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RESEARCH PAPER

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Parasites associated with bile contents of gall bladder from pigs in Oghara, Delta State, Nigeria

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ABSTRACT

This study investigated helminth parasites associated with the gall bladder of pigs slaughtered in Oghara, Delta State, Nigeria. A total of 121 gall bladder samples were collected between January and June 2025 from different slaughter slabs across dry and rainy seasons. Samples were examined using direct wet mount, formol-ethyl sedimentation, and centrifugation techniques. Data were analyzed using SPSS (version 20). The overall prevalence of gall bladder helminth infection was 76.8% (93/121). Two parasites were identified: *Fasciola* spp. (74.2%) and *Strongyloides* spp. (25.8%). Females (54.5%) showed higher infections than males (22.3%), while exotic breeds (47.1%) were more affected than local breeds (29.7%). Seasonal prevalence was higher during the rainy season for both *Fasciola* spp. (43.1%) and *Strongyloides* spp. (14%). These findings highlight significant economic and public health implications. Improved hygiene, routine deworming, farmer education, and restricted access to snail-infested or contaminated water sources are recommended to reduce infection burdens.

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INTRODUCTION

Helminth infections continue to pose a significant challenge to pig production worldwide, with the impact being particularly severe in developing countries such as Nigeria, where poor hygiene, inadequate management practices, and fluctuating climatic conditions increase transmission risks (Abonyi and Njoga, 2020; Bernard *et al.*, 2021; Lemy and Egwunyenga, 2017). These infections lead to considerable economic losses through reduced growth rates, poor feed conversion efficiency, condemnation of affected organs during meat inspection, and, in severe cases, increased mortality (Adesehinwa *et al.*, 2024; Li *et al.*, 2022).

Although considerable attention has been given to gastrointestinal helminths in pigs, far less focus has been placed on parasites of the hepatobiliary system—particularly those affecting the liver and gall bladder—despite their clinical and economic significance. The gall bladder, though not a typical site for helminth habitation, may become infested by trematodes that migrate through the hepatobiliary tract. Key species implicated include *Fasciola hepatica*, *Dicrocoelium dendriticum*, and the migrating larvae of *Ascaris suum* (Chougar *et al.*, 2019; Oyebamiji *et al.*, 2021). These parasites can obstruct bile flow, trigger hepatic inflammation, and impair liver function, resulting in subclinical disease and reduced productivity in pigs (Silva *et al.*, 2021).

Pig husbandry systems in Nigeria vary widely and are typically classified as intensive, semi-intensive, or extensive. Intensive systems rely on confined housing and controlled feeding regimes, which reduce pigs' exposure to environmental pathogens. Conversely, semi-intensive and extensive systems permit scavenging or foraging, thereby increasing pigs' contact with contaminated environments, intermediate hosts such as snails and ants, and polluted water sources (Adesehinwa *et al.*, 2024; Abonyi and Njoga, 2020). These differing exposure levels significantly influence the risk and severity of helminth infections, including those involving the gall bladder. The risk is further elevated in areas where open defecation is prevalent and deworming practices are poorly implemented (Veterinary Authority of Nigeria, 2023).

With the growing demand for pork in Nigeria and the important contribution of pigs to rural livelihoods, understanding how different rearing environments influence parasite transmission has become increasingly urgent, particularly for understudied sites such as the gall bladder. Such insights are critical for designing targeted disease-control strategies that enhance animal health and ensure food safety (Adedokun *et al.*, 2023). As pork consumption continues to rise, the health status of slaughtered pigs has become a public health priority. Helminth infections—especially those involving the liver and gall bladder—can result in organ condemnation at slaughter, thereby reducing farmers' income and posing risks to consumers (Li *et al.*, 2022; Oyebamiji *et al.*, 2021).

Understanding the distribution of helminths within the gall bladder and how these infections vary across farming systems is essential for developing effective control programs. For example, if fluke infections are shown to be more common in pigs raised under semi-intensive systems, intervention efforts can prioritize disrupting the parasite life cycle through improved environmental hygiene and management of intermediate hosts (Abonyi and Njoga, 2020).

Although numerous studies have examined pig parasitology in Nigeria, most have focused on gastrointestinal helminths, leaving gall bladder infections largely understudied (Bernard *et al.*, 2021; Oyebamiji *et al.*, 2021; Lemy and Egwunyenga, 2018).

