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Cryptosporidium oocysts and *Balantidium coli* Cysts in Pigs Reared Semi-intensively in Zuru, Nigeria

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Abstract: A cross-sectional study was conducted on the presence of *Cryptosporidium oocysts* and *Balantidium coli* cysts in fecal samples from semi-intensively managed pigs in Zuru Local Government Area of Kebbi State, Nigeria between November 2005 and July, 2006. A total of 632 households with human population of 5905 were identified in seven pig- rearing locations in the study area while 105(16.6%) of these households with human population of 1105(18.7%) reared a total number of 3895 pigs. Physical randomization was used to select 50% representative samples of pig-rearing households and pigs for this study. Out of the 402 pigs from 55 households, 207(51.5%) pigs were positive for *Balantidium coli* cysts, 56(13.9%) for *Cryptosporidium oocysts* while mixed infection was observed in 29(7.2%). There is significance difference in the distribution of the two parasites in the pigs surveyed ($p<0.05$). Young pigs were most affected with infection rates of 33(58.9%) *Cryptosporidium oocysts*, 113(54.6%) *Balantidium coli* cysts and 17(58.6%) mix infection. Human fecal samples collected from 53 individuals revealed 3(5.7%) positive cases of *Cryptosporidium oocysts* all in young ones while a positive case of *Balantidium coli* cyst infection was found in an adult female. Water and soil samples from two areas were also found to contain both organisms. The semi-intensive system of pig rearing which allowed pigs to scavenge and defecate about, defective personal and environmental hygiene couple with the usage of untreated pig feaces as manure on vegetable farms in the study area can enhance the spread of these zoonotic diseases in human population.

Key words: Pigs, *Cryptosporidium oocyst*, *Balantidium cysts*, feace

INTRODUCTION

Cryptosporidium is a small protozoan parasite that colonizes the epithelial surfaces of the gut and can also be found in extra-intestinal tissues. It is known to parasitize a wide range of vertebrate including pigs. *Cryptosporidium* is primarily a parasite of neonatal animals and it is responsible for diarrhoea in piglets. Though animals generally develop a low level of infection, adult pigs are known to exhibit high prevalence of infection (Fleta *et al*., 1995; Olson and Guselle, 2000; Misic *et al*., 2003). Cryptosporidiosis in Nigeria livestock is largely underreported and there are few data on the infection in pig population. Ayeni *et al.* (1985) obtained 32.6% prevalence rate among pig population in a southwestern state while Kwaga *et al.* (1988) obtained 15.7% among piglets in a north central state of Nigeria. *Cryptosporidium* species as a zoonotic agent can cause diarrhoea in man and a prevalence range of 0.1 and 27.1% and 0.1 and 31.5% had been reported in developed and developing countries, respectively. Young children and immunologically deficient individuals are highly susceptible (Pasquali, 2004). A prevalence of between 2.9 and 21% had been reported in human in Nigeria (Kwaga *et al*., 1988; Onah *et al*., 1988).

Balantidium cyst on the other hand, is the largest protozoan and the only ciliate known to parasitize humans. It has a worldwide distribution with varieties of hosts ranging from man to various domestic and wild animals. Pig is probably the main reservoir host of *Balantidium cysts* in which it is most often asymptomatic. The incidence of infection had been noted in Bolivia, Papua New Guinea and the Philippines with prevalence of less than 1% (Nakauchi, 1999; Smith, 2003).

The ability of *Balantidium coli* to secrete hyaluronidase helps the organism to invade the mucosa, the lesions of which are similar to those of amoebiasis leading to perforation of the colon, hepatic abscesses and appendicitis (Smyth, 1996). In severe cases, pigs may manifest diarrhoea, dysentery, colitis and abdominal pains (Smith, 2003).

