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Prevalence of yersinia enterocolitica and yersinia pseudotuberculosis in pigs in Zuru local government area, Kebbi state

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ABSTRACT

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The study was carried out to establish the prevalence of Yersinia enterocolitica and Yersinia pseudotuberculosis in pigs in Zuru Local Government of Kebbi State. Faecal samples were collected from the randomly selected pigs and analysed using standard bacteriologic method of Yersinia isolation and identification. A total of 377 samples were collected, out of which 76(20.2%) samples were positive for Yersinia species. Yersinia enterocolitica was found in all the positive samples while only 7(9.2%) were positive for Yersinia pseudotuberculosis. The distribution of isolates among various age groups shows higher percentage of occurrence of 59.2% in pigs above 24 months of age, while the low incidence rate (9.2%) was recorded in pigs of 1 to 12 months of age. There was statistical association between the rate of isolation and the age, as p values are less than 5%(p<0.05). This investigation has revealed the presence of Yersinia enterocolitica and Yersinia pseudotuberculosis among pigs in the study area. Therefore, there is need to educate the pig rearing communities and public on the need for hygienic practices.

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1. Introduction

Yersinia enterocolitica and *Yersinia pseudotuberculosis* are enteroinvasive bacteria associated with variety of clinical manifestation in humans (fever, diarrhea, nausea, vomiting and abdominal pains) and animals (feetal wastage and abortion). Humans are infected primarily by ingestion of feecal contaminated food or water. The main sources of human infection is through consumption of under cooked pork and pork products (Lee et al., 1991), as pigs are known to be major reservoir of these pathogenic organisms (Bottone, 1997; Nesbakken et al., 2007).

Nigeria has an estimated pig population of 5 million (Lekule and Kyvsgaard, 2003), which are distributed mainly among the rural communities in the six geopolitical zones and Zuru is the only Local Government in this part of the country (Sokoto, Kebbi, Zamfara) where pigs are reared and consumed. These pigs are raised mainly semi-intensively as is the case in most parts of Africa and they have direct access to the environment as they scavenge around. Pigs are allowed to move freely and cohabited with humans in the pig rearing areas; this may lead to transmission of *Yersinia* organisms from pigs to humans.

Serological evidence of infection in man and various species of animals has also been documented (Adesiyun et al., 1986). *Yersinia* infection is often over looked in laboratory diagnosis unless it is specifically sought. Screening for these organisms has lead, over the past two decades, to a sharp increase in the number of human infection reported in many developed countries, supporting the importance of epidemiological surveys for these species (Blumberg et al., 1991). In Nigeria, particularly in Zuru Local Government Area most food animals are kept or slaughtered, under poor hygienic conditions with a high probability of contamination of drinking water, food and meat with faeces of domestic animals including pigs. Therefore these can serve as potential sources of infection to others animals and man within and outside the State when come incontact with contaminated faeces, water or consumption of pork or pork products of infected pigs.

There is maximum interaction between pigs, man and environment which can facilitate infection transfer in the study area. Moreso, pork is a delicacy to a number of people in the study area. Most of the reported cases of yersiniosis in Africa have been in Zaire, Rwanda (Makula et al., 1996), South Africa (Rabson and Koornhofi, 1972) and in Nigeria, Agbonlahor et al. (1981), Lombin et al. (1985) Okoroafor et al, (1988), Onyemelukwe (1993) and Okwori et al. (2005).

2. Materials and methods

2.1. Study area

The study was carried out in Zuru local government area of Kebbi State; the State is located in north-Western Nigeria, share boundaries with Sokoto State on the North-Eastern axis, Zamfara State on the Eastern part, Niger State on the Southern part and Republic of Niger on the Western part (Anonymous, 2010). The State has Sudan and Sahel-savannah. Zuru is located between latitudes 11° 24' 09" N and longitudes 5° 15' 07" E (Anonymous, 2012). Pigs are reared in seven communities namely Amanawa, Bedi, Dabai, Jarkasa, Rikoto, Tundun-Wada and Unguwar Zuru, all in Zuru local government area of Kebbi State. It has an area of 653km² and human population of 165,547 (NPC, 2006). The major occupations of the people are crop farming and animal rearing. Animals reared include pigs, sheep, goat and cattle. The three major religion practices in Zuru local government area are, islam, christianity and traditionalist.

