UNDER THE MICROSCOPE: ZOONOTIC PARASITES IN MEAT

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Biographical details:
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ZOONOTIC PARASITES IN MEAT

Nobody wants to hear about parasites in his meat. We prefer to believe that tapeworms and nematodes like *Trichinella* are parasites that nowadays appear only in history books. Because specialists in this field are hard to find and pertinent information difficult to obtain since textbooks do not really address this subjects, it can be interesting to verify if our beliefs meet today's reality.

In this text, we will discuss only those parasites naturally transmitted to man by carnivorism including fish, namely *Toxoplasma, Sarcocystis, Taenia, Diphyllobothrium, Anisakidae* parasites, and *Trichinella*. Other microorganisms like bacteria, virus and fungi with parasitism as a way of living will not be considered. We will questioned ourselves mainly about today's prevalence, diagnostic and how to destroy and prevent these infections.

Seven species or groups of parasites can be found in different animals' meat used for human consumption (Table 1).

Fish served in sushi, sashimi, ceviche, lomi-lomi or in vinegar favor the infection because non-cooked fish is served or prepared in such a way that parasites are not killed. For other parasites, ingesting raw meat or insufficiently cooked meat as in steak tartar, roast beef or fondue bourguignon can also lead to infection.

Indeed, the following parasitic species are found in animals more or less frequently (Table 2).

In about half of the case, detection cannot be done by visual inspection of the carcasses (Table 3).

Most of these parasitic species, when present in meat, cannot be detected with the naked eye. The *Toxoplasma* cyst is 0,1 mm long, those of *Sarcocystis* are variable in length, but can be as long as 4 mm in *S. bovihominis*, and the encysted *Trichinella* larvae measure about 1 mm long. Other species can be detected by visual inspection. The *Taenia solium* cysticerci are oval, 5-8 by 3-6 mm, small fluid-filled vesicle with the invaginated scolex inside appearing by transparency as a white dot of 4-5 mm in diameter. Those of *T. saginata* are similar but with slightly larger dimensions (7-100 x 4-6 mm). The *Diphyllo-*

bothrium larva can be free or encysted, 1-4 mm in length with transverse striations, translucent or blue white. Anisakidae larvae are translucent roundworms measuring between 10 and 50 mm.

Visual inspection at the slaughterhouse, as legally defined, is reputed highly sensible for *Taenia solium* in pork but between 70 and 75% effective for *Taenia saginata* and as low as 27% for parasite burden less than 10. These cysticerci are hardly detectable when alive because of their small dimensions and coloration looking much like muscular tissues while dead ones are white and easily detectable. Efficiency of candling has a sensibility between 53 and 79% for localizing Anisakidae larvae in fish.

As we cannot detect some species or all the parasites visible with the naked eye, we must then take special measures to ensure that they are destroyed in order to protect the consumer's health (Table 4).

Some complementary information has been published in literature about other method of food preparation and their efficiency to destroy parasites. The microwave oven efficiency for sterilizing meat is not totally effective for *Toxoplasma, Anisakidae*, *Trichinella,* and has not been reported for other species. Domestic freezer can be useful for *Sarcocystis* and *Trichinella* after three weeks but is not totally efficient for *Toxoplasma* and Anisakidae larvae. Efficiency has not been reported for *T. solium, T. saginata* and *Diphyllobothrium*. The *Trichinella nativa* larvae found usually in wild animals can resist freezing and are destroyed only by cooking. Radiation has been tested on some of these species and its efficiency has been demonstrated against *Toxoplasma, T. solium* and *Trichinella*. Smoking was of poor efficiency against *T. solium* but showed good results against *Diphyllobothrium* and *Trichinella.*

Usually, all these parasitosis in animals are non-symptomatic (Table 5) and cannot be of any help in detecting affected animals. Prevention is desirable because many of these infections cause serious diseases in man. Three of these parasites in animals have to be declared to the authorities: *Taenia solium, T. saginata* and *Trichinella,* and only the last one to the human medicine order.

Trichinella is hardly detected in meat. Since this disease is really serious in man, special detection measures have been implemented. Between 25 000 and 30 000 animals are sampled and tested each year in all provinces. Between 1980 and 1996, only three small focuses have been identified, all from a small location in Nova Scotia. On a world basis, 24 infected horses have been the source of human infection, only one coming from Canada. It has been estimated that six millions horses carcasses have been destined to human consumption during the same time. In Canada, human cases have been reported mostly in the native community located in the northern parts of the country.

