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Original article

Occurrence and public health implications of gastrointestinal parasites of domesticated pigs (*Sus scrofa domesticus*) in Billiri Local Government Area, Gombe State, Nigeria

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ABSTRACT

A cross-sectional study was designed, from February, 2016 to October, 2016 using systematic random sampling technique. For the determination of (GIT) parasites, faecal samples were collected from the study animals and subjected to faecal floatation and sedimentation technique. *A.suum* has the highest prevalence of 147 (24.5%), then followed by Trichuris suis 96 (16.0%), Emeria species 73 (12.2%), Oesophagostomum species 58 (9.7%), strongyloides spp 41 (6.8%), Fasciola species 28 (4.7%), Isospora suis 17 (2.8%), paragonimus suis 11 (1.8%), schistosoma suis 8 (1.3%) and Taenia solum 28 (0.3%) respectively. Pigs with single infection are (53.2%), double infections (18.5%) and triple infections (80.2%). For sex boars have prevalence of (34.0%) and sows have (46.2%) with P-value of 0.0007 which is statistically significant and relative risk of 1.208. For age the young have prevalence of (27.2%) and the adults (53.0%) with P-value of 0.0066 which is statistically significant and relative risk of 1.166. For management system the extensive have prevalence of (64.7%) while the semi intensive (15.5%) with p-value of 0.0001 which is statistically significant and relative risk of 0.7884. Dry season has prevalence of (30.2%) and (50.0%) for rainy season with p-value of 0.0001 which is statistically significant and relative

risk of 0.8017. The overall prevalence for households is (66.7%) out of 485 sample pigs while for abattoir is (13.5%) out of 115 sample pigs. The overall prevalence from this study is (80.2%) out of 600 pigs sampled.

1. Introduction

Domestic pig production system has a high potential to contribute significantly to a nation's gross economic growth in provision of opportunity for income generation for small-scale pig farmers, especially in developing countries of the world, including Africa (Huynh et al., 2007; Geresu et al., 2015). Pigs farming may also provide high quality food protein of animal origin for human consumption to curb hunger which could ensure food security. It may also create employment opportunities for the youth to reduce rural-urban migration and also eradicate poverty (Adebisi, 2008; Oluwafemi, 2008; Geresu et al., 2015). The pig population in Nigeria was estimated at 3.5 million animals (Bourn et al., 1994). Although, pigs are considered inexpensive to rear compared to other domesticated animals and are therefore an option for the low income earning livestock farmers (Dewey et al., 2011). Unfortunately, pigs could be infected by many intestinal parasites which would compromise successful and maximum productivity of the animal leading to significant economic losses to the livestock industries (Joachim et al., 2001; Weng et al., 2005), which is evidenced by decreased litter size, poor growth rate, reduced weight gain, organ condemnation at slaughter and death (Nsoso et al., 2000; Marufu et al., 2008; Nissen et al., 2011; Tomass et al., 2013). It has been reported that parasitic infections in pigs are estimated to be second to African swine fever (Permin et al., 1999). Parasites affecting domesticated pigs in some African countries which include Ghana (Atawalna et al., 2016), Burkina Faso (Tamboura et al., 2006), Ethiopia (Tomass et al., 2013; Geresu et al., 2015; Jufare et al., 2015), Uganda (Waiswa et al., 2007; Nissen et al., 2011), Tanzania (Paulo and Nonga, 2015), Kenya (Nganga et al., 2008; Kagira et al., 2010; Obonyo et al., 2012), Zimbabwe (Marufu et al., 2008) and Nigeria (Tidi et al., 2011; Olaniyi, 2014) and various parasite species have been identified. To our knowledge, there is paucity of information on the prevalence, and public health significance of gastrointestinal tract parasites in extensively reared domesticated pigs in the study area. Therefore, the objective of this study was to determine the prevalence of common gastrointestinal parasites and the risk factors associated with their occurrence in domesticated pigs.

