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Cockroach-borne human parasites of public health concern: A synoptic account of the literature

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Abstract

Cockroaches are insects of antiquity with great medical, veterinary and public health importance. The history of cockroaches are reportedly traceable to the tropical countries. However, many species of the insect eventually became cosmopolitan; a phenomenon that resulted from international trade and commerce. Cockroaches invade homes and induce psychological stress, contaminate food and mechanically transport and transmit pathogens. An extensive review of publications made over the years on cockroach-borne human parasites of public health concern was made from journal research articles and textbooks. Most of the publications were synthesized and presented in tabular forms. The findings indicated that many protozoan and helminth parasites that infect humans and domestic animals are borne by many cockroach species. This finding raises alarm on threat to public health by the synanthropic *Periplaneta species*. Personal hygiene, adequate housekeeping, environmental cleanliness, source reduction and application of IPM are advocated.

Keywords: Periplaneta, parasites, health, synopsis, literature

1. Introduction

Cockroaches are arthropods with jointed appendages, exoskeleton, segmented bodies, central nervous system, open circulatory system, digestive system and sensory receptors^[1]. They are oval, flat-bodied, dark in colour and dorso-ventrally flattened insects with chewing mouthparts and two pairs of wings. They have well-developed compound eyes and long thread-like antennae^[2]. Cockroaches have been reported to be pervasive, elusive and prolific insects that are incriminated in the transmission of pathogens and responsible for eliciting some human allergic reactions^[3].

Blattaria species are important members of the class -insecta, as they play significant roles in medical, veterinary and public health sectors^[4]. They induce psychological stress, environmental aeroallergens^[5], contaminate food and acquire and mechanically transport and transmit disease-causing organisms; majority of which have been reportedly isolated from cockroaches inhabiting different environments^[6, 7].

This important group of insects has been incriminated as vectors of both human helminth and enteric protozoan parasites. A review of earlier studies on the roles that cockroaches play in the transmission of human enteric protozoan parasites has been documented by Graczyk *et al.*^[8].

2. Brief History, Taxonomy, Behaviour and Ecology of Cockroaches

Cockroaches are insects of antiquity that have existed between the past 200 and 350 million years^[2, 9, 10]. In the past, 4,000 species of cockroaches were known to exist^[11] and 50 of them were regarded as pests^[2, 10]. These 50 species are from five families of which three (Blattidae, Blatellidae, and Blaberidae) have been reported to form most of the pest species^[10].

Periplaneta Americana and *Blattella germanica* are the most common species^[12]. While most cockroaches inhabit the warm tropical zones, approximately 25 species have spread worldwide, accidentally transported on ships^[11]. *P. Americana* and *B. germanica* were believed to have originated in Africa or Asia and spread to America and the Caribbean through commerce, especially during slave trade^[2, 10].

According to Cooke *et al.*^[11] and the Technical Learning College^[1], cockroach classification using *P. Americana* as a representative species is as follows:

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Kingdom	-	Animalia
Phylum	-	Arthropoda
Sub-phylum	-	Hexapoda
Class	-	Insecta
Order	-	Blattodea
Family	-	Blattidae
Genus	-	Periplaneta
Species	-	Periplanetaamericana

However, this classification is not sacrosanct, as some variations and modifications may continue to arise from the findings in taxonomy.

Eleven species of cockroaches are known to be well recognized by medical entomologists [10]. The species are *Blatra orientalis*, *Periplaneta Americana*, *Periplaneta australasiae*, *Periplaneta brunnea*, *Periplaneta fulginosa*, *Eurycotis floridana*, *Supella longipalpa*, *Blattella germanica*, *Blattella asabinai*, *Pycnoscelus surinamensis* and *Punchlora nivea*.

