

1 | **DETERMINATION OF PARASITIC AGENTS ASSOCIATED WITH PROTOZOAN AND NEMATODE**
2 | **PARASITES ISOLATED FROM COCKROACHES IN DUTSIN-MA TOWN, NORTHWESTERN**
3 | **NIGERIA**

4 | **ABSTRACT**

5 | Cockroaches are known to be mechanical vectors of disease causing agents such as parasites, bacteria, fungi and
6 | viruses. This study ~~determined parasitic agent~~~~examined protozoan and nematode parasites~~ associated with
7 | cockroaches in Dutsin-Ma Town, Northwest Nigeria. ~~The study was carried out in Dutsin-Ma Town, Dutsin-Ma~~
8 | ~~Local Government Area of Katsina State, Northwestern Nigeria.~~ A total of 600 cockroaches were collected from
9 | toilets, dumpsites, suck-away and sewages of Female and Male Hostels of Federal University Dutsin-Ma, residential
10 | houses in Darawa, Hayin-Gada and Kadangaru in Dutsin Ma town.

11 | to isolate protozoan and nematode parasites in and on the cockroaches. A total of 600 cockroaches (identified as
12 | *Periplanata americana* species) were examined, 95.33% were infected with several species of gastrointestinal
13 | parasites. Parasites isolated and identified include *Strongyloides stercoralis* (25.26%), fluke (17.89%), *Nyctotherus*
14 | *ovalis* (2.98%), *Enterobius vermicularis* (13.68%), *Entamoeba histolytica* (12.28%), *Toxascaris leonina* (24.46%).
15 | Cockroaches collected from the toilets had the highest parasite load, followed by those from the suck-away, and
16 | those from the dumpsite and then cockroaches from the sewages. More parasites were recovered from the gastro-
17 | intestinal than on the external parts with prevalence rates of 97.33% and 92.67%, respectively. This study has shown
18 | that *Periplanata americana* ~~represent americana represent~~ an important reservoir ~~of parasites of parasites~~ which can
19 | cause disease in man. Hence public awareness is required to educate people on the potential of *Periplanata*
20 | *americana* in transmitting intestinal parasites thus, there is need to control cockroaches indoors and outside.

21 | **Keywords:** *Periplanata americana*, *Parasitic Agentes*, *Cockroaches*, *Dutsin Ma*, *Nigeria*

22 | **1.0 INTRODUCTION**

23 | Cockroaches are the most abundant and obnoxious non-biting insect pests in residential buildings, hospitals, hostels,
24 | hotels and restaurants (Piper and Antonelli, 2012). They feed indiscriminately on human food and sewage. Over
25 | three thousand five hundred species of cockroaches have been identified and thirty of these species are more adapted
26 | to human habitation. Of these, *Periplanata americana*, *Blattela germanica* and *Blattela orientalis* are considered the
27 | most common pests of humans (Gullan and Cranston, 2005) When cockroaches run over food, they contaminate the
28 | food by leaving an oily liquid that has offensive odour or bacteria that can cause food poisoning (Brenner *et al.*,
29 | 1987). Some parasites have been found in the external and internal body parts of cockroaches (Chan *et al.*, 2004).
30 | Findings have also shown that exposure to cockroach antigens may play an important role in Asthma related health
31 | problems (Montessor *et al.*, 1998).

32 | In Nigeria, the risk to human health arising from cockroach infestations have been reported (Allen, 1987).
33 | Cockroaches are abundant in most homes in Nigeria, where they are fondly referred to as “landlords” in homes.
34 | They are among the most notorious pests of premises, which frequently feed on human faeces and can disseminate

Comment [OP1]: Check for other errors here especially grammatical and typographical and correct. Summarize your findings here and give tentative recommendation from your study outcomes.

35 cysts of enteric protozoans in the environment if such faeces are contaminated. Besides contaminating food by
 36 leaving droppings and bacteria that can cause food poisoning (Che Ghani *et al.*, 1993), they also transmit bacteria,
 37 fungi, and other pathogenic microorganisms in infested areas (Kopanic, 1994; Czajka *et al.*, 2003). They feed on
 38 garbage and sewage and so have high chances of disseminating human pathogens (Cotton *et al.*, 2000; Paii *et al.*,
 39 2005). In addition, their nocturnal and filthy habits made them ideal carriers of various pathogenic microorganisms
 40 (Allen, 1987). In 2016, Morenikeji *et al.* reported a very high prevalence (87.1%) of parasites in cockroaches
 41 recovered from residential houses around Awotan dumpsite in Ido Local Government Area of Oyo State in Nigeria.

