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Blood characteristics, microbial and gastrointestinal parasites of street pigeons (*Columba Livia*) in Owerri Imo State, Nigeria

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ABSTRACT

The study was conducted to determine the haematological and biochemical indices and the naturally occurring haemo and gastrointestinal microbes of 150 matured street pigeons in Owerri, Imo State, Nigeria. The PCV, WBC, MCV, MCH and total bilirubin values of the female pigeons were significantly ($p<0.05$) different from the male counterpart. All the other haematological and serum biochemical parameters measured were similar ($p>0.05$) between the two group. Out of 150 street pigeons examined for prevalence of parasites, 70 (46.70%) of them were infected with gastro-intestinal parasites of which 30 (42.93%) were males and 40 (57.1%) were females. Four gastro-intestinal parasites were identified with *Trichomonas sp*. giving the highest prevalence rate (42%), followed by *Eimeria sp.* (28%), and whereas *Coccidia sp*. and *Ascaridia sp*. returned the least with each having the prevalence rate of (14%). Results of haemo -parasitological examination of thin blood smears revealed haematozoa of two genera: *Haemoproteus sp.* which was more common gave a prevalence rate of 40 (66%) for the male and 70 (87%) for the female pigeons. *Plasmodium sp.* with prevalence of 20 (33%) and 10 (12%) in male and female pigeons respectively. Fecal cultures recorded high growth of bacterial organisms, of which *Proteus sp*. returned 50 (83%) and *Enterococcus sp*. returned 10 (16%). In totality, 40% of the pigeons had bacterial infections. In conclusion, the prevalence of gastrointestinal and haemoparasites in street pigeons in Owerri, Imo State, Nigeria. However, these parasites did not cause any visible deleterious effects in the blood parameters of the pigeons examined.

1. Introduction

Parasites are endemic in Africa, Central and South America, certain Caribbean islands and parts of Asia, with a wide variety of hosts and vectors. Many species of parasites have been isolated from birds and only few are pathogenic (Springer, 1991). Parasites infect domestic chickens, penguins, ducks, canaries, falcons, pigeons and several marine avifaunas (Brossy, 1992; William, 2005). Parasitic diseases in birds are associated with clinical signs such as fever, depression, anorexia, loss of body weight, dyspnea, hepatomegaly, spleenomegaly, ocular haemorrhage, haemolytic anaemia, haemoglobinuria, leukocytosis, lymphocytosis, hypoalbuminaemia, nephritis, fatty liver, oedema of the lungs, hydropericardium and occlusion of capillaries of the brain (Jordan and Pattison, 1996; Aiello and Mays, I998; William, 2005). Biu *et al*. (2005) recently reported 3.0 % infection rate of pigeons with *Plasmodium sp*. in Maiduguri, Nigeria.

Pigeons are stocky fast flying birds that mostly feed on the ground, though one group feeds on ripe fruits on tree tops (Stanhope, 1978). They are widely used as experimental models in biomedical research and have also been raised for meat production. Commercial squab (young pigeons) production has existed in North America since the early 1990s (Levi, 1974; Stanhope, 1978) and recently in Nigeria (Adang *et al*., 2008). Unlike other poultry species, pigeons form paired bonds to breed and hatchlings must be brooded and fed by their parents until the market age of 4 weeks (Levi, 1974). A pair of pigeons can raise about 15 squabs per year. They carry a number of potentially infectious diseases such as parasites, salmonella, tuberculosis, histoplasmosis, cryptococcosis and ornithosis (a mild form of psittacosis- pneumonia - like symptoms) (Soulsby, 1982).

Nigeria rates highest with a total of 190 millions of pigeons (CBN, 1999) and meat from squabs is produced commercially, birds scientists here know little (Bui *et al*., 2005) about the diseases they harbor naturally, unlike peafowl (Oyawale, 1994) andguinea fowl (Oyawale and Ogwuegbu, 1986; Oyawale, 1988). Blood and feaces are used to assess the physiological and pathological status of exposed animals to pathogenic organisms (Joshi *et al*., 2002). Moreso, examining blood for their constituents can provide important information for the diagnosis and prognosis of diseases in animals. Since the knowledge of blood parameters and parasites are essential for management purposes and in developing control measures towards improving public health, this paper was therefore designed to assess the blood characteristics, prevalence of gastro-intestinal haemoparasites that naturally occur in street pigeons in the southeastern Nigeria. In order to improve on the health status, productive capacity of the pigeons and safe guard public health, there is a need to ascertain the parasite spectrum of pigeons in Imo State, Nigeria. This study was therefore designed to determine the blood characteristics, prevalence of gastro-intestinal and haemo-parasites of street pigeons in Owerri.

