

---

## Flesh Borne Parasites of Man

---

Omolade. O. Okwa\* and Theodosia O. Olubode  
Department of Zoology and Environmental Biology,  
Faculty of Science, Lagos State University, Ojo  
Lagos State, Nigeria.  
\*omolade.okwa@lasu.edu.ng

**Received:** 04.09.2017, **Accepted:** 16.10.2017

### Abstract

Parasites are organisms living in or on another living organism called the host which is bigger and of a different species. Parasites derive nourishment from the host and display adaptive and structural modifications. They damage and cause illnesses and may eventually kill the host. Flesh-borne parasitic diseases are transmitted from ingesting raw or undercooked flesh contaminated with the infective stages of parasites such as eggs, cysts, oocyst, larva and encysted stages through the flesh of different animals. These parasitic organisms are of great medical importance some of which are: *Taenia saginata* (beef), *Taenia solium* (Pork), *Trichinella spiralis* (Pork), *Diphyllobothrium spp.* (Fish), *Paragonimus spp.* (Crab), *Echinococcus spp.* (Dog), *Toxoplasma spp.* (Cat), *Echinostoma spp.* (Oyster) and *Clonorchis sinensis* (Carp Fish). These parasites cause several illnesses that are detrimental to human health such as Taeniasis, Trichinellosis, Diphyllbothriasis, Paragonimiasis, Echinococcosis, Toxoplasmosis, Echinostomiasis and Clonorchiasis respectively. Prevention and control of these flesh-borne parasites is based on educating the populace on healthy eating habit and the dangers of consuming under cooked animal flesh or raw animal flesh.

**Key words-** Parasites, Man, Diseases, Flesh-borne, Meat, Beef.

---

### Introduction

Parasitic organisms derive free benefits from their host such as food, protection, shelter and sometimes locomotion and developmental stimuli. Parasitism is an interaction of two different living species of organism, but only the parasite which is the smaller organism derives benefit by being metabolically dependent on the host. The host gets harm, damage or death in return. This association is necessary for the parasite but not in the interest of the host. Flesh borne parasites (FBP) causes diseases which are regarded a neglected diseases which have not received an equal level of attention like other food-borne biological and chemical risks (Anna, 2014). In spite of this neglect, they cause a high load of infection in humans with serious consequences and deadly aftermath. FBP also result in significant suffering in terms of safety of food, safety of life, life quality and negative effects on life subsistence (Windor, 2008). FBP are usually transmitted by consuming raw, undercooked or poorly processed animal flesh which has been contaminated with the transmission stages of parasites such as eggs, cyst, oocyst or larvae via the environment (FAO, 2013). FBP are Zoonotic infections transmissible form humans to animals and vice versa. Some consumer prefer to undercook flesh of animals to retain the heat-labile nutrients and preserve the natural taste of the food but unfortunately this increases the menace of FBP infections (Guardone, 2016).

## Types of Animal flesh

Various animals like sheep, goat, chicken, pig and cattle are considered good sources of protein and produced on an industrial scale. Other sources of meat are horses, dogs, cats, camels, snakes and wild games. They are seasoned or processed in variety of ways. Meat frequently indicates the skeletal muscles and edible tissues such as offals of animals. In animal husbandry, meat is simply the flesh of certain domesticated farm mammals kept and raised for consumption by humans. Fish, seafood, poultry or other animals used as food are often excluded (Chrisafis, 2008). The level of the red iron containing protein (myoglobin) in muscle fibre can be used to categorize meat into white or red. The consumption of meat is cosmopolitan but varies culturally, religiously and economically. Consumption of meat may also depend on how available the animal is. White meat with low concentration of myoglobin indicates the flesh of chicken and turkey breast meat but red meat with higher level of myoglobin is referring to the flesh of herbivores like cattle, horses, camels, sheep and goats (Henchon *et al.*, 2014).

## Diseases caused by Flesh borne Parasites

**Taeniasis:** This is caused by *Taenia saginata* and *Taenia solium*, the beef and pork tapeworms respectively. The adult stages of *Taenia* reside in human small intestine, the definitive host. Cattle or pig ingest eggs which hatches in their digestive tract, releasing oncospheres (hexacanth embryos) which finds their way to their skeletal or heart muscles where they develop into metacestodes stages called *Cysticercus bovis* (beef) or *Cysticercus cellulosae* (pork). The stages from these intermediate hosts can contaminate humans (Pawloski and Schitz, 2009). Raw or undercooked meaty beef or pork consumed with cysticerci is the route of transmission to humans. Once the cysticerci are ingested by humans, they evaginate their scolexes and develop. Gravid proglottids actively migrate through the anal sphincter in three months. Anywhere undercooked or raw beef is preferred; taeniasis is widespread due to *T. saginata*. Such places include some parts of Eastern Europe, Philippines, Sub-Saharan Africa, Latin America and the Middle East (Sommer and Morse, 2010; Dormy and Praet, 2007). Even in the United States (US), with stringent national sanitation procedures, incidence of infection is at a minimal level, however cattle sold for consumption are still 25% infected (Larry *et al.*, 2009). The world-wide infection is between 40 and 60 million. *T. solium* and cysticercosis infections have low prevalence in Islamic communities because of the Islamic injunction not to eat pork (Okwa, 2017).