This research gap is concerning, as trematode infestations within the hepatobiliary system can impair liver function and compromise meat quality. It is particularly problematic given the wide range of pig-rearing systems in Nigeria; pigs kept under extensive or semi-intensive conditions face greater exposure to contaminated soil, vegetation, and intermediate hosts (Adesehinwa *et al.*, 2024). The absence of baseline epidemiological data on gall bladder-specific helminths limits the development of effective control measures. Without understanding how different production systems influence the prevalence and diversity of hepatobiliary parasites, interventions are often generalized and may not adequately address local transmission dynamics. Compounding this issue, weak veterinary surveillance in rural and peri-urban communities allows infections to persist undetected until they produce noticeable economic or health impacts (Veterinary Authority of Nigeria, 2023).

Ultimately, this knowledge gap affects both animal welfare and public health, particularly considering the zoonotic potential of helminths (Silva *et al.*, 2021; Chougar *et al.*, 2019).

Closing this gap is essential for strengthening disease control strategies and supporting the sustainable growth of Nigeria's pig industry. The aim of this study is to investigate the prevalence, diversity, and distribution of helminth parasites associated with the gall bladder of pigs in Oghara, Delta State.

MATERIALS AND METHODS

Description of study area

This study was conducted using biological samples collected from abattoirs in Oghara, a semi-urban town in Ethiope West Local Government Area, within Delta Central of Delta State, Nigeria (Ede *et al.*, 2025). Located within the Niger Delta region, Oghara experiences a humid tropical climate characterized by high annual rainfall and temperatures ranging from 26°C to 32°C—conditions that favor the development and transmission of parasitic infections.

The town hosts an active livestock market and several slaughter facilities that supply pork and other animal products to surrounding communities. Pigs in this area are reared under diverse production systems, including intensive and extensive methods, making Oghara a suitable location for investigating zoonotic and production-limiting diseases such as helminthiasis.

Geographically, Oghara is situated at approximately 5.941094° N latitude and 5.678682° E longitude. It is accessible through major road networks and supported by local veterinary and agricultural extension services, although routine surveillance for livestock parasitic infections remains inadequate.

Sampling technique

Simple random sampling was used for the selection of Slaughter slabs across the location selected for the study. Slaughter slabs were selected based on accessibility and compliance with slaughter owners. Simple random sampling technique was used for selection and collection of samples from pigs in the different locations and slaughter houses in the study area.

Sample collection

Gall bladder samples were collected and used for the study. The study was carried out for a period of six (6) months from January to June 2025. The period of sampling cut across the two seasons (raining season and dry season). Visits were made to the sampling sites and towns selected for the study weekly for a period of twelve (12) months for collection of samples.

Collection of gall bladder samples

Slaughter facilities across the study area were visited between 7:00 a.m. and 10:00 a.m. over a six-month period to collect gall bladders from freshly slaughtered pigs. With the assistance of slaughterhouse workers, gall bladders were removed and placed into clean polyethylene bags. Preservation methods varied based on the distance of the sampling site from the laboratory: samples obtained from locations near the laboratory were transported in ice-water–filled thermos flasks for immediate analysis without preservatives, whereas samples from more distant sites were preserved in a 2.5% (w/v) potassium dichromate solution, prepared by dissolving 2.5 g of potassium dichromate in 100 mL of deionized water (Adhikari *et al.*, 2021). All samples were promptly transported to the Department of Science Laboratory Technology, Faculty of Science, Delta State University, Abraka, where laboratory examinations were carried out.

Laboratory procedure

Centrifugation method

The gall bladder was aseptically opened using a sterile blade, and its contents were emptied into a clean beaker. The material was thoroughly mixed with a sterile stirring rod, after which a portion was transferred into a centrifuge tube. A rubber stopper was applied, and the tube was shaken vigorously for 10 seconds before centrifugation at 400–500 rpm for 2–3 minutes. Following centrifugation, two layers were observed: a sediment layer at the bottom and a clear supernatant above. The supernatant was carefully decanted, and a drop of saline solution was added to the sediment and mixed using a glass pipette. A drop of the resulting suspension was then placed on a microscope slide for examination under 10× and 40× objectives (World Health Organization, 2012).

