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# Parasitic Risks Due to Excrements from Pigs Bred in Some Villages of Vavoua, a Tropical Area Located in the Center-Western of Cote D'Ivoire

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## Abstract

Parasitic infestation remains a public health problem in Côte d'Ivoire. The general objective of this study is the parasitological characterization of pigs in breeding in Vavoua. The study allowed us to identify seven (7) species of parasites with a zoonotic effect: *Ascaris lumbricoides*, *Taenia soluim*, *Cryptosporidium parvum*, and *Giardia intestinalis*, and the specific species are *Fasciola hepatica Toxocara canis* and *Echinicocus granulosus*. The prevalence of zoonotic parasites varied between 65.14% and 93.82% in the villages of Vavoua. The regression of this rate may be possible on the basis of sensitization and monitoring of herders for compliance with the rules of hygiene and support from the human and animal health authorities and by the NGO working on health education and training, monitoring compliance with these rules.

## Keywords

Parasitic Risk, Abatement, High Pig, Wandering, Côte d'Ivoire

## 1. Introduction

Located in West Africa with a surface of 322,462 km$^2$, Côte d'Ivoire is a country whose economy is mainly based on agriculture [1]. In this agriculture, aquaculture, fishing, and livestock are secondary activities for most Ivorian populations [2]. Livestock production is low and livestock represents less than 1% of GDP (Gross Domestic Product) [2]. The number of pigs fell from 324,000 traditional pigs and 48,000 modern pigs in 1991 to 268,000 traditional pigs and 78,000 modern pigs in 2001. The pig industry was badly affected by the African swine

fever epizootic in May 1996, which has caused a 64% drop in numbers of modern pigs and 32% of traditional pigs [2]. The need to initiate action in favor of the revival and development of the pork sector in Côte d'Ivoire requires an in-depth analysis of the actors in the sector [3].

Pig farming constitutes an important saving for the farmer for the resolution of social problems [4]. It also contributes to the fertilization of the soil through manure. An adult pig can produce 600 to 730 kg of organic manure per year [5] [6]. The proliferation of breeding pig farming in the villages of the sub-region and more specifically that of Côte d'Ivoire is worrying. Pig breeding farming exists almost everywhere, even in the countryside. Many families in rural areas have a few pigs that they let around their homes. The villages of the commune of Vavoua are not left out of this type of pig farming. However, this kind of breeding pigs causes the phenomenon of predation and nuisance [1]. In addition to the predation and nuisance they cause, pigs constitute a reservoir of potentially pathogenic microorganisms dangerous for human beings and represent a risk for them [7]. There are many worms recognized as the causative agents of much pathology such as roundworms, echinococcus, dipylidium and tapeworms. These worms lay microscopic eggs which eliminated in the faeces, end up in the environment. These eggs, the main source of contamination, resist several years in the external environment and are very difficult to destroy [8]. Pig droppings accumulate and dry out during the dry season. The dust thus formed can scatter and affect people living in the vicinity [9]. In addition to the infectious nature, some parasites can create allergic reactions in some people [10]. And those whose harm is considered nil or very low for healthy humans can be seriously pathogenic in patients with diseases immunodeficient [11].

Despite these risks, we have not recorded any specific study on the excrements of pigs bred in wandering in Vavoua.

The general objective of this study is to characterize the species of pathogenic worms contained in the excrement of pigs bred in wandering.

## 2. Material and Methods

### 2.1. Study Environment

Vavoua is a city and the capital of the department of Côte d'Ivoire, located in the Haut Sassandra region in the center-western of Côte d'Ivoire. It is closed to Zuénoula and Daloa, it is a vast territory of 6480 km$^2$ with a population of more than 422,000 inhabitants (about 62 inhabitants/km$^2$) [12]. Vavoua is a prefecture located 50 km north of Daloa. The department is subdivided into cantons: Sétis, Natis, Gotron, Bronon, Sokuya and Gnandéboa. The rural population represents 80% of the total population [13].