**Trichinellosis or Trichinosis:** This is caused by *Trichinella spiralis* a small nematode parasite with the larva migrating from the intestinal lumen through the human blood stream to encapsulate and form cysts in various muscles of the body such as skeletal muscles and diaphragm. Where pork or wild games with the encapsulated larvae of *Trichinella* is consumed raw or undercooked, trichinellosis remains prevalent. Trichinellosis was prevalent in Europe, US and the arctic region (Oyerinde, 1999). Other sources of the infection are consumption of the raw or undercooked flesh of horses, dog and bear. However, reduced hog feeding in the US had led to a corresponding decrease in the incidence of trichinellosis. Currently, increased cases in the US are now caused by consumption of raw or undercooked wild games (Chomel, 2008). FAO (2013) had reported that several *Trichinella* species have been discovered in North America hence, trichinellosis is a problem.

**Toxoplasmosis:** Toxoplasmosis is the parasitic disease caused by *Toxoplasma gondii*. It is a protozoan tissue cyst forming coccidian parasite which prefers to infect endothermic vertebrates and this includes

human. The sexual life cycle occurs in family *Felidae*, which is a definitive host. Accidental ingestion of oocysts or pseudocysts of other paratenic host, preying on already infected mice or placental transmissions are the ways in which the definitive host gets infected. Humans may get infected by ingestion of oocysts in undercooked or raw meat of animals such as cattle, pig and game animals and transplacentally (Ortega and Ynes, 2009). Pregnant women are therefore at great risk. In human, the oocysts may encyst in the muscle tissue, lungs or in the central nervous system (Douglas, 2011). However, the status of immunocompetent people infected with this sporozoa remains at most times asymptomatic. (Dubey 2008) reported that between 1 and 2 billion people worldwide had been infected.

**Echinococcosis or hydratidosis:** This is caused by *Echinococcus spp.* (Dog tapeworm) a genus that includes small cestodes belonging to the Taeniidae family. The definitive hosts are Carnivorous mammals like dogs while the intermediate host is man. The infection can be obtained by eating undercooked entrails of dogs as is practiced in Turkana district in Kenya, East Africa (Ukoli, 1990). The areas of high incidence correspond with where dogs consume infected animal organs (Ukoli, 1990). According to (Adin & Cowgill, 2009), universally and medically, the most important species are *E. granulosus*, and *E. multilocularis*. Man may be infected by eating contaminated vegetables and fruits, drinking contaminated water and through contaminated soil (Francis, 2011). Accidental ingestion of eggs by humans by being close to infected dogs is also a risk. Therefore, *Echinococcus spp.* are not strictly FBP.

**Diphyllobothriasis:** This disease depletes Vitamin B<sub>12</sub> in man leading to anemia. It is caused by *Diphyllobothrium spp.* (broad fish tapeworm) a pseudophyllid tapeworm which infects humans by consumption of raw or undercooked freshwater fish such as Trout or Perch infected with pleurocercoid stages of the parasite. These fishes are infected from feeding on copepods with procercoid stages. Hence, there are three host involved in the life cycle. Diphyllobothriasis is common where lakes and rivers are common, where people practice commercial fishing and fish is consumed (Oyerinde, 1999). *D. latum* was endemic in Scandinavia, Western Russia, the Baltics, North America and the Pacific Northwest but now decreasing. *D. klebanovskii* (Pacific salmon tapeworm) is endemic in Far East Russia (Muratov and Posokho, 2008). *D. dendriticum* (the salmon tapeworm) is more widely distributed. Wicht *et al.*, (2010) reported that in Western Europe Diphyllobothriasis was a public health problem. However, it seems to be a emerging zoonoses in areas of Peri-alpine lakes of French- and Italian. About 48 incidents reported around Lake Geneva on its Swiss and French Watersheds in 2001 and 2002 (Duopouy-Camot and Peduzzi, 2011).