2. Materials and methods

2.1. Study area

Billiri Local Government is one of the 11 Local Government Areas of Gombe State, northeastern Nigeria. Its headquarters are in the town of Billiri in the northeast of the area on the A 345 highway, its coordinates are 9°51'53" N and 11°13'31" E in DMS (Degrees Minutes Seconds) or 9.86472 and 11.2253 (in decimal degrees). It is located at an elevation of 564 meters above sea level It has an area of 737 km² and a population of 202,144 at the 2006 census (Anon, 2009).

2.2. Study population

The study population includes apparently healthy domesticated pigs from households and those brought for slaughter at the pigs' abattoir within the study area. In the study area, investigations revealed that majority of the domesticated pigs are mainly reared under the extensive pig management systems, while few were kept under the semi-intensive by some rich piggery farmers. Age of pigs was determined using tooth eruption patterns as described by Xiaolin (2004). For the purpose of conveniences in sampling and recording ages of pigs were categorized into two broad groups which comprised of pigs less than 16 weeks considered as young pigs and above 16 weeks as adult pigs, following the age classification described by Keshaw et al. (2009).

2.3. Study designs and sample size determination

A cross-sectional study design was conducted to determine the prevalence of the major gastrointestinal parasites of extensively reared pig from households and those slaughtered at the pig abattoir from February, 2016 to October, 2016 using systematic random sampling technique. Households that rear domestic pigs and are willing

to participate in the study were selected for inclusion in the study sample collection locations. While, in the abattoir, every third pig in the slaughter line was selected for sampling. The sample size was calculated according to the equation of Thrusfield (2007). The calculated required sample size (N) was 594. However, the total number of sampled animals was increased to 600 to maintain the proportionality of the sample size.

2.4. Feacal sample collection and transportation

Each sampled pig was properly physically restrained by owners in households and by butchers in the abattoir, then using sterile disposable hand gloves fresh fecal samples were aseptically scooped directly from the rectum of the pigs. About 5 gram of the collected fecal sample was placed inside a sterile sample bottle, labeled appropriately and transported in an ice box to the parasitology unit, Zoology laboratory of Gombe State University for immediate processing, samples that were not processed on the same day of collection were stored in the refrigerator at 4 °C for a day before processing or kept in 10% buffered formalin as recommended by William (2001) and Anne and Gary (2006) and stored at -20°C until processed and examined for eggs and oocysts of gastrointestinal helminths and protozoan's, respectively.

2.5. Coprology and microscopy

Identification of parasite was carried out using faecal floatation and Sedimentation technique as the standard protocol and techniques recommended by Soulsby (1982), Urquhart et al. (1996), Bayou (2005) and Charles and Hendrix (2006).

2.6. Intensity of infection or worm burden

The intensity of infection or worm burden was estimated by counting the eggs per gramme faecal sample (EPG).

2.7. Data analysis

The data generated from the research were entered into a Microsoft Excel spreadsheet and coded appropriately. For data analysis, SPSS version 16 was used. Descriptive statistics were used to determine the prevalence of parasites in pigs. The chi-square test was used to determine the association between the infection and the risk factors such as age and sex. In all cases, 95% confidence intervals and $p<0.05$ were considered significant.

3. Results and discussion

Out of 600 pigs sampled the prevalence from the highest to the lowest are recorded respectively. Ladongo has the highest prevalence of 66 (93.9%), Sansani 60 (86.7%), Billirih 64 (82.8%), Tal 60 (81.7%), Amtawallam 57(80.7%), Angwan Bare 63 (79.4%) Bagenje 60 (78.3%), Todi 55 (74.5%) and the lowest is the Abattoir with 115 (70.4%), this is similar to report of (Karaye et al., 2016) (Table 1).

Table 1
Prevalence of gastrointestinal parasites of domesticated pigs, according to study location in Billiri Local Government Area of Gombe State.

Study location	Number of samples/ pigs examined (N)	Number of samples/ pigs infected (N)	Number samples/ pigs uninfected	Prevalence (%)
Tal	60	49	11	81.7
Amtawallam	57	46	11	80.7
Todi	55	41	14	74.5
Angwan Bare	63	50	13	79.4
Ladongo	66	62	4	93.9
Sansani	60	52	12	86.7
Bagenje	60	47	13	78.3
Billirih	64	53	11	82.8
Abattoir	115	81	34	70.4
Total	600	481	119	80.2

N = Number of pigs sampled; N = Number of pigs infected.

