



**Full Length Article**

## Gastrointestinal Parasite Infection in Pigs Bred on Traditional Farms in the Department of Man (Côte d'Ivoire)

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### Abstract

The breeding of pigs is an alternative way to compensate the lack of animal protein in the diet. However, farmers are confronted with parasitic diseases that hinder development. The aim of this study was to inventory of the parasites infesting pigs in the department of Man. The research method involved a parasite analysis of 120 faecal samples taken from apparently healthy pigs across six different traditional piggery. The flotation coprology method was used to detect parasite cysts or eggs. The results showed that the infection rate among the pigs was 89.1%, with a higher prevalence in males (98.0%) and pigs aged between one and two years. The isolated parasite species were *Ascaris suum* (58.3%), *Coccidia* (45%), *Strongyloides ransomi* (41.7%), *Oesophagostomum* spp. (29.2%) and *Hymenolepis diminuta* (19.2%). High infection rates were recorded on all farms. Pigs from Kpangouin were the most contaminated (100%), followed by those from Voungbé (95%) and Korgouin (94.4%). However, there was no significant difference between locality and pig infection level ( $P > 0.05$ ). Cases of co-infection were observed, with pigs harboring two different parasites being the most common (40.2%). Those harboring three, four or five parasites had rates of 25.2%, 5.6% and 1.8%, respectively. Based on these results, appropriate anti-parasitic treatments should be recommended to farmers to improve production.

**Keywords:** Prevalence; Gastrointestinal parasites; Pig; Traditional farm

### Introduction

Pig farming plays a crucial role in the rural economy of many regions around the world (Atawalna *et al.* 2016). It is an important activity for the survival of rural populations in many African countries (Toure *et al.* 2024). It is considered an animal of choice, providing additional income for nearly all socio-professional classes of the African population (Mopate 2008).

In Côte d'Ivoire, in response to the growing demand for meat, the pig industry was intensified and modernised between 1990 and 1996, thanks to the SODEPRA South-East (Society for the Development of Animal Resources) and SIVAC (Ivorian Society of Slaughter and Pork Butchers) projects. However, the outbreak of African swine fever (ASF) in May 1996 severely affected modern production, leading to a 64% decline in the number of modern pigs and a 32% decline in the number of traditional pigs (Tra 2009). Today, there is a spontaneous revival of the

pig industry by private operators throughout the country, with the creation in 2011 of INTERPORCI (Inter Profession Porcine of Côte d'Ivoire) under the impetus of the Ministry of Animals and Fisheries Resources (Toure *et al.* 2024). This meat is more consumed due to the high cost of other protein sources such as beef, mutton, chicken and fish sold in the markets (Atobla *et al.* 2017).

Pigs are bred either roaming around villages or in piggeries, often in poor hygienic conditions and without health prophylaxis. This situation makes pigs more susceptible to various diseases which cause huge economic losses to pig farmers. Gastrointestinal parasites are considered one of the most prevalent diseases in pigs. They play a crucial role in traditional pig farming systems, both economically and in terms of public health. These parasites cause high mortality, reduced litter size, poor growth, low production gains, poor feed conversion and increased treatment costs (Maganga *et al.* 2019; Ni-Komang *et al.* 2020; Pettersson *et al.* 2021). There are many worms known

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to be causative agents of various diseases, such as roundworms, echinococcus, dipylidium and tapeworms. Numerous studies have reported the presence of gastrointestinal parasites in pigs in Africa. The most commonly identified parasites in these studies included *Ascaris suum*, *Strongyles* spp., *Trichurus suis*, *Eimeria* spp., and *Oesophagostomum* spp. In regions where pig farming is a major source of income, these impacts can compromise food security and the livelihoods of farmers.

From a public health perspective, some gastrointestinal parasites of pigs, such as *Ascaris suum* and *Taenia solium* cysticerci and *Trichinella spiralis*, are zoonotic. These parasites cause enormous public health problems especially in areas, where environmental or personal hygienic standard are compromised (Abonyi and Njoga 2019). This highlights the importance of controlling these infections in pig farms to protect both animal and human health. Consuming raw or undercooked food that contains infectious larvae, eggs, or metacercariae is the main cause of human infections caused by helminth parasites (Pettersson *et al.* 2021). Moreover, gastrointestinal parasites are not limited to pigs. They also affect other livestock, such as cattle, sheep, goats, camels, and rats (Gragnon *et al.* 2020; Hassan *et al.* 2024; Sayed *et al.* 2024). These parasitic infections are therefore represent a common challenge for many livestock production systems and require integrated management strategies to minimise their impact.