*Microscopy (Direct wet mount and Formol-ethyl sedimentation***)**

For the direct saline wet mount, a drop of physiological saline solution (0.85% w/v sodium chloride) was placed on a clean, grease-free microscope slide. Using an applicator stick, a small amount of the thoroughly mixed gall bladder content was added to the saline and mixed to form a uniform suspension. A coverslip was then placed over the preparation, which was subsequently examined microscopically (Awujo *et al.*, 2023).

Informed consent

Before the study was carried out, prior notification was given to the slaughter slab owners at various study areas and permission soughed for were obtained. The slaughter owners and other relevant bodies were informed of the nature and possible outcome of the study.

Statistical analysis

All data generated from the study were entered into Microsoft Excel (Version 2016) and analyzed using the Statistical Package for the Social Sciences (SPSS) version 20.0. The percentage prevalence of each parasite species was determined by dividing the number of positive samples by the total number of samples examined and multiplying the result by 100.

RESULTS

Prevalence of parasites

Analysis of gall bladder samples from pigs in Oghara, Delta State, revealed the presence of multiple helminth species. Of the 121 samples examined, 93 were positive for helminth infection, representing a prevalence rate of 76.8%. These findings are presented in Table 1.

Table 1. Prevalence of parasites in gall bladder samples of pigs.

Sample	No. examined	No. of positive	Prevalence (%)
Gall bladder	121	93	76.8%

Sex-related prevalence

Of the 121 gall bladder samples examined, 43 were obtained from male pigs and 78 from female pigs. Among the males, 27 samples tested positive for helminth parasites, representing a prevalence of 22.3%. In contrast, 66 of the 78 female samples were positive, corresponding to a prevalence of 54.5%. These results are presented in Table 2.

Table 2. Sex-related prevalence of helminth parasites in gall bladder samples of pigs.

Sex	No. examined	No. infected	Prevalence(%)
Male	43	27	22.3
Female	78	66	54.5
Total	121	93	76.8

Breed-related prevalence

Of the 121 gall bladder samples examined, 46 were obtained from local breeds and 75 from exotic breeds. Among the local breeds, 36 of the 46 samples were positive for helminth parasites, representing a prevalence of 29.7%. In the exotic breeds, 57 of the 75 samples tested positive, giving a prevalence of 47.1%. These results are presented in Table 3.

Table 3. Breed-related prevalence of helminth parasites in gall bladder samples of pigs.

Breed	No. examined	No. infected	Prevalence(%)
Local	46	36	29.7
Exotic	75	57	47.1
Total	121	93	76.8

Prevalence of single parasite

Two helminth species were identified in the gall bladder of pigs examined in Oghara, Delta State. From the 93 positive samples, *Fasciola* spp. and *Strongyloides* spp. were detected. A total of 69 samples were infected with *Fasciola* spp., representing a prevalence of 74.2%, while 24 samples were positive for *Strongyloides* spp., accounting for 25.8% prevalence. These results are presented in Table 4.

Table 4. Prevalence of single parasite species in gall bladder samples of pigs.

Parasite	No. infected	Prevalence (%)
Fasciola spp.	69	74.2
Strongyloides spp.	24	25.8
Total	93	100

Seasonal prevalence

Gall bladder samples were collected over a six-month period spanning both the dry and rainy seasons. Of the 121 samples examined, 57 were collected during the dry season, with 29 testing positive for *Fasciola* spp. (31.1% prevalence) and 11 for *Strongyloides* spp. (11.8% prevalence). During the rainy season, 64 samples were examined; 40 were positive for *Fasciola* spp. (43.1% prevalence) and 13 for *Strongyloides* spp. (14.0% prevalence). These results are summarized in Table 5. Monthly analysis within each season revealed distinct trends. In the dry season, the prevalence of *Fasciola* spp. increased progressively from 7.5% in January to 9.7% in February and 13.9% in March. *Strongyloides* spp. prevalence remained stable at 3.2% in January and February before rising to 5.4% in March. During the rainy season, *Fasciola* spp. prevalence was 9.7% in April, peaked at 18.3% in May, and declined slightly to 15.1% in June. *Strongyloides* spp. prevalence followed a fluctuating pattern, recorded at 5.4% in April, decreasing to 3.2% in May, and rising again to 5.4% in June.

Table 5. Seasonal prevalence of *Fasciola* spp. and *Strongyloides* spp.