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A sporadic occurrence in humans in Nigeria have been reported with a prevalence rate of 0.62% (Fabiyi, 2001). In pigs, Akinboade *et al.* (1983) obtained a prevalence rate of 2.75% in a Southwestern city of Nigeria while Nnamso and Okaka (1998) observed *Balantidium cysts* in faeces of chimpanzees, baboons, mangabeys and gorilla kept in a zoological garden in a Mid-western State of Nigeria. Infection in gorilla can progress rapidly from loose stool to haemorrhages and death (Samuel *et al*., 2001).

Investigations on cryptosporidiosis and balantidiasis have not been conducted actively in the study area where backyard pig rearing is one of the major occupations. Also, there is dearth of information on the two parasites in most pig raising communities in Nigeria. This survey therefore is expected to serve as base line data for further works on these two zoonotic parasites in the study area.

MATERIALS AND METHODS

Zuru Local Government Area is located in the Southeastern part of Kebbi State in Northwestern Nigeria. It lies between latitude 11°15′ N - 11°55′ N and longitude 4°35′.E 5°47′ E in Sudan savannah zone with annual mean rainfall of 1022 mm. The estimated human population was 141,192 people with the major occupations of animal rearing and crop farming (Damana, 1994). Seven major divisions of the local government area were identified in this study.

Total households, households with pigs and pig population in these seven locations were enumerated. Fifty percents of the total households keeping pigs and that of pig population were used in this study. Representative samples were selected by physical randomization using card shuffling. The technique involved numbering of houses in each area with corresponding number written on cards which were then shuffled and a card is picked after each shuffling until the require 50% was reached. The procedure was repeated in selection of the representative pigs in the selected households (Cameron, 1999).

Fecal samples were collected per rectum of each pig with the aid of plastic gloves, put in sterile bottles, transported to laboratory and immediately processed. If untested immediately, the samples were kept in refrigerator at 4°C for a maximum of 3 days. Likewise, fecal samples were collected from human volunteers from households with pigs in sterile bottles and processed immediately or stored.

Flotation technique using sucrose solution with specific gravity of 1.18 was employed to prepare wet mounts for *Balantidium coli* cysts examination while concentration of cryptosporidium was achieved through formol ether centrifugal sedimentation technique and the staining of the oocysts was conducted using modified Zeihl Neelsen (mZN) staining technique (OIE Manual, 2004).

Both balantidium cysts and the *Cryptosporidium oocysts* were measured using calibrated eye- piece micrometer.

Water samples from four natural sources within the study areas meeting the domestic needs of inhabitants and source of watering for wandering pigs were collected and processed by centrifugal flotation technique (Smith, 1998). While about 50 g each of soil samples from some 2-5 cm beneath the surfaces of refuse dumping sites in the seven locations were collected at interval of 20 m apart, brought to the laboratory and processed as described by Kuczynska and Shelton (1999).

RESULT

A total number of 105(16.6%) households out of 632 households in the 7 locations of Amanawa, Bedi, Dabai, Jarkasa, Rikoto, Tundun-Wada and Unguwar-Zuru reared pigs (Table 1). Tundun-Wada area had the highest pig rearing households of 30(26.8%) with pig population of 2211(56.8%) while the lowest pig rearing households and pig population of 7(8.4%) and 120(3.0%), respectively were found at Unguwan-Zuru.

Out of the total 5905 people enumerated within the study areas, 1105(18.7%) belonged to pig rearing households with children constituting 34.1%.

A total number of 804(20.6%) pigs were enumerated in the 105 randomly selected households of which 55(50%) and 402(50%), respectively were surveyed.

