Measuring microbial food safety output and comparing self-checking systems of food business operators in Belgium

dr. ir. Liesbeth Jacxsens – prof. Mieke Uytterdaele
Department of Food Safety and Food Quality, Faculty of BioScience Engineering, University of Ghent

Msc. Klementina Kirezieva – dr. Pieter Nel Luning
Product Design and Quality Management Group, Department of Agrotechnology and Food Sciences, Wageningen University

Ir. Jacques Ingelram – dr. Herman Diricks
Belgian Federal Agency for the Safety of the Food Chain (FASFC)

Objective of research?

Belgian risk management decision in 2003 to:
• introduce ‘self-checking system’ based on PRPs, HACCP, traceability, notification, legal quality aspects along the agri-food chain
• each food business operator must implement a ‘self-checking system’
• certification is possible by commercial third parties or by governmental food safety authority
• certificate ➔ minus on yearly taxes
• Research question: does the introduction of a self-checking system improve the safety?
Introduction

Food Safety Requirements:
EU Legislation, Belgium legislation, CODEX, PRP/GMP, HACCP, BRC, ISO22000, ...

Development and implementation of a Food Safety Management System in a specific SME/industrial company in the agri-food chain

Safe food products?

Diagnostic instrument (FSMS-DI) for food processing companies to measure:
- the performance of current FSMS (core control activities and core assurance activities)
- the performance of food safety output
- in relation to the context of a company
- standing apart from auditing/inspection of implemented commercial QA standard/legislation!

EU Research project PathogenCombat (www.pathogencombat.com)
Introduction

FSMS = Control + Assurance

Core assurance activities
- Setting system requirements
- Validation
- Verification
- Documentation and record keeping

Core control activities
- Preventive measures design
- Intervention processes design
- Monitoring system design
- Operation control strategies

Internal: - sampling results
- judgement of microbial analysis
- non-conformities

External: - certification/inspection status
- results of audits
- complaints

CONTEXT

Food Safety Management 2012 – Campden BRI

Part I: Introductory section for Food Safety Management System (FSMS)
A. Introduction questions (1-11)
B. Selection of Representative Production Unit (RPU) (12-20)

Part II: assessment of contextual factors
A. Assessment of product characteristics (A1-3)
B. Assessment of process characteristics (B4-6)
C. Assessment of organisation characteristics (C7-13)
D. Assessment of chain environment characteristics (D14-17)

Part III: assessment of core safety control activities
E. Assessment of preventive measures design (E18-23)
F. Assessment of intervention processes design (F24-27)
G. Assessment monitoring system design (G28-34)
H. Assessment of operation of preventive measures, intervention processes and monitoring systems (H35-41)

Part IV: assessment of core assurance activities
I. Assessment of setting system requirements activities (I42-43)
J. Assessment validation activities (J44-46)
K. Assessment of verification activities (K47-48)
L. Assessment of documentation and record-keeping to support food assurance (L49-50)

Part V: assessment of food safety performance
M. EXTERNAL Food Safety Performance (M51-54)
N. INTERNAL Food Safety Performance (N55-57)

FSMS-DI – content (58 indicators)
Introduction

• FSMS-DI – indicators translated into grids

1. In which situation would you place the risk of your raw materials in your RPU (representative production unit)?

   a. Situation 1:
      - Raw materials are not associated with high initial microbial levels and pathogens.
      - Storage at an uncontrolled room temperature (greater than 5°C).

   b. Situation 2:
      - Raw materials are associated with high initial microbial loads and pathogens, which potentially can affect safety of the final product.
      - Raw materials are stored at below room temperature but to specific shelf-life requirements.

   c. Situation 3:
      - Raw materials are associated with high initial microbial loads and pathogens, which potentially can affect safety of the final product.
      - Raw materials are stored at below room temperature but to specific shelf-life requirements.

