

Diphyllobothrium latum

Scientific name: *Diphyllobothrium latum*
English names: “*Bothriocephalus*⁽¹⁾”, “fish tapeworm”
Helminths
phylum Plathelminths (flatworms)
Parasite

Characteristics and sources of *Diphyllobothrium latum*

Main microbiological characteristics



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Adult *Diphyllobothrium* (rings are about 1 cm wide)

Diphyllobothrium is a flat tapeworm (class Cestoda, Order Pseudophylidia, family Diphylobothriidae) around ten meters long that can live for several years. It is responsible for a gastrointestinal parasitic infection called diphyllobothriasis.

The life cycle of the parasite (Figure 1) involves a definitive host⁽²⁾: humans (and other fish-eating mammals) and at least two intermediate hosts⁽³⁾: a planktonic crustacean and one or more freshwater fish. In favourable environmental conditions, the eggs (45 × 65 µm), after being released in freshwater with the faeces of the definitive host, complete their maturation in 8-12 days and then hatch and release a ciliated embryo, the coracidium. This is ingested by a microscopic crustacean of the genera *Cyclops* or *Eudiaptomus* and turns into larvae (called proceroids) within the body cavity. When a carnivorous fish ingests this planktonic crustacean, the larva turns into a second type of larva (called plerocercoids), a few millimeters long. This becomes encysted in the musculature or viscera of the fish. Humans and other fish-eating mammals then become contaminated after ingesting the raw or undercooked flesh of these freshwater fish. Once in the intestine of the definitive host, the plerocercoid larva grows

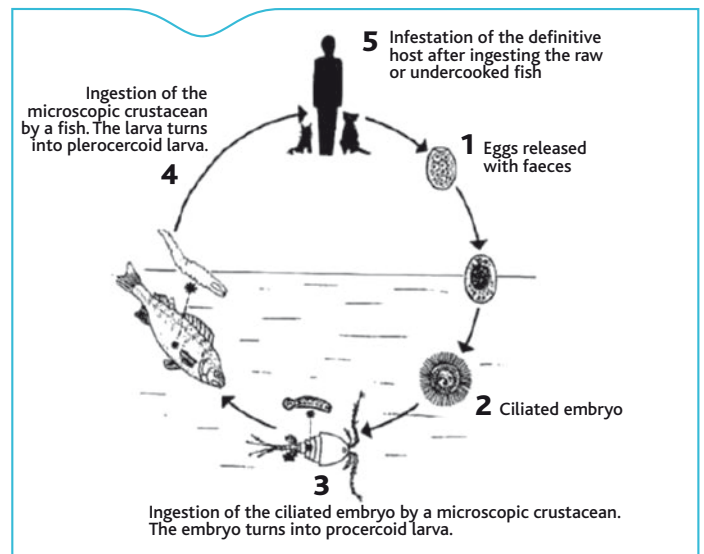


Figure 1. Biological cycle of *Diphyllobothrium latum* (according to Wicht and coll., 2010)

by several centimeters a day and the first eggs are released with faeces, approximately one month after infestation. Several species of this parasite are pathogenic for humans, but only *D. latum* can be contracted from freshwater fish found in mainland France. However, cases of infestation by *D. nihonkaiense* (Pacific species) have been observed among consumers of salmon (*Onchorynchus* sp.) imported from the Pacific (Canada).

Sources of the hazard

The source of the hazard consists of carnivorous freshwater or anadromous (i.e. living in both fresh and salt water) fish.

The reservoir consists of the parasite’s definitive hosts (humans, cats, dogs, foxes, etc.) and its intermediate hosts (carnivorous fish).

(1) The name *Bothriocephalus* should no longer be used because it corresponds to a different genus of intestinal parasite of many species of fish that differs from the genus *Diphyllobothrium*.

(2) Definitive host: host that harbours the adult parasite.

(3) Intermediate host: host that harbours the larval form of the parasite.



Proceroid larva on the surface of a perch fillet

Transmission routes

This parasite affects fish-eating mammals and fish, and can therefore cause a zoonosis.

Human contamination occurs exclusively through eating raw or undercooked fish flesh or eggs. Eggs released with human faeces are not direct contaminants.

Recommendations for primary production

- In principle, given the complexity of the cycle, the parasitosis is unlikely to affect fish farms.

Foodborne human disease

Nature of the disease (Table 1)

Susceptible population group(s) ⁽⁵⁾

There is no evidence to date to suggest that there is a population at higher risk of infection or complications.

Dose-effect ⁽⁶⁾ and dose-response ⁽⁷⁾ relationships

A single plerocercoid larva can cause infestation.

Epidemiology

Monitoring system

There is no system for monitoring diphyllobothriasis in France or Europe (except in Poland and the Baltic states).

Prevalence

Diphyllobothriasis is a cosmopolitan parasitosis, consistently found in Western Europe. It is decreasing in the Baltic or Scandinavian countries that were its historical foci. However, it seems to be emerging in the French- and Italian-speaking areas of the perialpine lakes where commercial fishing is common. Since 1987, over 200 cases have been reported or published around the lakes Geneva, Murten, Biel, Maggiore, Como, Iseo and Garda. Lake Geneva seems particularly affected, with 48 cases of contamination being identified on its Swiss and French watersheds in 2001 and 2002. Between 2002 and 2007, 44 cases were identified in the medical analysis laboratories of Haute-Savoie.

