Analysis of fresh produce in Norway for contamination with Cryptosporidium oocysts and Giardia cysts

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Waterborne transmission

- Accepted transmission route for both Cryptosporidium and Giardia
- Multiple outbreaks recorded involving tens, hundreds +++ of individuals
- Relevant (accepted) parasite factors:
  - Excreted in large quantities
  - Low infectious dose
  - Small
  - Robust – especially in cool, damp conditions
  - Zoonotic potential

Foodborne transmission

- Same factors relevant for waterborne transmission should also lend themselves to foodborne transmission
- But relatively few foodborne outbreaks reported
- Why?
  1. Outbreaks/infections occur - but are not detected
  2. Outbreaks/infections occur - but the foodborne route of transmission is not identified
  3. Foodborne transmission occurs only very rarely

1. Outbreaks/infections occur - but are not detected

- Water is commodity common to a community – most people ingest some water from municipal supply daily
  - Less people exposed to pathogen via food – less people sick = outbreak not detected
  - Most likely infection vehicles (e.g. raw vegetables) not associated with children
    - Immunity
    - Adults less likely to report diarrhoeal sickness unless prolonged
2. Outbreaks/infections occur - but foodborne transmission not identified

- Clinician etc. does not consider foodborne transmission:
  - Risk factors usually considered: travel, water, contacts, animals – rarely food
  - More likely to consider food if several illnesses + single event/place with communal eating (wedding, party, work canteen, conference….)

- If foodborne transmission considered, different confounders can prevent identification:
  - Long incubation period,
  - Lack of recall (people barely remember what they ate yesterday…)
  - Lack of food for testing – all consumed or discarded between infection and symptoms/diagnosis

3. Foodborne transmission occurs only rarely – data reflect actual situation

- Parasites generally do not contaminate food
  - Faeces more likely to reach water than food
  - Parasites usually removed from food during processing

- Parasites do not survive well on food – desiccation etc.

- Contamination by food-handler immediately prior to consumption main possible scenario

Two parasites - three possible scenarios

<table>
<thead>
<tr>
<th>Scenario 1: Occur - but are not detected</th>
<th>Scenario 2: Occur - but foodborne route not identified</th>
<th>Scenario 3: Rarely occur</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Giardia</strong></td>
<td><strong>Crypto</strong></td>
<td></td>
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Outbreak aspects

<table>
<thead>
<tr>
<th><strong>Giardia</strong></th>
<th><strong>Cryptosporidium</strong></th>
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<tbody>
<tr>
<td>9 documented outbreaks since 1960 – low numbers infected</td>
<td>Ca. 30 documented outbreaks since mid-1980s; sometimes many (100s) infected</td>
</tr>
<tr>
<td>&gt; 50 % associated with food-handler</td>
<td>Some outbreaks speculated to be due to food-handler – but many not</td>
</tr>
<tr>
<td>Total no. cases: &lt; 200</td>
<td>Total no. cases: &gt;3000</td>
</tr>
<tr>
<td>Matrices: Christmas pudding, canned salmon, noodle salad, sandwiches, tripe soup, fruit salad, raw veg, oysters,</td>
<td>Matrices: milk + dairy products, apple cider, raw meat, sandwich bar ingredients, salads, herbs, and «ready-to-eat» leaves</td>
</tr>
</tbody>
</table>

Food:
- Relatively unimportant transmission vehicle
- Contamination usually occurs at serving place (food-handler)
- 1 small outbreak < every 5 years

Food:
- Could be important transmission vehicle
- Contamination anywhere along the food-chain
- 1 outbreak every couple of years – sometimes many infected
Outbreak aspects

The Telegraph

Ready-to-eat salads from Morrisons and Asda caused infection outbreak, HPA say

"Ready-to-eat" salads from two major supermarket chains were behind a stomach infection which poisoned 300 shoppers, the Health Protection Agency has claimed.

Experts believe the Cryptosporidium infection may have come from the spinach which would have been in both bags.