Supporting information to differentiate situation 2 and 3:
- When your raw materials are stored at below room temperature and shelf-life, it should be stored below room temperature (higher than 5°C).
- For level 3, the high requirements on storage are crucial for prevention of undesired growth of micro-organisms (including pathogens).

Introduction

• Indicators are organised in spiderwebs
• Results can be applied as internal audit
• Short/mid/long term improvements of FSMS
Introduction

• FSMS-DI:
  • Tool available for PROCESSING FOOD INDUSTRY
  • On line www.pathogen combat.com – on paper
  • Dutch, French, English, Spanish, Greek
  • Data companies in database of WU
  • Profiling countries – sectors – interventions – …
  • Applied in Belgium study (june 2010 – october 2010)
  • Cooperation FAVV – UGent – WU

Belgian study

• Quantitative study in Belgian food/feed processing companies
• Different sectors - different size
• With/without certified self checking systems : can we see a difference in level of food safety and level of implemented FSMS ?
• 200 companies invited ➔ 82 respondents
• 50% certified for self checking
• 90% certified for commercial system (BRC, IFS, GMP+, etc)
• Only 3 companies without any certificate …
Belgian study

BIAS in our study …

- Difficult to get companies involved
- Involved companies assumed to have higher level in FSMS due to (multiple) certification
- Involvement of non certified companies?

Questions:

- Can we identify clusters/profiles in FSMS performance in food processing companies in Belgium?
- Do we see a difference in level of performance of food safety output (low – moderate – good)?
- Do we see a difference in level of performance of actual implemented FSMS (basic – generic – tailored/scientific underpinned)?

Characterisation of respondents

<table>
<thead>
<tr>
<th>Production sector</th>
<th>Micro and small (1-9 &amp; 10-49)</th>
<th>Medium (50-249)</th>
<th>Large (&gt;249)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self checking system</td>
<td>Non certified</td>
<td>Certified</td>
<td>Non certified</td>
<td>Certified</td>
</tr>
<tr>
<td>Meat products</td>
<td>10</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Red meat</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Slaughterhouses/cutting + Poultry slaughterhouses/cutting</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Ready-to-eat meals</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Dairy</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Fish processing</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Vegetables, fruits, potatoes trade/processing</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Industrial bakery</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Brewery</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Feed</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Others</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>22</td>
<td>13</td>
<td>10</td>
<td>20</td>
</tr>
</tbody>
</table>

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Results - database

Etc….

Results - Food safety output?

• Overall: moderate (overall score 2) to good (overall score 3) performance of FS output for all Belgian food/feed processing companies

<table>
<thead>
<tr>
<th>n</th>
<th>Overall score for food safety output</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 (18%)</td>
<td>Good</td>
</tr>
<tr>
<td>57 (70%)</td>
<td>Moderate-good</td>
</tr>
<tr>
<td>9 (11%)</td>
<td>Moderate</td>
</tr>
<tr>
<td>1 (±1%)</td>
<td>Moderate-low</td>
</tr>
</tbody>
</table>
## Results - Clusters

- Individual database
- Hierarchical cluster analysis
- Dendograms
- 5 clusters could be defined

### Results - Identification of Clusters

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Number of companies</th>
<th>% certified for self checking</th>
<th>Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cluster I</td>
<td>38</td>
<td>60</td>
<td>Animal products</td>
</tr>
<tr>
<td>Cluster II</td>
<td>7</td>
<td>71</td>
<td>Non animal products (FVP, candies, brewery, feed, bakery)</td>
</tr>
<tr>
<td>Cluster III</td>
<td>15</td>
<td>20</td>
<td>Animal products</td>
</tr>
<tr>
<td>Cluster IV</td>
<td>18</td>
<td>44</td>
<td>Mixture of companies but no intervention possible in process</td>
</tr>
<tr>
<td>Cluster V</td>
<td>4</td>
<td>50</td>
<td>Mixture</td>
</tr>
</tbody>
</table>

