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A Study on Public Awareness on Meat Borne Parasites in Malaysia

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Abstract

The protozoan and helminth of meat borne parasites can be transmitted through ingestion of raw or undercooked infected meat. A survey was performed to determine the public awareness and understanding of meat borne parasites, their effect and the importance of meat inspection in ensuring food safety. A total of 508 respondents were involved in the survey that was conducted from November 2020 to March 2021. The results showed that 90.8% of the respondents were aware of the presence of the parasites in the meat. Among all 79.7% knows that the parasites are zoonotic, however, 37.7% unfamiliar with the specific disease. The expectation that the disease may cause mortality in humans and animals was moderate at 59.4% and 66.9%, respectively. A 90.7% thought that the infection in animals will cause economic loss to the farmers. In terms of meat inspection, 79.7% believed that all the meat was strictly inspected and 74.0% were confident that it is safe for consumption. Based on the findings, shows a great level of awareness regarding the meat borne parasites among respondents. However, the understanding of the specific zoonotic diseases can be improved. Transfer of knowledge can be performed through several platforms such as exhibitions, posters and articles towards reducing the zoonotic occurrence of meat borne parasitic diseases by educating the public on the transmission and prevention of specific diseases.

Keywords: Food safety; meat inspection; meat borne parasite; public awareness; zoonotic

1. Introduction

Meat borne parasite is referred to the parasitic organism that can be found in muscle tissue either macro- or microscopically. The parasite has food safety risk as it can be transmitted through ingestion of raw or lightly cooked meat that infected with the parasitic cyst or larvae. Generally, it causes the disease known as meat borne parasitic disease. The disease is zoonotic and has a public health concern as it may infect human, animals and vice versa. The parasites can be divided into two main classifications which are meat borne protozoan and meat borne helminth.

In Malaysia, the disease cause by meat borne parasites such as *Sarcocytis* spp., *Toxoplasma gondii* and *Taenia* spp. in human and animals have been reported in several studies (Nadzirah et al., 2020; Wana et al., 2020; Latif & Muslim, 2016; Nissapatom & Abdullah, 2004). The other potential zoonotic pathogenic parasite that may results with the disease is *Trichinella* spp. The hydatosis by *Echinococcus* spp. and fascioliasis by *Fasciola* spp. has sometimes been reported as meat borne parasitic diseases. However, the parasites were usually found in various organs of animals commonly in lung and liver during post-slaughtered inspection, not in the meat (muscle). In other countries, a few meats borne parasites have been reported. The list includes; *Trichinella spiralis*, *Trichinella nativa*, *Taenia solium*, *Taenia saginata*, *Taenia asiatica*, *Echinococcus* spp., and *Toxoplasma gondii* in China (Zhou et al., 2008), *Taenia saginata*, *Taenia solium*, *Taenia asiatica*, *Echinococcus* spp., *Fasciola* spp., *Toxoplasma gondii*, *Cryptosporidium* spp., and *Sarcocystis* spp. in Arab countries (in the continents of Asia and Africa) (Abuseir, 2021), and *Echinococcus* spp., *Fasciola* spp., and *Amphistomes* spp. in Bangladesh (Kabir et al., 2010).

Even though the case of meat borne parasitic disease has been reported in Malaysia, the occurrence was relatively low and usually detected upon autopsy. Besides meat inspection, the Malaysian cultured of thoroughly cook the meat prior consumption was believed helps in reducing the potential zoonotic infection (Shekhar, 1995). However, there is a probability that the case was under reported due to the level of awareness among public. Therefore, this study was conducted to determine the level of awareness and understanding of public regarding the presence of meat borne parasites, the effect of the diseases and the importance of meat inspection to ensure food safety.

2. Methodology

2.1. Research design and respondents

A set of dual language (Malay and English) questionnaires contained 25 questions was developed according to the purpose of the study. The question was divided into four sections; (i) demographic profile of respondents, (ii) knowledge regarding meat borne parasites, (iii) the effect and symptoms of meat borne parasitic diseases, and (iv) the importance of meat inspection for food safety. The study was conducted by nonprobability sampling technique with convenience approach as described by Elfil and Negida (2017). The method allowed the respondents to be selected based on nearby functional distance, easily accessible, available at given time, and willingness to participate in the survey.

2.2. Study procedure

The survey was performed to more than 18 years old respondents by in-person interview, distribution of hard copy questionnaire, mailed questionnaire and through online approach. The online survey was accessible at http://www.dvsvri.gov.my/form/meatborneparasiteresearch during the sampling period.

