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PARASITIC ZOONOTIC DISEASES OF PIGS: AN ABATTOIR SURVEY ON PREVALENCE FROM 2014 TO 2018

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ABSTRACT

To ensure that pork meat from the Société Ivoirienne d'Abattage et de Charcuterie (SIVAC) is safe for the Côte d'Ivoire population, a thorough inspection is routinely carried out by veterinarians to identify infected individuals that are not fit for consumption. The examination is partly focused on important zoonotic parasitoses such as echinococcosis, distomatosis, and cysticercosis. The objective of this survey was to record the number of cases of three parasitoses (echinococcosis, distomatosis and cysticercosis) in organs (liver, lungs, kidneys, spleen and tongue) of slaughtered pigs in SIVAC abattoir located in Yopougon in Côte d'Ivoire from 2014 to 2018. The para-clinical inspection of the various organs of slaughtered pigs resulted in the overall prevalence of porcine echinococcosis, distomatosis, and cysticercosis of 9.36%, 1.34% and 0.18% respectively. The highest infection rate of all the identified zoonotic parasitoses occurred in the year 2014. Most cases of distomatosis, cysticercosis, and echinococcosis were isolated from the liver, tongue, and kidneys respectively. Echinococcosis was the most frequent zoonosis in slaughtered pigs during the five years inspection. Although cases from these zoonoses were low, their occurrence in pigs should not be neglected based on their potential danger to the public. Therefore, appropriate measures should be taken by competent authorities to control these diseases in pigs in Côte d'Ivoire.

INTRODUCTION

The World Health Organization defines zoonoses as infectious or parasitic diseases naturally transmitted from vertebrate animals to humans, and vice versa (WHO, 1959). In Côte d'Ivoire, the population is vulnerable to the effects of these zoonotic diseases because pig farming was practiced by 360,000 farmers or 6% of the agricultural population (FAO, 2016).

The increasing demand for animal protein has led to a boom in the swine industry. In 2017, the pig

herd was estimated at 290, 000 head in traditional breeding and 121, 520 in modern husbandry system (MIRAH/DPSP). Pork is the most consumed meat in the world even though some religions forbid its consumption. Fresh meat, ready meals, and already prepared and packaged foods contribute to the great diversity of our daily diet (FAO, 2016). In Côte d'Ivoire, pork meat is the third most consumed meat after cattle and poultry.

The farmers in this sector contribute to meet the need for animal protein but in precarious operating conditions and the absence of hygienic measures (Mfewou & Sevidzem, 2018). Pigs represent a potential reservoir of many pathogens and can transmit these agents to animals (Mfewou & Sevidzem, 2018). The direct contact of people (this mainly concerns persons close to pigs by their occupation, i.e., persons working in piggery and veterinarians) with infected live animals or carcasses (butchers and technicians in slaughterhouses) or consumers via contaminated meat (Shaibu et al., 2017) provokes the transmission of such zoonotic pathogens.

Echinococcus granulosus was mostly encountered in rural areas, in pasture and in places where dogs ingest infected animal organs. The main host of this parasite is the dog and other canids (Craig et al., 2015). Intermediate hosts are ungulates, marsupials, primates, and humans (Craig et al., 2015). In Africa, echinococcosis is a public health problem, particularly in most Maghreb countries such as Algeria, Morocco and Tunisia (Majorowski et al., 2015), East Africa (Kenya, Ethiopia, Sudan, etc.) and South Africa (Eckert et al., 2001). In West Africa, particularly in Côte d'Ivoire, this zoonosis is still poorly understood (Bizuwork et al., 2012). The prevalence of cystic echinococcosis in the Port-Bouët abattoir in Côte d'Ivoire between 2008 and 2015 was 1.6% (Acapovi et al., 2019).