73% of all companies and 76% certified SC
Results – Cluster I versus III

Cluster I:
97% commercial
60% self checking

Cluster III:
90% commercial
20% self checking

* Cluster I and Cluster III: all animal products

Cluster III less advanced FSMS compared to cluster I
Belgian results in the European context

- Survey also conducted in Spain, Greece, the Netherlands
- Outside Europe e.g. Japan
- Differences with Belgium?
  - Lower food safety output ➔ internal evaluation of food safety output (e.g. product sampling, judgement criteria, non-conformities) ➔ more severe internal judgement by Belgian companies
  - Core assurance activities (validation and verification) elaborated at higher level in Belgian companies
  - Belgian companies high level of performance of FSMS (more advanced, tailored and scientific underpinned)
  - Awareness of importance of food safety and FSMS?
  - Drive of legislation / self checking systems?

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Belgian results in the European context

- Example of lowest cluster in European study (no Belgian companies…)

<table>
<thead>
<tr>
<th>Food Safety output</th>
<th>Product and process characteristics</th>
<th>Organizational and chain characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Design of control activities</th>
<th>Actual operation of control activities</th>
<th>Assurance activities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Improvement of FSMS by introduction of self checking system?

- Evolution of official inspection results conducted by government (Belgian FASFC)

<table>
<thead>
<tr>
<th>No acceptable inspection results</th>
<th>Acceptable inspection results with remarks</th>
<th>Acceptable inspection results</th>
</tr>
</thead>
<tbody>
<tr>
<td>7,19%</td>
<td>21,48%</td>
<td>71,48%</td>
</tr>
<tr>
<td>78,72%</td>
<td>78,72%</td>
<td>78,72%</td>
</tr>
<tr>
<td>17,31%</td>
<td>17,31%</td>
<td>17,31%</td>
</tr>
<tr>
<td>3,97%</td>
<td>52,45%</td>
<td>22,27%</td>
</tr>
<tr>
<td>0%</td>
<td>22,27%</td>
<td>25,28%</td>
</tr>
<tr>
<td></td>
<td>17,47%</td>
<td>9,04%</td>
</tr>
</tbody>
</table>

Transformation sector

<table>
<thead>
<tr>
<th>non validated SCS</th>
<th>SCS validated</th>
</tr>
</thead>
<tbody>
<tr>
<td>7,19%</td>
<td>21,43%</td>
</tr>
<tr>
<td>78,72%</td>
<td>73,49%</td>
</tr>
<tr>
<td>17,31%</td>
<td>17,31%</td>
</tr>
<tr>
<td>3,97%</td>
<td>52,45%</td>
</tr>
<tr>
<td>0%</td>
<td>22,27%</td>
</tr>
<tr>
<td></td>
<td>25,28%</td>
</tr>
<tr>
<td></td>
<td>9,04%</td>
</tr>
</tbody>
</table>

Distribution sector

<table>
<thead>
<tr>
<th>non validated SCS</th>
<th>SCS validated</th>
</tr>
</thead>
<tbody>
<tr>
<td>25,28%</td>
<td>22,27%</td>
</tr>
<tr>
<td>73,49%</td>
<td>73,49%</td>
</tr>
<tr>
<td>17,47%</td>
<td>17,47%</td>
</tr>
<tr>
<td>9,04%</td>
<td>52,45%</td>
</tr>
</tbody>
</table>

Conclusions

- Overall Belgian food processing companies demonstrated good performance of food safety output and rather advanced level of food safety management systems.
- Validation and verification activities in a FSMS are less advanced worked out.
- Impact of introduction of self checking systems was more difficult to see in transformation sector due the high presence of voluntary standards and certification.
Conclusions

• To be continued…
• Current running FP7 project ‘Veg-i-Trade’
  • Extended to other actors in the chain (e.g. primary production, trade sector)
  • Context ➔ aspect of globalisation will be included
  • Focus also on mycotoxins and pesticide residues next to microbial hazards
  • Veg-i-Trade
    • www.veg-i-trade.org

Acknowledgements

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• Sector organisations

• Responding companies !!!