2.3. Data analysis

The data was collected from 508 respondents in Malaysia within four-month period commencing from November 2020 to March 2021. Statistical analysis was performed by using Microsoft excel ver. 3.2013 (Microsoft Corp., Washington, USA) and SPSS software version 20.0 (IBM Corp., Armonk, NY, USA).

3. Results and discussion

3.1. Demographic profile of respondents

The demographic characteristics of the 508 participated respondents are shown in Table 1. Briefly, more than half of the respondents were females (65.4%), married (61.1%), and above 30 years old (64.0%) with 31.1% were at middle-aged adults group. The data on educational level shows 85.8% with University or collage background and followed by secondary and primary school. Ethnically, majority were Malay (83.5%), followed by Indian and Chinese with 7.5% and 3.0%, respectively. Another 6.1% of the respondents were recorded as 'others' which inclusive of Kadazan, Dusun, Rungus and etc.

Table 1. Demographic characteristics of respondents in the study of public awareness on meat borne parasites

Characteristics	Frequency	%
Age (years)		
< 20	20	3.9
21-30	163	32.1
31-40	167	32.9
> 40	158	31.1
Gender		
Male	176	34.6
Female	332	65.4
Race		
Malay	424	83.5
Chinese	15	3.0
Indian	38	7.5
Others	31	6.1
Educational level		
University/College	436	85.8
Secondary school	66	13.0
Primary school	5	1.0
Others	1	0.2
Marital status		
Married	310	61.1
Single	193	38.0
Others	5	1.0
Residential area		
Urban	384	75.6
Village	122	24.0
Others	2	0.4

Most of the respondents (75.6%) live in urban area and the location according to states and federal territories were recorded and shown in Figure 1. Based on the results, most of the respondents were from Selangor and Perak with 149 (29.3%) and 98 (19.3%) respondents, respectively. The least were from Perlis and Sarawak with 4 (0.8%) respondents each. No feedback was received from Federal Territory of Labuan.

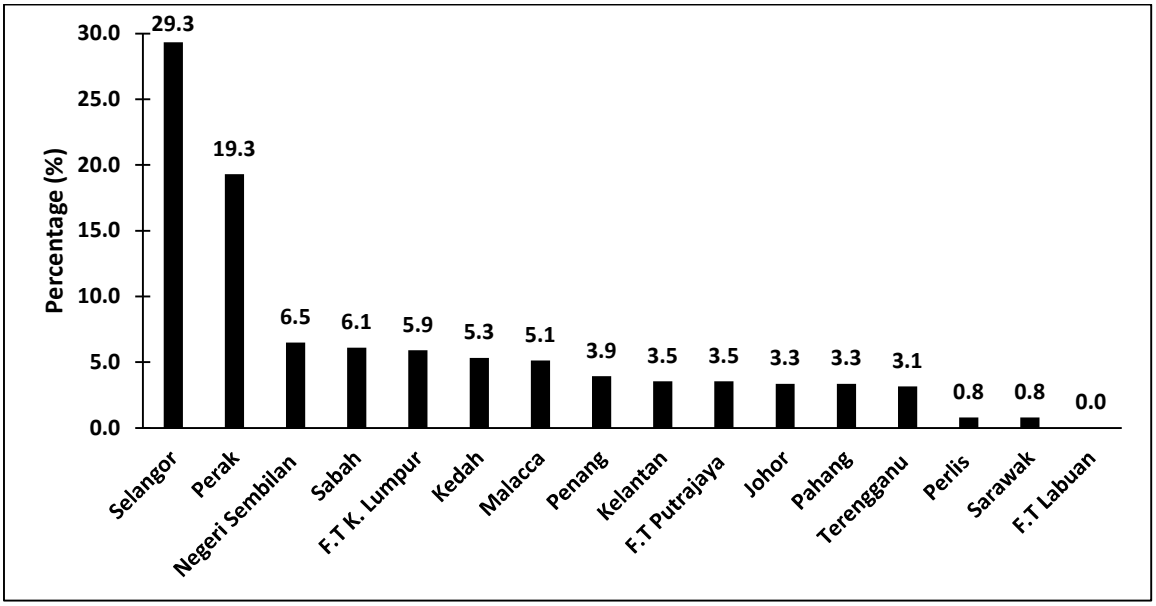

Figure 1. Percentage of respondents in the study of public awareness on meat borne parasites in Malaysia according to location (n = 508).