In Côte d'Ivoire, information on the prevalence of gastrointestinal parasites in pigs is scarce. To date, work has been carried out by Kone *et al.* (2022) in some villages of Vavoua and by Kouadio *et al.* (2023) on pigs at the abattoir of SIVAC. These authors reported the presence of several parasite species such as *Ascaris lumbricoides*, *Strongyloides ransomi*, *Taenia solium*, *Echinococcus granulosus* and *Oesophagostomum* spp. It should be noted that parasitism is crucial in animal production, but is often neglected because the clinical signs are not obvious (Aiyedun and Oludairo 2016).

Pig farmers in the department of MAN a city in the west of Côte d'Ivoire, are not spared these parasite problems either, given the conditions in which they are bred. However, to our knowledge, there are no data on parasites in pig farms in this area. The aim of this study was to compile an inventory of gastrointestinal parasites in pigs bred in the department of Man.

## Materials and Methods

### Study area

This study was carried out from February to April 2024 on six traditional pig farms in the department of MAN. Sampling was conducted in the localities of Kassiapleu, Dompleu, Kpangouin, Kouintongouin, Korgouin and Voungbé. The department of Man is located in the west of

Côte d'Ivoire, and is the capital of the Tonkpi region. It is a mountainous area situated between 7°00' and 7°40' north latitude and 7°20' and 7°60' west longitude. The region has a humid tropical climate (1600 to 2500 mm/year). There are two seasons: A rainy season from March to October (eight months) and a dry season from November to February (four months). The average annual temperature ranges from 24.8°C to 28.5°C (Traoré *et al.* 2021).

### Sampling of faeces

The samples were collected in six localities in the department of Man. In each village, one farm was selected for sampling. The piggeries were chosen after an investigation primarily using the snowball sampling technique (Addy *et al.* 2023) based on the number of pigs on the piggeries (> 20 pigs), the hygiene conditions on the farms, and the regular occurrence of disease symptoms. Additionally, the consent of the farmers to access the animals for fecal sampling was required.

For each piggery, 20 pigs were chosen. A total of 120 pigs, comprising 50 males and 70 females, were included in the study, with one fresh fecal sample taken from each pig. The selection of these pigs was based on their physical condition (good) and health status (no visible signs of disease).

The samples consisted of wet feces from apparently healthy live pigs that had not been dewormed for three months. The pigs were isolated individually in the piggery and then monitored until they defecated on the ground. These faeces were placed immediately into labeled jars and then sent to the laboratory for analysis. Information on the sex and age of each animal was also recorded on a card.

### Research of parasites oocysts and eggs

Collected samples were analyzed using the flotation technique with a sodium chloride solution (Kone *et al.* 2022). The procedure consists of taking 5 g of fecal matter and crushing it in a porcelain mortar. It was then diluted and homogenised in 70 mL of a supersaturated solution of sodium chloride (NaCl 33%) in a graduated glass. After sieving with a tea strainer, the mixture was poured into a 20 mL centrifuge tube until a convex upper meniscus was obtained. A slide was then carefully placed on each tube and the whole assembly was left to stand for 20 to 30 min. The coverslip was then removed with forceps and carefully placed on a microscope slide. The eggs were observed using a light microscope with X10 and X40 objectives.

### Data analysis

All data obtained from breeders and during sample analysis were coded and recorded in SPSS 20.0 software. During the analysis, the prevalence of parasites and the confidence

interval (CI 95%) were determined. The chi-square test was used to test relationships between variables. The aim was to evaluate the effect of the different sites on the level of contamination of pigs on the farms. Prevalence was calculated by dividing total numbers of infected pigs by total numbers of collected feces and multiplying it by 100.

## Results

### Infection rate in pigs according sex, age and locality

The results (Table 1) show that 89.1% (107/120) of the pigs examined on the six traditional farms were infected with parasites. The infection rate observed in males (98%) was higher than in females (82.9%) ( $P < 0.05$ ). In addition, pigs aged between one and two years were the most exposed to parasites (94.3%).

The infection rate by locality ranged from 75% to 100% with the highest infection rate observed in Kpangouin (100%) followed by Voungbé (95%). No link was established between the age of the animals and infection, nor between locality and infection ( $P > 0.05$ ).