2. Materials and methods

2.1. Experimental location and animals

This research was carried out in the Poultry Unit of the Teaching and Research Farm, Department of Animal Science and Technology, Federal University of Technology, Owerri, Imo State. Imo state ($4^{o}4'$ - 6o3' N, $6^{o}15'$ - $8^{o}15'$ E) is situated in the south-eastern agro-ecological zone of Nigeria. The mean annual rainfall, temperature range and humidity of the area are 2500 mm, 26.5 - 27.5 ^{0}C and 70 - 80 % respectively

One hundred fifty matured non descript pigeons commonly referred to as street pigeons and popularly known as *Columba livia* (100 females and 50 males) were purchased from Relief Market in Owerri and used for the study. Non random sampling was done to increase the chances of detecting diseases, if present and was considered appropriate because the main aim of this study was to determine the presence or absence of infectious pathogens in the pigeons. They were kept in metallic cages within the Poultry Unit, non randomly and fed with commercial poultry feed (Vital Feed®) and were allowed unrestricted access to clean water and feed throughout the study in order to stabilize for a period of 14 days.

2.2. Blood collection

Blood samples (5 mL) were collected via the brachial vein of the pigeon and put into heparinized and non heparinized bottles for haematology and serum biochemistry respectively. Serum was separated from the clotted blood in the non - heparinized bottles and centrifuged into clean bottles for biochemical analysis. Determination of haemoglobin (Hb) concentration and red blood cell count was done as described by Schalm *et al.* (1975), using the cyanomethhaemoglobin method. Packed cell volume (PCV) was done by conventional method of filling the capillary tubes with venous blood as described by Schalm *et al.* (1975). Leukocyte differential counts were similarly evaluated. The serum total protein was measured using Biuret method while serum albumin was measured by Colorimeter using the Sigma diagnostics albumin reagent (Sigma Diagnostic, U.K.) containing Bromocresol green. Aspartate aminotransferase (AST), Alkaline phosphatase (ALP) and Alanine aminotransferase (ALT) were determined using photoelectric colorimeter (Gallenkamp and Sons Ltd; England) as described by Duncan *et al.* (1994). Serum urea and serum creatinine were evaluated similarly using photoelectric colorimeter as described by[18].

2.3. Blood parasites and bacterial examinations

About 2 ml of blood samples was collected heparized bottles for parasitological examination and identification using standard parasitological techniques according to Cheesbrough (2000). Using some of the blood collected, thin films of each of the blood samples were made with Leishman stain (thin film) and allowed to dry for about 12 minutes

2.4. Fecal Collection

Feacal samples were collected via the cloaca of each of the bird with a cloacal swab for freshly voided faeces. The feacal samples were then put into sterile sample bottles and labelled appropriately and were later taken to the laboratory within 3 hours of collection.

In the laboratory, a drop of normal saline was put on clean, grease – free glass slide using an applicator stick, 2 grams of feaces was emulsified and covered with a cover slip. The slide was then examined for helminthes ova and protozoa cysts using a standard microscope and viewed under ×10 magnification. Thereafter a drop of lugols iodine was added to the cover slip and allowed to diffuse into the sample, in order to stain the cysts of protozoa and also to differentiate them from the ova of helminthes.

Two growth media, blood agar and MacConkey agar were prepared according to the manufacturer's instruction and thereafter sterilize by autoclaving at 121^0C for 15 minutes in 15 pounds per square inch using autoclave. They were allowed to cool to 45^0C on the workbench before plating out into the various Petri dishes at 15 - 20 ml following standard laboratory procedures. The dishes were inoculated with faecal samples and incubated at room temperature for 48 hours at the end of which they were examined for bacterial growth, stained according to standard microbiological procedures of Black (1996) and viewed under the microscope using oil immersion at × 100 magnifications.

