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Prevalence and risk factors of porcine cysticercosis by tongue examination: a case in the rural commune of Manazary, Madagascar

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Abstract: *Swine cysticercosis is a major public health and economic problem. It is a parasitic disease of pigs caused by "Cysticercus cellulosae", a Taenia solium larva or tapeworm responsible for tapeworm disease in humans. Swine cysticercosis is a neglected disease. It is a major zoonosis that severely affects underdeveloped countries like Madagascar. This study is conducted in the rural commune of Manazary, District of Miarinarivo, Itasy Region, from June to July 2020 for eight weeks. The rural commune of Manazary is known for its abundance of pigs. The surveys were conducted in the local live pig market. 255 farmers were surveyed at the market and 42 pigs (11.6%) were found to be positive out of 362 sold and tested by the tongue test method. During the survey, 72% of the pigs were found to be roaming in the wild. In general, 92% of the populations have latrines and the rest defecate in the open air. These results indicate a high infestation of pigs in the municipality, which requires the implementation of an appropriate control programme.*

I. INTRODUCTION

Cysticercosis is a larval cestodosis caused by the parasite *Taenia solium*. Unlike taeniasis, cysticercosis is linked to the ingestion by humans or pigs of the parasite's eggs present in water or food soiled by human excrement. Thus, these eggs will release embryos capable of becoming encysted in various organs; the most dreaded the most feared locations being the eye and the central nervous system.

In parasitic infections with *Taenia solium*, humans are the only natural definitive host (taeniasis), while pigs are an intermediate host in the larval stage (cysticercosis) [1]. Cysticercosis is a cosmopolitan zoonosis endemic in many countries. It particularly affects rural areas with intensive pig farming where hygiene conditions are poor, sanitary facilities are scarce where hygiene conditions are poor, sanitary facilities are scarce, consumption of meat or pork preparations meat or pork preparations are common and where human-animal interaction is very high [2, 3]. The geographical distribution of porcine cysticercosis and *Taenia solium* mainly covers countries with high endemicity, mainly in developing countries such as Madagascar, India, China, Thailand, Mexico,

Brazil, Guatemala, Haiti [4]. In Europe, the most numerous observations are from the Iberian Peninsula and Central Europe. The disease is normally absent in countries where the Jewish and Muslim religions predominate, which prohibit the consumption of pork and therefore do not have significant pig farming.
Free-ranging pigs are still practised in developing countries [5]. In Madagascar, pig farming is dominated by an extensive system with local pigs. The two improved breeds that are used semi-intensively or intensively are concentrated in the large cities and on a few big farms [6]. The rural areas are still dominated by a free-ranging pigs system. Fifty percent of the people who have only one animal do not build a pigsty and leave the animal to roam [7]. In some regions, the farmer leaves the pigs tied to a stake during the day and parked at night. They are confined only in the finishing phase for 3 to 4 months before their sale [8].

The Commune of Miarinarivo is located 88 km from Antananarivo along the Route National n°1 in the Itasy region. Livestock rearing is considered by farmers as only a complementary activity for some and an income-generating activity for other families. The main livestock activities encountered were cattle, pigs and poultry.

Tongue examination is a method of ante-mortem diagnosis of pigs for cysticerci larvae. It consists of palpating the tongue, and identifying Taenia solium cysts on the underside of the tongue. Tongue examination used to be practised in pig markets and is still valid today in endemic countries.

II. Material and Methods

2.1 Inspection

The inspection was carried out on pigs of local breeds, and exotic breeds (large white, landrace and products of crossbreeding). Of the 362 pigs inspected, 295 were males and 67 females. Of the total number, 92 were young pigs between 3 and 8 months of age, 73 were young pigs between 8 and 12 months of age, and 197 were pigs over 12 months of age.