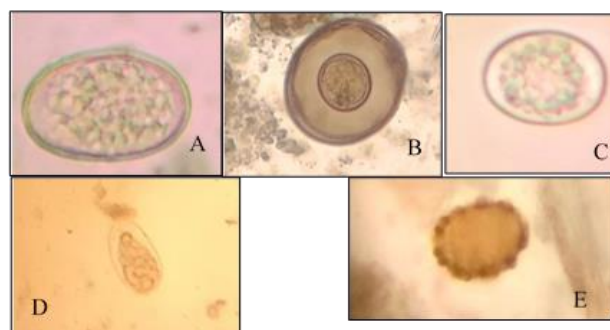
### Parasites identified and cases of polyparasitism

During the study, five species of parasites were identified (Fig. 1). The parasite eggs found in pig faeces were those of *Ascaris suum* (58.3%,  $n = 70$ ), coccidia (45%,  $n = 54$ ), *Strongyloides ransomi* (41.7%,  $n = 50$ ), *Oesophagostomum* spp. (29.2%,  $n = 35$ ) and *Hymenolepis diminuta* (19.2%,  $n = 23$ ). The different percentages obtained in this study are represented in the Fig. 2.

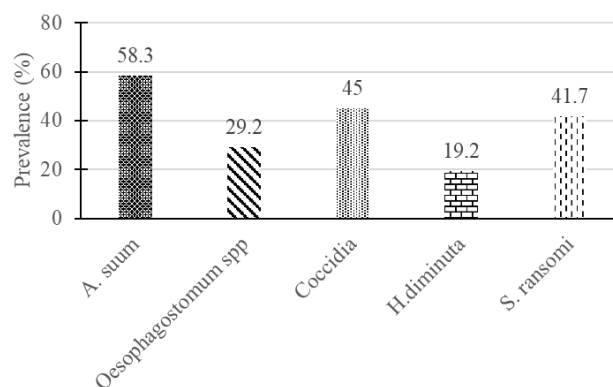
Cases of polyinfection with parasites were also observed (Fig. 3). Pigs harboring two parasites were the most numerous (35.8%,  $n = 43$ ) followed by pigs harboring only one type of parasite (24.2%,  $n = 29$ ). The results showed that only two pigs (1.7%) were infected with all five parasites isolated at the same time. Among the poly-infected cases, the *Ascaris suum* + coccidia association accounted for 15% ( $n = 18$ ). Other associations such as *Ascaris suum* + *Strongyloides ransomi* and *Oesophagostomum* spp. + *Strongyloides ransomi* accounted for 4.2% and 2.5%, respectively.

### Rate of parasite species infection in pigs, according to the sampling sites

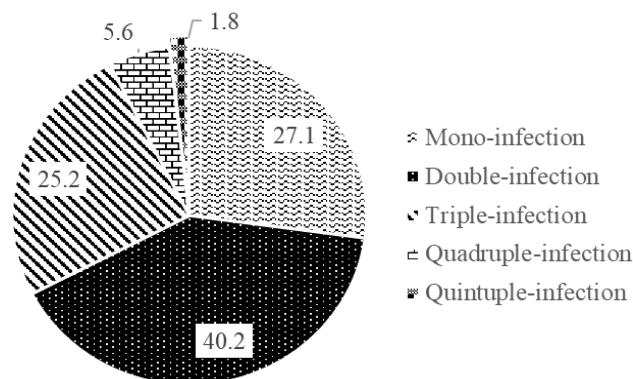
The rate of infection of pigs by parasites according to the sampling area is shown in Table 2. Analysis of this table shows that *Ascaris suum* was more common in pigs from the Korgouin (67.7%, CI 95%; 65.6-67.7) and Voungbé (65%, CI 95%; 63.9-66.1) farms. As for *Oesophagostomum* spp. and coccidia, they were found more frequently on the Voungbé (40%; CI95%: 38.6-41.4) and Kassiapleu (54.2%, CI 95%: 53.1-55.4) farms, respectively. Half of the pigs from the Voungbé, Korgouin and Kpangouin farms were



**Fig. 1:** Parasites eggs in pig feces; (A) *S. ransomi* egg, (B) *H. diminuta* egg, (C) coocidia, (D) *Oesophagostomum* spp., (E) *A. suum* egg



**Fig. 2:** Prevalence of different species of parasites identified in pig



**Fig. 3:** Prevalence of parasite poly-infection in pig from Man department

infected with *Strongyloides ransomi* (50%, CI 95%: 48.7-51.3). Statistical analysis showed that pig contamination was not related to sampling area ( $P > 0.05$ ).