Three groups of cockroaches have been ecologically recognized and are categorized as domestic, peridomestic and feral [10]. The domestic species to a great extent and the peridomestic species, to a less extent are of human public health importance. The domestic species are those ones that live indoors in buildings with humans and depend on the resources provided by humans for their survival. The cockroaches are gregarious, nocturnal, and omnivorous animals that hide in cracks and crevices during day time and emerge during night hours, in search of moisture and all sorts of available food [2]. Despite their endowment with high level of adaptation to different conditions, four (4) basic resources are needed by cockroaches in order to survive and thrive in their habitats. The basic needs are food, water, warmth and

shelter [3, 13]. The availability of these resources encourages them to cluster for foraging, which mainly takes place at night and is usually obstructed by human activities.

Thirty (30) species of cockroaches are reported to be associated with human dwellings [14]. Even though homes with certain levels of sanitation can still be infested with cockroaches, their presence in homes is a strong indication of poor level of sanitation, resulting from sub-standard housekeeping [10]. Poor sanitation and hygiene, accompanied by structural disrepair and poor housekeeping have been reported to contribute to the survival and home infestation of cockroaches [2, 10].

3. Public Health Importance of Cockroaches

The negative impact of cockroaches in public health is enormous and should not be overemphasized. They are incriminated in food contamination with their excrement, dissemination of pathogens, inducing allergic conditions, inducing psychological stress (in cases of delusory parasitosis) and in bites on finger nails, eye lashes and some other body parts. On the course of foraging, cockroaches may defecate and contaminate food with pathogenic organisms from the gut. Consumption of such contaminated food may result in the transmission of the potential disease-causing organisms to humans or to the domestic animals [2, 15]. Exposure to certain arthropods and/or their products, including fragments of cockroach exoskeleton and excrement available in infested environments can generate a wide spectrum of allergic reactions in humans and animals with poor prognosis that can end up in asthma [2, 15, 16].

Many studies have reported cases of cockroach-borne human parasites of public health concern (Table 1 and Table 2).

Table 1: Cockroach –borne protozoan parasites of public health concern

S. N	Author(s)	Date of Publication	Location of Study	Number of Cockroaches Examined	Number of Cockroaches Infected	Isolated Parasite Taxa/species	Prevalence (%)
1	Bala and Sule [17]	2012	Arkillawamakko LGA, Sokoto State	218	169	<i>E. histolytica</i>	40.83
2	Etim <i>et al.</i> [18]	2013	Anantigha Calabar, Cross River State, Nigeria	322	187	<i>B. Coli</i> <i>E. histolytica</i>	8.80 13.70
3	Alzain [19]	2013	North Gaza Governorate Palestine	200	47	<i>E. histolytica</i> <i>B. Coli</i>	12.80 14.90
4	Iboh <i>et al.</i> [20]	2014	Yakurr, Cross River State, Nigeria	352	331	<i>Balatidium coli</i> <i>E. histolytica</i>	14.71 23.53
5	Ojianwuna [21]	2014	Abraka, Delta State, Nigeria	841	841	<i>E. histolytica</i>	7.30
6	Iboh <i>et al.</i> [22]	2015	Calabar Municipality Cross Rivers State, Nigeria	430	NI	<i>E. histolytica</i>	17.00
7	Oyeyemi <i>et al.</i> [23]	2015	Ilishan Remo Town, Ogun State, Nigeria	130	NI	<i>E. histolytica</i>	0.80
8	Tatang <i>et al.</i> [24]	2017	Melong sub-division Muongo Division, Littoral Region, Cameroon	844	NI	<i>Eimeriaspp</i>	2.73
9	Haile <i>et al.</i> [25]	2018	Wolkite Town Southwestern Ethiopia	209	157	<i>Giardia lamblia</i> <i>E. histolytica/dispar</i>	23.90 28.70
10	Adenusi <i>et al.</i> [4]	2018	Somolu LGA, Lagos State	749	722	<i>E. histolytica/dispar</i> <i>E. Coli</i> <i>G. Lamblia</i> <i>Cryptosporidium sp</i>	44.10 37.80 18.70 13.80

Key: NI means not indicated.