3.2. Knowledge regarding meat borne parasites

The level of understanding and knowledge of respondents regarding the meat borne parasites is very important. It may provide the information on the approach that can be perform to control the spread of the disease. In this study, most of the respondents (90.8%) were aware regarding the presence of the parasites. Chi-Square analysis shows there is a significant relation between the respondent awareness and residential location ($\rho = 0.006$). Most of the respondents that aware of the parasites were from urban area which most probably due to easy access to the source of information such as has better internet coverage, nearby book stores or library. However, the relation between respondent awareness with educational level and ethnicity were not significant with the ρ value were recorded at $\rho = 0.149$ and $\rho = 0.614$, respectively. The survey revealed 74.8% of the respondents obtained the information from reading materials, followed by social media (49.2%), interpersonal communication (24.4%), campaign or program (16.3%), and others (1.8%). Among the types of meat listed in the survey, pork was selected as the most common meat that they assumed can be infected with the parasite (88.8%). The selections of meat were followed by beef or carabeef with 72.2%, wild or exotic meat with 68.5%, and chevon or mutton with 53.3%. Poultry meat was the least been selected with 47.0%.

Further feedbacks of respondents on their awareness, understanding and personal experience regarding the meat borne parasites are presented in Table 2. Based on the table, less than 30.0% of the respondents have seen the real parasite. Cross tabulation result shows 83.5% of them were from highest educational background which they saw the parasite in laboratory during academic program. Among all, only 1.2% has the experience being infected with the parasite. Statistically, the experience being infected was not related with the residential location ($\rho = 0.178$). Majority (90.6%) of the respondents were aware that they can be infected if they consume undercooked or raw infected meat, and almost 80.0% knows the infection is zoonotic. A total of 37.7% of respondents have not heard the specific name of zoonotic meat borne parasitic diseases such as sarcocystosis, toxoplasmosis, taeniasis, and trichinosis. However, the cross tabulation result shows 59.2% of them aware that the disease can be transmitted to human.

Table 2. Respondents awareness, understanding and experiences regarding the meat borne parasite

Respondents feedback	Respondents, n (%)		
	Yes	No	Not sure
Respondent aware the presence of meat borne parasites	461 (90.8)	21 (4.1)	26 (5.1)
Respondent have seen the meat borne parasites	133 (26.2)	340 (66.9)	35 (6.9)

Respondent aware the infection is zoonotic	405 (79.7)	25 (4.9)	78 (15.4)
Respondent aware that they can be infected if they eat undercooked infected meat	460 (90.6)	18 (3.5)	30 (5.9)
Respondent have been infected with the disease	6 (1.2)	421 (82.9)	81 (15.9)

Sarcocystosis is a disease cause by a coccidian protozoa namely *Sarcocystis* spp. At least 200 species of *Sarcocystis* were recorded globally, and the recognized zoonotic species in domestic animals are *S. hominis* in beef, and *S. suihominis* in pork (Dubey, 2015). In comparison with toxoplasmosis, the only causative agent is *Toxoplasma gondii*. The clinical disease of toxoplasmosis are rare but the seroprevalence study have shown the presence of *T.gondii* antibodies in both animal and human (Roslan et al., 2021; Sahimin et al., 2021; Rahman et al., 2011). For taeniasis and trichinosis, the diseases are caused by the helminths which are the tapeworm and roundworm, respectively. Malaysian cases of taeniasis by *Taenia saginata* has been reported due to consumption of undercooked contaminated beef (Chua et al., 2017). Instead of taeniasis, specifically for *Taenia solium* in pigs, the disease was named as cysticercosis. For trichinosis, the seroprevalence in pigs have shown the presence of the disease in Northern States of Malaysia (Chandrawathani, 2010). Whereas, in human, a study by Intapan et al. (2011) have reported the Thailand worker presented with the disease after returning from Malaysia with the history of eating wild boar meat.

3.3. The effect and symptoms of meat borne parasitic diseases

Respondents understanding regarding the effect and symptoms of meat borne parasitic disease were captured in this study. The result shows 87.6% agreed that the disease was dangerous, and 59.4% assumed it will cause death in human. However, for infected animal, 66.9% of the respondents believe that the disease will end up with mortality cases. Presented in Figure 2 is the symptoms of meat borne parasitic disease in human and animals according to respondent's expectation. Based on the bar chart, it shows that abdominal pain, diarrhoea and vomiting are the common symptoms develop in human compared to the animals. The most common sign show by the infected animals is inappetence and the least is muscle pain.