Teniae solium cysticercosis or porcine cysticercosis is a parasitic zoonosis caused by the presence and development of *T. solium* larvae (*Cysticercus cellulosae*) in the host. It exists in developing countries where pig farming is still in the traditional mode, and latrine used (Garcia et al., 2003). The presence of porcine cysticercosis is an indication of active transmission of the parasite between pigs and humans (Melki et al., 2011). Pigs become infected by ingesting human faeces, food or drinking water contaminated with *Taenia* eggs, while humans, who can harbor both the adult and larval stages of the parasite are transmitted via the consumption of pork meat (infested with cysticerci), poorly cooked food, eating food that is soiled with the eggs of this parasite and through an oro-fecal self-infestation (Acha et al., 2018). The taeniasis/cysticercosis complex due to *T. solium* is endemic in several developing countries of sub-Saharan Africa, Latin America, and Asia (Bouteille et al., 2014).

Distomatosis due to *Fasciola gigantica* is endemic in tropical African livestock. Extensive studies on the prevalence of fascioliasis due to *F. gigantica* have been carried out in various parts of tropical Africa including those by Coyi (1959), Megard (1975), Schillhorn et al., (1980) and Ogunrinade et al., (1981). In addition to *F. gigantica*, *Dicrocoelium hospes* has been identified in the livers of cattle in Mali (Tembely et al., 1987). The occurrence of distomatosis caused by *Paragonimus* spp. in Cameroon was documented by Ollivier et al., (1995). There is a lack of information on porcine distomatosis in Côte d'Ivoire.

In endemic areas, these parasitic zoonoses are a scourge to public health and lead to significant economic losses to farmers due to the seizure of meat or organs in slaughterhouses (Jayashi et al., 2012). The objective of this study is to provide information on the prevalence of these parasitic zoonoses in an abattoir of Côte d'Ivoire.

MATERIALS AND METHOD

Study area

This study was conducted at the Société Ivoirienne d'Abattage et de Charcuterie (SIVAC) located in the industrial area in the Yopougon municipality. This municipality is located in the western part of the District of Abidjan, it is bordered to the north by the Abobo and Anyama municipalities; in the south by Ébrié Lagoon; to the east by Attécoubé and to the west by Songon from the city of Abidjan (Côte d'Ivoire), between the Atlantic Ocean to the south and the Ebrié lagoon to the north. This municipality covers an area of 111.1 km². SIVAC was put in place in 1991; this abattoir is the only approved structure for the primary processing of pigs in the District of Abidjan. It has a surface area of 7076m² and can be geo-localized using the following coordinates: latitude 5°22'11, 37432" north and longitude 4°5'31, 10604" west (Figure 1). It has a slaughter capacity of 100 pigs/day and is the principal source of supply to the pig meat distribution and marketing network in the District of Abidjan.



Figure 1: Location of the SIVAC abattoir (Google earth)

Pig Inspection for Zoonotic Parasitoses

The study included all pigs (*Sus scrofa domesticus*) slaughtered at SIVAC from 2014 to 2018. All carcasses and elements of the fifth quarter were submitted for the sanitary and qualitative inspection carried out at the end of the preparation of the carcass and viscera before weighing. The veterinary officers made all the inspections to ensure the safety of the pork meat. The inspection was carried out as in Acapovi et al., (2019). The inspection of the target organs likely to harbor the parasites was carried out thorough para-clinical examination based on the existence of macroscopic lesions suggestive of cysticercosis, distomatosis, and echinococcosis. Target organs including the liver, lungs, spleen, kidneys, heart, and tongue were palpated and incised for the presence of nodules or cysts. The data in the annual inspection reports from 2014 to 2018 was used for this study.

Data Analysis

Data were analyzed using the Statistica (version 20.0) software. The Chi-square test was used to

compare the yearly prevalence concerning disease type. The significance level was stated at 5%. The prevalence was calculated using the following formula:

$$\text{Prevalence} = \frac{\text{number of cases}}{\text{number inspected}} \times 100$$

RESULTS

The number of pigs slaughtered in five years was 136, 376, and the carcasses of all these animals were inspected. The month with the highest pig slaughter number was December, and the least was February (Figure 2).