2.2. Study design

Pigs rearing communities and total households with pigs and pig population in each household were identified in Zuru local government area by administering a questionnaire. Each household was given arbitrary number using card and corresponding house number written on it. Fifty percent of the pigs rearing households and fifty percent of pigs in the selected households were sampled for this study Putt, et al. (1987). Putt, et al. (1987) stated that sample requirement for precision in terms of relative accuracy must be within 10% of the true population value and the higher the percentage the better the result. This justified the selection of 50% samples in this study.

Representative samples were selected by physical randomization using card shuffling. The technique involved numbering of households with pigs in each area with corresponding number written on cards which were

then shuffled and a card is picked after each shuffling until the required 50% is reached. The procedure was repeated in selection of the representative pigs in the selected households whereby pigs are numbered and corresponding numbers are written on each card which was then shuffled and a card is picked after each shuffling until the required 50% pigs were selected in each household, as described by Cameron, (1999).

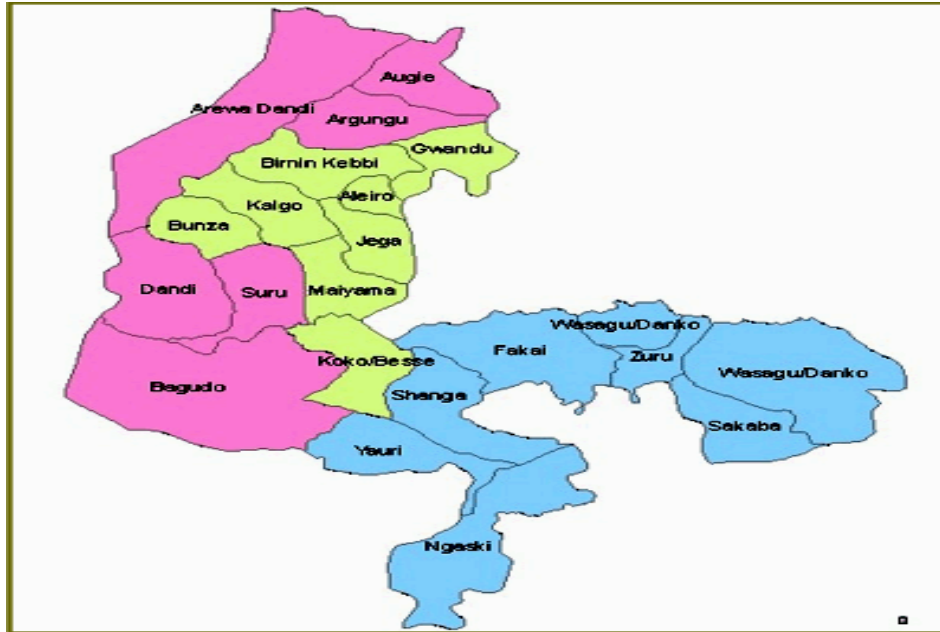


Fig. 1. Map of Kebbi state showing Zuru local government area (Source: <http://www.collinsmaps.com/maps/Nigeria/Kebbi>).

2.3. Determination of sample size

The sample size was calculated using the formula $n = \frac{Z^2 PQ}{L^2}$ (Thrusfield, 2002) whereby n is the number of individuals, Z is score for a given confidence interval, P is a known or estimated prevalence $Q = (1 - P)$ and L the allowable error of estimation. As there was no previous study on *Yersinia* species in the study area, prevalence rate of 18.1% of reported cases for *Yersinia enterocolitica* and *Yersinia pseudotuberculosis* in pigs in Jos Plateau State of Nigeria (Okwori, 2007) was used. For the purpose of this study the sample size was 228 of pigs based on 50% prevalence at 95% level of confidence.

2.4. Collection of faecal samples

Faecal samples were collected aseptically from each selected pig by rectal extraction using disposable hand glove. The samples were then aseptically transferred into 10ml of phosphate buffer saline (PBS) that was supplemented with sodium hydroxide sterile sample bottles and homogenized for about 30 seconds, as described by Schiemann, (1983). The samples were then transported in an ice cooled box to Veterinary Public Health and Preventive Medicine laboratory of Usmanu Danfodiyo University Sokoto for processing.

2.5. Isolation and identification of yersinia species

Suspended faecal samples in phosphate buffer saline were inoculated into *Yersinia* Selective Agar and *Yersinia* Selective Supplement plates by streak-plate method and incubated for 48 hours at 30°C aerobically.

