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# Evaluation of a cross contamination model describing transfer of *Salmonella* spp. and *Listeria monocytogenes* during grinding of pork and beef

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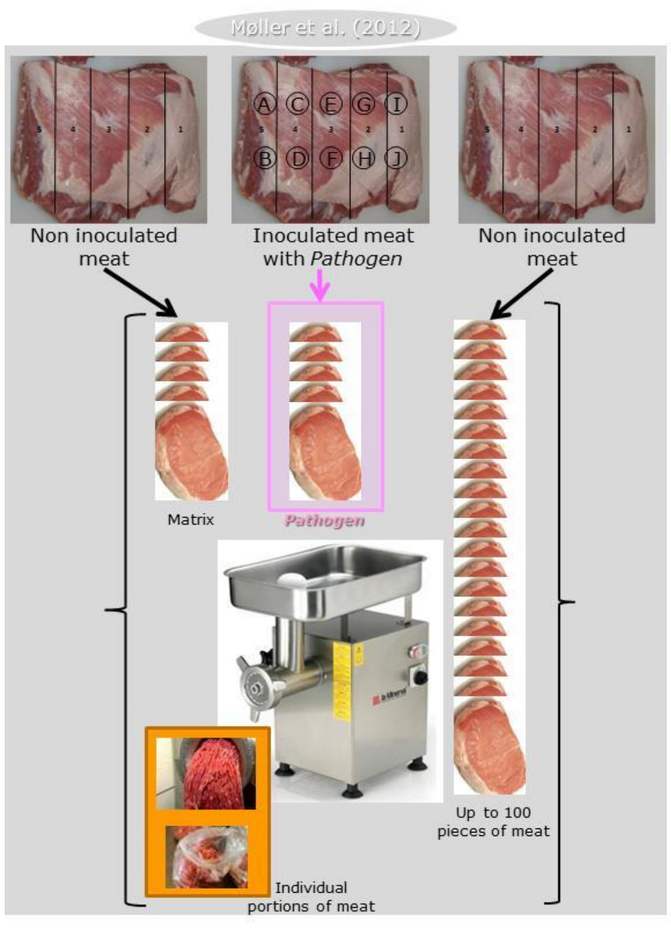
**Can a promising cross contamination model be successfully applied to any condition of meat grinding? To answer this question we performed different challenge tests and developed a set of evaluation approaches.**

**The cross contamination model (Møller et al. 2012) was evaluated to investigate its capability of describing transfer of *Salmonella* spp. and *L. monocytogenes* during grinding of pork and beef of varying sizes (50 – 324 g) and numbers of pieces to be ground (10 – 100), in two grinder systems.**




Data from 19 trials were collected. Three different evaluation approaches were applied:

i) **ASZ** – an Acceptable Simulation Zone method which compared observed transfer with simulations using the proposed model

ii) **QMRA** – each trial was fitted to equation 1 and its respective parameter estimates were integrated in a Quantitative Microbiological Risk Assessment model (Møller et al. 2015) to compare risk estimates

iii) **TTP** – the Total Transfer Potential was calculated for each of the trials based on fitted parameter estimates

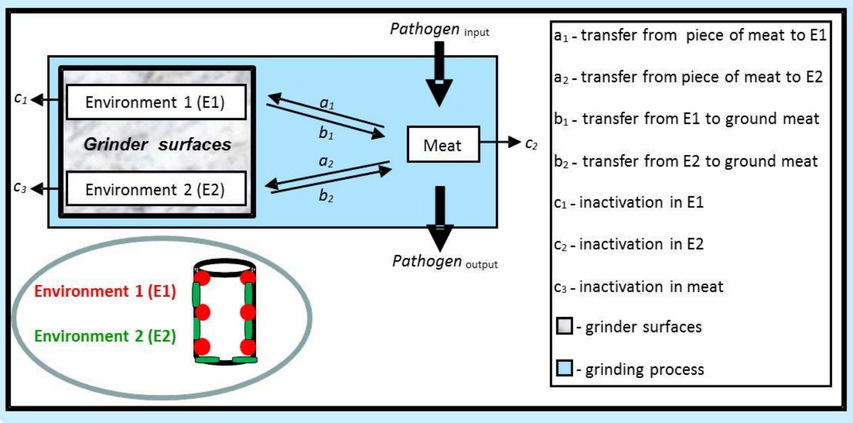
**Møller et al. (2012) model**

$$\begin{cases} M_i = (1-a_1)(1-a_2)(1-c_2)\,P_i + (b_1\,gr_{1,i-1}) + (b_2\,gr_{2,i-1}) \\ gr_{1,i} = a_1\,P_i + (1-b_1)(1-c_1)\,gr_{1,i-1} \\ gr_{2,i} = a_2\,P_i + (1-b_2)(1-c_3)\,gr_{2,i-1} \end{cases} \quad \textbf{Equation 1}$$

**Evaluated parameter estimates:**

| $a_1$ | $b_1$ | $a_2$ | $b_2$ | $1-c_3$ |
|---|---|---|---|---|
| 0.0010 | 0.0275 | 0.8909 | 0.0558 | 0.4887 |

