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**Review Article**

# Meat-Borne Parasites a Health Hazard Concern in the Sudan: A Review

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**Abstract:** Food-borne diseases in general have received more attention in the last decade, but little attention has been paid to parasitic food-borne infections. This is probably due to the fact that they are not associated with acute illness as bacterial and viral infections do. In the Sudan, the most important parasitic meat-borne infections are *Taenia saginata*, *Toxoplasma gondii*, *Sarcocystis* spp., *Linguatula serrata* and fish infection with trematode metacercaria. Control measures used in the country to prevent infection with these parasites are through inspecting meat in slaughterhouses for cysticercosis. *Toxoplasma* and *Sarcocystis* infections are not considered during routine meat inspection due to lack of techniques for detection of these infections. Prevalence of infection with these parasites in humans and livestock in all States of Sudan is not available. Methods for routine diagnosis, monitoring or recording of these infections are inadequate, or not existing, in most of the laboratories. Studies are required to establish seroprevalence in livestock and humans. There is an urgent need to monitor and control meat-borne parasites using new technologies such as serological and molecular techniques, health education and vaccination. Researchers are urged to participate and establish innovative ways and means to control these diseases.

**Keywords:** Meat-Borne, Parasites, Zoonosis, Sudan

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## 1. Introduction

Sudan is rich in animal resources approximately 106 million animal units [1] such as cattle, sheep, goats, camels, horses, donkeys and poultry, with consider potentials in animal production. The most important animal products are milk, meat, poultry meat, hides and to some extent hair and wool and animal traction power. Livestock production in the Sudan plays a pivotal role in national food security and generating hard currency income from export. Food safety has become a subject of policy importance internationally [2]. Experts of the Institute of Food Technologists, US, warn that parasites are a food safety concern that is generally underrecognized but is probably on increase due to globalization of the food supply [3]. Animals can be infected

with parasitic and microbial pathogens. Some of these pathogens can be transmitted to humans via consumption of infected meat and milk causing food-borne diseases. Meat-borne parasites are transmitted to humans by ingestion of infected raw, undercooked or seasoned meat and meat-derived products of animal origin. The most important meat-borne parasites are helminths such as *Trichinella* spp., *Taenia solium* and *Taenia saginata* or protozoa viz, *Toxoplasma gondii* and *Sarcocystis* spp. or arthropods such as *Linguatula serrata*. Fish meat can be infected with various parasites viz, *Diphylllobothrium* spp., *Spirometra* spp., *Opisthorchis* spp., *Clonorchis sinensis*, *Gnathostoma* spp. and *Anisakis* spp. In the Sudan, the major meat-borne parasites are *T. saginata*, *T. gondii*, *Sarcocystis* spp., *L. serrata* and fish infection with trematode metacercaria..

## 2. Materials

Data were collected from different sources including journals, books and annual reports of Ministry of Animal Resources, Sudan. In addition, scientific publications by the help of internet websites up to the end of the year 2016 were reviewed.

*Taenia saginata* is a cosmopolitan parasite. This beef tape-worm is found in industrialized countries as well as in developing countries. Taeniasis is more common in populations that consume raw or undercooked beef infected with *Cysticercus bovis* the larval stage of the tape worm. Human taeniasis may be associated with abdominal discomfort, nausea, weight loss and anal pruritis, but occasionally more severe symptoms, such as intestinal perforation and peritonitis have been recorded [4]. In a community based study conducted among randomly selected 300 children, aged less than five years, in Khartoum. *T.*

*saginata* was detected in 1.7% of the examined stool specimens [5]. About one thousand and five hundred food-handlers in Khartoum city, were screened for intestinal helminths, 0.3% were harboured *T. saginata* [6].

Bovine cysticercosis can inflict serious economic losses to cattle industry due to total or partial condemnation, refrigeration and downgrading of infected carcasses [7, 8]. The overall prevalence of *C. bovis* in cattle slaughtered in Khartoum State, Sudan was 0.42% [9]. However, comparing this with other countries it was found that in Egypt ranging between 0.23% to 20% [10, 11, 12], in Nigeria 26% [13], and in Zambia 6.1% [14]. Darien [15] conducted a retrospective study to determine the prevalence of *C. bovis* in cattle slaughtered in Ghanawa abattoir in Khartoum State during 2005-2007. She reported that cysticercosis in the liver ranged from 0.29 to 0.58%, in the heart 0.007– 0.01%, and in the masseter muscles 0.002– 0.006% (Table 1).