### 2.2. Methods

#### 2.2.1. Choise of Study Sites

In a rural area of Vavoua, pigs roam the villages in direct and indirect contact

with the population and other domestic or wild animals. The choice of villages was motivated by criteria of accessibility, cooperation of rural populations and the presence of pigs. The five villages selected for the study are: Danzerville, Dèma, Gatifla, Gouabafla and Sebouafla.

#### 2.2.2. Sample Collection

The biological material was pig's faeces. The samples were taken from April 25 to July 26, 2019, due to one campaign per week, *i.e.* a total of twelve sampling campaigns. The pig faeces samples were taken from the villages visited during the survey. Two types of faeces are collected, wet faeces and dry faeces. Wet faeces were collected just after faecal matter emission. As for the dry faeces, they were collected on the places of wandering. In each village, a total of 30 samples of wet faeces and 30 samples of dry faeces are taken randomly after four (4) campaigns. The faeces are collected using a wooden applicator stick and put in salt boxes before being immediately fixed with 70% alcohol. The samples are kept in a bucket with a lid and transported to the Laboratory where they underwent parasitological analyses.

#### 2.2.3. Applied Analysis Technique

In the laboratory, 5 g of faeces were taken from each stool box, to which 20 ml of Willis' Liquid (aqueous NaCl solution at saturation (d = 1.20)) was added. The suspension was filtered through a cleaned sieve (mesh, 0.5 mm) before any new handling to avoid any risk of contamination by microorganisms. The filtrate is poured into a 20 ml conical tube, filled to the maximum and closed, then centrifuged at 2500 rpm for 5 min at 4˚C. The goal is to bring up the parasitic elements while letting the fecal debris flow. The supernatant is recovered and then placed on a slide covered with coverslips and identified with the name of the sample, before being observed under the microscope. We then counted each type of parasite. The samples are then observed at low magnification (×40), in order to search for the eggs and larvae present in the samples, then at high magnification (×100 and ×400), to specify their identification.

#### 2.2.4. Parasite Egg Identification Technique

The identification of the parasites was carried out from the work and identification keys of some authors [14] [15] [16] [17] [18]. The classification proposed in the key established by the editors of "Sawasserflora Von Mitteleuropa" [19] [20] [21] [22] was adopted in this study.

#### 2.2.5. Species Richness of Parasites

Species richness is the total number of species recorded on the given site and/or at a given time. According to Travers obverse, [23] they are made directly on the total number of taxa observed in a site.

#### 2.2.6. Frequency of Occurrence of Parasites

The frequency (*F*), also known as the occurrence or constancy index [24], is the

percentage of the ratio of the number of samples taken in which the species was recorded in a given site to the total number of samples taken at the level of the same site.

The frequency of the species is given by Equation (1):

$$F = \frac{N_i}{N_t} * 100 \quad (1)$$

with:

$N_i$: number of samples containing species $i$; $N_t$: total number of samples taken.

According to this frequency, three classes of species are to be distinguished:

- If $F > 50\%$: the species are said to be constant;
- If $25\% < F < 50\%$: the species are incidental;
- If $F < 25\%$: the species are accidental.

#### 2.2.7. Prevalence of Parasites with Zoonotic Effects

The prevalence of zoonotic parasites was used to calculate the percentage of parasite eggs or oocysts at each site. It is determined by the following Equation (2):

$$P(\%) = \frac{\text{Number of zoonotic oocysts}}{\text{Number of faeces analyzed}} * 100 \quad (2)$$

#### 2.2.8. Data Processing

The information collected in the field and in the laboratory is ordered and has been codified and then entered using Microsoft Excel version 2016 software.

## 3. Results

### 3.1. Specific Richness of the Parasites Inventoried

The microscopic analyzes made it possible to observe 628 individuals in the faeces samples. After using the identification keys, 2 groups of parasites including 5 branches and 8 classes have been established (Table 1).