Presumptive identification of *Yersinia* species was carried out based on morphological appearance of the colonies. Typically, *Yersinia enterocolitica* colonies will have a deep-red centre surrounded by a transparent border giving the appearance of a “bull eye”. *Yersinia pseudotuberculosis* colonies are smaller, deep-red with a sharp border surrounded by translucent zone (Barrow et al., 1983; FDA/CFSAN, 2001).

2.6. Biochemical tests

The biochemical tests used for further identification of the isolates include; urease, lactose, sucrose, rhamnose and oxidase tests. The biochemical procedures were as described by (FDA/CFSAN, 2001).

| Reactions | Y. enterocolitica | Y. pseudotuberculosis |
|-----------|-------------------|-----------------------|
| Oxidase | - | - |
| Urease | + | + |
| Sucrose | + | - |
| Lactose | - | - |
| Rhamnose | - | + |

2.7. Data analysis

Results were presented in the form of tables and graphs. Chi-square test was used to determine any association between occurrence of Yersinia infection and the sex and age of the pigs using Graph pad InStat 3.10, 32 bit for window.

3. Results and discussion

3.1. Pigs rearing households

A total of 3896 pigs were enumerated in all the identified seven pigs rearing communities. Tudun-Wada had the highest number of pigs accounting for 1552 (39.84%) and the lowest Unguwar Zuru 113 (2.90%) (Table 1). From the total households and pigs identified, 67 (50.76%) households and 377 (50.20%) pigs were selected respectively and studied (Table 2). Table 3 showed the population of pigs by age groups while table 4 showed the distribution of pigs by sex group in the different pig rearing communities selected for the study.

3.2. Occurrence of yersinia species in pigs in zuru communities of kebbi state

A total of 76 (20.16%) out of 377 samples examined were positive for Yersinia species. However, the entire total positive samples 76 (20.16%) were positive for Yersinia enterocolitica and 7 (9.21%) of the positive samples for Yersinia pseudotuberculosis.

The highest incidence of 8 (25.00%) of Yersinia enterocolitica and Yersinia pseudotuberculosis was recorded in Unguwar Zuru while a low incidence of 20 (15.87%) was recorded in Tudun Wada (Table 5). The age distribution of incidence rate showed highest percentage of occurrence in pigs of above 24 months age group while the lowest incidence rate was recorded in pigs of 1 to 12 months age groups (Fig 1). Higher and a low incidence rates were observed in male pigs in Dabai and Bedi communities respectively while higher and a low incidence rates were recorded in female pigs in Bedi and Amanawa communities respectively (Fig 2).

Table 1

Households rearing pigs and the pig population in each household in Zuru local government area of Kebbi state.

| Community | Pig rearing households | Total no. of pigs |
|--------------|------------------------|-------------------|
| Tudun Wada | 34 | 1552(39.84%) |
| Bedi | 16 | 231(5.93%) |
| Dabai | 18 | 578(14.84%) |
| Jarkasa | 17 | 418(10.73%) |
| Unguwar Zuru | 10 | 113(2.90%) |
| Rikoto | 24 | 80320.58%) |
| Amanawa | 13 | 201(5.16%) |
| Total | 132 | 3896(100%) |

no= number

Table 2

Distribution of pig population from different selected communities in Zuru local government area of Kebbi state.

| Communities. | Total no. Of household rearing pigs. | 50% of selected household rearing pigs. | Total population of pigs in selected households. | 50% of pigs in selected sampled households. |
|--------------|--------------------------------------|---|--|---|
| Tudun Wada | 34 | 17 | 252 | 126(33.42%) |
| Bedi | 13 | 7 | 74 | 37(9.81%) |
| Dabai | 24 | 12 | 110 | 55(14.58%) |
| Jarkasa | 17 | 9 | 98 | 49(12.99%) |
| Unguwar Zuru | 10 | 5 | 63 | 32(8.49%) |
| Rikoto | 18 | 9 | 81 | 41(10.88%) |
| Amanawa | 16 | 8 | 73 | 37(9.81%) |
| Total | 132 | 67 | 751 | 377(100%) |

no=number

Table 3

Age distribution of pigs in communities of zuru local government area of kebbi state.