42 Despite the abundance of cockroaches in residential areas in Dutsin-Ma town and the relatively high prevalence of
 43 parasitic infections in the area, there is no reported studyresearch on the roles of cockroaches as carriers of bacteria,
 44 parasites and other pathogens in Dutsin-Ma Town. To provide the public with this knowledge, this study was put
 45 forward to determine parasitic agents associated with cockroachesStudy investigated protozoan and nematode
 46 parasites associated with cockroaches in Dutsin-Ma Town, Northwestern Nigeria.

Comment [OP2]: Check grammatical and typographical errors.
 2. Check misspelled errors and use recent references here.

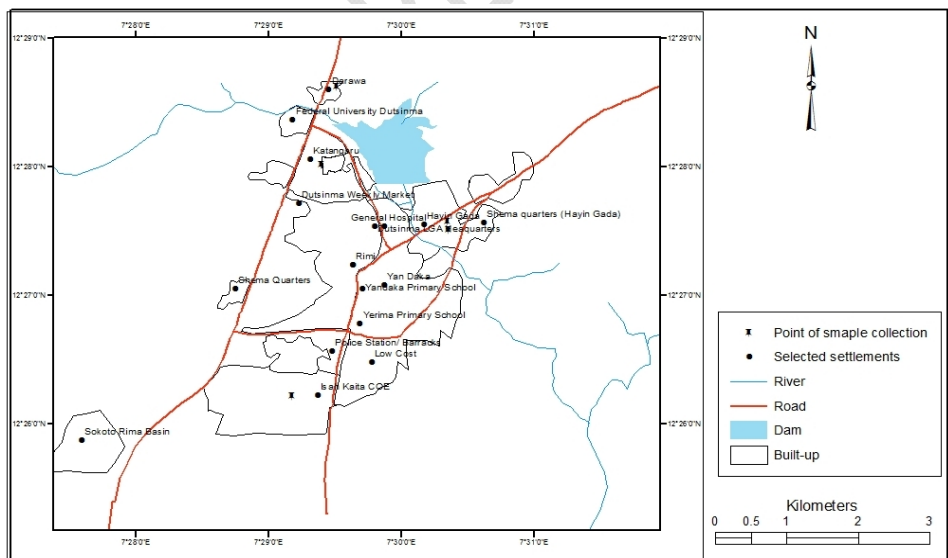
47 **2.0 METHODOLOGY**

48 **2.1 Study Area**

49 The study was carried out in Dutsin-Ma Local Government Area on latitude 12.455' and longitude 7.4914, area of
 50 527km² (Figure 1) with elevation of 605m and average temperature of 26°C, wind NW 2km/h 25% humidity and a
 51 population of 169,671 as at 2006 census (Reference).

Comment [OP3]: State the references here.

52



Source: Google Earth 2016 & FUDMA GIS Lab

53

54 **Fig. 1:** Map showing Study Area

Comment [OP4]: Add Citation here

55 Aborigines of Dutsin-Ma are predominantly farmers, cattle rarers and traders. There ~~have been tremendous~~
56 ~~increase~~ has been tremendous increase in human population, number of houses and activities in Dutsin-Ma in the last
57 6 years, which is not unconnected with the siting of the new Federal University in the Town. Dutsin-Ma is a
58 community where sanitary conditions are below standard, residential areas are under developed with inadequate
59 pipe-borne water supply, residents relying on wells, Dutsin-Ma Dam, commercial water vendors and a few private
60 boreholes for their water needs. Most households lack good water cistern toilet, relying majorly on pit latrines or
61 dumping their faecal matter in the nearby dumpsites. The high ~~number~~ numbers of almajiri schools, which mostly
62 lack sanitary facilities, with almajiris practicing open defecation also contribute to the poor sanitary condition of the
63 area.

Comment [OP5]: Citation here

64 2.2 Sample Collection, and Parasites Isolation and Identification

Comment [OP6]: Separate headings and explain exactly what you did.