Table 1: Number and pigs inspected

Pigs studied		Number
Sexe	Female	67
	Male	295
Breed	Landrace	40
	Large white	35
	Crossbreed	28
	Local breed	259
Weight	[20-40[	207
	[40-60[	94
	[60-80]	61
Ages	<8	92
	[8-12[	73
	>12	197

2.2 Tongue examination

This is a method of ante-mortem diagnosis of pigs for cysticerci larvae. It consists of palpating the tongue, and identifying Taenia solium cysts on the underside of the tongue. Tongue examination used to be practised in pig markets and is still valid today in endemic countries.

Diagnosis of porcine cysticercosis by tongue examination by experienced personnel has 100% specificity and sensitivity varies with parasite load. It is not a sensitive technique for pigs with low cysticerci loads, but it can be used to identify pigs with high parasite loads.

Figure 1: Tongue examination of pig

Excel® was chosen for data entry. The calculation of means, standard deviations, variances and comparison of means (Student's t test) were performed using Statgraphics Centurion Version 17.2 software. A value of $p<0.05$ was considered significant.

III. Results

362 pigs were inspected by the tongue diagnostic method, of which 295 were males and 67 females. During the survey at the live pig markets, 42 were infested with cysticerci.

3.1 Origin of pigs

The origins of the pigs tested by the langueyage method during the survey at the pig market living in the commune are listed in 13 "Fokontany" (the smallest division area in Madagascar).

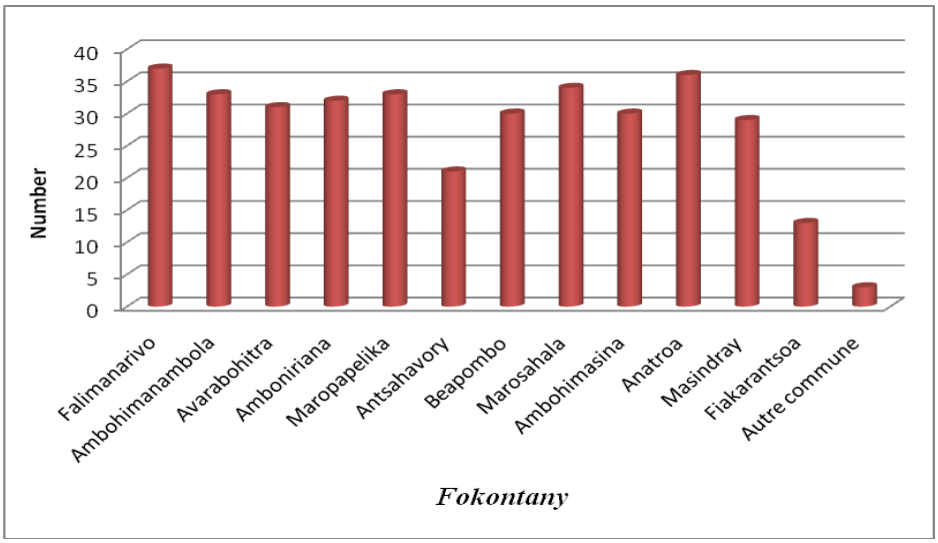

Figure 1: Origins of pigs distributed in different Fokontany

3.2 Breeds of pigs

The number of pigs according to the breeds of the surveyed pigs is shown in the figure below with different breeds used: 40 for Landrace, 35 for Large White, 28 for mixed breed and 259 for local breeds.

