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Food Safety—Related Aspects of Parasites in Foods

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Summary As natural foods derive from soil or water environments, they may contain the infective stages of parasites endemic to these environments. Infective stages may enter the human food supply via infected animal hosts so there is a need for increased awareness of the impact of parasites on the food supply. Safe handling of food and good kitchen hygiene can prevent or reduce the risk posed by contaminated foodstuffs. In addition, parasites cannot cause a health problem in any thoroughly cooked foods.

Key Words parasites, foods

Parasites derive their nutrition from their hosts, and can thereby cause disease among humans. Some parasites, helminths and protozoa, can be transmitted directly or indirectly between animals and humans through food- and water-borne routes (*1*), particularly in Southeast Asia, Africa, and the Western Pacific. Animal husbandry represents a valuable source of food and employment in the developing countries in these regions. Clinical symptoms of infection vary, depending on the type of parasite ingested, ranging from mild discomfort to illness and possibly death (*2*, *3*). Parasites can also be transmitted to humans or animals through intermediate hosts (Table 1).

Food- and Animal-Borne Transmitted Helminths

Transmission is almost entirely caused by the consumption of food containing infective parasite stages that have developed in food animals. The distribution of disease is highly focal, depending on the food habits of the people eating raw, lightly cured or insufficiently cooked foods and the presence of susceptible intermediate parasite hosts including specific definitive hosts (*4*, *5*). High numbers of definitive reservoir hosts can contaminate water and intermediate hosts, making it difficult to control the parasite's life cycle. These parasites include *Angiostrongylus* spp., *Anisakis* spp., *Capillaria philippinensis*, *Clonorchis sinensis*, *Dicrocoelium dendriticum*, *Diphyllobothrium latum*, *Echinostoma* spp., *Eurytrema pancreaticum*, *Fasciola* spp., *Fasciolopsis buski*, *Gnathostoma* spp., *Haplorchis* spp., *Heterophyes* spp., *Hymenolepis* spp., *Metagonimus* spp., *Opisthorchis* spp., *Paragonimus* spp., *Phaneropsolus* spp., *Prosthodendrium molenkampi*, *Spirometra mansoni*, *Taenia* spp., *Toxocara* spp., and *Trichinella* spp.

Soil-Transmitted Helminths (Geohelminths)

Soil-transmitted helminths are a group of nematodes, the infective stages of which--eggs or larvae--develop after incubation in soil. The most common species are *Ascaris lumbricoides*, *Ancylostoma duodenale*, *Necator americanus*, *Strongyloides stercolaris*, *Trichostrongylus* spp., and *Trichuris trichiura*, which are highly prevalent in the tropics (*6*), with the highest number of infections among people from Asia, Latin America, and Africa. Soil-transmitted helminth diseases deleteriously affect health, particularly among children with high worm burdens living in poor rural communities with inadequate sanitation. The infective stage of the worm contaminates the ground due to the lack of an appropriate latrine or when human excreta are used as a crop fertilizer. These worms directly affect nutritional status, physical development, and educational performance.

Food- and Water-Borne Transmitted Protozoa

Small bowel diarrhea: Watery diarrhea with some mucus but no blood can cause dehydration or malabsorption syndrome. The causative organisms often occur among travelers, and immunocompromised patients, and immunocompetent hosts. They comprise the flagellate group: *Giardia duodenalis*, the coccidian group: *Cryptosporidium parvum*, *Cyclospora cayetanensis*, *Isospora belli*, the microsporidian group: *Microspora* spp. and the amoeba group: *Blastocystis* spp. (*7*).

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Table 1. The most common parasites transmitted by fresh foods.

Group/Genus	Infective stage	Common sources
Food-animal borne transmitted parasites: Nematodes (roundworms)		
Angiostrongylus	3rd stage larvae	molluscan intermediate hosts, slugs, reptiles, amphibians, crustaceans (prawns, shrimp, crabs)
Anisakis	3rd stage larvae	marine fish (salmon, cod, herring, haddock, pollock, halibut, common mackerel), squid
Capillaria	1st stage larvae	fresh water fish (*Hypseleotris bipartita*)
Gnathostoma	3rd stage larvae	swamp eels, loaches, fresh water fish (snake-headed fish, cat fish, carp, tilapias), amphibians, reptiles, birds, mammals
Trichinella	Encysted larvae	carnivorous animals, mammals
Toxocara	Embryonated eggs, 2nd stage larvae	fresh vegetables, mammals
Trematodes (flukes)		
Clonorchis	Metacercaria cysts	fresh water fish
Dicrocoelium	Metacercaria cysts	vegetables, insects (ants)
Echinostoma	Metacercaria cysts	fresh water snails, clams, tadpoles, newt, fresh water fish
Eurytrema	Metacercaria cysts	aquatic insect larvae (naiad) of the dragon fly
Fasciola	Metacercaria cysts	aquatic plants, vegetables, weed
Fasciolopsis	Metacercaria cysts	aquatic plants
Opisthorchis	Metacercaria cysts	fresh water fish
Paragonimus	Metacercaria cysts	crustaceans (crabs, crayfish), wild boars, rodents
Phaneropsolus	Metacercaria cysts	fresh water fish
Prosthodendrium	Metacercaria cysts	fresh water fish
Minute intestinal flukes (*Haplorchis*, *Heterophyes*, *Metagonimus*)	Metacercaria cysts	fresh water fish
Cestodes (tapeworms)		
Diphyllobothrium	Plerocercoid larvae	marine fish (salmon, trout, pike, perch, turbot)
Hymenolepis	Egg, Cysticercoid larvae	fresh vegetables, contaminated foods with fleas, insects
Spirometra	Plerocercoid larvae	amphibians, reptiles, birds, mammals
Taenia	*Cysticercus* larvae	pigs, cows, buffaloes
Soil-transmitted helminths (geohelminths):		
Ascaris	Embryonated eggs	fresh vegetables
Ancylostoma	3rd stage larvae (Filariform larvae)	fresh vegetables, fresh water fish, snails
Necator	3rd stage larvae (Filariform larvae)	fresh vegetables, fresh water fish, snails
Strongyloides	3rd stage larvae (Filariform larvae)	fresh vegetables
Trichostrongylus	3rd stage larvae (Semifilariform larvae)	fresh vegetables
Trichuris	Embryonated eggs	fresh vegetables
Food- and water-borne transmitted protozoa:		
Crytosporidium	Oocysts	fresh vegetables, salad, milk, cider, water, molluscs
Cyclospora	Oocysts	fresh vegetables (Basil), fruits (Raspberries), water
Giardia	Cysts	fresh vegetables, fruit salad, water
Isospora	Oocysts	fresh vegetables, water
Microspora	Spores	fresh vegetables, water
Blastocystis	Cysts	fresh vegetables, water