65 A total of six hundred (600) cockroaches were caught using Sticky traps of cardboard paper and adhesive, one
66 hundred and eighty (360) cockroaches were from houses with open toilets and one hundred and seventy-two (240)
67 from houses with broken sewage systems. They were examined for external and internal together with the mouth
68 part pathogens. Selected houses around Dutsin-Ma Town were stratified in to 5 cardinal points: Darawa, Hayingada,
69 Kadangaru, Female hostel and Male hostel of the Federal University Dutsin-Ma. Cockroaches were collected from
70 randomly selection houses from each cardinal points area of studies.

71 The prepared trap was pinned to flat wooden surfaces found in kitchens, toilets, bathrooms, bedrooms and living
72 rooms .The traps were set at 7:00 pm and inspected at 7:00 am daily for four weeks, as described by Mogbo *et al.*
73 (2013). Cockroaches trapped were transferred into universal containers and then transported to the Laboratory for
74 further examination. The cockroaches were put to sleep by using chloroform soaked cotton wool and examined
75 under the dissecting microscope for identification using standard taxonomical keys by Department of Biological
76 Sciences Federal University, Dutsin-Ma (2017).

77 Sedimentation technique as described by Brook and Sloss (1968) was used to extract parasites in each sample
78 collected. Parasites collected were examined using light microscope $\times 40$ objective lens as described by Salehzadeh
79 *et al.* (2007). Parasites were identified using taxonomical keys by Cheesbrough (2005) and Lee *et al.* (2000).

Comment [OP7]: Present methodology in a scientifically manner and all protocol should carry a cited reference. State exactly what you did here

80 2.3 Statistical Analysis

81 Data collected are presented in tables and prevalence expressed in percentage.

Comment [OP8]: Use a statistical package for analyzing your results. Percentage only is not accepted at this stage. Use SPSS or SSP package (Chi square etc) etc.

82 3.0 RESULTS

83 A total of Six hundred cockroaches were Collected from five sampling areas (Female Hostel, Male Hostel, Hayin-
84 gada, Kadangaru and Darawa toilets and dumpsite) were examined. The examination was done both externally and
85 internally fl2or 300 samples each. A total of 300 cockroaches each for external and internal examination were found

86 as 278(92.67%) and 292(97.33%) prevalence respectively. Highest prevalence [78(28.06%)] and the lowest
 87 [26(9.35)] was recorded in Hayin-Gada and Darawa respectively (Table 1).

88 Table 2 shows the prevalence of identified parasites species on external body parts of cockroaches with highest
 89 prevalence *Toxascaris leonine* 68 (24.46%) and least prevalence of *Strongyloides stercoralis* 108 (36.98%) and none
 90 recorded as globular substrate

91 Table 3: shows overall (external and gut) prevalence of parasites according to sample area.

92 Table 4: shows the overall (external and gut) prevalence of identified species was: *Strongyloides stercoralis*
 93 144(25.26%), flukes 102(17.89%) *Nyctotherus ovalis* 17(2.98%), globular substrates 49(8.60%), egg of *Enterobius*
 94 *vermicularis* 78(13.68%), *Entamoeba histolitica* 70(12.2%), with the highest and lowest prevalence recorded in
 95 *Strongyloides stercoralis* and *Nyctotherus ovalis* respectively.

96 Table 1: Prevalence of Parasites Infestation According to cockroach Body Parts in Dutsin-Ma Town

Sampling Site	External Body Part		Internal Body Part	
	Number	Number	Number	Number
	Examined	Infested (%)	Examined	Infested (%)
Female Hostel	78	74 (94.9)	72	70 (97.2)
Male Hostel	74	64 (86.5)	80	78 (97.5)
Hayin-Gada	81	78 (96.3)	76	76 (100)
Kadangaru	41	36 (87.8)	36	36 (100)
Darawa	26	26 (100)	36	32 (88.9)
Total	300	278 (92.7)	300	292 (97.3)

97

98 Table 2: Prevalence of Parasites Recovered from body parts (external and gut) of cockroach

Type of Parasite	External Body Part		Internal Body Part	
	Number Examined	Number Present	Number Examined	Number Present
		(%)		(%)
<i>Strongyloides stercoralis</i>	300	36 (12)	300	108 (36)
Flukes	300	60 (20)	300	42 (14)
<i>Nyctotheru sovalis</i>	300	1 (0.3)	300	16 (5.3)

