Epidemiological Survey of Gastrointestinal Parasites of Pigs Slaughtered in Makurdi Metropolis, Benue State

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Authors’ contributions

This work was carried out in collaboration between all authors. Authors VUO and SSI designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors POA, VUO and SSI managed the analyses of the study. Authors VUO and POA managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Gastrointestinal parasites are among the most devastating disease-causing organisms of swine. An epidemiological survey of gastrointestinal parasites of pigs was carried out between the months of October 2015 and January 2016. Aim: The study was aimed at determining the current epidemiological status of GI parasites of pigs in Makurdi metropolis with the goal to determine the prevalence of GI parasites, identify the different types of GI parasites found in pigs and also to highlight the public health significance of these parasites in pigs. Methods: A total number of 318 pigs of different age groups and sexes were sampled using random sampling method. Faecal samples were collected from the rectum and examined using zinc sulphate floatation technique for isolation of parasitic eggs. Results: Out of 318 pigs examined, 159(50%) were infected. Five types of GI parasites were identified from samples and they include; Ascaris suum (11.32%), Strongyloid ransomi (22.96%), Stephanurus dentatus (13.2%), Oesophagostomum spp

*Corresponding author: Email: talk2vu@gmail.com;
(6.92%) and Macracanthorhynchus hirudinaceus (0.31%). The study revealed that single infection occurred significantly more frequently than multiple infections (P<0.01). The prevalence was higher in females and young pigs than in males and adults respectively though sex and age were not significant statistically (p>0.05). The high prevalence of GI parasites in pigs indicates there is an urgent need for regular veterinary intervention with an effective anthelminthic program in the study area.

Keywords: Epidemiological; survey; gastrointestinal; parasites; pigs.

1. INTRODUCTION

There has been an over reliance on carbohydrates as food sources in Nigeria due to some challenges like increased cost and availability of protein sources in the country [1]. The availability of livestock, which is the major source of animal protein, are in low numbers in the country as a result of some factors affecting the optimization of management methods in practice in the country as well as the incidence of diseases. These have led to low consumption of animal protein over the past few years [2]. Pigs, called hogs or swine, are ungulates which have been domesticated as a source of food, leather and similar products since ancient times [3]. Recently, pigs have been used in biochemical research and treatment [4]. Pig farming has become a lucrative business in major parts of Nigeria and also is an important task which provides opportunity as an income generating activity for small scale farmers. The activity is most common in Africa, Latin America and South East Asia [5]. Pigs are among the abundant livestock potentials which Nigeria is endowed with. Some of the uses of pigs include; provision of animal protein for human consumption, livestock farming, processing and marketing, and revenue generation with a significant contribution to the Nation’s Gross Domestic Product (GDP), [6]. However, swine could carry many intestinal pathogens which would hinder the growth of pigs, leading to significant economic losses to the livestock industries and farming communities [7,8]. Often times gastrointestinal helminths and parasites are overlooked because its clinical symptoms are rarely present or apparent hence, are said to be among the most devastating disease causing organisms for swine. However, the diseases and infection of pigs with gastrointestinal parasites is widely reported from all corners of the world and shown to be influenced by the type of pig management practiced [9]. Pigs infected with gastrointestinal parasites have poor feed conversion rate and delays in the achievement of market weight. Some of the gastrointestinal parasites of pigs result in condemnation of organs or entire carcasses causing economic losses in pork industry [10]. In addition pigs infected with gastrointestinal parasites may act as a source of zoonosis by contaminating the environment with infective stages of intestinal parasites present in their excreta [10,11].

2. MATERIALS AND METHODS

2.1 Study Area

Makurdi town is the capital city of Benue State, Nigeria lies between Latitude 7°15- 7°45’N and 8°155- 8°40’E. It is situated on the banks of River Benue. The town covers an area of about 16km radius. There are two major climatic seasons, rainy and dry. The rainy season begins in April and last till October while the dry season begins in October and last until March April.

2.2 Sampling Technique

Samples were collected by random sampling (using the table of random numbers) of pigs slaughtered at Wurukum, Modern Market and Fiidi abattoirs. Age group and sex were determined with the help of the workers at the various abattoirs.

2.3 Faecal Sample Collection

Faecal samples were collected as recommended [3]. All samples were kept as recommended by William and Anne and Gary [12,13].