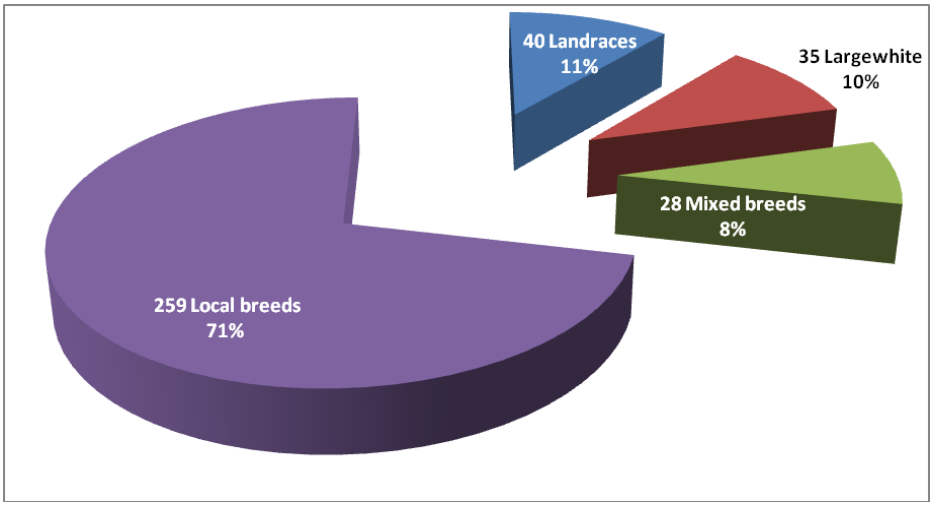

Figure 2: Numbers and breeds of pigs surveyed at the pig market

3.3 Ages

During the field trip, the age of the pigs varies from 3 months to over 12 months.

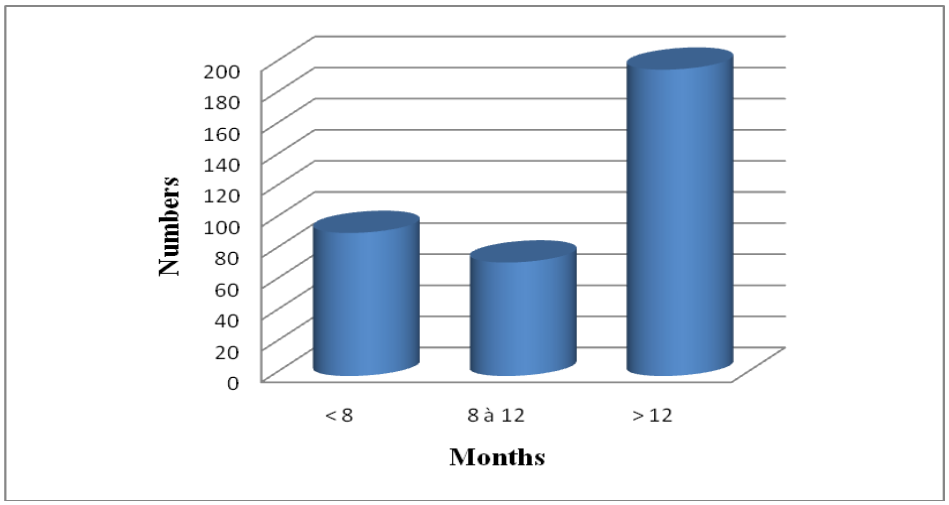

Figure 3: Ages and numbers of pigs studied

3.4 Results of langueyage

The prevalence of porcine cysticercosis through tongue examination was 42 (11.6%) out of 362 pigs examined in the commune's live pig market. During this study, at least one pig was found positive in each Fokontany.