## Discussion

In this study, animals infected with gastrointestinal parasites were observed after coprological analysis. Parasitic

**Table 1:** infection rate of pigs by sex, age and locality

	Number of animal analyzed	Number of animal infected (%)	<i>P</i> value
Sex			
Female	70	58 (82.9%)	0.009
Male	50	49 (98.0%)	
Age Group			
< 1 year	41	35 (85.4%)	0.267
1-2 years	53	50 (94.3%)	
> 2 years	26	22 (84.6%)	
Site of sampling			
Kpangouin	18	18 (100%)	0.088
Kassiapleu	24	18 (75%)	
Dompleu	16	13 (81.2%)	
Korgouin	18	17 (94.4%)	
Kouitongouine	24	22 (91.7%)	
Youngbé	20	19 (95%)	
Total	120	107 (89.1%)	

**Table 2:** Rate of parasite species infection in pigs, according to the sampling sites

Sites	Parasites identified in pig % (CI 95%)				
	<i>A. suum</i>	<i>Oesophagostomum</i> spp.	Coccidia	<i>H. diminuta</i>	<i>S. ransomi</i>
Kassiapleu	54.2 (53.1-55.4)	20.8 (19.2-22.4)	54.2 (53.1-55.4)	25 (23.4-26.5)	33.3 (31.6-34.7)
Dompleu	62.5 (61.4-63.5)	25 (23.4-26.5)	31.2 (29.7-32.7)	25 (23.4-26.5)	31.2 (29.7-32.7)
Kpangouin	61.1 (59.9-62.2)	22.2 (20.6-23.7)	50 (48.7-51.3)	5.6 (3.8-7.3)	50 (48.7-51.3)
Youngbé	65 (63.9-66.1)	40 (38.6-41.4)	50 (48.7-51.3)	30 (28.5-31.5)	50 (48.7-51.3)
Kouitongouiné	45.8 (44.4-47.1)	37.5 (36.1-38.9)	45.8 (44.4-47.1)	25 (23.4-26.5)	37.5 (36.1-38.9)
Korgouin	66.7 (65.6-67.7)	27.8 (26.3-29.3)	33.3 (31.6-34.7)	0	50 (48.7-51.3)

infections are considered the second most critical problem after African swine fever in tropical and subtropical regions (Permin *et al.* 1999). These parasites not only affect the health of the animal, but also reduce the quality of the meat (Maganga *et al.* 2019). The results show that the rate of intestinal parasites in pigs in the Man department was high (89.1%; 107/120). This result is higher than those obtained by several authors who have also worked on pigs in many African countries. Varying infection rates were recorded in Cameroon (74.7%), Nigeria (36.36%) and Côte d'Ivoire (63.75%) (Kouam *et al.* 2018; Adenaike 2020; Kone *et al.* 2022). However, higher infection rates were reported in Cameroon (90.4%), Gabon (98.7%), Ghana (91.07%) (Ntonifor *et al.* 2013; Maganga *et al.* 2019; Addy *et al.* 2023). The significant infection rate found in this study could be attributed to the lack of hygiene on the farms, as evidenced by the large amount of organic matter, feces and urine observed in the animal pens. According to Barbosa *et al.* (2015), the lack of control of health management which is an excellent bioindicator of the health of pig farming intensifies the presence of parasites. In breeding, cleaning must be carried out regularly (daily) to reduce the risk of parasite contamination of the animal. In addition, variations in the prevalence of gastrointestinal parasitic infections observed between studies could be explained by differences related to age, species, climatic conditions, and management and husbandry methods of the pigs. The proportion of infected males (98%) was higher than that of females (82.9%). This result is consistent with that of Addy *et al.* (2023), but contrary to that reported by Abonyi and Njoga (2019) in Nigeria, where

males (25.3%) and females (30.7%) were infected. In contrast to our results, these two authors did not find a significant relationship between sex and animal infection ( $P > 0.05$ ). Young pigs were the most contaminated. According to Addy *et al.* (2023), the high prevalence in young pigs is due to a weakened immune system.

The high infection rate at all sampling sites, ranging from 75% to 100%, could be the result of a lack of regular disinfection practices and the absence of appropriate deworming of pigs on some pig farms, which could reduce transmission. In fact, pig farms are of the traditional type and are generally run by people who have no training in good farm biosecurity practices.