The platyhelminthes branch with 12 species: *Fasciola hepatica*, *Dicrocoelium dentriticum*, *Clonorchis sinensis*, *Paragonimus westermani*, *Schistosoma haematobium*, *Taenia solium*, *Diphyllobothrium latum*, *Hymenolepis nana*, *Hymenolepis nana*, *Echinicocus granulosus*, and *Moniezia expansa* is the most encountered. This phylum is followed of the Nemathelminthes phylum composed of 6 species including *Trichuris trichiura*, *Enterobius vermicularis*, *Ascaris lumbricoides*, *Strongyloide stercoralis*, *Toxocara canis*, and *Oesosphagostomum bifurcum*.

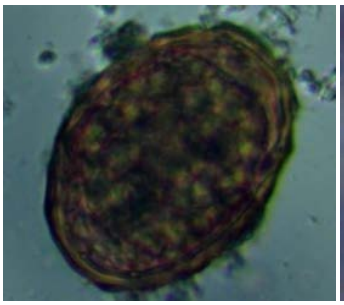
The phylum of Rhizoflagellates including *Isospora belli*, *Entamoeba histolytica*, *Giardia intestinalis*, *Chilomastix mesnili*, and *Balantidium coli* and the phylum of Apicomplexa consisting of 3 species: *Toxoplasma gondii*, *Cryptosporidium parvum*, and *Isospora belli* as well as Ciliates (*Blastocystis hominis*) are least recorded.

The identified species are grouped into three categories: constant species, accidental species and incidental species in Table 1 and Figure 1.

**Table 1.** List of parasite species identified with their frequency of appearance.

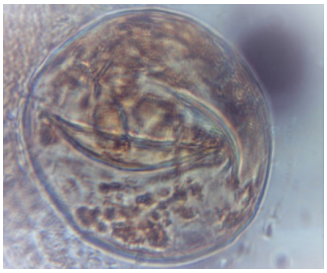
| Philum | Class | Genus | Species | C1 | C2 | C3 | C4 |
|---|---|---|---|---|---|---|---|
| Apicomplexa | Sporozoa | Toxoplasma | *Toxoplasma gondii* | ** | ** | ** | *** |
| | | Cryptosporidium | ***Cryptosporidium parvum*** | *** | *** | *** | *** |
| | | Isospora | *Isospora belli* | ** | | * | * |
| Rhizoflagellated | Rhizopods | Entamoeba | *Entamoeba histolytica* | ** | *** | *** | *** |
| | | Giardia | ***Giardia intestinalis*** | * | * | * | ** |
| Ciliated | Flagellated | Chilomastix | *Chilomastix mesnili* | ** | * | ** | *** |
| | | Balantidium | *Balantidium coli* | * | ** | ** | *** |
| Nemathelminthes | Nematods | Trichures | ***Trichuris trichiura*** | ** | * | ** | ** |
| | | Enterobius | *Enterobius vermicularis* | | ** | * | * |
| | | Ascaris | ***Ascaris lumbricoides*** | ** | *** | ** | ** |
| | | Strongyloides | *Strongyloide stercoralis* | ** | ** | * | ** |
| | | Toxocara | *Toxocara canis* | * | * | | |
| | | Oesophagostomum | *Oesophagostomum bifurcum* | * | | ** | ** |
| Plathelminthes | Trematods | Fasciola | ***Fasciola hepatica*** | *** | ** | ** | ** |
| | | Dicrocoelium | *Dicrocoelium dentriticum* | ** | * | ** | *** |
| | | Clonorchis | *Clonorchis sinensis* | | ** | * | |
| | | Paragonimus | *Paragonimus westermani* | | ** | * | ** |
| | | Schistosoma | *Schistosoma haematobium* | *** | ** | ** | ** |
| | Cestods | Taenia | ***Taenia solium*** | * | ** | * | ** |
| | | Diphyllobothrium | *Diphyllobothrium latum* | *** | ** | ** | ** |
| | | Hymenolepis | *Hymenolepis nana* | ** | ** | *** | |
| | | Echinococcus | *Echinicocus granulosus* | * | *** | * | ** |
| | | Moniezia | *Moniezia expansa* | ** | * | * | ** |
| | | *Blastocystis* | *Blastocystis hominis* | | ** | | * |

*: accidental species; **: ancillary species; ***: constant species; C: campaign; bold names are zoonotic species.



