Diagnosis of *Fasciola hepatica* in livestock

Chasing the fluke or it’s impact?

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Contents of presentation

- Available diagnostics and their evaluation
- Correlation with fluke burden and productivity
- From parasitic to economic diagnosis
Diagnostics available

- Coprology
- Serology
- Copro-antigens
- DNA-based
Coprology (1)

- Microscopic detection of eggs
- Numerous methods described (Sedimentation-(flotation))

<table>
<thead>
<tr>
<th>PRO’S</th>
<th>CON’S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specificity</td>
<td>Sensitivity</td>
</tr>
<tr>
<td>Current infections</td>
<td></td>
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</tbody>
</table>
# Coprology (2)

<table>
<thead>
<tr>
<th>Method</th>
<th>Sensitivity (Se)</th>
<th>Specificity (Sp)</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>S 10 g</td>
<td>33%</td>
<td>-</td>
<td>Conceição et al., 2004</td>
</tr>
<tr>
<td>S 30 g</td>
<td>83%</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Rapsch et al., 2008</td>
</tr>
<tr>
<td>S 10 g</td>
<td>69%</td>
<td>98%</td>
<td>Rapsch et al., 2008</td>
</tr>
<tr>
<td>S 10 g – 2 times</td>
<td>86%</td>
<td>98%</td>
<td>Rapsch et al., 2008</td>
</tr>
<tr>
<td>S 10 g – 3 times</td>
<td>90%</td>
<td>98%</td>
<td>Rapsch et al., 2008</td>
</tr>
<tr>
<td>S-F 4 g</td>
<td>43%</td>
<td>100%</td>
<td>Charlier et al., 2008</td>
</tr>
<tr>
<td>S-F 10 g</td>
<td>64%</td>
<td>93%</td>
<td>Charlier et al., 2008</td>
</tr>
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</table>
Detection of *F. hepatica*-specific antibodies in serum or milk

Many elisa’s have been described based on complete or subfraction of excretory-secretory (ES) products of *F. hepatica*

<table>
<thead>
<tr>
<th>PRO’S</th>
<th>CON’S</th>
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<tbody>
<tr>
<td>Higher Se</td>
<td>Active infection?</td>
</tr>
<tr>
<td>High-throughput</td>
<td></td>
</tr>
<tr>
<td>User-friendly matrix: milk</td>
<td></td>
</tr>
</tbody>
</table>
## Serology (2)

<table>
<thead>
<tr>
<th></th>
<th>ES</th>
<th>“f2”</th>
<th>MM3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Se</strong></td>
<td>86-100 %</td>
<td>88-98 %</td>
<td>99 %</td>
</tr>
<tr>
<td><strong>Sp</strong></td>
<td>83-96 %</td>
<td>84-98 %</td>
<td>100 %</td>
</tr>
<tr>
<td><strong>Commercial format</strong></td>
<td><strong>Svanova</strong></td>
<td><strong>IDEXX</strong></td>
<td><strong>Bio-X</strong></td>
</tr>
<tr>
<td><strong>References</strong></td>
<td>Anderson et al., 1999 Cornelissen et al., 1999 Salimi-Bejestani, 2005 Charlier et al., 2008 Kuerpick et al.,2013</td>
<td>Reichel, 2002 Molloy et al., 2005 Rapsch et al., 2006 Charlier et al., 2008 Kuerpick et al.,2013</td>
<td>Mezo et al., 2010</td>
</tr>
</tbody>
</table>
Copro-antigen

- MM3-copro-ELISA (Mezo et al., 2004):
  - Detection of active infection with high Se and Sp. (> 95%)

- Commercial version available (Bio-X Diagnostics, Jemelle)
  - Field evaluations report rather low sensitivity (Düscher et al., 2011; Salem et al., 2011, …)
  - Successfully applied in copro-antigen reduction test (CRT)
DNA-based methods

- **PCR** (Martinez-Perez, 2012):
  - Highly Se/Sp
  - Detection 2 weeks pi vs. 4 weeks pi for copro-antigen

- **LAMP** (Ai et al., 2010):
  - Amplification in ca. 60 min under 61 °C.
  - Reaction visible by naked eye
  - Potential of pen-side diagnostic?
The problem with current approach

What is the message?
Closer look at the fluke burden (1)

- Geomean: 9(1-446)
- 60% < 10 flukes
- 28% > 30 flukes
Closer look at the fluke burden (2)
Correlation of diagnostics with fluke burden

- Coprology to detect infections with > 10 flukes
  - SF on 4 g: PPV 87%
  - SF on 10 g: PPV 48%.

- Copro-antigens: $R \approx 0.6$

- Serology ES ELISA: $R \approx 0.3$
Correlation of diagnostics with production parameters (1)

- **ES ELISA** (Charlier et al., 2007; 2009; Kuerpick et al., 2012)
  - Herd average milk yield (3%)
  - Herd mean carcass weight (0.7%)
  - Intercalving interval (+ 5 days)

- **MM3 ELISA** (Mezo et al., 2011)
  - “Light infection”: no effect
  - “Heavy infection”: -2 kg milk/cow/day
Prediction of production responses

(Charlier et al., 2012)
Estimating herd-specific cost of disease

Estimated costs of worm infections on your herd

<table>
<thead>
<tr>
<th></th>
<th>Gastrointestinal worms</th>
<th>Liver fluke</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Young stock</td>
<td>Dairy cows</td>
</tr>
<tr>
<td>Production losses</td>
<td>NA</td>
<td>£ 4,272.00</td>
</tr>
<tr>
<td>Cost of anthelmintics</td>
<td>£ 0.00</td>
<td>£ 0.00</td>
</tr>
<tr>
<td>Total</td>
<td>NA</td>
<td>£ 4,272.00</td>
</tr>
</tbody>
</table>

Total costs gastrointestinal worms per year: £ 4,272.00
Total costs gastrointestinal worms per cow: £ 61.00
Total costs liver fluke per year: £ 641.00
Total costs liver fluke per cow: £ 9.00
Putting it all in the right context

Preventive Veterinary Medicine xxx (2012) xxx–xxx

Conceptual framework for analysing farm-specific economic effects of helminth infections in ruminants and control strategies

Mariska van der Voort, Johannes Charlier, Ludwig Lauwers, Jozef Vercruysse, Guido Van Huylkenbroeck, Jef Van Meensel
Conclusions

- **Wide array of diagnostics** available
  - Antibody detection: detect farms/animals “at risk”
  - Coprology: support treatment decisions

- **Traditional focus** very much on **Se/Sp**

- **Need for novel approaches** to assess the **farm-specific impact of fasciolosis** before taking remedial measures
Acknowledgements

- Prof. Diana Williams
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