Based on coprological examinations, the main parasite species identified as infecting pigs were *Ascaris suum*, *Strongyloides ransomi*, *Oesophagostomum* spp., *Hymenolepis diminuta* and coccidia. These data confirm the results of previous studies that reported the presence of these parasites in pigs with different prevalences. The main parasite found was *Ascaris suum* (58.3%). These results are in agreement with those of Tamboura *et al.* (2006), Nissen *et al.* (2010) and Thanasuwan *et al.* (2024), who reported high prevalence rates of *Ascaris suum* at 73%, 40% and 68.52% in infected pigs, respectively. This could be due to the ability of *Ascaris suum* eggs to survive longer in the environment of infected animals (Singh *et al.* 2017).

The infection rate of pigs with *Strongyloides ransomi* worms was 41.7%. This was higher than that in Gabon (4.48%) (Maganga *et al.* 2019), Indonesia (18%) (Ni-Komang 2020) and Thailand (28.4%) (Thanasuwan *et al.*

2024). *Strongyloides* sp. is an important parasite that can infect most piglets before weaning. These worms are usually found in the small intestine. Common clinical signs include diarrhea followed by progressive dehydration. Death in piglets occurs between 10 and 14 days of age (Ni-Komang *et al.* 2020).

For *Oesophagostomum* spp., the prevalence in pig farms in the MAN department was 29.2%. In Nigeria (37%) (Nwokoye *et al.* 2021) and in Ghana, Addy *et al.* (2023) recorded 19%. The presence of parasites is a major problem for livestock farmers. *Ascaris suum* and *Oesophagostomum* spp. are parasites that cause anorexia, vomiting, yellowing of the skin, diarrhoea, stunted growth and death (Jufare *et al.* 2015; Ni-Komang *et al.* 2020). In addition, clinical manifestations such as diarrhea and emaciation in pigs have already been attributed to *Strongyloides* and *Oesophagostomum* spp.

Regarding coccidia, 54 pigs (45%) were infected in our study. This rate is lower than the 88% and 87.5% reported by Keshaw *et al.* (2009) and Melo *et al.* (2020). This parasite causes poor performance during the fattening period, diarrhea and predisposes the animal to secondary bacterial and viral infections (Koudela and Vítovec 1998).

Cases of polyparasitism were observed in infected pigs. Of these pigs, 65% developed co-infection and the majority (35.8%) were infected with two parasite species. This rate was lower than the 84.1% reported in Rwanda (Tumusiime *et al.* 2020) and 72.55% reported by Addy *et al.* (2023) in Ghana. However, this value was higher than the 46% co-infection rate in Burkina Faso (Tamboura *et al.* 2006) and 7% in Nigeria (Nwokoye *et al.* 2021).

The cases of co-infection found in this study, ranging from double infection (35.8%) to quintuple infection (1.7%) are alarming. As reported by Nonga and Paulo (2015), co-infections contribute significantly to reduced pig production and performance. The presence of these parasites is also a public health concern, as some, such as *Ascaris suum*, *Oesophagostomum* spp. and *Strongyloides ransomi*, are considered zoonotic parasites (Addy *et al.* 2023). These results indicate the need to train pig farmer in good feeding, hygiene and management practices. The application of the good practices could reduce the parasite that negatively affect animal productivity and are capable of causing disease in farms.

The prevalence of parasites per collection site was high and varied from site to site. However, no significant differences were found. Several factors could explain these high levels, including the study area, which is characterised by high temperatures and humidity that favor the proliferation and development of certain parasites, including those isolated in this study. In addition, the sampling season, feed quality and farmer awareness have been repeatedly reported as factors determining the level of parasitism in pigs (Nwafor *et al.* 2019).

## Conclusion

This study showed a high rate of parasitism in pigs on traditional farms in the department of MAN. On all six farms, the prevalence was 89.1% and five types of parasite were identified, with a predominance of *Ascaris suum* and Coccidia. In addition, certain isolated parasites such as *Ascaris suum*, *Oesophagostomum* spp. and *Strongyloides ransomi* have a negative impact on pig productivity and also are zoonotic. Thus, farmers must clean piggeries daily and apply disinfection regularly. Farmers are strongly advised to implement a sanitary prophylaxis programme and to use antihelmintics to interrupt the parasite cycle, which constitute a major impediment to efficient and profitable livestock production. Awareness-raising campaigns must be carried out to make farmers aware of the risks of diseases transmitted by pigs.

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## Author Contributions

The design of the research idea and the collection of data were carried out by BYC and EASA. The laboratory work and statistical analysis of data was performed by BYC and ZBZF. BYC, ZBZF and EASA wrote the article. DA coordinated research and redaction.

## Conflict of Interest

All authors declare no conflict of interest.

## Data Availability

Data presented in this study will be available on a fair request to the corresponding author.

## Ethics Approval

Not applicable to this paper.

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