**Clonorchiasis:** This is caused by *Clonorchis sinensis* (Chinese liver fluke) a digenetic trematode parasite with three hosts. The eggs of *C. sinensis* are excreted along with human feces and eaten up by fresh water snails like *Parafossarulus spp.* which may serve as first intermediate host. When infected freshwater *Cyprinus carpio* (Carp fish) which are the second intermediate host is eaten raw or undercooked, man becomes infected due to presence of larval forms of parasite. The preferred site of the adult parasite in human is in the liver, bile duct and gallbladder and may cause cirrhosis of the liver and obstruction of bile duct. Recently studies have shown the parasite can cause carcinoma of the liver and bile duct (Kim *et al.*, 2017). (Wu *et al.*, 2012) reported that cosmopolitanly, the third most prevalent parasitic worm is *C. sinensis*. This worm is endemic in China (85% cases), Taiwan, Japan and Southeast Asia and infects about 30 million individuals. About 200 million people are constantly being exposed where the parasite is still been actively transmitted in places such as Korea, China, Vietnam and Russia (Hong & Fang, 2012).

**Paragonimiasis:** This is caused by *Paragonimus spp.* (Lung fluke), a digenetic trematode parasite with three host. Freshwater molluscan snails such as *Pomaptosis spp* or *Potadoma spp* are the first intermediate host while freshwater crustaceans like crabs or crayfish are the second intermediate host. Consuming these second intermediate hosts as undercooked or pickled is the means of contacting paragonimiasis due to *P. westermani*. Crabs or crayfish are infected with the metacercariae stage of the parasite. *P. uterobilateralis* was been discovered in isolated foci in Eastern parts of Nigeria, South west Cameroun and Liberia where undercooked crab such as *Potamon spp.* and *Sudanonautes spp.* are relished. Use of crab juices for medicinal use is also a risk (Ukoli, 1990). Excystation of the metacercariae stage occurs in the duodenum of the human small intestine. They find their way into the lungs, encapsulates and transforms to the characteristics egg shaped adult flukes. The flukes can also migrate to organs and tissues of the human brain and striated muscles (Shibara, 2011). Paragonimiasis infects roughly 22 million people worldwide especially in East/ West Africa, Indian and North/ South America (Procop, 2009).

**Echinostomiasis:** This is caused by *Echinostoma spp.* a digenetic trematode parasite. These gastrointestinal flukes have a life cycle of three hosts with freshwater snails such as *Gyraulus* and *Pila spp* as the first intermediate host. (Toledo *et al.*, 2008) explained that eating infected raw or undercooked molluscs such as snails, oysters and clams which are the second intermediate host is the route of infection. The disease is prevalent in South East Asia, South Korea and the Philippines and in certain European countries like Norway and Romania (Kanev, 2014). *E. trivolvis* has been discovered in North America (Keiser and Utzinger, 2014).

#### **Prevention and control of Flesh Borne Parasites:**

- As measured with a food thermometer, with a minimum internal temperature of 160° F, 165° F and 145° F respectively, always cook raw beef, pork and lamb, secondly poultry, thirdly chops, pork, roasts etc prior to removing from heat.
- Meat should always be cooked thoroughly to higher temperatures until it are no longer pinkish inside to destroy parasite stages.
- Before cooking raw meat, first put on clean latex gloves and wash your hands with warm soapy water after handling meat.
- Always use hot, soapy water to clean cutting boards and other utensils used for raw meats properly.
- Meat grinders should always be thoroughly cleaned each time grinding of meat is done.

#### **To prevent Toxoplasmosis :**

- The daily cleaning of litter boxes of cat is very essential because more than one day old cat faeces may contain mature parasites.
- Always wash hands properly and carefully with warm soapy water after handling cats or their litter boxes.
- There is need to wear latex gloves always during you handle garden soil because cats may used them as litter boxes.
- There is need to cover sandboxes also to protect from cats.

- There is need to avoid cats from hunting and scavenging to protected from *T. gondii* infection.
- Pregnant women should keep away from cats to prevent congenital transmission.

Inactivate fish intended to be eaten raw in restaurant by freezing. For fish, cooking at (65°C) or freezing for 7 days in a domestic freezer is recommended.

Health education of food handlers, cooks and people who relish undercooked or raw flesh is urgently needed as effective control measure in endemic areas.

## Conclusion

FBP infections exert significant economic impact, with more than 40 million people infected worldwide. Efforts to control these FBP parasites are unsatisfactory. To prevent and control FBP requires universal involvement. Changes in human behaviors of the local populations in making positive adjustments in the handling and cooking of animal flesh are the main issues. The danger associated with eating game meats, undercooked and raw flesh must be uncovered in order to prevent FBP infections.