2.5. Data analysis

Data obtained on haematology and serum biochemistry were subjected to the Student's t – test, in order to compare the values according to sex of the pigeons. The results were considered significant at $p<0.05$ according to the procedures of Elleston and Johnson (2008). The data obtained for gastro-intestinal microbials and blood parasites were analyzed using simple descriptive statistics.

3. Results and discussion

The differences in the mean values for haematological parameters between the male pigeons and female pigeons during the study are shown in Table 1. The differences between male and female pigeons for Hb, MCHC, DWBC (Heterophils, Lymphocytes, Monocytes, Eosinophils and Basophils) and RBC were not significantly ($p>0.05$) different. The higher percentage of heterophils as observed in the male pigeons when compared with the females agreed with the findings of Oyawale (1994) who reported similar values in the laughing doves. The male sex hormone, testosterone has been reported to be responsible for this higher heterophil counts in males (Short, 1980). The difference between the PCV values for male (43.80 ± 4.64) and female (51.40 ± 2.21) pigeons was significantly ($p<0.05$) different. The mean WBC value of male pigeons (0.64 ± 0.12) was significantly ($p<0.05$) higher than that of

the females (0.35±0.07), whereas the MCV and MCH values of the female pigeons were significantly (<0.05) lower when compared with those of the males.

Table 2 shows the differences in mean values for serum biochemical parameters obtained in this study. The differences in the values for urea, creatinine, total protein, albumin, conjugated bilirubin and globulin respectively between male and female pigeons were not significant (p>0.05) whereas for serum total bilirubin was significant (p<0.05), whereas total bilirubin was significant (p<0.05). The serum sodium, potassium and chlorides values were similar (p>0.05) between the two treatment groups. Similarly, the differences between male and female values for serum ALP (276.80 ± 4.51 and 275.60 ± 2.93), serum AST (3.60 ± 0.81 and 3.20 ± 0.42) and serum ALT (14.40 ± 2.66 and 15.70 ± 0.84) were not significantly (P<0.05) different.

The prevalence rates of parasites from the gastro-intestinal tract of street pigeons in Imo State are reported in table 3. Out of the 150 pigeons examined for gastrointestinal parasites, 70 (46.7%) were infected comprising 30 (42.90%) males and 40 (57.1%) females.

Table 1

The mean haematological indices of street pigeons (*Columba livia*) in Owerri Imo State, Nigeria.

Parameters	Male	Female
PCV (%)	43.80 ± 4.64[a]	51.40 ± 2.21[b]
RBC (× 10^6 / µl)	2.16 ± 0.14	2.16 ± 0.11
WBC (× 10^6 / µl)	0.64 ± 0.12[a]	0.35 ± 0.07[b]
Hb (g / dl)	14.60 ± 1.49	17.12 ± 0.73
MCV (fl)	205.40 ± 23.38[b]	239.80 ± 9.11[a]
MCH (pg)	68.40 ± 7.53[b]	80.00 ± 2.94[a]
MCHC (g)	333.60 ± 1.66	333.50 ± 1.54
Heterophils (%)	42.20 ± 4.79	37.00 ± 2.11
Lymphocytes (%)	56.40 ± 4.61	59.40 ± 2.70
Monocytes (%)	1.20 ± 0.74	1.30 ± 0.30
Eosinophils (%)	0.00 ± 0.00	0.20 ± 0.13
Basophils (%)	0.00 ± 0.00	0.00 ± 0.00

[ab]Means within a row with different superscripts are significantly different at p<0.05; PCV - Packed Cell Volume, RBC - Red Blood Cell, WBC - White Blood Cell, Hb - Haemoglobin concentration, MCH - Mean Haemoglobin Concentration, MCV - Mean cell volume, MCHC - Mean Cell Haemoglobin Concentration.

Table 2

The mean serum biochemical parameters of street pigeons (*Columba livia*) in Owerri, Imo State, Nigeria.

