

LIFE CYCLE OF *Hymenolepis*

CONTENTS

1. Introduction
2. Classification
3. Distribution
4. Habitat
5. Food Habits
6. Morphology
7. Life Cycle
8. Reproduction
9. Behaviour
10. Communication and Perception
11. Ecosystem Role
12. Hymenolepiasis
 - Symptoms
 - Diagnosis
 - Treatment
 - Prevention
13. Case Report

Introduction

The generic name is derived from the membranous character of the egg shell (from G. *hymen*, membrane; *lepis*, kind or shell). The characteristics of the genus Hymenolepis are as follows:

There are three testis in each mature segment.

The uterus is sac-like and transverse.

The individual segment is greater in breadth than in length.

The egg possesses two membranes:

The outer one (egg-shell) is thin and transparent.

The larval stage is Cysticercoid.

Hymenolepis diminuta, also known as rat tapeworms, is a species of Hymenolepis tapeworm that causes Hymenolepiasis. It has slightly bigger eggs and proglottids than H. nana and infects mammals using insects as intermediate hosts.

The adult structure is 20 to 60 cm long and the mature proglottid is similar to that of H. nana, except it is large.

CLASSIFICATION

Kingdom	Animalia
Phylum	Platyhelminthes
Class	Cestoda
Order	Cyclophyllidea
Family	Hymenolepididae
Genus	<u>Hymenolepis</u>
Species	<u>diminuta</u>

Hymenolepis diminuta (Rudolphi, 1819)

DISTRIBUTION

Hymenolepis diminuta, has been reported from various areas of the world. But only a few hundred human cases have been reported.

Few cases have been reported in Australia, United States, Spain and Italy. In countries like Malaysia, Thailand, Jamaica, Indonesia, the prevalence is higher.

HABITAT

The adult worm lives in the intestine of its host, normally rats but also sometimes dogs and humans. Hymenolepis diminuta passes through the required intermediate arthropod host as juvenile. Only when the intermediate host is ingested by the definitive host will H. diminuta mature. The intermediate arthropod host is normally a grain beetle, and ingestion of the intermediate host into the definitive host normally occurs in piles of grain, where both rats and beetles live.

Habitat regions: temperate, tropical.

Terrestrial biomes: desert or dune; savanna or grassland; chaparral; forest; rainforest; scrub forest; mountains.

Other habitat features: urban, sub-urban, agricultural.

FOOD HABITS

Hymenolepis diminuta has no digestive tract, all nutrients needed must be absorbed by the tegument, which is the external covering of the cestode. The cestode is covered in tiny posteriorly directed microtriches which increase the absorptive area of the tegument. The **glycocalyx** found on the surface membrane of the microtriches is a layer of carbohydrate-containing macromolecules. Interaction between the glycocalyx and certain molecules has been reported to enhance **amylase activity** in H. diminuta, inhibit the host **trypsin**, **chymotrypsin** and **pancreatic lipase** and increase the absorption of cations and absorption of bile salts.

Primary diet: carnivore (eats body fluids)

Animal Food: body fluids.

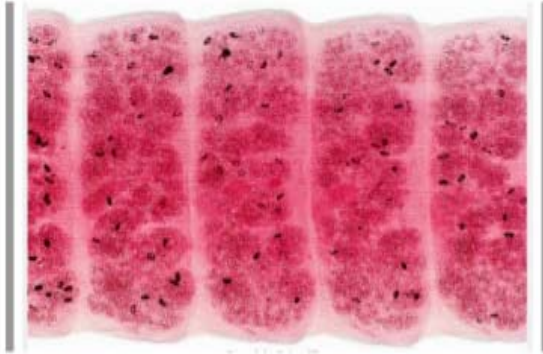
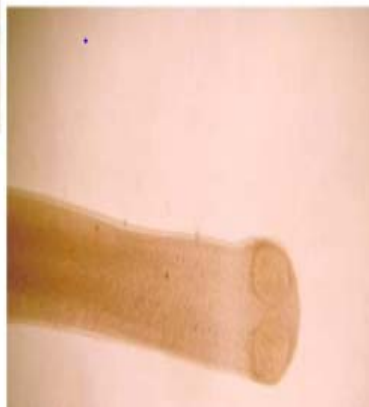
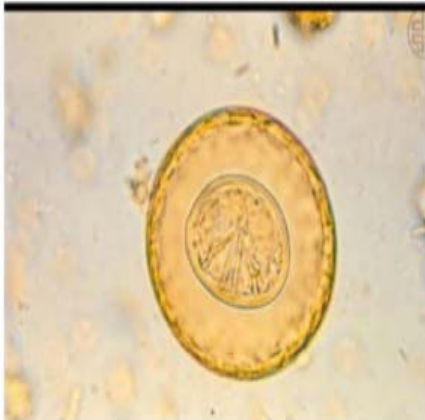