Month	No. examined	*Fasciola* spp. (No. infected)	*Fasciola* spp. (%)	*Strongyloides* spp. (No. infected)	*Strongyloides* spp. (%)
Dry season					
Jan	19	7	7.5	3	3.2
Feb	18	9	9.7	3	3.2
March	20	13	13.9	5	5.4
Total	57	29	31.1	11	11.8
Rainy season					
April	22	9	9.7	5	5.4
May	21	17	18.3	3	3.2
June	21	14	15.1	5	5.4
Total	64	40	43.1	13	14
Overall total	121	69	74.2	24	25.8

DISCUSSION

The high overall prevalence (76.8%) of helminth infections recorded in the gall bladder of pigs in Oghara, Delta State, indicates a significant parasitic burden in the study area. High helminth prevalence in pigs has been reported across various tropical regions, largely due to favorable environmental conditions, poor sanitation, and semi-intensive husbandry practices (Nissen *et al.*, 2011; Kassai, 1999). Such infections have important economic consequences, including reduced weight gain, lowered productivity, and organ condemnation during meat inspection (Soulsby, 2006; Phiri *et al.*, 2006). Additionally, some helminths of pigs, including *Fasciola* species, have zoonotic potential, posing public health risks especially in communities dependent on backyard slaughter or where meat inspection is inadequate (Mas-Coma *et al.*, 2005).

With respect to species composition, *Fasciola* spp. was the most prevalent parasite (74.2%), followed by *Strongyloides* spp. (25.8%). The predominance of *Fasciola* spp. is consistent with findings in humid tropical regions, where the ecology strongly supports the presence of freshwater snails (*Lymnaea* spp.), the intermediate hosts crucial for the parasite's life cycle (Beesley *et al.*, 2018; Mas-Coma *et al.*, 2005). Areas with abundant slow-moving water, swamps, and poorly drained pastures create ideal conditions for *Fasciola* transmission.

Conversely, the lower prevalence of *Strongyloides* spp. may be influenced by its more specific requirements, particularly the need for moist but not waterlogged soil for larval development (Urquhart *et al.*, 1996). Excessive rainfall or flooding may reduce larval survival, thereby affecting transmission dynamics.

Sex-related differences showed that females (54.5%) had higher infection rates than males (22.3%). Similar trends have been reported in several helminth studies, where females—particularly pregnant and lactating sows—exhibit higher susceptibility due to stress-related immunosuppression (Houdijk, 2008; Roberts and Janovy, 2009). Hormonal fluctuations during pregnancy and lactation are known to reduce immune responsiveness, increasing vulnerability to parasitic infections. In addition, management factors play a role: breeding females typically remain in herds longer, increasing cumulative exposure to infective stages, while males are often sold earlier, reducing their risk of chronic infection (Nansen and Roepstorff, 1999).

Breed-related differences indicated that exotic breeds had a higher prevalence (47.1%) than local breeds (29.7%). This pattern aligns with established findings that indigenous breeds often possess stronger genetic resistance to endemic parasites due to long-term adaptation to local environments (Stear *et al.*, 2007; Chimonyo and Dzama, 2007). Exotic breeds, in contrast, frequently lack such adaptive resistance and can be more susceptible when exposed to local parasites under the same management systems. Differences in skin thickness, behavior (e.g., wallowing), and immune responses between breeds can further influence susceptibility.

Seasonal patterns showed higher prevalence of *Fasciola* spp. and *Strongyloides* spp. during the rainy season. Increased rainfall typically enhances the abundance and activity of snail intermediate hosts, thus boosting *Fasciola* transmission (Beesley *et al.*, 2018). Peak infection levels in the rainy season have been widely documented in fascioliasis studies (Phiri *et al.*, 2005; Mas-Coma *et al.*, 2009). For *Strongyloides* spp., the slightly elevated rainy-season prevalence is consistent with the parasite's dependence on moist soil for larval development.

Optimal soil moisture promotes larval survival and mobility, contributing to higher infection rates (Urquhart *et al.*, 1996). However, heavy flooding may disrupt transmission for both parasites by washing away larvae or intermediate hosts.

CONCLUSION

This study demonstrates a high prevalence of gall bladder helminth infections in pigs reared in Oghara, Delta State, with *Fasciola* spp. and *Strongyloides* spp. identified. This suggests that local environmental conditions and husbandry practices, particularly during the rainy season, favor parasite transmission. Overall, these findings highlight the need for targeted parasite control strategies—including improved management systems, restricted access to contaminated water sources, and routine deworming—to reduce parasite burden, enhance productivity, and mitigate economic losses.

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