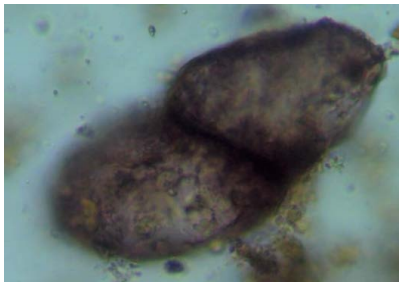
*Ascaris lumbricoides*

*Taenia solum*



*Toxocara canis*

*Balantidium coli*



*Isospora belli*

**Figure 1.** Images of some eggs of parasite species identified.

### 3.2. Abundance of Parasitic Worms According to the Type and Place of Sampling

The analysis of the frequency of occurrence reveals that 93.33% and 90% of species are constant respectively in dry faeces in enclosures and fresh faeces in scavenging, 46.66% of species are incidental in dry faeces stray and 25% are accidental in fresh faeces in enclosures (**Table 2**).

### 3.3. Prevalence of Zoonotic Parasites According to the Villages

The observation of the oocysts made it possible to distinguish 7 zoonotic species which are *Ascaris lumbricoides*, *Taenia soluim*, *Cryptosporidium parvum*, *Giardia intestinalis*, *Fasciola hepatica*, *Toxocara canis* and *Echinicocus granulosus* (**Table 3**).

## 4. Discussion

The results concerning manure collection and management methods at the farm level revealed that open storage is the most widespread system in villages where pen farming is practiced. This mode of practice is used by 55% of pig farmers while 10% store waste in pits.

This result agrees with that obtained in Senegal by Clerk [25]. This author has indeed recorded that 10% of manure is stored only in the pits and that the majority of manure is in the open air. The exposure of manure to the open air may be related to the lack of adequate infrastructure for storing animal manure. According to Marquis & Marchal [26] and Vua *et al.*, [27], the absence of pits would contribute to the emission of odors. Also, the majority of populations have not livestock as their main activity. As a result, the construction of habitats for their animals would be considered a fortuitous and non-beneficial investment.

The presence of parasitosis is an indicator of the awareness and level of education of the population in the field of health [28]. Loreille & Bouchet [29] asserted the opposite that these factors have no impact on biological risk. Only the external factors related to the practices of the breeders on the respect of hygiene and the conduct of breeding that must be taken into account as a source of contamination by the zoonotic disease.

**Table 2.** Occurrence frequencies of samples taken according to type of breeding system.

| Breeding system | Type of faeces | Number of samples examined | Number of positive samples | Occurrence frequency |
|---|---|---|---|---|
| Enclosure | fresh faeces | 60 | 15 | 25% |
| | dry faeces | 60 | 56 | 93.33% |
| Divagation | fresh faeces | 60 | 54 | 90% |
| | dry faeces | 60 | 28 | 46.66% |

**Table 3.** Prevalence of parasites with zoonotic effects in the different study sites.

| Parasites or Oocysts | Sites | | | | |
|---|---|---|---|---|---|
| | Sébouafla | Déma | Gouabafla | Gatifla | Denzerville |
| *Cryptosporidium parvum* | 18% | 21% | 35% | 16% | 10% |
| *Toxocara canis* | 17% | 24% | 10% | 25% | 24% |
| *Giardia intestinalis* | 9% | 22% | 32% | 17% | 20% |
| *Taenia solium* | 6% | 18% | 19% | 24% | 33% |
| *Ascaris lumbricoides* | 23% | 17% | 25% | 17% | 18% |
| *Fasciola hepatica* | 6% | 6% | 39% | 29% | 20% |
| *Echinicocus granulosus* | 11% | 23% | 29% | 13% | 24% |
| Others parasites | 9% | 10% | 31% | 19% | 31% |
| **Zoonotic prevalence** | **65.14%** | **82.1%** | **93.82%** | **82%** | **91.22%** |

A total of 7 parasites with zoonotic effect have been identified which are *Ascaris lumbbricoides*, *Taenia soluim*, *Cryptosporidium parvum*, *Giardia intestinalis*, *Fasciola hepatica*, *Toxocara canis* and *Echinicocus granulosus*. The frequent zoonotic species are *Ascaris lumbbricoides*, *Taenia soluim*, *Cryptosporidium parvum*, and *Giardia intestinalis*. The specific zoonotic species are *Fasciola hepatica*, *Toxocara canis*, and *Echinicocus granulosus.* The number of species of zoonotic parasites can be considered to be high, given the adverse effects that a single species can cause in pigs and humans.