Table 1: Pig population structure observed in Zuru, Nigeria

Area	Total household	Household with pigs	Adult male	Young male	Adult female	Young female	Total
Amanawa	91	10 (11.0)	72.0	64.0	58.0	59.0	253
Bedi	64	11 (17.2)	42.0	49.0	31.0	45.0	167
Dabai	84	13 (15.5)	18.0	26.0	27.0	18.0	89
Jarkasa	78	15 (19.2)	49.0	100.0	257.0	239.0	645
Rikoto	120	19 (15.8)	53.0	93.0	95.0	169.0	410
Tudun- wada	112	30 (26.8)	384.0	549.0	658.0	620.0	2211
Ugwan-zuru	83	7 (8.4)	26.0	37.0	24.0	33.0	120
Total	632	105 (16.6)	644 (16.5)	918 (23.6)	1150 (29.5)	1183 (30.4)	3895

Table 2: Distribution of *Balantidium cysts* and *Cryptosporidium oocysts* in pigs examined

Area	50% household with pigs	Pig pop.	50% pigs	Positive for *Balantidium cysts*					Positive for *Cryptosporidium oocysts*				
				AM	YM	AF	YM	Total	AM	YM	AF	YM	Total
Amanawa	5	73	37	8.0	7.0	5.0	8.0	28 (75.7)	-	3.0	3.0	2.0	8 (21.6)
Bedi	6	87	44	8.0	3.0	10.0	3.0	24 (54.5)	2.0	2.0	6.0	-	10 (22.7)
Dabai	7	102	51	4.0	6.0	2.0	6.0	18 (35.3)	1.0	1.0	3.0	-	5 (9.8)
Jarkasa	8	117	58	4.0	7.0	9.0	10.0	30 (51.7)	-	3.0	-	-	3 (5.2)
Rikoto	10	146	73	6.0	14.0	8.0	8.0	36 (49.3)	2.0	1.0	1.0	3.0	7 (9.5)
Tudun-wada	15	220	110	7.0	8.0	12.0	27.0	54 (49.1)	1.0	3.0	2.0	8.0	14 (12.7)
Ugwan-zuru	4	59	29	7.0	5.0	4.0	1.0	17 (58.6)	-	5.0	2.0	2.0	9 (31.0)
Total	55	804	402	44 (10.9)	50 (12.4)	50 (12.4)	63 (15.8)	207 (51.5)	6 (1.5)	18 (4.5)	17 (4.2)	15 (3.7)	56 (13.9)

Note: In brackets are the percentages, AM = Adult Male, YM = Young Male, AF = Adult Female, YF = Young Female

Overall prevalence of the two parasites encountered was 292(72.6%) of which 207(51.5%) were positive for *Balantidium cysts*, 56(13.9%) for *C. oocysts* and 29(7.2%) mixed infections. Higher rates of infections were recorded in young pigs for both parasites with 113(54.6%) and 33(58.9%) having *Balantidium cysts* and *Cryptosporidium oocysts*, respectively (Table 2).

Mixed infection was observed in 29(7.2%) pigs overall with 7(18.1%) pigs from Amanawa, 4(9.1%) from Bedi, 1(2.0%) from Dabai, 2(3.4%) from Jarkasa, 4(5.5%) from Rikoto, 5(4.5%) from Tundun-wada and 6(20.7%) from Ugwan-zuru being infected.

The average sizes of the oocysts and cysts obtained were between 4-5 and 52-56 μm, respectively. Out of the 35 soil samples obtained from the seven areas only soil samples from Rikoto area was positive for *Balantidium cysts* while water samples from Tundun-Wada area were positive for *Cryptosporidium oocysts* (Table 2).

Three (5.7%) of the 53 human fecal samples from pig rearing households examined were positive for *Cryptosporidium oocysts* while 1(1.9%) was positive for *Balantidium cysts*. The positive cases for the presence of *Cryptosporidium oocysts* were children while that of *Balantidium cysts* was found in an adult woman.

DISCUSSION

The pig population obtained in this study was more than the estimated 2000 pigs by FLD (1990) for the same area. Zuru is the only location where pigs are being raised in the entire state. This is suggestive of increase involvement of people in rearing of pigs probably due to inexpensive cost of production and awareness on rapid and huge economic returns.