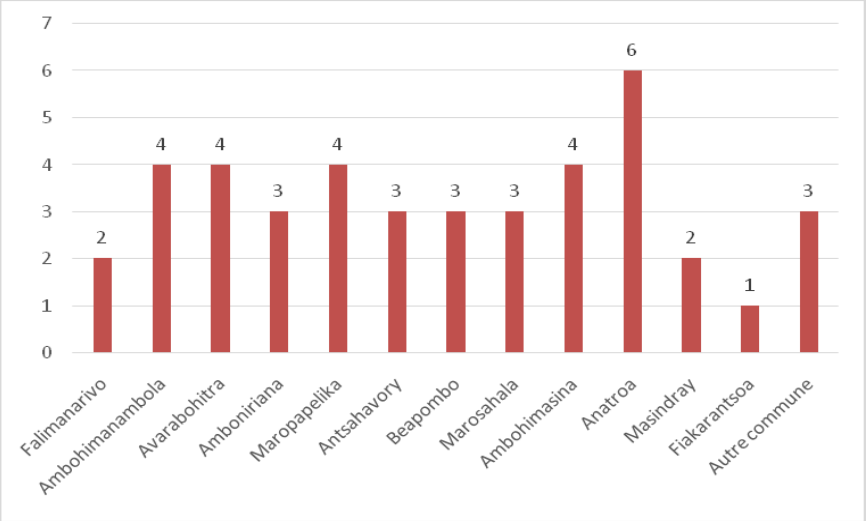

Figure 4 : Number of infested pigs per Fokontany

3.5 Breeding system

The farming system in the farms surveyed can be summarised in two parts: free-ranging system and confinement farming. The number of farmers practising free-ranging pigs is 156 (61%) compared to 99 (39%) for confinement farming.

3.6 Feeding

During the survey, pig feed was based on the use of rice bran combined with kitchen scraps or feed supplements such as maize, cassava, potatoes, breeds of grass, etc., and more rarely than feed for local breeds. Exported breeds and cross-breeds consume more suitable and formulated feeds such as animal feed, purchased at markets or formulated by the farmer himself. The problem is how to adapt the feed for each category of animal and how much to feed.

3.7 Educational level of farmers and awareness of porcine and human cysticercosis

The figure 5 shows the educational level of the herders surveyed at the commune's live market during the field visit: high school student 4%, secondary school student 33%, primary school student 44%, and illiterate 19%.

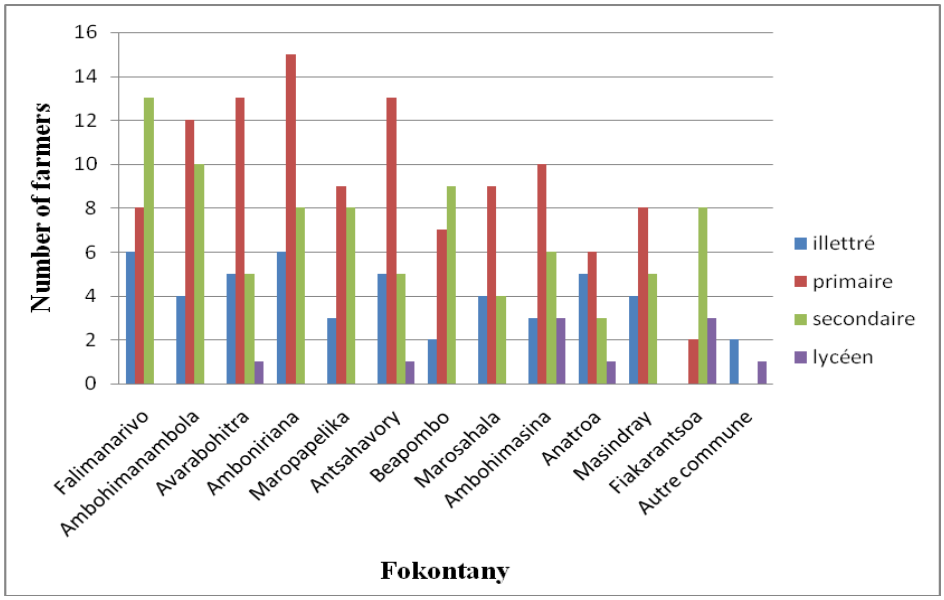

Figure 6: Educational level of farmers in each Fokontany

Then, 73% of the farmers are aware of the existence of swine cysticercosis and 27% are conscious of the transmission of swine cysticercosis to humans. Concerning hygiene and sanitary conditions on pig farms of the 255 farms surveyed, the majority of farmers (92%) use latrines.

3.8 Risk factors for swine cysticercosis

Farming methods are the risk factors for swine cysticercosis. The absence of a latrine leads to the dispersion of faeces. Farmers with tapeworms are a source of infestation for their animals. The water source is often close to the pigsty and sometimes unprotected. It may be contaminated with human faeces. Wastewater from the human dwelling is dispersed throughout the farm and may bring with it faecal debris. The presence of an infected person promotes the spread of *T. solium* eggs. As a result, farmers infest their pigs via their dirty hands. Passive vectors (shoes) and visitors disperse the parasite eggs which are carried by dirty shoes, clothes and hands.