2.4 Faecal Sample Examination

2.4.1 Zinc sulphate floatation

Identification of parasitic eggs and oocysts was carried out by viewing under the microscope and the adult warms were identified using keys laid down by Roepstorff and Nansen [14]. Some of the eggs are as shown in Plates 1, 2 and 3.
2.5 Method of Statistical Analysis

The results obtained were subjected to chi-square test in order to express the significant relationship between age groups, sexes and the various abattoirs. Correlation analysis was also used to determine the degree of relationship between age groups and the type of infection (single or mixed infection) using SPSS (Statistical Package for Social Sciences) version 2.

3. RESULTS

3.1 Overall Parasitological Screening in the Study Area

A total number of three hundred and eighteen (318) pigs were screened for gastrointestinal parasites between the months of October (2015) and January (2016). One hundred and eighteen (118) samples were collected from the Wurukum market abattoir, one hundred (100) samples from the modern market abattoir and another hundred (100) samples from Fidi. The three hundred and eighteen (318) pigs sampled comprised of, one hundred and fifty one (151) males and one hundred and sixty seven (167) female respectively. A total of one hundred and fifty nine (159) pigs were infected with one or more types of gastrointestinal parasitic egg and the overall prevalence of gastrointestinal parasites obtained
from the survey was 50.00% as shown in Tables 1 and 2.

Across the three locations, the Wurukum abattoir had the highest infection rate of 62(21.07%), followed by the modern market abattoir 56(17.61%) while Fiidi had the lowest infection rate of 51(16.04%). However, the relationship between infection and location was not significant as $p > 0.05$. Also the following species of gastrointestinal parasites were found across the three abattoirs surveyed; *Ascaris suum* 36(11.32%), *Strongyloides ransomi* 73(22.96%), *Stephanurus dentatus* 42(13.21%), *Oesophagostomum* spp 22(6.92%) and *Macracanthorynchus hirudinaceus* 1(0.31%) as represented in Table 1.

The samples population comprised of 243 adult pigs and 75 young pigs out of which 120 adult and 39 young pigs were infected giving a percentage prevalence of 49.38% and 52.00% respectively as represented in Table 2. The statistical relationship between infection rate and the age group was however not significant ($P > 0.05$). There was also a strong negative correlation between infection rate in adult and young pigs as $r = -1$. Figs. 1 and 3 show the distribution of GI Parasites in relation to sex in Wurukum and Fiidi. Respectively, while Fig. 2 shows the distribution of GI parasites in modern market.

The frequency of single and multiple infections was also determined which comprised of 141(44.34%) number of single and 18 (5.66) number of mixed infections as shown Table 3. In this case the relationship between infection rate and the type of infection was significant ($p < 0.01$) and there was also a strong positive correlation between single and double infection ($r = 0.981$).

### 4. DISCUSSION

This study revealed that the overall prevalence of gastrointestinal parasites recorded among three hundred and eighteen (318) pigs from Wurukum, Modern market and Fiidi was moderately high. The prevalence was significantly lower than 100% reported from intensively managed pigs in Umuahia, Abia [15] and 83.6% from Makurdi [16]. However, the prevalence rate was higher than 24.10% reported by Wosu [17] also in intensively managed pigs in Nsukka, South-East Nigeria. The differences in the prevalence observed in this study and aforementioned studies could be due differences into the management system and lack of veterinary care. Some pigs brought to the abattoirs were from the traditional system of management in which pigs are allowed to roam freely under poor hygienic conditions such as those obtainable in dirty isolated lots or pens. Also pigs that are managed under intensive care are at the mercy of the management and may be irregularly dewormed, leading to high prevalence of GI parasitic infections.

The higher prevalence recorded in female than males among both age groups suggest that females may be generally more susceptible to GI parasites. However, [18] suggested that males are usually slaughtered at an early age while females are kept for breeding and will have a greater chance of acquiring the infection before they are eventually slaughtered [16] also obtained a higher infection rate of 46.7% in females than that of male (45.4%) in Makurdi. On the contrary, however, [17,19] obtained higher