These different species of zoonotic parasites have previously been reported in other regions of West Africa, such as Guinea [30], Gambia [18], Senegal [31], Burkina Faso [32] and Mali [33]. However, in some of these countries mentioned above, other species of zoonotic parasites have been observed, in addition to the seven species mentioned. These are the species *Bunostomum phlebotomum*, *Opistorchis felineus* and *Necator americanus*.

The difference between the number of species of zoonotic parasite identified in our study and that of the authors who worked in the countries mentioned above would be related to the duration of the sampling campaign. The longer the study period, the greater the probability of encountering a large number of species. This is explained by the fact that each species of parasite, having a seasonal or periodic development cycle, is only observable during this time. Thus, ex-

tending the sampling period over a long period would contribute to a high specific richness.

In Côte d'Ivoire, as elsewhere in West Africa, helminths are the most numerous parasites. This abundance is due to the fact that when the animal emits the faeces, the larvae are still intact. But with time and environmental conditions the abundance decreases and some are washed away by erosion and others in the air [34]. This explains the abundance of parasitic worms in fresh stray faeces (29%) compared to dry faeces (24%).

Contrary to the faeces which are in enclosures, there is a significant amount in dry faeces (26%) than in fresh faeces (21%) of the accumulation of parasites in the enclosures if it is not cleaned regularly. This is similar to that of Levasseur & Dutrémé [35] who demonstrated that the materials in the pigsty constitute vectors of contamination if it is not cleaned regularly.

Prevalence plays an important role in the fight against the biological risks of worms because all parasites with a zoonotic effect can be avoided by means of prophylaxis. The prevalence of zoonotic parasite varies between 65.14% and 93.82% in the villages of Vavoua. The prevalence of zoonotic parasite varies between 65.14% and 93.82% in the sampled villages of Vavoua. These prevalence values are very high. They also show the high risk of zoonotic infestation to which the populations of these villages would be exposed. The zoonotic parasitic index values, high in pigs from the sampled villages, could be explained by the fact that swine are stranded frequent areas of human defecation. Indeed, in most of these villages, common septic tanks are almost non-existent and the inhabitants defecate in nature at the level of the brush around their own homes. Stray animals, such as stray pigs, will feed on human excrement on these defection grounds.

Unlike Brazil, the prevalence was 12.2% according to Carneiro [36] and it was around 37.14% in Lebanon according to Hamze [37], after a study on zoonotic parasites. Infestation of pigs resulting from the negligence of deworming agents and non-compliance of the hygiene measures can be avoided by training farmers in livestock management.

## 5. Conclusions

There are 7 species with zoonotic effect, of which the most frequent species are *Ascaris lumbbricoides*, *Taenia soluim*, *Cryptosporidium parvum*, and *Giardia intestinalis*, and the specific species are *Fasciola hepatica*, *Toxocara canis* and *Echinicocus granulosus*. The lack of knowledge on intestinal parasitosis, the non-respect of the rules of hygiene of the individual and the pigsty and the non-mastery of livestock management constitute risk factors for the transmission of parasites from pigs to populations.

Strategies for eliminating zoonoses should focus on educating farmers to respect individual and collective hygiene.

In addition, support from the government or NGOs can improve the living

conditions of each household while influencing the health of the environment.

The results obtained can serve as a reference to better guide subsequent interventions in terms of zoonosis.

Admittedly, parasite eggs were identified, but the study did not allow the counting of pig parasites in the absence of a more efficient tool. Further study would suggest the prior determination of the presence of parasites in human faeces and the detection of worms in the environment followed by the search for potential risk factors that are at the origin of the infestation.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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