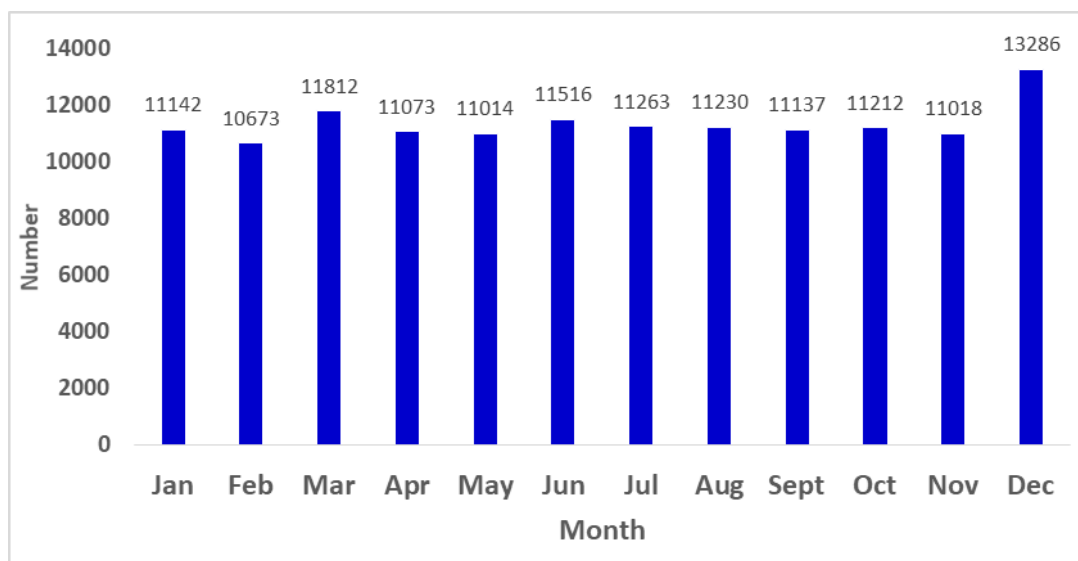


Figure 2: Monthly number of pigs slaughtered in SIVAC abattoir between 2014 and 2018.

The year with the most pig slaughtered was 2014 and the year with the least number slaughtered was 2018 (Figure 3).

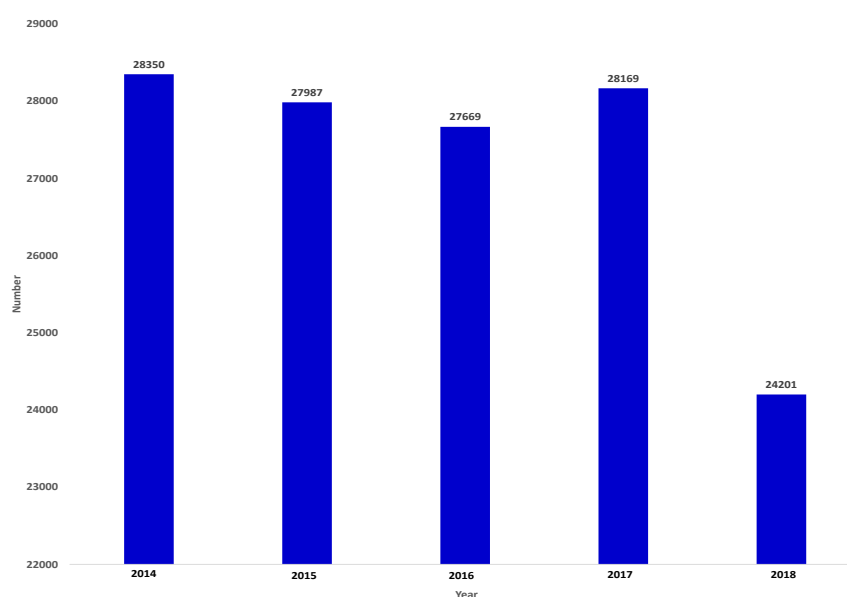


Figure 3: Yearly number of pigs slaughtered at the SIVAC abattoir between 2014 to 2018.