### Table 1. The distribution of gastrointestinal parasites in relation to sampled location

<table>
<thead>
<tr>
<th>Parasites</th>
<th>Wurukum number examined =118</th>
<th>Modern market number examined =100</th>
<th>Fiidi number examined =100</th>
<th>Total (%) number examined 318</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Ascaris suum</em></td>
<td>17(14.4)</td>
<td>11(11)</td>
<td>08(8)</td>
<td>36(11.32)</td>
</tr>
<tr>
<td><em>Strongyloides ransomi</em></td>
<td>27(22.9)</td>
<td>25(25)</td>
<td>21(21)</td>
<td>73(22.96)</td>
</tr>
<tr>
<td><em>Stephanurus dentatus</em></td>
<td>13(11)</td>
<td>17(17)</td>
<td>12(12)</td>
<td>42(13.21)</td>
</tr>
<tr>
<td><em>Oesophagostomum</em> spp</td>
<td>09(7.6)</td>
<td>03(3)</td>
<td>10(10)</td>
<td>22(6.92)</td>
</tr>
<tr>
<td><em>Macracanthorynchus hirudinaceus</em></td>
<td>01(0.85)</td>
<td>00</td>
<td>00</td>
<td>1(0.31)</td>
</tr>
<tr>
<td>Total (%)</td>
<td>174(54.72)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$N = 318, \chi^2 = 2.58, p > 0.05, df = 8$
### Table 2. The prevalence of gastrointestinal parasites with respect to sex and age groups

<table>
<thead>
<tr>
<th>Age group</th>
<th>Male</th>
<th>Female</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number examined</td>
<td>Number positive (%)</td>
<td>Number examined</td>
<td>Number positive (%)</td>
<td>Number positive (%)</td>
<td></td>
</tr>
<tr>
<td>Adult</td>
<td>110</td>
<td>52 (47.3)</td>
<td>133</td>
<td>68 (50.4)</td>
<td>120 (49.38)</td>
<td></td>
</tr>
<tr>
<td>Young</td>
<td>41</td>
<td>20 (48.9)</td>
<td>34</td>
<td>19 (55.9)</td>
<td>39 (52.00)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>151</td>
<td>72 (47.7)</td>
<td>167</td>
<td>87 (53.1)</td>
<td>159 (50.00)</td>
<td></td>
</tr>
</tbody>
</table>

$\chi^2 = 1.951, \quad df = 1, \quad p > 0.05, \quad r = -1$

**Fig. 1.** The distribution of GI parasites in relation to sex in Wurukum

$N = 118, \quad \chi^2 = 1.923, \quad p > 0.05, \quad df = 4$

**Fig. 2.** Percentage distribution of GI parasites in modern market in relation to sex
According to the distribution of gastrointestinal parasites in relation to age groups, young pigs had a higher prevalence rate than adult pigs similar to the earlier findings [19]. This could be attributed to immune status, pre-exposure as an adult has acquired some immunity [3,20]. Adult pigs are more likely to have been exposed to GI parasites over time which enables them to develop resistance against re-infections [18].

In addition, the prevalence of each type of parasite was also determined from each of the sample locations. In Wurukum, each parasite except Oesophagostomum spp. female had higher infection rate than male. Strongyloides ransomi had the highest infection rate in both male and female while Macracanthorhynchus hirudinaceus had the lowest infection rate in both male and female. The percentage distribution of GI parasites in the Modern market showed an infection rate with S. ransomi having the highest infection rate and Oesophagostomum spp with the lowest infection rate. In Fiidi female had higher infection rate except in Strongyloides ransomi where the male had a higher rate. The male of Oesophagostomum spp. had the lowest infection rate. Comparatively, among the three locations, Wurukum had the highest prevalence, followed by the Modern market and then Fiidi with the lowest prevalence.

In this study, Strongyloides ransomi was the most prevalent parasite and the prevalence was higher than 16.2% recorded in previous findings [3], 20.55% recorded in Burkina Faso [21] and 6.9% reported in Makurdi [16]. The survival of

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**Table 3. The frequency of single and double infection of gastrointestinal parasites**

<table>
<thead>
<tr>
<th>Single infection</th>
<th>Frequency</th>
<th>Multiple infections</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ascaris suum</td>
<td>33</td>
<td>As + Str</td>
<td>01</td>
</tr>
<tr>
<td>Strongyloides ransomi</td>
<td>61</td>
<td>As + Ste</td>
<td>03</td>
</tr>
<tr>
<td>Stephanurus dentatus</td>
<td>31</td>
<td>Str + Ste</td>
<td>07</td>
</tr>
<tr>
<td>Oesophagostomum spp</td>
<td>15</td>
<td>Str + Oe</td>
<td>04</td>
</tr>
<tr>
<td>Macracanthorhynchus hirudinaceus</td>
<td>01</td>
<td>Ste + Oe</td>
<td>03</td>
</tr>
<tr>
<td>Total (%)</td>
<td>141(44.34)</td>
<td></td>
<td>18(5.66)</td>
</tr>
</tbody>
</table>

N = 318, \( \chi^2 = 0.003, p < 0.01, r = 0.981 \)

Key: As = Ascaris suum, Str = Strongyloides ransomi, Ste = Stephanurus dentatus, Oe = Oesophagostomum spp
Strongyloides larvae depends on the environmental temperature and moisture. The larvae of these species are susceptible to desiccation with the dry areas providing an unfavorable environment for the survival of Strongyloides larvae [3]. Hence, the relatively high humidity of Makurdi metropolis favours the propagation of Strongyloides spp. It may be important to note that Strongyloides ransomi has not been found to be of public health significance to human [22].