## References

- Adin, C.A., Cowgill, L.D. 2009. Treatment and outcome of dogs with Echinococcus. *Journal of American Veterinary Medical Association*, 216, 371-375.
- Anna, R.S. 2014. Prevention of Zoonosis: Center for food security and public health, *College of Veterinary Medicine, Iowa State*, 3-7.
- Chomel, B.B. 2008. Control and prevention of emerging parasitic Zoonoses: *International Journal for Parasitology*, 38 (11), 1211-1217.
- Chrisafis, A. 2008. France horsemeat lovers fear. *The Guardian Newspaper*, London, United Kingdom.
- Dormy, G., Praet, N. 2007. *Taenia saginata* in Europe. *Veterinary Parasitology* 147, 22-24
- Douglas, A.E. 2011. Parasitic transmission modes and the evolution of virulence. *Evolution* 55, 289-2400.
- Dubey, J.P. 2008. The history of *Toxoplasma gondii* in the first 100 years. *Journal of Eukaryotic Microbiology* 55(6), 467-475.
- Duoponu-Camot, J., Peduzzi, R. 2011. Current situation of human Diphyllbothriasis in Europe. *European Surveillance*, 5, 31-35.
- FAO. 2013. Codes committee on food hygiene. Proposed draft guidelines for control of specific zoonotic parasites in meat *Trichinella spiralis* and *Cystecercus bovis*. Mimi, United States.
- Francis, H. 2011. Carnivores and some Atlantic Zoonoses. *Articles*, 13, 111-122.
- Guardone, L. 2017. Food borne parasitic Zoonoses . *Department of Veterinary Science, University of Pisa Italy*.
- Henchon, M., McCarty, H., Mary, R., Virginia, C., Declan, T. 2014. Meat consumption. Meat science

sustainability and Innovation. 60<sup>th</sup> International Conference on Meat Science and Technology.

Hong, S.T., Fang, Y. 2012. *Clonorchis sinensis* and Clonorchiasis: An update. *Parasitology international*, 61(1), 17-24.

Kanev, L. 2014. Life cycle, delimitation and redescription of *Echinostoma revolutum*. *Systemic Parasitology*, 28, 125-144.

Keister, J., Utzinger, J. 2014. Emerging food borne trematodiasis. *Emerging infectious disease*, 11, 57-69.

Kim, C., June, K.J., Cho, S.H., Park, S.K., Lee, S.H., Park, J.Y. 2017. Prevalence and related factors of Clonorchiasis among five major riverside residents in South Korea. *Journal of Korea Academy of Community Nursing*, 27(4), 346-357.

Larry, S., Roberts, G., John, M., Janovy, D. 2009. *Foundations of Parasitology (8th Ed.) Boston, Mc Grow Hill.*

Muratov, I.V., Posokko, P.S. 2008. Causative agent of human Diphyllbothriasis *D. klebanoskis*. *Parasitologia*, 22(2), 165-170.

Okwa, O.O. 2017. Epidemiology and Epizootiology of Taeniasis In: The biology of the Tropical parasites. *Lambert Academic Publishers*, 98pp.

Ortega, A., Ynes, R. 2009. Food borne parasites. *New York. Springer*, pp 207-210.

Oyerinde, J.P.O. 1999. Essentials of medical tropical parasitology, *University of Lagos press, Nigeria*, pp. 435.

Palowski, Z., Schltz, M.G. 2009. Taeniasis and Cysticercosis (*Taenia saginata*). *Advances in Parasitology*, 10, 260-343

Procop, W.V. 2009. North American Paragonimiasis in the context of global paragonimiasis. *Clinical Microbiology Review*, 22, 415-416.

Shibara, T. 2011. The route of infection of *Paragonimus westermani* in the fresh water crab. *Journal of Helminthology*, 65, 38-42.

Somers, K., Morse, D. 2010. Microbiology and infectious diseases. *Lange medical books, New York*, 184-186

Toledo, R., Estaban., J.G., Fried, B. 2008. Current state of food borne trematode infections. *European Journal of Clinical Microbiology and Infectious Diseases*, 23(4), 34-38.

Ukoli, F.M.A. 1990. Introduction to parasitology in tropical Africa. *Textflow Publishers, Ibadan, Nigeria*, 462.

Wicht, B., Peduzzi, R., Duopouy- Camet, J. 2010. Diphyllbothriasis In: *Clinical Archive of Parasitology and Microbiology, IX Edition.*

Windor, D.A. 2008. Most of the species on earth are parasites. *International Journal of Parasitology*, 28, 1934-1941.

Wu, W., Quian, X., Hung, Q. 2012. A review of the control of *Clonorchis sinensis* and *Taenia solium* in