**Table 1.** Infection rate of *Cysticercus bovis* in different organs of the slaughtered cattle during 2005-2007 in Khartoum State, Sudan.

Year	No examined cattle	No infected (%)	Organ		
			Liver No infected (%)	Heart No infected (%)	Masseter muscles No infected (%)
2005	68232	303 (0.44)	293 (0.43)	7 (0.01)	3 (0.004)
2006	80072	472 (0.59)	464 (0.58)	6 (0.007)	2 (0.002)
2007	85871	264 (0.31)	249 (0.29)	9 (0.01)	6 (0.006)

It seems that the liver is the most affected organ by *C. bovis*. This is quite significant as Sudanese have the habit of eating *Marrara* (raw liver, lung and rumen of ruminants). These figures are underestimated because routine visual meat inspection is the only method used for detection of *C. bovis*. Many studies indicated the underestimation of meat inspection, resulting in low prevalence of bovine cysticercosis by a factor of 3-10 times [16, 17]. More sensitive, rapid methods are needed to detect infection with cysticercosis in slaughterhouses or even in live animals.

Recently, for the first time in the Sudan parasite was detected in fish meat [18]. Fish borne trematode metacercaria was found in 6/50 (12%) examined Mullet fish in the Red Sea Waters, Sudan [18]. No parasite cysts or eggs were found in the 30 stool samples taken from fishermen [18].

The causative agent of toxoplasmosis is an intra-cellular protozoan, *T. gondii*, which is widely prevalent throughout the world in humans and warm-blooded animals. The cat is the only definitive host. This zoonotic disease is transmitted to humans by accidental ingestion of sporulated oocysts shed in feline feces, or by eating raw or semi-raw meat contaminated with tissue cysts. Most of human infections are asymptomatic and do not cause any disease. However, in pregnant women, toxoplasmosis is considered as a serious health problem and can lead to infection; of the foetus or newborn. Information on the prevalence in humans and animals in the Sudan and the risk of infection associated with food source is limited. Human toxoplasmosis was first studied by Carter and Fleck [19], using the Dye Test (DT), who reported a prevalence of 61% in four different States of the country. A sero-epidemiological survey of toxoplasmosis in pregnant Sudanese women showed

that 34.1% (166/487) were seropositive for anti-toxoplasma IgG antibodies [20]. Eating raw meat was the risk factor for toxoplasmosis in pregnant Sudanese women [20]. Khalil et al., [21] reported overall prevalence 43.6% using Latex Agglutination Test (LAT) in Khartoum State. High prevalence rate was found among 75% HIV patients, 58.3% aborters, and 55.5 % suspected cases. Khalil et al., [21] found the risk factors for *T. gondii* infection in humans were contact with cats, eating raw meat, and eating soil ( $P = 0.0001$ ,  $0.0001$  and  $0.006$ , respectively). In Gezeira State, Abdel Hameed [22] found infection rate of 41.17% using LAT. In North Gezeira, 73.1% of childbearing age women showed seroactivity for *T. gondii* IgM and IgG [23]. Recently, toxoplasmosis was reported among pregnant women in Tendalty Town, White Nile State [24]. The overall prevalence of the parasite was 38.5% (40) of 104 examined serum samples [24].

Several studies were done on seroprevalence of *T. gondii* in camels in different localities in the Sudan. Zain Eldin et al., [25] reported an infection of 54% using Indirect Hemagglutination Test (IHT), Bornstein and Musa [26] 22.5% via Sabin-Feldman Test and Abbas et al., [27] 12% by (IHT). Afterwards, Elamin et al., [28] in Butana Plain using (LAT) reported 67%, Manal et al., [29] found an overall prevalence of 61.7% in six different localities of the country (El Gedarif, North Kordofan, El Shawak, River Nile, Butana and El Hamra), and Khalil et al., [30] in three ecologically different areas recorded a prevalence of 22.2% utilizing LAT. The prevalence of *T. gondii* in camels in neighboring countries, in Egypt 27.9% [31] and in Saudi Arabia 16% [32].