The overall echinococcosis prevalence recorded between 2014 and 2018 in the Yopougon abattoir was 9.36%. The prevalence was highest between 2016 and 2017, and least in 2014, even though there was no statistically significant difference ($P>0.05$) in prevalence with respect to inspection year (Table 1).

Table 1: Prevalence of porcine echinococcosis between 2014 and 2018

The overall distomatosis prevalence between 2014 and 2018 in the SIVAC abattoir was 1.34%. The prevalence was highest in 2014 followed by 2016 and lastly by 2018 even though there was no statistically significant difference ($P>0.05$) between prevalence and inspection year (Table 2).

Year	No. Slaughtered	No. Inspected	Echinococcosis	Prevalence	P-value
2014	28350	6735	320	4.75	$P>0.05$
2015	27987	7460	676	9.06	
2016	27669	11876	1307	11.00	
2017	28169	15407	1778	11.54	
2018	24201	10719	805	7.51	
Total	136376	52197	4886	9.36	

Table 2: Prevalence of porcine distomatosis between 2014 and 2018

Year	No. Slaughtered	No. Inspected	Distomatosis	Prevalence	P-value
2014	28350	6735	134	1.99	$P>0.05$
2015	27987	7460	111	1.49	
2016	27669	11876	188	1.58	
2017	28169	15407	190	1.23	
2018	24201	10719	78	0.72	
Total	136376	52197	701	1.34	

The overall prevalence of cysticercosis from 2014 to 2018 at the SIVAC abattoir in Yopougon was 0.18% and highest in 2014, followed by 2015 and zero prevalence was signalled from 2016 to 2018. There was a statistically significant difference ($P<0.05$) between prevalence and inspection year (Table 3).

Table 3: Prevalence of porcine cysticercosis between 2014 and 2018

Year	No. Slaughtered	No. Inspected	Cysticercosis	Prevalence	P-value
2014	28350	6735	78	1.16	$P<0.05$
2015	27987	7460	14	0.19	
2016	27669	11876	0	0.00	
2017	28169	15407	0	0.00	
2018	24201	10719	0	0.00	
Total	136376	52197	92	0.18	

It was noticed that distomatosis cases were only isolated from the liver with highest cases recorded in 2017 (Table 4). Cysticercosis was isolated from the tongue, heart, kidney and highest cases were found in the tongue. Highest cases were encountered in the year 2014 (Table 4). Echinococcosis was

isolated from liver, heart and kidneys. The highest cases were encountered in the kidneys. The highest number of such cases observed in the kidneys was in the year 2017 (Table 4).

Table 4 : Number of cases of porcine zoonotic parasitoses with year and organ

Disease	Year	Tongue	Liver	Heart	Kidney	Lungs
Distomatosis	2014	0	134	0	0	0
	2015	0	111	0	0	0
	2016	0	188	0	0	0
	2017	0	190	0	0	0
	2018	0	78	0	0	0
Cysticercosis	2014	36	0	25	17	0
	2015	10	0	4	0	0
	2016	0	0	0	0	0
	2017	0	0	0	0	0
	2018	0	0	0	0	0
Echinococcosis	2014	0	13	4	294	9
	2015	0	1	0	675	0
	2016	0	0	0	1301	6
	2017	0	0	0	1778	0
	2018	0	0	0	805	0
Total		46	715	33	4870	15