Figure D: Proglottids of *H. diminuta* stained with carmine. Notice the craspedote form of the proglottids.



MORPHOLOGY

Adult Hymenolepis diminuta reach 20 to 60 cm, and up to 90 cm. The cestode has a long cylindrical body. The unarmed "head" has four suckers and an apical organ at its scolex with no rostellum hooks. The proglottids number about 800 to 1000. The mature proglottids are much broader than long (2.5 mm by 0.75 mm).

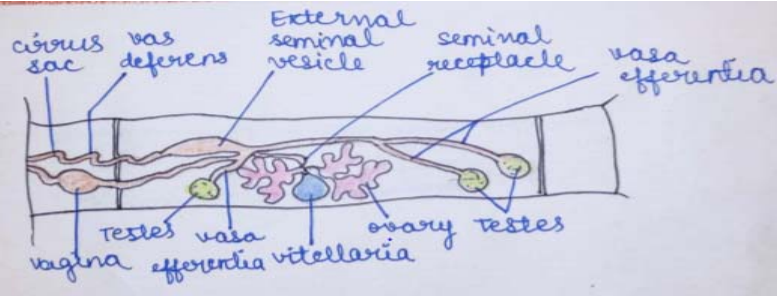
Hymenolepis diminuta, along with all cestodes, lacks any trace of a digestive tract, and it absorbs all required substances through its external covering. Posteriorly directed microtriches cover the cestode's tegument, which add to the surface area of the animal and thus to the amount of nutrients it can absorb.

Hymenolepis diminuta, has three body sections:

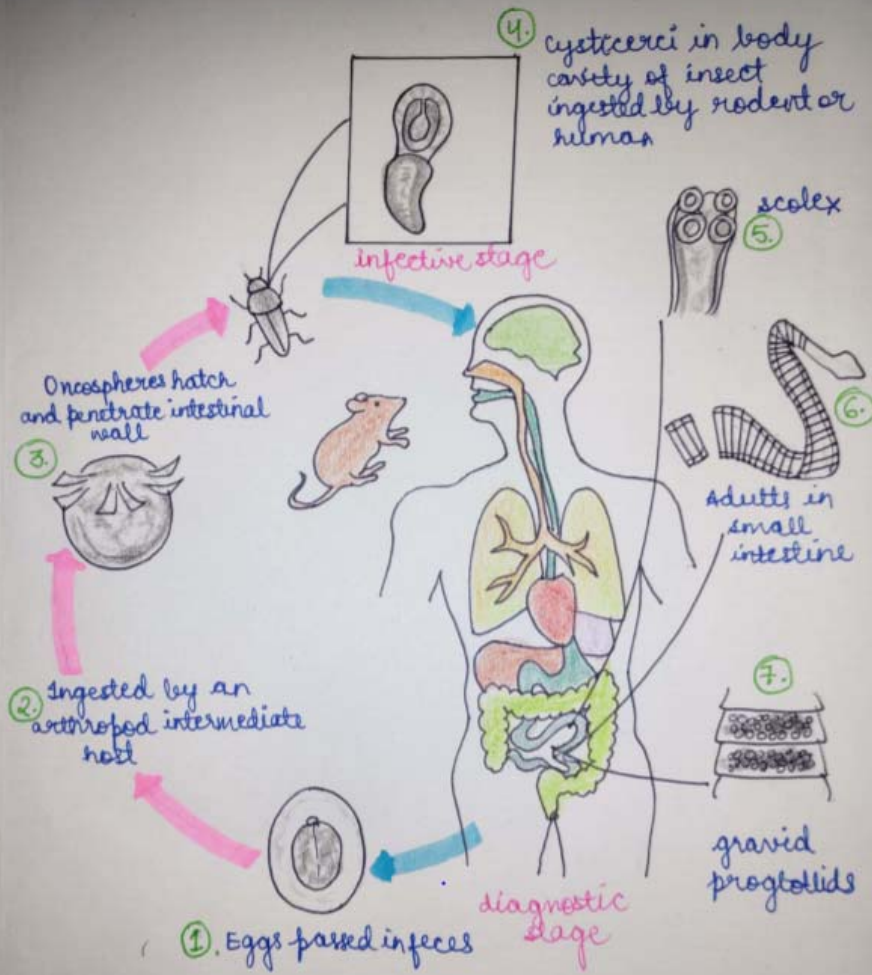
1. Scolex (head)
2. Neck
3. Strobilus

The strobilus is divided into many sections called proglottids, each with male and female sexual organs. These are the defining characteristics of cestodes.

Other Physical Features: Ectothermic, heterothermic, bilateral symmetry



Segment of *H. diminuta*



Life Cycle of *Hymenolepis diminuta*

LIFE CYCLE

The life cycle of H. diminuta involves Rodents (rats primarily) as the definitive host and beetles (flour and grain beetles, Tribolium spp. and Tenebrio spp., respectively) as the intermediate host.

- ① The mature eggs are passed into the rat's feces, and are ingested by the intermediate host (various arthropod adults or larvae).
- ② Onchospheres are released from the eggs and penetrate the intestinal wall of the host.
- ③ which develop into cysticercoid larvae. species from the genus Tribolium. the cysticercoid larvae persist through the arthropod's morphogenesis to adulthood. H. diminuta infection is acquired by the mammalian host after ingestion of an intermediate host carrying the cysticercoid larvae.
- ④ Humans can be accidentally infected through the ingestion of insects in pre-cooked cereals or other food items and directly from the environment. (eg. oral exploration of the environment by children). After ingestion, the tissue of the infected arthropod is digested releasing the cysticercoid larvae in the stomach and small intestine. Eversion of the scolex.

⑤ occurs shortly after the cysticercoid larvae are released. Using the four suckers on the scolex, the parasite attaches to the small intestine wall. Maturation of the parasite occurs within 20 days and the adult worms can reach an average of 30 cm in length.

⑥ Eggs are released in the small intestine from gravid proglottids.

⑦ That disintegrate after breaking off from the adult worms. The eggs are expelled to the environment in the mammalian host's feces.

Additionally, more infections occur due to the mechanism of egg dispersal.

⇒ Species used as host:

- Rats Rattus
- Dogs Canis
- Arthropods Arthropoda
- Grain beetles Cucujidae
- Stored-grain beetles Tribolium
- Mealworm beetles Tenebrio
- Humans Homo sapiens



Hymenolepis diminuta egg from stool sample (under $\times 40$ magnification)



Figure B: *Tribolium castaneum*, another beetle commonly found in grain products that may serve as an intermediate host for *Hymenolepis* spp. Image courtesy of Parasite and Diseases Image Library, Australia.



Figure C: Eggs of *H. diminuta* in an unstained wet mount of concentrated stool. Image taken at $200\times$ magnification.



Figure A: *Tribolium confusum*, a common intermediate host for *Hymenolepis* spp. *Tribolium* and related genera breed in cereals, grains, and grain-based snack foods and are easily ingested by humans and rodents. Since these food products are usually not heated prior to consumption, cysticercoids within the beetles remain viable and infective. Image courtesy of Parasite and Diseases Image Library, Australia.



Figure D: Higher magnification ($400\times$) of one of the eggs in Figure C.



Figure E: Egg of *H. diminuta* in a wet mount stained with iodine. Four of the hooks are visible at this level of focus.

