MC and consequently better protection of public health.

Summary

TRiMiCri can be a practical tool for the evaluation of risk-based microbiological criteria.

TRiMiCri

- translates QMRA model
- facilitates the choice the most suitable criterion
- has a user friendly interface offering useful guidance to risk managers to decide on the implementation of MCs

About one-third of all broiler meat batches produced in Belgium would not meet the ML-MC criterion with $n = 5$; $m = 1000$; $c = 0$.

To improve the ability of the slaughterhouses to comply with potential MC:

- risk factors associated with high *Campylobacter* counts on broiler carcass have been described by Prof. Lieven De Zutter (previous presentation)
- as an alternative, also the physical treatment or decontamination of broiler meat can be considered

Properly defined baseline risk if working with RRL-MC

Be conscious about the number of analyzed units per batch



Acknowledgment

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Slaughterhouses



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Thank you for listening!