Discussion

Over 136, 376 pigs were slaughtered over five years by SIVAC and the month of boom slaughter is December which marks the festive period for Christians in Côte d'Ivoire. Mfewou & Sevidzem (2018) propounded on the importance of urban pig farming and the dangers to the environment. Part of this danger is the dissemination of dangerous zoonotic parasitoses and ectoparasites to the environment (Yao-Acapovi et al., 2018). The prevalence of porcine echinococcosis in the study site was 9.36% which is higher than the 1.6% bovine echinococcosis obtained from the kidney of cattle slaughtered at the Port-Bouët abattoir in Côte d'Ivoire (Acapovi et al., 2019). The differences could be due to the difference in the number of inspection years as that in the present study was carried out for five years, and that at Port-Bouët was eight years. Also, the discrepancies in the prevalences could be due to the geographical location and host species. Porcine echinococcosis was isolated from the liver, heart and kidneys with kidneys recording the highest number of cases. The highest cases of echinococcosis have been encountered in the kidneys of livestock, especially cattle in Côte d'Ivoire (Acapovi et al., 2019). The current infection prevalence of porcine echinococcosis is similar to the 6.4% reported in cattle in Egypt by Haridy et al., (2006).

The overall prevalence of porcine distomatosis was 1.34% and was less than the lower limit of the 7-50% range of infection prevalence in zebu cattle in Mali (Tembely et al., 1987). The infection prevalence obtained in this study is similar but superior to 0.09% reported in the major abattoirs of Botswana from 2001 to 2010 by Mochankana & Robertson (2016). The fact that all cases of distomatosis were identified from the liver was not surprising as this has been reported by other authors (Tembely et al., 1987; Mochankana & Robertson, 2016). The Worldwide prevalence of

fasciolosis has been reported to range from 1.15% to 80% (Bouteille, 2014). The lower limit (1.15%) of this range is similar to the results obtained in the present study. The lower prevalence in the present study can be attributed to the provision of better veterinary services to the farming community by private veterinary practitioners, whose numbers have increased in recent years and who also provide advice to farmers on livestock management which could reduce the prevalence of distomatosis. Also, the difference could be related to the number of prospection years and the host species considered in the different studies.

The prevalence of porcine cysticercosis in the abattoir of Côte d'Ivoire was 2.5% and 3.6% in 1978 and 1991 respectively (Melki et al., 2018). This prevalence has decreased over the years as the prevalence barely reached 1% in the present study. Porcine cysticercosis in Burkina Faso is estimated to have, by far, the highest prevalence of porcine cysticercosis (between 32.5% and 39.6% in 2011). Although modern pig-breeding was introduced to Burkina Faso at the beginning of the twentieth century, 80% of the pigs are still slaughtered by farmers at home and sold without prior meat inspection for cysticercosis (FAO, 2012), which constitutes a major risk for public health. Nigeria has the largest pig population in West Africa with 5 million animals (Gweba et al., 2010). The pig husbandry system is very similar to that used in Asia and Latin America (Steinfeld et al., 2006), i.e. (1) intensive management, where pigs are confined within a shelter and are not allowed to move outside, (2) semi-intensive, where pigs are provided, with shelter but are allowed to move outside to feed on natural vegetation, and (3) extensive or free-range farming, where pigs are left to scavenge for all their food. The massive use of the free-range farming system materially increases the risk of pigs being exposed to viable *T. solium* eggs and is certainly one of the factors that may have contributed to the spread of the disease in Nigeria (Kungu et al., 2015). The recent scanty prevalence of porcine cysticercosis could be due to the recent sensitization of farmers on the diseases as the number of veterinarians have also increased over the years. It could also be that farmers select healthier animals to bring to the SIVAC abattoir. The highest number of porcine cysticercosis was isolated from the tongue and this finding is similar to that observed by Mishra & N'Depo (1978).

CONCLUSION

Porcine zoonotic parasitoses were identified in animals brought to the SIVAC abattoir. The five years inspection study reveals the prevalences of 9.36 %, 1.34 % and 0.18% of echinococcosis, distomatosis and cysticercosis respectively. Echinococcosis was most recurrent of them. The year 2014 recorded the highest prevalence of each of them. Distomatosis, cysticercosis and echinococcosis were highly encountered in the liver, tongue and kidneys respectively. Due to the public risk posed by these zoonoses, their low numbers still indicate that they need to be monitored regularly to inform competent control authorities in Côte d'Ivoire.

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