The presence of the two organisms in the faeces and environmental samples from the study area is significant as they are both zoonotic and potent danger to public health. The system of pig rearing in the study area is largely semi-intensive whereby there is only minimum sheltering and feeding. This allow for the pigs to be out-door roaming and scavenging all day long. The pigs can pick up the infective agents and at the same time disseminate to and contaminate the environment with cysts and oocysts.

The prevalence rate of 13.9% obtained in this study for *Cryptosporidium* is slightly lower than 15.7% obtained by Kwaga *et al.* (1988) in a North-central State and much more lower than the 32.6% obtained by Ayeni *et al.* (1985) in a Southwestern State. The study area and the area where Kwaga *et al.* (1988) worked shared similar ecological and environmental feature that is characterized by low humidity and short rainfall period while the southwestern state experiences rainfall with high humidity all year round. High relative humidity and rainfall is known to aid the survival of oocysts in environment (Yu and Seo, 2004). Likewise at high temperature (which characterized the study area most time of the year), the oocysts rapidly lose its viability and become less infective (Fayer *et al.*, 2000). Infection however, may be higher in damp areas, water holes, along the stream and riverbeds.

Though *Cryptosporidium oocysts* are known to be highly restricted to young ones in the ruminants, infection in pigs occurs over a wider age range (Radostits *et al.*, 2003) and this may explain the occurrence of oocysts in both young and adults in this study. The young ones are more affected with oocysts in this study (58.9%) and this may lead to increase in environmental contamination as the rate of oocyst shedding is always greater among this age group. Preweaned animals can produce high oocysts output sometimes exceeding 10^{10} oocysts per day (Graczyk *et al.*, 1999).

The higher percentage of *Balantidium coli* cysts (51.5%) encountered in this study is lending credence to the fact that the organism is widespread and can be found in any pig if adequate examination is made (Soulsby, 1982). Pig is known to have a particularly high rate of infection ranging from 20 to 100% when compare to other animal species known to harbour the cysts. In a survey conducted in Bolivia, 54% of porcine samples examined were positive for *B. cysts* (Esteban *et al.*, 1998) and in China, 47.2% of 3636 pigs sampled in intensive farms were positive (Weng *et al.*, 2005).

The presence of the parasites in human faeces examined is also significant as the lack of toilet facilities in most homes in the study area predispose them to defecate indiscriminately around their immediate habitation and on pasture, this allow pigs to have direct access to such deposited faeces. The faeces can also contaminate vegetables and run off to source of water supply especially during the rainy season. Contaminated drinking water is considered an important mode of transmission of cysts and oocysts as most of the outbreaks worldwide are linked to water supplies (Smith, 1998). The organisms remain viable in drinking water supplies and damp soils for prolonged periods and *Cryptosporidium oocysts* are known to be resistant to concentrations of disinfectants and chlorine (Kuczynska and Shelton, 1999; Goh *et al*., 2005). Though numbers of oocysts in the samples were not determined, the median infectious dose of *Cryptosporidium oocysts* for man is relatively low (about 132 oocysts) (Clark, 1999) and he can pick up such from a single exposure to contaminated environment.

The average oocysts sizes obtained (4-5 micrometers) is suggestive of *Cryptospsoridium parvum* though specification was not conducted. It is known that the major species that affect pigs is *Cryptosporidium parvum* (Fayer *et al*., 2000). The rearing of animals together in homesteads in the study area may predispose pigs to infection with cattle species of cryptosporidium. Pigs with unrestricted movement are potential sources of environmental contamination with oocysts and cysts (Atwill *et al*., 1997).

Diarrhoea, which is a common phenomenon and caused by various pathogens including *Cryptosporidium* and balantidium species, is known to be a major deterrent to livestock development with great economic consequences. The semi-intensive mode of animal rearing couple with unhygienic environment (as observed in the study area) may predispose the animals to infections that can manifest in diarrhoea, thus there is the need to encourage intensive management of pigs where animal health can be effectively monitored for greater profitability and protection of public health in the study area.

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