However, limited publications are available on *T. gondii* infection in goats, sheep and cattle in the Sudan. The first

study was conducted in 1985 [25], who reported an infection rate of 63% in goats, 34% in sheep, and 40% in cattle. Khalil and Intisar [33] found 57.5% and 32% of sheep and cattle in Khartoum State were seropositive to *T. gondii* antibodies, respectively. Recently, Elfahal *et al.*, [34] using ELISA found the prevalence rate of antibodies in cattle was 12.7% and 14.9% in Khartoum and Gezira States, respectively. The prevalence rate of toxoplasmosis in other African and Arab countries in cattle in Ethiopia was 6.6% [35], Egypt ranges from 21% to 49% [36, 37] and in Saudi Arabia 2% [38]. In sheep and goats the infection rate was in Ethiopia 22.9% and 11.6%, [35], in Ghana 33.2% and 26.8% [39] and in Saudi Arabia 39% in sheep and 28% in goats, respectively [40].

Chicken toxoplasmosis was recorded for the first time in the Sudan this year 2016 [41]. A study was conducted in 3 states of the Sudan (Khartoum, River Nile and Sennar) in cages and free range chickens. Seroprevalence for *T. gondii* antibodies was 68/68 (100%) examined samples [41].

Seroprevalence studies are required to be carried out in the Sudan in animals and humans. This data is useful in monitoring and reporting the disease. Advanced methods are needed to detect different infective stages of *T. gondii* in food and meat and to detect viable cyst in edible tissue.

*Sarcocystis* species are obligatory intracellular protozoan parasite, with a heteroxenous life cycle based on prey (intermediate) – predator (definitive) host relationship. Humans are the definitive hosts for two species, *Sarcocystis hominis* and *Sarcocystis suihominis* but cysts of several unidentified species occasionally are found in human muscle [42]. Eating raw or undercooked beef and pork containing mature sarcocysts of *S. hominis* and *S. suihominis*, respectively, has resulted in human acquiring intestinal sarcocystosis [43]. In Sudan, several studies have been conducted to determine prevalence of *Sarcocystis* spp. in food animals [44, 45]. These studies have not attempted to differentiate species of *Sarcocystis* found in meat.

Linguatuliiasis is a zoonotic disease. The disease has been reported in the Middle East, Africa, America, and South-East Asia [46, 47, 48, and 49]. The causative agent of the disease is *Linguatula serrata* (Tongue worm) a pentasomide parasite. Adult of *L. serrata* inhabit the nasal sinuses and nasopharynx of carnivores mammals, especially dogs. Intermediate host are various mammalian species but herbivores are the best hosts for the development of nymphal stage. The intermediate hosts become infected by ingestion of eggs, which containing fully developed larvae, that are discharged in the dogs' nasal secretion, and which develop to nymphal stage in various organs particularly in Mesenteric Lymph Nodes (MLNs). There are two types of linguatuliiasis in human: nasopharyngeal and visceral. Linguatuliiasis has been reported in the Sudan and known as “*Marrara syndrome*” and occur due to consumption of *Marrara* (raw liver, lungs, trachea and rumen of goats and sheep infected with larvae *L. serrata* [47, 48]. *L. serrata* nymph was isolated from human and goat in the Sudan [47, 48, 50]. A survey in an endemic village of *L. serrata* infection in the Sudan, showed that 20% (48/240) individuals experienced symptoms of allergic nasopharyngitis [48].

Clinical signs include itching in the throat and nose, unilateral conductive deafness, tinnitus and facial palsy. Moreover, adults *L. serrata* were found in the nasal passages of 56 and 47% of male and female dogs in the endemic area [48].

### 3. Conclusion

It is evident from the research conducted in meat inspection and laboratory examination that meat-borne parasites constitute health hazards. The parasites detected in the meat may be much underestimated as there is no data available in rural areas of the country among resource-poor people. It is expected that these parasites are widespread among these people threatening their lives and lowering their productivity. To provide parasite free meat, it is necessary to direct research towards efficient detection of these parasites in live and slaughtered animals. Advanced techniques for detection of parasites in the meat are required in the Sudan.

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