Parameters	Male	Female
Creatinine (mg/dl)	0.66 ± 0.09	0.56 ± 0.10
Urea (mg/dl)	6.50 ± 0.31	5.69 ± 0.38
Total protein (g/dl)	5.47 ± 0.17	5.31 ± 0.23
Albumin (g/dl)	4.62 ± 0.26	3.84 ± 0.15
Globulin (g/dl)	1.36 ± 0.31	1.47 ± 0.20
Albumin-globulin ratio	3.26 ± 0.06	2.37 ± 0.05
Total cholesterol (mg/dl)	68.80 ± 4.71	62.00 ± 2.96
Total bilirubin (mg/dl)	1.64 ± 0.33[b]	1.53 ± 0.19[a]
Conjugated bilirubin (mg/dl)	0.70 ± 0.12	0.63 ± 0.12
Sodium (mmol/l)	80.00 ± 4.06	83.00 ± 3.92
Potassium (mmol/l)	4.14 ± 0.22	4.71 ± 0.37
Chloride (mmol/l)	91.00 ± 5.05	87.80 ±4.23
ALT (µ/l)	14.40 ± 2.66	15.70 ± 0.84
AST (µ/l)	3.60 ± 0.81	3.20 ± 0.42
ALP (µ/l)	276.80 ± 4.51	275.60 ± 2.93

[ab]Means within a row with different superscripts are significantly different at p<0.05; ALT - Alanine aminotransferase; AST - Aspartate aminotransferase; ALP - Alkaline phosphatase.

Table 3
Prevalence of gastro-intestinal parasites of street pigeons (*Columba livia*) in Owerri, Imo State, Nigeria.

Sex	Number examined (%)	Number infested (%)	Number not infested (%)
Male	50 (33.3)	30 (42.9%)	20 (25%)
Female	100 (66.7)	40 (57.1%)	60 (75%)
Total	150 (100)	70 (46.7%)	80 (53.3%)

Table 4 shows the prevalence of different parasite species in the gastro-intestine of street pigeons in Imo State. Four gastro-intestinal parasites were found during this study. These were: *Trichomonas sp*. (42%), *Eimeria sp*. (28%), *Coccidia sp*. (14%) as gastro-intestinal tract protozoa and *Ascaridia sp*. (14%) (Table 4), being the only helminth. These results were in agreement with those reported by Keymer (1982) and Zwart (1993) in Uganda, who reported the same array of parasites as the aetiological agents of most diseases of cage and aviary birds. However, it does not agree with Adang *et al*. (2008), who while working in Zaria Nigeria, found 9 helminths (6 cestodes and 3 nematodes). Animals kept under intensive management and or domestication should have an extremely low or zero parasite tolerance with proper hygiene and good management (Atsineka and Banke, 2006). High parasitic infections may therefore be an indication of poor management and control efforts in either the animal or in the immediate environment where infection or re-infection (directly or indirectly) may emanate. The prevalence of 46.7% gastro-intestinal tract infections recorded in this study is considered high, even though it is comparable to the 48.3% [9] and 43.4% reported by Audu *et al.* (2004) in domestic pigeons in Zaria. Alarming rates of 66.7% and 69.2% have been reported by (Dede and Richards, 1998; Oniye *et al*., 2000) in both wild and domestic pigeons in north-East zone of Nigeria and the Zaria area. The moderate prevalence (14%) of helminth infection recorded in this study could be an indication of a corresponding moderate incidence of the infective stages and intermediate hosts of the parasites in places where these pigeons are reared. The intermediate hosts of these parasites; beetles, pill bugs, ants, earthworms and snails which form part of the diet of pigeons (Adang *et al*., 2008) [9] are abundant and may easily infect the birds via their diet since they travel long distances in search of food. This moderate prevalence may be attributed to the food searching habits of the pigeons of not scratching below the surface soil where most infective stages of these nematodes are hidden. All the birds examined are adults and this may also have conferred certain level of host immunological response against the establishment of the nematodes. All species found were isolated in females, while only *Trichomonas sp.* and *Eimeria sp.* were isolated in males. The reason for this cannot be substantiated now, but further future studies may explain it.

Table 4
Prevalence of gastro-intestinal parasites species recovered from street pigeons (*Columba livia*) in Owerri, Imo State, Nigeria.