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<i>Toxascaris leonine</i>	300	68 (22.7)	300	42 (14)
<i>Enterobius vermicularis</i>	300	26 (8.7)	300	52 (17.3)
<i>Entamoeba histolytica</i>	300	38 (12.7)	300	32 (10.7)
Glubular Substrates	300	49 (16.3)	300	42 (14)

99

100 Table 3: Prevalence of Parasites Infested Cockroaches According to Sampled Sites

Sampled Site	Number Examined	Number Infested	Prevalence (%)
Female Hostel	150	144	96
Male Hostel	154	142	92.2
Hayin-Gada	157	154	98.1
Kadangaru	77	72	93.5
Darawa	62	58	93.5
Total	600	572	95.3

101

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103 Table 4: Prevalence of Parasites according to types of parasite isolated from cockroaches in Dutsin-Ma Town

Type of Parasite	Number of Samples examined	Number of Parasites Present	Prevalence (%)
<i>Strongyloides stercoralis</i>	600	144	24.0
Flukes	600	102	17.0
<i>Nyctotherus ovalis</i>	600	17	2.8
<i>Toxascaris leonine</i>	600	110	18.3
<i>Enterobius vermicularis</i>	600	78	13.0
<i>Entamoeba histolytica</i>	600	70	11.7
Globular substrates	600	49	8.2

104

105

106 4.0 DISCUSSION

107 In this study, the intestinal parasites of medical importance were isolated from the body surface and guts contents of
108 the cockroaches. 95.33% of cockroach specimens examined had been found to harbor at least one species of human
109 intestinal parasites. This is similar to high parasites carriage rate (77.52%) had been reported from Nigeria (Bala and
110 Sule, 2012). In contrast, no parasites species were collected from residential area in Iran but relatively low
111 percentage of parasites were isolated from cockroaches gotten from public hospital in the same study area.
112 (Salehzadeh, *et al.*, 2007) Therefore the variation in the incidence of parasites load associated with cockroach varies
113 with hygiene condition of the environment and also the population of people living within the environment. This
114 may account for the variation in parasites carriage rate among the different sampling areas.

115 Although no study on epidemiology of pathogens in cockroaches has been carried out in the study areas, the present
116 study suggests cockroaches as important agents of pathogens transmission to man. In this study show that
117 cockroaches may be an agents of parasitic infection which were more contaminated were infested with six parasite
118 *Strongyloides stercoralis*, fluke, *Nyctotherus ovalis*, *Enterobius vermicularis*, *Toxascaris leonina*, and *Entamoeba*
119 *histolytica* species. Which is similar to the salehzadeh *et al*; 2007. All the parasites recovered from their body are of
120 medical importance and have been implicated in many gastrointestinal disorders. *Enterobius vermicularis*, hook
121 worm and *Ascaris lumbricoides* have been reported to cause chronic diarrhea. The higher percentage of the
122 cockroaches harbouring gastrointestinal parasites encountered in the residential environment is not departure from
123 the expected results as similar observation have also been reported elsewhere Adeleke *et al*; 2012. Hospital host
124 patients suffering from different ailments and these cockroaches would have been contaminated during their
125 nocturnal movements from one ward to other areas including toilets. Graczyk *et al*; 2005.

126

127 5.0 CONCLUSION AND RECOMMENDATION

128 This study reveals that most cockroaches in Dutsin-Ma are carriers of different types of nematode and protozoan
129 parasites. This high prevalence of parasites in the cockroaches places them as potential transmitters/carriers that
130 could contaminate food and other items in human residents in Dutsin-Ma. It also shed light on the potential
131 mechanical transmission of human nematode and protozoan parasites that may be threats to public health if not
132 properly managed.

133 Therefore, adequate awareness needs to be created among inhabitants of the residents and students hostels on the
134 need to avoid contact or contamination of food and water with cockroaches. Proper covering and washing of any
135 food and cooking utensils should be promoted. Controlling of the cockroaches population through the use of

Comment [OP11R10]: Represent results with Chi square analysis or Odd ratio placed. The headings needs to be reframed according to the modified Manuscript title.

136 insecticides and screening of houses is highly recommended. Building of modern houses devoid of crevices that
137 support cockroaches life should be adopted.

138 Proper waste management practices should also be put in place.

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Comment [OP13]: References are small for such study. Use recent references (2015-2019). Make sure it is arranged according to the Journal format.

UNDER PEER REVIEW

