

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 cysticercosis, 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 an 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.

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CDC parasites site: <http://www.dpd.cdc.gov/dpdx/>

Transmission of major foodborne parasites:

Food vehicle	Source or mode of contamination	Parasite species	Infectious form
Drinking water	Feces (human)	<i>Cyclospora cayetanensis</i>	Oocyst
		<i>Entamoeba histolytica</i> ^a	Cyst
	Feces (human & animal)	<i>Cryptosporidium parvum</i>	Oocyst
		<i>Giardia lamblia</i>	Cyst
		<i>Toxoplasma gondii</i>	Oocyst
Foods contaminated in handling	Handling by infected person (feces)	<i>Cryptosporidium parvum</i>	Oocyst
		<i>Entamoeba histolytica</i> ^a	Cyst
		<i>Giardia lamblia</i>	Cyst
		<i>Taenia solium</i>	Egg (proglottid)
Vegetables and fruits contaminated in the field	Agent in feces-contaminated soil and water	<i>Ascaris lumbricoides</i> ^b	Egg
		<i>Cryptosporidium parvum</i>	Oocyst
		<i>Cyclospora cayetanensis</i>	Oocyst
		<i>Entamoeba histolytica</i> ^a	Cyst
		<i>Fasciola hepatica</i>	Metacercaria
		<i>Fasciolopsis buski</i>	Metacercaria
		<i>Giardia lamblia</i>	Cyst
		<i>Taenia solium</i>	Egg (proglottid)
		<i>Toxoplasma gondii</i>	Oocyst
Meats (raw or rare)	Infected food animal	<i>Taenia saginata</i>	Cysticercus
		<i>Taenia solium</i>	Cysticercus
		<i>Toxoplasma gondii</i>	Bradyzoite (tissue cyst)
		<i>Trichinella spiralis</i>	Cyst
Fish and seafood (raw or rare)	Infected fish (sea)	Anisakids	Larva
	Infected fish (fresh water)	<i>Clonorchis sinensis</i> , etc.	Metacercaria
	Crustacea	<i>Diphyllobothrium latum</i>	Plerocercoid
		<i>Paragonimus westermani</i>	Metacercaria

^a Perhaps also *Balantidium coli*^b Perhaps also *Trichuris trichiura*