For nematodes *A.suum* has the highest prevalence of 147 (24.5%), then followed by Trichuris suis 96 (16.0%), Oesophagostomum species 58 (9.7%), strongyloides spp 41 (6.8%), respectively and overall species prevalence of 342 (57.0%). Cestodes e.g taenia solum 28 (0.3%). Trematodes e.g fasciola species 28 (4.7%), paragonimus suis 11(1.8%), schistosoma suis 8 (1.3%) species prevalence of 47 (7.8%). For protozoans Emeria species 73 (12.2%) and Isospora suis 17 (2.8%) and species prevalence of 90 (15.0%). In this study *Ascaris suum*., *Trichuris suis*., *Oesophagostomum* spp and *Strongylus* spp are the most common parasites of pigs identified and is in agreement with report of Caballero-Hernández et al. (2004); Kagira et al. (2008) *Eimeria* spp and *Isospora* spp (Nosal and Eckert, 2005). Domesticated pigs infected with GIT parasites may act as source of zoonosis by contaminating the environment with infective stages of the parasites they harbor in their excreta (Tomass et al., 2013; Geresu et al., 2015). Gastrointestinal parasites of pigs origin, such as *Trichuris suis, Ascaris suum* and *Isospora suis* have been reported to be of public health significant (Olso and Guselle, 2000; Uysal et al., 2009; Pittman et al., 2010; Obonyo et al., 2013; Sowemimo et al., 2014; Inpankaew et al., 2015). Prevalence of *A.suum* (24.5%), Trichuris suis (16.0%), Oesophagostomum species (9.7%), strongyloides spp (6.8%) and fasciola species (4.7%), were higher than those reported by Jufare et al. (2015) A. suum (4.9%), strongyles (5.2%), Trichuris suis (2.9%) and Karaye et al. (2016) Ascaris (16.5%), Trichuris cyst (2.5%), Oesophagustomum oocyst (7.5%) except for Strongyloides (13.5%) and Fasciola (7.5%). For Emeria species (12.2%) prevalence was lower in this study when compared to report of Karaye et al. (2016) Coccidian oocyst (14%), while Isospora suis (2.8%) have higher prevalence than that reported by Sachin et al. (2016) Isospora suis (1.48%) (Table 2).

Table 2
Species prevalence of gastrointestinal parasites of domesticated pigs in Billiri Local Government Area of Gombe State.

Gastrointestinal parasites encountered	Species of parasites encountered	Number of pigs affected (N = 600)	Prevalence (%)
Nematodes	*Ascaris suum*	147	24.5
	Trichuris suis	96	16.0
	Oesophagostomum spp	58	9.7
	Strongyloides spp	41	6.8
	Total	342	57.0
Cestodes	*Taenia solium*	2	0.3
	Total	2	0.3
Trematodes	*Fasciola spp*	28	4.7
	Paragonimus suis	11	1.8
	Schistosoma suis	8	1.3
	Total	47	7.8
Protozoans	*Eimeria spp*	73	12.2
	Isospora suis	17	2.8
	Total	90	15.0

Out of 600 samples, pigs with single infection are (53.2%), double infections (18.5%) and triple infections (80.2%). Infections by parasites in pigs could single, double or multiple Infections, have been reported by Sowemimo et al. (2012) and Tomass et al. (2013) which is similar to the findings of this study (Table 3).

For sex male (boars) have prevalence of (34.0%) and female (sows) have (46.2%) with p-value of 0.0007 which is statistically significant and relative risk of 1.208. For age the young have prevalence of (27.2%) and the adults (53.0%) with p-value of 0.0066 which is statistically significant and relative risk of 1.166. For management system the extensive have prevalence of (64.7%) while the semi intensive (15.5%) with p-value of 0.0001 which is statistically significant and relative risk of 0.7884. Dry season has prevalence of (30.2%) and (50.0%) for rainy season with p-value of 0.0001 which is statistically significant and relative risk of 0.8017. Male (boars) have prevalence of (34.0%) and female (sows) have (46.2%) its similar to report of Tamboura et al. (2006) where female pigs have higher prevalence than the males but it disagree with studies of Sowemimo et al. (2012) and Wosu, (2015) who said that prevalence of intestinal parasites was significantly higher in male pigs (45.0%), (31.58) than in females (30.4%) (17.78). For age the young have lower prevalence of (27.2%) and the adults (53.0%) its similar to