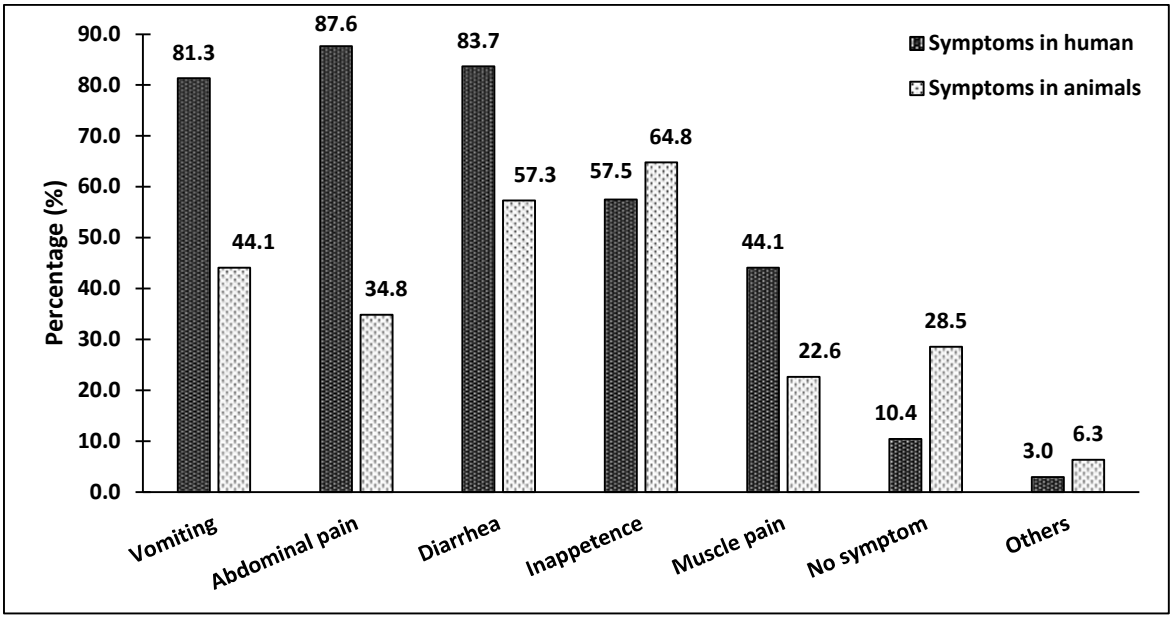

Figure 2. The symptoms of meat borne parasitic disease in human and animals according to respondent's expectation

Generally, the infection of meat borne parasites initiated with the consumption of the infective stage of the pathogens. For *Sarcocystis* spp., there are two infective stages which are the sarcocyst in the meat and sporocyst (oocyst) in the faeces. Consumption of sarcocyst from undercooked meat will result with intestinal sarcocystosis. While, muscular sarcocystosis occur after accidently consumed food or drinking water contaminated with the sporocyst. In this study, the meat borne parasitic disease cause by *Sarcocystis* spp. is referring to the intestinal sarcocystosis. After ingestion, the sarcocyst ruptured and released the bradyzoites in small intestine. The bradyzoites then invade the lamina propria of the intestinal epithelium of the host before the sexual stages of the protozoa take place. The symptoms in the hosts are usually mild and asymptomatic (Shekhar, 1995). However, the review by Fayer (2004) have stated the development of

clinical signs such as inappetence, nausea, vomiting, stomach ache, bloat, diarrhoea, dyspnoea and tachycardia in the host after at least three hours post consumption of the infected meat.

In comparison with *Sarcocystis* spp., *Toxoplasma gondii* has three infective stages; tissue cyst bradyzoites in meat, free tachyzoites in bloodstreams, and sporozoites in oocyst (Dubey et al., 1998). Human clinical illness specifically due to ingestion of tissue cyst bradyzoites in semi-cooked meat is relatively uncommon and asymptomatic. The viable tissue cyst of *T. gondii* was likely to seen in brain and placenta of the infected animals compared to muscle tissue. However, a study by Fazly Ann et al. (2013) on exotic meat screening in Malaysia, have found *T. gondii* at skeletal muscle of squirrel and monkey histologically. The seropositivity of the disease was high and the factors contributing it are most probably due to the variable infective stages of the parasites, history of infection and reinfection. The study by Nissapatorn and Abdullah (2004) has shown that the consumption of infected undercooked meat had no impact on *T. gondii* seropositivity. The symptoms such as infertility, stillbirth, congenital and ocular toxoplasmosis occur due the ingestion of contaminated food or drinking water with sporulated oocyst.