**Explaining Møller et al. (2012) model**




**Lessons learned:**

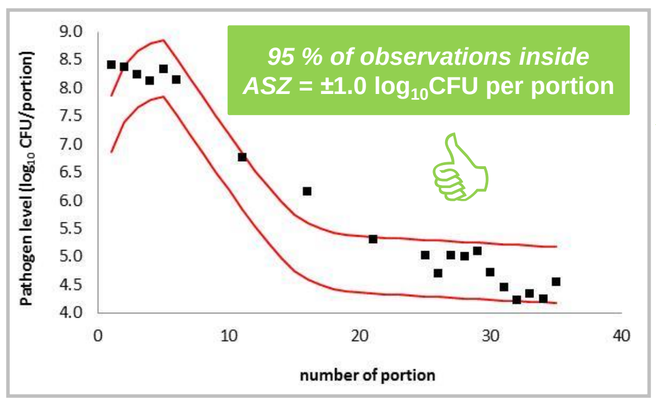
- Results indicated that transfer estimates were not applicable for unlike processing
- QMRA risk estimates and TTP both revealed that risk attribution from grinding was influenced by:
  1) sharpness of grinder knife
  2) specific grinder
  3) grinding temperature
  4) specific pathogen was of minor importance

Classification of trials according agreement of results obtained with three different approaches for evaluating performance of the model proposed by Møller et al. (2012) describing the transfer of pathogens during meat grinding in trials with at least 15 pieces of meat.

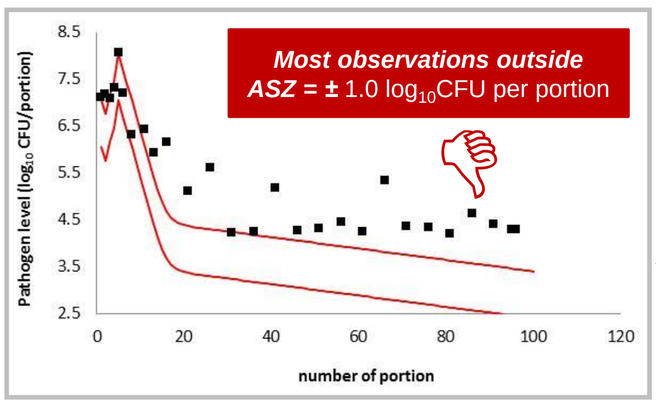
**DECISION MAKING WHEN:**
at least 2 evaluation approaches are **IN AGREEMENT**

| Trial identification | Size of ASZ[b] to include 95 % of the predictions (± CFU/portion of meat) | Absolute Risk[c] Estimates x $10^{-3}$ | TTP %[d] | **Møller et al. (2012) model** | |
|---|---|---|---|---|---|
| | | | | Applicability | Evaluation approaches in agreement |
| 1 | 2.0 | 3.02 | 103 | - | 3 |
| 2 | 2.0 | 2.87 | 101 | | 3 |
| 3 | 2.0 | 2.94 | 100 | - | 3 |
| 4 | 0.8 | 1.01 | 21 | + | 3 |
| 5 | 1.4 | 1.56 | 36 | + | 2 |
| 6 | 1.2 | 1.10 | 24 | + | 2 |
| 7 | 1.1 | 0.86 | 16 | + | 2 |
| 8 | 1.2 | 0.62 | 11 | + | 2 |
| 9 | 2.0 | 2.21 | 60 | - | 3 |
| 11 | 1.1 | 1.92 | 51 | - | 3 |
| 12 | 1.4 | 3.04 | 102 | - | 3 |
| 13 | 1.2 | 1.44 | 35 | + | 2 |
| 14 | 1.5 | 2.22 | 64 | - | 3 |
| 15 | 1.1 | 1.54 | 36 | + | 2 |
| 16 | 1.1 | 2.24 | 60 | - | 3 |
| 17 | 2.2 | 1.59 | 39 | + | 2 |
| 18 | 0.6 | 1.41 | 34 | + | 3 |
| 19 | 0.6 | 1.14 | 25 | + | 3 |
| 20[a] | 0.5 | 0.96 | 20 | + | 3 |

A positive correlation was found between **QMRA risk estimates** and **TTP %**




Evaluated parameter estimates are **APPLICABLE** (58 % of trials)




Evaluated parameter estimates are **NOT APPLICABLE** (42 % of trials)

**Nevertheless**
**All trials were successfully described when fitted to equation 1**

[a] Parameter estimates suggested by Møller et al. (2012) and evaluated in this study were obtained from the fitting of observed transfer in trial 20.

[b] ASZ – Acceptable Simulation Zone.

[c] Risk estimates from scenarios testing different sets of transfer parameter estimates, and using the QMRA of *Salmonella* in meatball processing model (Møller et al., 2015) at low concentration and prevalence of the pathogen.

[d] Calculated with base on Equation 1. It indicates the percentage (%) of CFU of *Salmonella*, from the contaminated pieces of meat that ends up in the total portion of ground meat, assuming that the grinding process will continue forever.

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