Role of foods

Main foods to consider

Foods involved are the raw flesh (marinated fillets, carpaccio, etc.) or raw eggs of freshwater fish: perch (*Perca fluviatilis*), pike (*Esox lucius*), Arctic char (*Salvelinus alpinus*), burbot (*Lota lota*), etc. Four to ten per cent of perch fillets consumed on the banks of Lake Geneva carry the parasite. Coregonid fish (fera) and probably European salmonids of the genus *Salmo* are resistant to *D. latum*. Canadian salmonids of the genus *Onchorynchus* may host larvae of *D. nihonkaiense*.

Inactivation treatments in industrial environments

Table 2. Inactivation treatments in industrial environments

Disinfectants	Effects of temperature
No data	<ul style="list-style-type: none"> • Cooking at 65°C kills plerocercoid larvae. • Freezing at -20°C kills plerocercoid larvae in 8-72 hours depending on the thickness of the fish.
High pressure	Salting
No data	Plerocercoid larva survival: <ul style="list-style-type: none"> • 7 days in a solution of 1% NaCl, • 2 hours in a solution of 10% NaCl, • 15 minutes in a solution of 20% NaCl.
Ionisation	Smoking / pickling
No data	Ineffective

(4) This vitamin B12 deficiency anaemia has been described in cases of prolonged multiple infestation in undernourished populations because the worm absorbs this vitamin.

(5) Susceptible population group: people with a higher than average probability of developing symptoms of the disease, or severe forms of the disease, after exposure to a foodborne hazard [definition used in ANSES data sheets].

(6) Relationship between the dose (the quantity of microbial cells ingested during a meal) and the effect on an individual.

(7) For a given effect, the relationship between the dose and the response, i.e., the probability of this effect appearing in the population.

Table 1. Characteristics of the disease

Mean incubation period	Target population	Main symptoms	Duration of symptoms	Duration of the contagious period	Complications	Asymptomatic forms
1 month	Consumers of raw or undercooked fish flesh (particularly lake anglers)	Gastrointestinal symptoms: abdominal pain, diarrhoea General symptoms: asthenia, dizziness, etc. Hypereosinophilia	Entire lifespan of the parasite in the intestine	Entire lifespan of the parasite in the intestine	Exceptional megaloblastic anaemia ⁽⁴⁾ No lethality	Yes

Monitoring in food

There are no regulations on detection of the parasite applicable to foodstuffs identified as being at risk. There is no standardised method for detecting, counting and typing. The plerocercoid larvae can be observed by direct examination of fillets cut into thin strips. Due to the presence of larvae of other similar parasites, molecular identification is useful for confirming species diagnosis.

Recommendations to operators

- With regard to collective hygiene, treatment of wastewater in modern sewage plants is able to interrupt the transmission cycle.
- The usual food hygiene measures (washing of food, hands, etc.) have no effect on the larvae, nor does storage in the refrigerator.
- The European Regulation ⁽⁸⁾ requires freezing of the flesh of fish intended to be eaten raw in restaurants.

Domestic hygiene

Storage of fish in the refrigerator does not affect the survival of the parasite. Freezing ensures inactivation.

Recommendations to consumers

- Cooking (65°C) or freezing (for 7 days in a domestic freezer) fish are the only measures to avoid contamination.

(8) Regulation (EC) No 854/2004 of the European Parliament and of the Council of 29 April 2004 laying down specific rules for the organisation of official controls on products of animal origin intended for human consumption (<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:226:0022:0082:EN:PDF>)

References and links

General references

- von Bonsdorff B. (1977). Diphyllobothriasis in man. Editions Academic Press, Londres.
- Dupouy-Camet, J. and Peduzzi, R. (2004). Current situation of human diphyllobothriasis in Europe. *Euro Surveill*ance, 5, 31-35. <http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=467&LanguageId=2>
- Wicht, B., Peduzzi, R. and Dupouy-Camet, J. (2010). Diphyllobothriose. *In: Actualités permanentes en bactériologie clinique*, vol. IX, Editions ESKA, Paris. http://congres.eska.fr/pdf/APBC_1_2010.pdf

Useful links

- DPDx - CDC: <http://www.dpd.cdc.gov/dpdx/>
- Expertise parasitologique et identification moléculaire disponibles dans le Laboratoire de parasitologie de l'hôpital Cochin, 27 rue du Faubourg Saint-Jacques, 75014 Paris
- FDA: <http://www.fda.gov/Food/FoodSafety/FoodborneIllness/FoodborneIllnessFoodbornePathogensNaturalToxins/BadBugBook/ucm070785.htm>
- FAO/OMS: <http://www.fao.org/docrep/006/y4743e/y4743e0c.htm#TopOfPage>
- Laboratoire national de référence (LNR) des parasites transmis par les aliments, hormis *Echinococcus* sp.: Laboratoire de santé animale – Anses, Maisons-Alfort
- Reportage de la Télévision Suisse Romande, sur le risque de manger des poissons crus: <http://www.rts.ch/emissions/abe/1375410-poissons-crus-ou-peu-cuits-attention-aux-parasites.html>