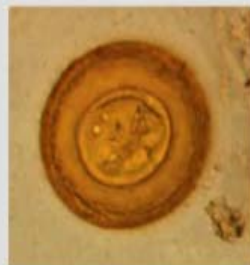


Figure A: Egg of *H. diminuta* in a



REPRODUCTION

Hymenolepis diminuta has both male and female reproductive organs in the same individual (Hermaphrodite). Each segment has one complete set of male and female sex organs. As the segments move toward the posterior end of the strobilus, first the male organs mature, and produce sperm that are stored until the maturation of the ovary. Once the adult H. diminuta is embedded in the host, it can produce over 250,000 eggs per day. Thus, over a period of slightly over a year, a single tapeworm could produce a hundred million eggs and if all these eggs are reached maturity, it would be equal to 20 tons of tapeworm tissue. There is an extremely low chance for each egg to reach reproductive maturity and that is why H. diminuta lays so many eggs.

Recent studies have been on the temperature tolerance of H. diminuta eggs. The tapeworm's eggs survived at higher and lower temperatures and for longer periods of time than did adult beetles, indicating that the thermal tolerance of the eggs does not limit the parasite's distribution.

BEHAVIOUR

A behaviour modification of *H. diminuta* is the cestode's movement. The cestode has two types of muscle portions in the strobiles, the contractile myofibril and the non-contractile myocytion. The myocytion contain a nucleus, rough endoplasmic reticulum (RER), free ribosomes, a vesicular golgi apparatus, few mitochondria and abundant glycogen. Lipid is stored in them as well. The myofibril contain actin and myosin filaments which do the same contractions and make movement possible. The contractile portions of the muscle cells are arranged in discrete bundles and propagation of contractions down the body make movement possible. The internal musculature of the scolex is complex, making the scolex extraordinarily motile. The scolex has three distinct muscle types:

- the peripheral myofibers.
- tentacle retractor muscles.
- tentacle bulb muscles.

The bulb muscles are obliquely striated and have numerous motor end plates. Thus the muscular system of *H. diminuta* is complex.

Key Behaviour: Parasite, motile, sedentary.

Communication & Perception

Cestodes in general have sensory organs in the scolex, which are attached to longitudinal nerves extending down the body. The nerves are attached to organs and the cestodes can detect tactile stimulation.

Communication Channels: Tactile

Perception Channels: Tactile.

Ecosystem Roles

The adult worm lives in the intestine of its host, normally rats but also sometimes dogs and humans. *H. diminuta* passes through the required intermediate arthropod host as a juvenile. Only when the intermediate host is ingested by the definitive host will *H. diminuta* mature. The intermediate arthropod host is normally grain beetle, and ingestion of the intermediate host into the definitive host normally occurs in piles of grain, where both rats and beetles live.

HYMENOLEPIASIS

Hymenolepiasis is an infectious disease.

Symptoms:

Hymenolepiasis does not always have symptoms, but they usually are described as abdominal pain, loss of appetite, itching around anus, irritability, diarrhea, nausea, anorexia.

Diagnosis:

Diagnosis is made by the identification of ova in stool samples. Egg counts in stool of over 10,000 eggs per gram are considered heavy infection. Concentration techniques and repeated examinations will increase the likelihood of detecting light infections.

Treatment:

Paraziquantel - adult and children, 25 mg/kg in a single dose therapy.

Niclosamide: adult, 2 gm in a single dose for 7 days. children 11-34 kg, 1 gm in a single dose on day 1 then 500 mg per day orally for 6 days.

Nitazoxanide adults, 500 mg orally twice daily for 3 days; children aged 12-47 months, 100 mg orally twice daily for 3 days; children 4-11 years, 200 mg orally twice daily for 3 days.

Oral praziquantel is available for human use in United States.

PREVENTION:

Good hygiene, public health and sanitation programs and elimination of infected rats help to prevent the spread of hymenolepiasis. Preventing fecal contamination of food and water in institutions and crowded areas is of primary importance. General sanitation and rodent and insect control (especially control of fleas and grain insects) are also essential for prevention.