It is also of prime importance to implement prevention measures at the farm in order to lessen the number of infected animal (Table 6).

Fish parasites are usually concentrated in visceral organs but, after the death of their host, some of them can migrate to the flesh. It is important that fish be eviscerated and freezed as soon as possible, this migration occurring in a few hours, even at low temperatures.

Unfortunately, parasites in meat is still a reality nowadays. Human infections are rarely detected but, with the increasing number of immunosupprimed people, the popularity of exotic food, the imports increase and international travelling, we are more exposed to new infections, greater than ever. Education remains the essential factor to protect ourselves properly.

Excellent reviews on some of these subjects have been published recently:

- Cheng TC. 1998. Anisakiosis. In: Zoonoses. Palmer SR, Soulsby EJL, Simpson DIH eds. Oxford Medical Publications, Oxford, pp. 823-840.

- Gamble HR, Bessonov AS, Cuperlovic K, Gajadhar AA, van Knapen F, Noeckler K, Schenone H, Zhu X. 2000. International Commission on Trichinellosis: Recommendations non methods for the control of Trichinella in domestic and wild animals intended for human consumption. Veterinary Parasitology 93: 393-408.

- Tenter AM, Heckeroth AR, Weiss LM. 2000. Toxoplasma gondii: From animals to humans. International Journal for Parasitology 30: 1217-1258.

Table 1. List of zoonotic parasites and their host

Parasite specie	*classification*	*animal host*
Toxoplasma	protozoa	pork, lamb, goat, rabbit, bear, deer, chicken, horse, beef, moose
Sarcocystis	protozoa	beef, pork
Taenia solium	tapeworm	pork
Taenia saginata	tapeworm	beef
Diphyllobothrium	tapeworm	fish (Salmonidae and others)
Anisakidae	nematode	fish (mainly all well known species, over 200)
Trichinella	nematode	pork, wild pig, walrus, horse, beef

Table 2. Parasite prevalence in Canada

Parasite specie	*animal prevalence*
Toxoplasma	Highly variable between species. Higher if in contact with cats. Decreasing
Sarcocystis	90-100% infected but most of the species are not zoonotic
Taenia solium	No cases since many years
Taenia saginata	About 20 to 50 cases each year
Diphyllobothrium	Not evaluated
Anisakidae	Highly variable but frequent
Trichinella	In pork, no cases reported by federally inspected slaughterhouses Very few cases in other animal species

Table 3. Method of detection of meat parasite

Parasite specie	*Method used*
Toxoplasma	Not detected
Sarcocystis	Not detected
Taenia solium	**Visual inspection** at the slaughterhouse
Taenia saginata	Visual inspection at the slaughterhouse
Diphyllobothrium	Visual inspection
Anisakidae	Candling
Trichinella	**Peptic digestion** of a sample of tongue or diaphragm

Table 4. Efficiency of meat parasites destruction method

Parasite specie	*cooking*	*freezing*	*microwaves*
Toxoplasma	61°C, 4 min	-12°C	no
Sarcocystis	65°C,	- 4°C	not tested
Taenia solium	60°C	-10°C, 14 d	not tested
Taenia saginata	60°C	-10°C, 10 d	not tested
Diphyllobothrium	56°C, 5min	-10°C, 6 h	not tested
Anisakidae	60°C, 1 min	-20°C, 60 h	no
Trichinella	58°C, 10 min	-15°C, 15 d	no

Table 5. Diseases caused by parasites in animals and men

Parasite specie	*Animals*	*Man*
Toxoplasma	non-symptomatic in most animals abortion in lambs and goats	Congenital: abortion, hydrocephaly, etc Primary: fever, lymphadenopathy, headache
Sarcocystis	myositis	No symptoms
Taenia solium	no symptoms	digestive disorders, neurocysticercosis
Taenia saginata	no symptoms	digestive disorders
Diphyllobothrium	unknown	digestive disorders
Anisakidae	unknown	gastritis, enteritis, lasts about one week
Trichinella	non-symptomatic	fever, diarrhea, oedema, muscular pain

Table 6. Prevention of animal infection:

Parasite specie	*Preventative measures*
Toxoplasma	Keep only adult sterilized cats, litter box for cats on the farm
Sarcocystis	No known measures
Taenia solium	**Testing and treating** infected humans
Taenia saginata	Testing and treating infected humans, avoid human fecal contamination of food
Diphyllobothrium	None
Anisakidae	None
Trichinella	**Rodents** control for domestic animals