report of Wosu, (2015) young (15.39) adult (25.71) but it disagree with studies of Sowemimo et al. (2012) who said that prevalence of intestinal parasites was slightly higher in younger pigs (37.2 %) than in adult pigs (35.7%) (Table 4).

Table 3
Infection rate of gastrointestinal parasites in domesticated pigs in Billiri Local Government Area of Gombe State.

Study locations	No. of sample/ pig examined	No. of single infection	No. of double infection	No. of multiple infection	No. of sample/ pig infected
Tal	60	33	11	5	49
Amtawallam	57	36	7	3	46
Todi	55	24	10	7	41
Angwan Bare	63	28	13	9	50
Ladongo	66	36	21	5	62
Sansani	60	41	9	2	52
Bagenje	60	32	11	4	47
Billirih	64	36	12	5	53
Abattoir	115	53	17	11	81
Total	600	319 (53.2%)	111 (18.5%)	51 (8.5%)	481 (80.2%)

Table 4
Risk factors associated with gastrointestinal parasites in domesticated pigs in Billiri Local Government Area of Gombe State.

Risk factors	Variables	No. of samples examined	No. of samples affected	Prevalence (%)	95% CI		p-value	RR
					Lower limit	Upper limit		
Sex	Male (Boars)	318	204	34.0	0.5656	0.6507	P=0.0007	1.208
	Female (Sows)	282	277	46.2	0.4617	0.5474		
Age	Young	253	163	27.2	0.5594	0.6558	P=0.0066	1.166
	Adult	347	318	53.0	0.4839	0.5610		
Management system	Extensive	420	388	64.7	0.4854	0.5539	P<0.0001	0.7884
	Semi-intensive	180	93	15.5	0.5999	0.7156		
Season	Dry	300	181	30.2	0.5789	0.6675	P<0.0001	0.8017
	Rainy	300	300	50.0	0.4588	0.5412		

Key: LL-UL = Lower Limit-Upper Limit; CI = Confidence Interval; RR = Relative Risk; Degree of freedom = 1

The overall prevalence for households is (66.7%) out of 485 sample pigs while for abattoir is (13.5%) out of 115 sample pigs. The overall prevalence from this study is (80.2%) out of 600 pigs sampled, which is significantly higher compared to 32.5% and 50% reported by Sowemimo et al. (2012) and Nwoha and Ekwurike (2011) in pankshin, Plateau state, and Umuahia, Abia State, Nigeria respectively. But higher prevalence of 91% was reported in Burkina Faso (Tamboura et al., 2006; Obonyo et al., 2012). The high prevalence recorded in this study may be attributed to poor animal husbandry and biosecurity measures. Similar findings were observed by Obonyo et al. (2013) in Kenya. The differences in prevalence of GIT helminthes may also be associated with differences in environmental conditions, stocking rate, nature of their diet immunity status (Kumar et al., 2002). Information on prevalence, types of GIT parasite and management practices helps to formulate pig husbandry and extension programmes. In addition, knowledge about GIT parasite species can be used as baseline information to design effective parasite control measures (Kumsa and Kifle, 2014) (Table 5).

Table 5
Overall prevalence of gastrointestinal parasites of domesticated pigs in Billiri Local Government Area of Gombe State.

Study location	Number of samples/ pigs examined (N)	Number of samples/ pigs infected (N)	Number samples/ pigs uninfected	Prevalence (%)
Households	485	400	85	66.7
Abattoir	115	81	34	13.5
Total	600	481	119	80.2

4. Conclusion

This study indicates that pig parasites are prevalent in the study area, hence implementation of strategic control measures are recommended to reduce the prevalence of parasites.

Competing interests

The authors have unanimously declared that, there is no any conflict of interest regarding the publication of this manuscript.

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