Young pigs are most susceptible to disease. Pigs are roamed during lactation at the age of 2 months and even up to fattening age.

IV. Discussion and suggestion

This study shows the importance of the research carried out in the rural commune of Manazary concerning swine cysticercosis using survey and tongue examination methods. This technique was used to determine the health status of pigs without slaughter. Tongue examination is a tool for estimating cysticercosis infestation before selling the pigs. This method is simple, fast and very specific.

The exact prevalence of this larval parasitosis is impossible to determine with endemic areas due to the fact that many cases are asymptomatic and/or unreported, the asymptomatic and/or unreported, the high cost of diagnostic methods and poor public awareness of the knowledge of the disease and the lack of veterinary control of meat [9].

For this study, the prevalence of swine cysticercosis by langueyage is 11,6%. The national prevalence of swine cysticercosis in Madagascar in 2003 varies from 7% to 21% depending on the region with a higher rate in the central region of the island according to the Pan African Journal.

According to the surveys conducted, pigs were found to be roaming freely and the type of farming was found in the rural communes. During harvest periods, pigs were allowed to roam free to feed in order to mitigate the losses associated with the transport of harvested products.

Pigs, as coprophagous animals, can therefore come into contact with eggs of *Taenia solium* if exposed to human faeces. These eggs are very resistant in the external environment and can survive for several months or even years [10]. The same case can also be encountered when farmers do not wash their hands after defecation and feed the pigs. According to the results of the survey, 61% of the farmers who practised rambling livestock, 7% did not have a latrine and 1% of the farmers who practised confinement livestock.

There is a variation between farmers' knowledge of swine cysticercosis and its relationship with human cysticercosis. However, more than half of the farms visited were aware of swine cysticercosis (73%) through language, and 27% are aware of the transmission of swine cysticercosis to humans. Lack of knowledge on the part of farmers can lead to the consumption of undercooked meat. Lack of knowledge can also lead to the spread of swine cysticercosis and human cysticercosis.

The educational level of the farmers varies greatly: 4% for high school, 33% for secondary school, 44% for primary school and 19% for illiterate. This level of knowledge as well as the rate of schooling decreases from the city to the countryside due to the lack of infrastructure, the lack of teachers, and even the absence of schools in most rural communes. This affects the level of knowledge of the disease.

The proportion of farms without latrines is increasing in rural areas, resulting in deplorable hygiene and sanitary conditions in these regions. The neglect of livestock farmers and the lack of awareness on the part of the authorities and non-governmental organisations of the need to use latrines are the causes of the lack of hygiene in these rural areas [11].

The risk factors for cysticercosis have been linked to diet. The use of swill and kitchen waste should be avoided. However, 61% of farmers use kitchen waste in their basic pig feed

V. Conclusion

Overall, our study demonstrates the existence and spread of cysticercosis in Manazary district. The prévalence rates found in this area led it to be considered a high prevalence area for cysticercosis. Systematic investigation of cysticercosis in pigs and humans is needed, along with health education and hygiene measures to control Ascaris suum to avoid neurological sequelae. It is necessary to assess the clinical status of affected schoolchildren, conduct contact studies and implement measures to combat and prevent the disease.

Awareness seems to be emerging in endemic regions, leading to the implementation of various collective and individual prevention measures. However, these measures require significant behavioural changes on the part of the population as well as considerable economic resources that are often not available in these regions. Thus, international involvement is necessary in order to finance programmes for the prevention and control of cysticercosis. Cysticercosis is a preventable disease that can be eradicated. This requires the implementation of a national control programme for swine cysticercosis with close collaboration of public health authorities and veterinarians. Sincerely, the dissemination of T. solium is favored by poor sanitation and hygiene driven by lifestyle and poverty.

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