Parasites	No. observed (%)	No. of male (%)	No. of female (%)
Trichomonas sp.	30 (42.9)	20 (66.7)	10 (25)
Eimeria sp.	20 (28.6)	10 (33.3)	10 (25)
Coccidia sp.	10 (14.3)	-	10 (25)
Ascaridia spp.	10 (14.3)	-	10 (25)
Total	70 (46.7)	30 (42.9)	40 (57.1)

Results from haemo-parasitological examination of thin blood smears from street pigeons in Imo State, revealed haematozoa of mainly two genera: *Haemoproteus* and *Plasmodium* (Tables 5 and 6). Of the 150 street pigeons examined 80% were infected with haematozoa, out of which 33.3% were in the males and 66.7% were in the females. Two blood parasite species were identified, with *Haemoproteus sp.* 75% and plasmodium sp. 25%. The prevalence of *Haemoproteus sp*. and *Plasmodium sp*. observed in this study agrees with the reports of Dranzoa *et al*. (1999) who indicated that *Haemoproteus* and *Plasmodium sp*. are the most common haemoparasites in birds reared in Uganda. The prevalence of *Plasmodium sp* infections of domestic pigeons here did not agree with earlier studies in Ghana which was 35 % Poulsen *et al*. (2000), 35% in Zimbabwe Permin *et al*. (2002) and 39.5 % in Malawi (Njunga, 2003). The reason for the lower prevalence of *Plasmodium* as observed in this study may be attributed to the type of housing and other management practices adopted for the pigeons in the studies elsewhere. The slightly higher prevalence of haemoparasites in pigeons could be attributed in part to the unhygienic nature of the

environment where these birds are kept. Poor environmental conditions encourage the abundance of ectoparasites vectors of these haemo – parasites. For example, *Pseudolynchia canariensis* for *Haemoproteus sp* and mosquitoes for *Plasmodium sp*. This high prevalence of haemoparasites in street pigeons supports the works of Cooper (1997) who reported that these birds often harbor zoonotic parasites in the African environment.

Table 7 shows the prevalence of bacterial organisms in faecal samples of street pigeons in Owerri, Imo State, Nigeria. It was observed that there was heavy growth of *Proteus sp*. 130 (86.7%) after 48 hours of incubation in all the samples *Enterococuss sp*. 20 (13.3%). Out of 130 pigeons infected with *Proteus sp*., 50 (38.5%) were in the male and 80(61.5%) were in the female. The prevalence for *Enterococcus species* had the same value for both sexes. High bacteria infections frequently accompany as many infectious diseases, malnutrition as well as poor sanitation. They also occur as contaminants in viral, parasitic and rickettsial infections.

Table 5
Prevalence of blood parasites of street pigeons (*Columbia livia*) in Owerri, Imo State, Nigeria.

Sex	Number examined (%)	Number infested (%)	Number not infested (%)
Male	50 (33.4)	40 (33.3)	20 (66.7)
Female	100 (66.7)	80 (66.7)	10 (33.3)
Total	150	120 (80)	30 (20)

Table 6
Prevalence of blood parasites species recovered from street pigeons (*Columba livia*) in Owerri, Imo State, Nigeria.

Parasites	No. observed (%)	No. of male (%)	No. of female (%)
Haemoproteus sp.	90 (75)	30 (75)	70 (87.5)
Plasmodium sp.	30 (25)	10 (25)	10 (12.5)
Total	120 (80)	40 (33.3)	80 (66.7)

Table 7
Prevalence of bacteria species in the faecal culture of street pigeons (*Columba livia*) in Owerri, Imo State, Nigeria.

Parasites	No. observed (%)	No. of male (%)	No. of female (%)
Proteus sp.	130 (86.7)	50 (38.5)	80 (61.5)
Enterococcus sp.	20 (13.3)	10 (50)	10 (50)
Total	150	60 (40)	90 (60)

4. Conclusion

This study revealed high prevalence of both haemo and gastro-intestinal microbes in street pigeons in Imo State, Nigeria. It has also provided evidence of the potential of the pigeons as carriers of pathogenic organisms, some of which might be zoonotic. This finding should not be taken as definitive, because the study did not involve in-depth identification of the microbes encountered up to the species level. Overall, the occurrence of infections were more in the female than male pigeons, probably because of peculiar physiological activities (reproduction), which usually result into stress and lowering of the body immunity. However, the ability of the pigeons to harbor and serve as disease carriers, suggests that from epidemiological point of view, both sexes of birds are equally at risk of being infected by these parasites and bacteria and thus, are endowed to transmit the pathogens to man and his livestock.

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