Stephanurus dentatus a kidney worm of pigs is one of the intestinal parasites of pigs identified in this study, having a moderately high prevalence after that of S. ransomi. Infection of pigs with this parasite may occur either by ingestion of infective larvae, by skin penetration or ingestion of infected earthworms. The result recorded here is higher than 1.1% reported [19]. This could be as a result of environmental conditions that favour the survival of the infective larvae in the environment.

The prevalence recorded for Ascaris suum in this study was higher than 10.5% reported in Makurdi, Benue state of Nigeria [16], 4.9% reported from bishoftu, [23], 3.7% from Turkey [24] but lower than 54.6% reported from Botswana [25], 40.40% reported in eastern centre province, Burkina Faso, 12.6% reported from Addis Ababa, Ethiopia [3] 17.6% from Korea, 18.0% reported elsewhere [19] in Ibadan and 18.5% from Plateau state of Nigeria [26]. The moderately high prevalence of Ascaris suum in this study might be associated with farm management and the access of free roaming of pigs in the environment which facilitates ingestion of thick-shelled eggs of A. suum. These thick shelled eggs are resistant to adverse environmental factors as well as chemicals and can maintain infectivity for long periods of time [14].

Also the prevalence of Oesophagostomum spp. was higher than 3.9% reported in Ethiopia [3] but however lower than 17.61% obtained elsewhere [21] and 43.7% reported by [16]. Infective larvae of Oesophagostomum spp. can remain protected in continuously contaminating the pens and enabling cycling of infection for years in the affected area [15]. Infected piglets usually often develop uneven growth rate with gray sticky diarrhea at two to three weeks of age.

Among all the species of parasites identified in these studies, Macracanthorhynchus hirudinaceus had the lowest prevalence. There is no evidence of this parasite in previous studies in the area. However, an earlier study [27] reported that Macracanthorhynchus hirudinaceus is the most common helminthic infection of wild boars in Nigeria because Macracanthorhynchus hirudinaceus is of public health significance in human.

Lastly, single infection occurred more frequently than double. This work is similar to that of [19] in Ibadan, who reported the prevalence of 35.8% and 17. 5% for single and double infections respectively. The high positive correlation between single and multiple infections in this study however, suggest that GI infection may start as single infection and progress into multiple infections as a result of lowered immunity due to the single infection.

5. CONCLUSION

The prevalence of 50% recorded in this research indicates that half of the population of pigs in the study area is infected with GI parasites. The result of this study has also revealed that pig faeces could be an important source of some parasites capable of infecting humans. In community setting like Makurdi where pigs are reared in open neighborhoods and pork is consumed by a large part of the population, they could be involved in zoonotic helminthosis. Hence, there is a need for better veterinary intervention with an effective anthelminthic program in the study area and further investigations are needed to formulate appropriate and cost-effective strategies for the control of GI parasites of pigs in the study area.

6. RECOMMENDATION

Based on the findings of this study, the following recommendations are put forward:

- The effective anthelminthic treatment program should be carefully followed by pig producers.
- Meat inspection practices at both private and government owned abattoirs and slaughter slabs should be enforced by all stakeholders in the meat industry.
- Good management practices which incorporates ideal housing system feeding and proper hygiene should adopted in all parts of the country.
- Extensive or scavenging pig production should be discouraged as much as possible.
• Suspected meat or meat products should be thoroughly cooked and consumption of raw or undercooked meat from dubious sources should be avoided.
• Suspected meat should be frozen for at least three weeks to kill the larvae of gastrointestinal parasites.
• Viable eggs and embryos may also be present in water contaminated by faecal matter, therefore the water treatment procedures should be applied to water of unknown quality.
• There is a need for further investigations to study the possible impact of GI parasitic infections of pigs and boars on public health in Nigeria.

We equally recommend that similar work is carried out in rainy season as to ascertain seasonal variations.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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