

TOXOPLASMA GONDII

THE ORGANISM/TOXIN

This organism is an obligate intracellular protozoan parasite that is able to infect warm blooded animals and birds. The results of infection can range from being asymptomatic in healthy adults to miscarriages with death of the foetus.

The organism has a complicated life cycle with numerous stages.

Infected cats are the only species to shed oocysts in their faeces which subsequently sporulate in the environment. These can be ingested by humans, and the sporozoites released enter the body. The invasive tachyzoites, which are derived from the sporozoites, then invade body tissues.

Otherwise, meat animals that have been infected in the same way as man eventually produce cysts (which contain large numbers of bradyzoites) in muscle tissue. If eaten by humans the digestive juices break down the cyst to release the bradyzoites which transform to tachyzoites and cause infection.

GROWTH AND ITS CONTROL

Growth: The organism does not grow in foods or in other environments outside of a suitable host.

Survival: The resting stage, or oocysts can survive outside of susceptible hosts.

Temperature: Oocysts in faeces or suspended in water retained infectivity for up to 400 days at temperatures ranging from 4 to 37°C.

Sporulated oocysts are killed to some extent by freezing at -21°C, while unsporulated oocysts are killed within 1-7 days at this temperature.

Water Activity: Sporulated oocysts are gradually inactivated by drying.

Encysted *T. gondii* survived for 4 days in 8% NaCl.

Inactivation (CCPs and Hurdles):

Temperature:

Cysts in pork were killed in 336 sec at 49°C, 44 sec at 55°C, 6 sec at 61°C.

Microwave heating to 65°C gave variable results for the inactivation of cysts in mutton.

D times for bradyzoites are reported to be; 53.5 min at 49°C, 5.8 min at 55°C, 3.8 min at 61°C and 3.6 min at 67°C.

Meats cooked to 80°C for "several" min do not contain the organism.

Meats cooked "rare" will not have achieved a high enough temperature to destroy the organism.

Cysts present in pork and mutton are inactivated by freezing at temperatures of -9.4°C or lower.

Preservatives: The organism is thought to be susceptible to curing agents used in meat products.

Sanitisers/Disinfectants: (These products must be used as advised by the manufacturer).

Exposure to 28% ammonia for 10 min, 5% ammonia for 30 min, 10% ammonia for 10 min, iodine (7% I₂+5% KI) for 30 min or 1-10% formaldehyde for 24h, eliminates oocysts.

(N.B. The absence of a sanitiser/disinfectant from this section does not necessarily imply that it is ineffective).

Radiation: Exposure of tachyzoites to 70 J m⁻² ultraviolet light renders the organism non infectious. A dose of 1 kGy would ensure that pork is free of the organism.

THE ILLNESS

Incubation: From 3 to around 20 days.

Symptoms: In otherwise healthy people the infection can be asymptomatic. Symptoms may include swollen lymph nodes, a rash, malaise, fever and 'flu' like symptoms, and the disease is usually self-limiting.

In congenital infections: disease of the new born child, or disease in later childhood or adulthood. In babies 5-10% die, 8-10% have brain and eye lesions while 10-13% become visually impaired. Nearly all born with subclinical disease will develop symptoms later on.

In other immunocompromised people disease seems to result from the activation of a previously subclinical infection. AIDS patients can experience a number of symptoms.

Condition: Toxoplasmosis.

Toxins: Toxins are not produced in foods.

At Risk Groups: If infection is acquired during pregnancy the infection can spread to the foetus. The probability of this occurring increases with the trimester of pregnancy; 17% in the first, 24% in the second and 62% in the third. Severity of disease is more significant the earlier infection occurs.

The rate of congenital toxoplasmosis has been estimated at 2-2.5 per 1000 births in Melbourne, but other Australian studies recorded only 10% of this level.

Immunocompromised people are also at more risk of infection. 30% of AIDS patients who are seropositive will develop toxoplasmic encephalitis.

Long Term Effects: Even in otherwise healthy people infection can in rare cases lead to death. Visual impairment and brain damage may follow infections.

Dose: Not established, but likely to be less than 10,000 organisms.

NZ Incidence: Not known.

Treatment: Sulfadiazine and pyrimethamine can be used in combination, but not with pregnant women.

SOURCES

Human: Person-to-person spread has not been described, but sub-clinical human infection can be chronic and become activated if the immune system becomes weakened.

Animal: The significance of beef cattle in the epidemiology of toxoplasmosis is unclear and pigs are considered to be a more significant source of infection. Piglets can be killed by toxoplasmosis, but older infected pigs are asymptomatic.

Sheep and goats can be infected by the organism, and the major clinical effect is abortion.

Other animals that can be infected include birds, horses, game animals (e.g. deer), mice and rats, marsupials and dogs.

Cats are the only animals known to shed oocysts.

Animals such as flies that have come into contact with infected faeces may harbour the organism.

Food: Meat containing *Toxoplasma* cysts may act as a source of human toxoplasmosis.

Infected meat and milk from cattle is not considered to be important, but undercooked pig meat is considered to be significant. Sheep and goat meats are also a potential source of infection for man. Goat milk has also been implicated as a source of disease. Poultry could be a source of infection if it is insufficiently cooked.

Other meats that may be sources of infection include rabbit, horse, and game (e.g. deer).

It has been detected in 1 of 67 ready-to-eat cured meat samples (ham).

Foods that come into contact with contaminated soil could theoretically also act as a transmission route.

Environment: It is possible that the consumption of infected water can result in infection, and outbreaks

have been attributed to this. The source of contamination is thought to be members of the cat family.

Oocysts have been isolated from soils, and soils may be important intermediates in the transmission from cats to humans via buried faeces.

Transmission Routes: Potentially by contact with soil, consumption of contaminated water, contact with cat faeces, or by consumption of contaminated meats (and possibly foods that have been in contact with contaminated soil).

OUTBREAKS AND INCIDENTS

Overseas Outbreaks:

Kangaroo Meat: 12 cases plus one congenital case. Control measure failure: Meat cooked rare.

Goat's Milk: 10 cases. Control point failure: Milk not pasteurised.

Hamburgers: 5 cases. Control point failure: Inadequate heat treatment.

Municipal Water: 94 cases. Control point failure: Open reservoir, no water filtration, chemical treatment insufficient to destroy the organism.

Epidemiology: A study from Norway identified eating raw or undercooked minced meat products, eating unwashed raw vegetables and fruits, eating raw or undercooked mutton, eating raw or undercooked pork, cleaning the cat litter box and washing kitchen knives infrequently as independent risk factors of infection.

Risk factors predictive for acute *Toxoplasma* infection in pregnant European women were; eating undercooked lamb, beef or game (30-63% of infections attributed to this source), contact with soil (6-17% of infections attributed to this source), and travel outside of Europe, the USA and Canada. Contact with cats was not a risk factor.

REFERENCES

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