| Age groups | Total number of pigs | Percentage |
|-----------------|----------------------|------------|
| 1 – 12 months | 1546 | 39.7 |
| 13 – 24 months | 1254 | 32.2 |
| Above 24 months | 1096 | 28.1 |
| Total | 3896 | 100 |

Table 4

Sex distributions of pigs sampled from different pig rearing communities of Zuru local government area of Kebbi state.

| Communities | Males | Females | Total |
|--------------|-------|---------|-------|
| Tudun Wada | 43 | 83 | 126 |
| Bedi | 18 | 19 | 37 |
| Dabai | 16 | 25 | 41 |
| Jarkasa | 18 | 27 | 49 |
| Unguwar Zuru | 13 | 19 | 32 |
| Rikoto | 26 | 29 | 55 |
| Amanawa | 20 | 17 | 37 |
| Total | 158 | 219 | 377 |

Table 5

Percentage distributions of yersinia enterocolitica and yersinia pseudotuberculosis positive in pigs in different pigs rearing communities in Zuru local government area of Kebbi state.

| Community | Positive (%) | Negative (%) | Total |
|------------|--------------|--------------|-------|
| Tudun Wada | 20(15.87) | 106(84.13) | 126 |
| Bedi | 8(21.62) | 29(78.38) | 37 |
| Dabai | 9(21.95) | 32(78.05) | 41 |
| Jarkasa | 11(22.44) | 38(77.55) | 49 |
| U/ Zuru | 8(25.00) | 24(75.00) | 32 |
| Rikoto | 13(23.64) | 42(76.36) | 55 |
| Amanawa | 7(18.92) | 30(81.08) | 37 |
| Total | 76(20.16) | 301(79.84) | 377 |

(%) = Percentage

U= Unguwar

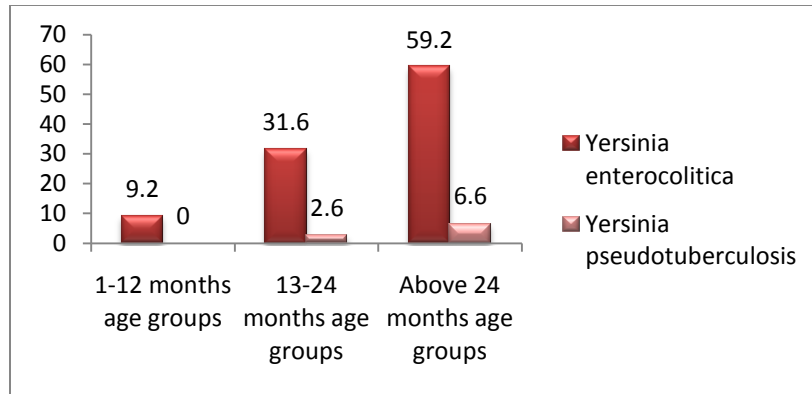


Fig. 1. Age distribution of the pigs positive to yersinia among pig rearing communities in zuru local government area of kebbi state.

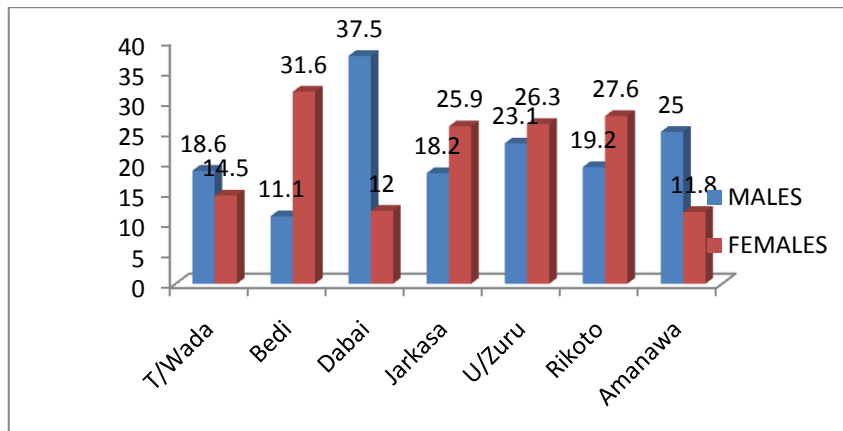


Fig. 2. sex distribution of the pigs positive to yersinia among pig rearing communities in Zuru local government area of Kebbi state.

