PARASITES

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Introduction

• We’ll look at some of the parasites that are transmitted via food and water, with emphasis on those most prevalent in North America.
• Metazoan parasites may be quite visible, but are typically transmitted at a microscopic stage in their lives.
• All have sexual reproduction, but some are hermaphrodites.
• Life cycles often involve two or more host species.

Roundworms

*Trichinella spiralis* — trichinosis (potentially fatal)

• Larval cysts in pork or muscles of other carnivores (bears)
• Mating in intestine, ovovivipary, larvae via lymph & blood to muscles, encystation
• Prevention by thorough cooking (or freezing or irradiation) of meat

*Ascaris lumbricoides*

• Large roundworms may cause intestinal obstruction
• Transmitted by eggs in human feces; under favorable conditions, eggs mature after 2-3 weeks, may remain viable in soil for years

*Anisakids* (*Anisakis simplex, Pseudoterranova decipiens* are principal species)

• Larvae from marine fish eaten raw (sushi, ceviche, etc.) are sometimes invasive.
• Complex life cycle: “definitive” hosts are cetacea (e.g., dolphins, porpoises) for *Anisakis* or pinnipeds (seals, walruses) for *Pseudoterranova*
• Prevention by cooking fish thoroughly, or freezing

Tapeworms

*Taenia saginata* — beef tapeworm (rare in US and Canada)

• Cysticerci (macroscopically visible) ingested with raw or undercooked beef
• Scolex attaches in intestine, generates a tape of proglottides; many years of essentially inapparent infection may follow, with shedding of eggs or proglottides in feces.
• If human feces are applied to land where cattle ingest them, the eggs produce oncospheres which give rise to cysticerci in the bovine tissues.
Taenia solium — pork tapeworm (in U.S. principally as imported cases from Latin America)
- Cysticerci (macroscopically visible) ingested with raw or undercooked pork
- Scolex attaches in intestine, generates a tape of proglottides; many years of essentially inapparent infection may follow, with shedding of eggs or proglottides in feces.
- If human feces are disposed where swine can ingest them, the eggs produce oncospheres, which give rise to cysticerci in the swine tissues.
- Taenia solium eggs are infectious perorally for humans: tapeworm carriers may autoinfect themselves or contaminate food they touch, or their feces may transmit the eggs to other people via food or water; the result is cisticercosis, often of the CNS, in the recipient human.

Diphyllobothrium latum — fish tapeworm (Asia, Europe, North & South America)
- Plerocercoid ingested with fresh water fish; scolex attaches in intestine, producing the largest tapeworm that infects humans (other species that eat raw fish are also definitive hosts, but produce a low proportion of viable eggs); eggs shed in feces that reach water infect copepods which are later eaten by fish; other species infect humans.
- Symptoms in humans are usually trivial, but vitamin B₁₂-deficiency anemia sometimes occurs.

Flukes (seldom foodborne in North America)

Clonorchis sinensis, Opisthorchis spp., Metagonimus yokagawai, Heterophyes heterophyes — fish flukes (limited distributions)
  - Definitive hosts are humans or other fish-eating vertebrates; hermaphroditic adults in
    liver produce eggs shed in feces, intermediate host is a very specific snail species, fish are
    the food vehicle, metacercariae the infectious form.

Paragonimus westermani — lung fluke (limited distributions on several continents)
  - Eggs from flukes in lung are passed with sputum or swallowed and passed in feces; snail
    intermediate hosts, food vehicles are crustacea (crabs and crayfish) eaten raw.

Fasciola hepatica — liver fluke (widespread, but sporadic in North America)
  - Principal definitive hosts are sheep and cattle (other species reported, accidental in
    humans), eggs shed via bile in feces, snail intermediate host; vehicles for human infection
    are water plants (e.g., watercress) on which metacercariae have encysted, eaten raw.

Fasciolopsis buski — intestinal fluke (occurs in southeast Asia)
  - Main definitive hosts are humans, pigs, and dogs; unembryonated eggs shed in feces
    develop and hatch in fresh water within 3–7 weeks at 27–32°C; snail intermediate host;
    food vehicles are water plants that have encysted metacercariae.
Summary

- Roundworms, tapeworms, and flukes are transmitted to humans via food and water in many parts of the world.
- Nonhuman hosts play a vital role in the life cycles of many of these parasites.
- Careful disposal of human waste can have a significant effect in reducing the threat of some of these.
- Foods can be made safe by cooking, but not all foods are customarily cooked.

Bibliography


CDC parasites site: http://www.dpd.cdc.gov/dpdx/
## Transmission of major foodborne parasites:

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<th>Food vehicle</th>
<th>Source or mode of contamination</th>
<th>Parasite species</th>
<th>Infectious form</th>
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<tbody>
<tr>
<td>Drinking water</td>
<td>Feces (human)</td>
<td><em>Cyclospora cayetanensis</em></td>
<td>Oocyst</td>
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<td><em>Entamoeba histolytica</em>&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Cyst</td>
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<td>Feces (human &amp; animal)</td>
<td><em>Cryptosporidium parvum</em></td>
<td>Oocyst</td>
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<td><em>Giardia lamblia</em></td>
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<td><em>Toxoplasma gondii</em></td>
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<td>Foods contaminated in handling</td>
<td>Handling by infected person (feces)</td>
<td><em>Cryptosporidium parvum</em></td>
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<td><em>Taenia solium</em></td>
<td>Egg (proglottid)</td>
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<td>Vegetables and fruits contaminated in the field</td>
<td>Agent in feces-contaminated soil and water</td>
<td><em>Ascaris lumbricoides</em>&lt;sup&gt;b&lt;/sup&gt;</td>
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<td><em>Fasciola hepatica</em></td>
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<td><em>Fasciolopsis buski</em></td>
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<td>Meats (raw or rare)</td>
<td>Infected food animal</td>
<td><em>Taenia saginata</em></td>
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<sup>a</sup> Perhaps also *Balantidium coli*

<sup>b</sup> Perhaps also *Trichuris trichiura*