Consumption of raw or lightly cooked meat infected with the cysticerci of *Taenia* spp. resulted in the development of adult tapeworm in human. The worm may survive for years and will reside in small intestine. The length of adult *T. solium* from pork may reach up to 7 m, while *T. saginata* from beef is usually 5 m but may reach up to 25 m long (CDC, 2021). The worm will detached the proglottids and migrate to the anus. The disease resulted in abdominal discomfort in human and occasionally with appendicitis or cholangitis due to the migration of the proglottids. Some of the cases reported with the expelled of worm during defecation which actually referring to the proglottids (Chua et al., 2017). Besides taeniasis, human trichinosis occurs upon consumption of inadequate cooked meat containing encysted larvae of *Trichinella* spp. According to Liu (2005), *T. spiralis* from pork and *T. nativa* from exotic meat were reported being the source of human infection. After digestion, the larvae will developed into an adult worm in small intestine and invade the mucosa. The newborn larvae will then produce and migrate to the striated muscle in human and encyst. The clinical symptoms may vary from gastrointestinal distress to headache, fever and occasionally with muscle pain (Bruschi & Murrell, 2002).

In terms of economic effect, most of the respondents (90.7%) believed that meat borne parasitic disease will cause losses to the farmers. Most of the symptoms of the disease were seen in human compared to animals. The mild and asymptomatic condition in infected animals resulted in underdiagnosed of the disease before slaughter. Only in some severe cases that involved weight loss, reduced in milk production, abortion or stillbirth like in the case of bovine sarcocystosis will give an economic impact to the farmers (Rassouli et al., 2014; Wee & Shin, 2001). The parasites were typically found during post mortem inspection. The losses for farmers were usually due to the condemnation of the infected meat during inspection rather than the treatment for medication.

3.4. The importance of meat inspection for food safety

Respondent's awareness regarding meat inspection of the animals that slaughtered in veterinary abattoir was studied. The survey showed almost 80.0% were aware that all the meat was inspected prior to release for consumption. Among all, 74.0% of the respondents confident that the inspected meat is safe. The confidence level was lesser for the animals that slaughtered at other place than the veterinary abattoir. Only 40.9% were still believed that the meat without thorough inspection is healthy to consume.

Meat inspection is one of the services provided by the authority which is Department of Veterinary Services (DVS), Malaysia for the animal that slaughtered in government veterinary abattoir. The procedure including *ante-* and *post mortem* inspection was clearly stated in 'Arahan Prosedur Tetap Veterinar Malaysia: Pemeriksaan Daging' (DVS, 2013). It is to ensure all the meat that inspected by competent personnel in the abattoir are fit consumption. All the lesions and suspected diseased meat will be removed from the carcasses, and either to send to the laboratory for diagnostic purpose or condemn according to the established procedure. For meat borne parasites such as macroscopic sarcocyst that can be seen grossly with naked eye, the whitish rice grain look-liked material together with the attached meat will be removed during inspection as it can be the source of infection. However, for the other microscopic parasites, the suspected infected meat especially at the predilection site, will be send for laboratory confirmation.

In preventing the transmission of the zoonotic meat borne parasites, besides inspection and condemnation at the abattoir, it is highly recommended to eat thoroughly cooked meat. The habits of eating raw or undercooked meat must be avoided as the infective stage of the parasite might be viable in the meat. Other than heating, the frozen treated meat also will cause the parasite or its larvae became innocuous. For *Sarcocystis meischeriana,* the study by Saleque et al. (1990) have shown the safe consumption of pork after being cooked at 60°C for 20 minutes, 70°C for 15 minutes, and 100°C for 5 minutes, or frozen at -4°C for 48 hours or -20°C for 24 hours. Balderas et al. (2009) mentioned, the boiling

pork with 4 cm thickness at 80°C for 15 minutes or freezing them at 0°C for 96 hours or -20°C for 48 hours will inactivate the larvae of *Taenia solium*. Another experimental study by Franssen et al. (2021) have shown the harmless *Trichinella* spp. muscle larvae in mice after being exposed to 60°C for more than 12 minutes.

4. Conclusions

In conclusion, majority of the respondents were aware regarding the presence of meat borne parasite. Even though they unfamiliar with the specific disease, most of them know that the disease is zoonotic and can be transmitted via eating undercooked meat. Their expectation on mortality rate was quite high and majority believed that it will cause economic effect to the farmers. Most of them aware that the meat supply in Malaysia was thoroughly undergo proper meat inspection and fit for consumption. The findings of this study recommend the next approach of campaign towards reducing the zoonotic occurrence of meat borne parasitic diseases by educate them on the transmission and prevention of specific diseases through exhibitions, posters and public articles.

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