4. Discussion

The population of pigs in Sokoto State, then including Kebbi and Zamfara States was estimated at 2000 (FLD, 1990) mostly found in Zuru but in this study a higher population of 3896 was recorded in this study. Percentage increase in the pigs population is an indication of increase participation of people in pig rearing, which may be as a result of low cost in pigs production, as many farmers practice extensive rearing and also the awareness on the rapid economic benefit (Muirhead, 1978).

Among the seven communities Tudun wada has the highest number of pigs (39.84%) while Unguwar Zuru have the lowest number (2.90%). The higher percentage in Tudun Wada could be attributed to large concentration of traditionalist and Christians whose religion do not forbid the consumption and rearing of pigs. Pigs with age group of 1 -12 months ranked the highest with 39.7% while pigs of above 24 months age groups has the least with 28.1%. This could also be attributed to the fact that pigs are mainly reared for commercial purposes and farmers preferred to sell off adult males and leaving the piglets and the adult female for fattening and breeding.

The overall incidences of 20.2% of Yersinia enterocolitica and Yersinia pseudotuberculosis in pig population was recorded in this study. All the positive samples (20.2%) were positive for Yersinia enterocolitica while 9.2% of the positive samples for Yersinia pseudotuberculosis. The findings in this study is in agreement with the observation of Okoroafor et al. (1988) and Okwori (2007) who reported 23.2% and 18.1% incident rate in pigs respectively in Jos, plateau Nigeria and 25% rate in pigs at the Swiss abattoir by Fredriksson-Ahomaa et al. (2007). The results of this study is however, in contrast with the report of Brewer and Corbel (1983) who reported incidence rate of 5.2% in pigs in United Kingdom and Fukushima et al. (1997) who reported lower incidence rate of

3.0% from pigs imported into Japan. The higher incidence rate recorded in this study could be as a result of extensive system of management and poor hygienic practice of pig production while the lower incidence rates observed in United Kingdom and Japan could be as a result of intensive system of management and good hygienic practice of pigs rearing.

Also from this study the highest incidence rate of 59.2% was recorded among pigs of above 24 months age groups, a low incidence rate of 9.2% was recorded in pigs of 1 – 12 months age group. The higher incident rate among pigs of above 24 months age groups may be associated with the fact that adult pigs have unrestricted movement and scavenge extensively on refuse dumps or dung of other animals and contaminated materials, during which more of these pathogens may be ingested. Lower incidence rate observed in 1 - 12 months age groups may be as a result of the restricted movement and supply of feed and minimal care offered by the owners, thereby reducing the incidence of exposure to contamination and infection.

In general, there was statistical association between the isolation rate and age as p value is less than 5% ($p < 0.0001$, $X^2 = 34.541$ and degree of freedom =2) but no statistical association between the isolation rate and sex as p value is greater than 5% ($p > 0.8660$ and $X^2 = 0.02847$). This finding has revealed that *Yersinia enterocolitica* and *Yersinia pseudotuberculosis* are common pathogens in pigs as reported by Ray et al. (2004). Furthermore, the overall frequency of occurrence obtained in this study may be attributed to the selective culture media used in this study which is a selective and differential medium supporting good growth of *Yersinia* species and provides increase inhibition of normal enteric organisms, thereby enhancing and the direct recovery of *Yersinia* species from faeces (Schiemann, 1982).

This finding is also in line with reports in other parts of the world particularly India where *Yersinia enterocolitica* was frequently isolated from intestinal contents of slaughtered pigs and rectal swabs of apparently healthy pigs through the use of selective media (Verma and Mishra, 1984). Isolation and identification of *Yersinia enterocolitica* and *Yersinia pseudotuberculosis* in these communities is a confirmation of the presence of the organisms in the study area leading credence to what was obtained in both humans and animals in some parts of Nigeria by Okoroafor et al. (1988), Onyemelukwe (1993), Omoigberale and Abiodun (2002), Okwori et al. (2005) and Okwori (2007).

5. Conclusion

It is obvious that the level of isolation of *Yersinia* spp from this study poses serious public health problem in the pig rearing communities and its environs.

Based on the observations from the study the followings are recommended:

- Pigs farming should be intensive with strict observation of biosecurity.
- There should be efficient and preventive control program in collaboration with pigs owners, veterinarians, medical doctors and ministry of information on *Yersinia* infection.
- There should be further study among human population for detection of *Yersinia* species in Zuru communities and the state at large, as the prevalence obtained in pigs that roams about freely in the communities is high.

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