Risk-ranking: Crypto = 2nd most important FBP in N. and W. Europe

Foodborne cryptosporidiosis – geographical bias – reported outbreaks

Prior to 2000

From 2000 onwards

Risk ranking: Crypto = 2nd most important FBP in N. and W. Europe

Foodborne cryptosporidiosis: is there really more in Nordic countries?

Greater contamination?

Prolonged oocyst survival?

Greater dietary exposure?

More animal infections?

Better diagnostic chain and more investigation?

Scenario 1: Occur - but are not detected

Scenario 2: Occur - but foodborne route not identified

Scenario 3: Rarely occurs

Giardia

Two parasites - three possible scenarios

OK programmer – overvåking & kartlegging (monitoring & surveillance)

• Every year the Norwegian Food Safety Authority (NFSA) undertakes different monitoring and surveillance programmes.

• The main intention is to provide an overview of selected areas for which NFSA is responsible.
OK program (2012)

- 194 lots of fresh produce samples (Norwegian and imported) analysed for *Salmonella* and *E. coli*, and sugarsnap peas analysed for STEC
- *Salmonella* and STEC not detected
- Low numbers of *E. coli* in 8 samples
- 22 lots of lettuce and 17 lots of frozen raspberries analysed for norovirus and adenovirus
- All negative

OK programme (2012)

- 21 lettuce samples, 10 sugarsnap pea samples and 10 fresh raspberry samples analysed for Cryptosporidium and Giardia.
- All sugarsnaps and raspberries imported.
- ISO Method 18744 used for analysis
- All negative apart from one sugarsnap sample (50 g) imported from Kenya
- No *E. coli* contamination found in sample

What action should be taken?

- In Norway, sugarsnaps often eaten raw in salad.
- No information on viability (dried to slide, so dead when detected)
- No information on Assemblage (potential infectivity to humans)

OK program (2012)

- 176 lots of fresh imported berries (strawberries, raspberries, blueberries) analysed for *Salmonella* and *E. coli*
- *Salmonella* not detected
- High numbers of *E. coli* in two samples (blueberries from Netherlands, raspberries from Spain)
- 52 lots of frozen imported berries analysed for hepatitis A virus and norovirus
- All negative
• 19 fresh strawberry samples, 14 fresh raspberry samples and 22 fresh blueberry samples analysed for Cryptosporidium and Giardia.

• ISO Method 18744 used for analysis

• All negative apart from one strawberry sample (45 g) imported from Spain (1 Giardia cyst).

• No E. coli contamination found in this sample

• Two follow-up samples analysed from the same batch – each contained 3 cysts.

• Two further samples – 1 contained 2 cysts (external to programme).

• Molecular analysis – Assemblage A

• As strawberries imported via Netherlands, reported to Dutch authorities

• Who then reported to RASFF....
OK program (2012 & 2015-2016)

- Chain: Producer in Spain to Trader in Netherlands (as organized by a further company in Spain), then forwarded to Norwegian distributor – and then out to shops etc.
- Production site visit (May 2016): irrigation water pond and 3 intermediate tanks
- Total coliform, *E. coli*, and *Salmonella* tests satisfactory
- Water chlorinated prior to use - no filtration
- Random testing for parasites to be introduced

Conclusions

- Analyses are expensive and provide limited information (spot tests, few samples, random, genotyping difficult from low numbers, no viability / infectivity data)
- However, do provide background information and an indication that contamination with parasites occurs (more frequently than expected?)
- Background information is essential for MRA and targeting interventions.
- No apparent correlation with bacterial contamination
- Authorities need to know how to react to low level contamination results.

Future thoughts

- OK program 2017: 75 samples of imported leafy vegetables and fresh herbs.
- Cryptosporidium only (not *Giardia*).
- Use reduced cost (veg-i-trade*) method based on ISO Method 18774 (trialed in 10 different labs; mean recovery rates 53% for Cryptosporidium and 33% for *Giardia*).
- No positive samples to date.
- Which other parasites may be there – *Cyclospora, Echinococcus* etc…?*
- No approved /standard testing methods for these parasites currently available.

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Thank you for your attention!

Please remember:

Fresh produce is an essential part of a healthy diet.

Acknowledgements:

Bacteria analyses, Norwegian Veterinary Institute – Gro Johannessen

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