Table 2: Cockroach- borne helminth parasites of public health concern

S. N	Author (s)	Date of Publication	Location of Study	Number of Cockroaches Examined	Number of Cockroaches Infected	Isolated Parasite Taxa/species	Prevalence (%)
1	Bsala and Sule ^[17]	2012	Arkillia, Wamakko LGA, Sokoto State	218	169	<i>A. lumbricoides</i> <i>E. vermicularis</i> <i>S. mansoni</i> <i>S. haematobium</i> <i>T. trichiura</i>	82.40 15.98 9.48 2.95 2.36
2	Etim <i>et al.</i> ^[18]	2013	Anantigha, Calabar, Cross River State, Nigeria	322	187	Hookworm <i>E. vermicularis</i> <i>T. trichiura</i> <i>Ascaris lumbricoides</i>	9.60 12.90 16.90 27.40
3	Alzain ^[19]	2013	North Gaza Governorate Palestine	200	47	Hookworm <i>E. vermicularis</i> <i>A. lumbricoides</i>	4.30 12.10 36.20
4	Ojianwuna ^[21]	2014	Abraka, Delta State, Nigeria	841	841	<i>A. lumbricoides</i> <i>Strongyloides stercoralis</i> <i>Nyctothermus ovalis</i> <i>E. vermicularis</i> Hookworm	33.60 22.40 11.30 6.10 1.90
5	Iboh <i>et al.</i> ^[20]	2014	Yakurr, Cross River State, Nigeria	352	331	<i>Ascaris lumbricoides</i> <i>T. trichiura</i> <i>Enterobius vermicularis</i> <i>Ancylostoma duodenale</i> <i>Strongyloides stercoralis</i>	17.65 12.94 5.88 9.41 15.98
6	Iboh <i>et al.</i> ^[22]	2015	Calabar Municipality, Cross River State, Nigeria	430	NI	<i>A. duodenale</i> larvae <i>A. lumbricoides</i> <i>E. vermicularis</i> larvae <i>E. vermicularis</i> ova <i>Strongyloides stercoralis</i> larvae <i>S. stercoralis</i> ova	23.00 16.00 10.00 8.00 11.00 10.0
7	Oyeyemi <i>et al.</i> ^[23]	2015	Ilishan Remo Town, Ogun State, Nigeria	130	NI	<i>A. lumbricoides</i> <i>E. vermicularis</i> Hookworm <i>T. trichiura</i> <i>Taeniaspp</i>	52.30 15.40 63.10 20.80 40.80
8	Tatang <i>et al.</i> ^[24]	2017	Melong Sub-division Muongo Division Littoral Region, Cameroon	844	NI	<i>Ascaris spp</i> <i>Trichuris spp</i> <i>Capillaria spp</i> <i>Toxocara spp</i> Hookworm	33.76 11.97 6.16 4.86 4.86
9	Adenusi <i>et al.</i> ^[4]	2018	Somolu LGA, Lagos State	749	722	<i>A. lumbricoides</i> <i>T. trichiura</i> Hookworm <i>S. stercoralis</i> <i>Taeniaspp</i> <i>E. vermicularis</i> <i>H. nana</i>	61.30 55.80 11.60 11.70 10.50 17.20 11.60
10	Haile <i>et al.</i> ^[25]	2018	Wolkite Tow Southern Ethiopia	209	157	<i>A. lumbricoides</i> Hookworm <i>H. nana</i> <i>Taeniaspp</i> <i>E. vermicularis</i> <i>S. stercoralis</i> <i>T. trichiura</i>	9.60 18.20 7.70 29.70 3.80 12.40 1.40

Key: NI means not indicated

4. Prevention and Control of Cockroach Infestations

The prevention and control of cockroach infestations can be a great challenge to public health entomologists as the insects possess diverse structural and behavioural features that enable them to survive and thrive in their habitats.

However, the obstacles surrounding the control of cockroaches can be surmounted through good knowledge of the insects' biology and behaviour, maintenance of good sanitation and proper house-keeping and by the proper use of commercially available insecticides. Brener ^[10] and

Chartered Institute of Environmental Health ^[2] had also suggested the underlisted methods for prevention and control of cockroach infestations:

- Application of residual insecticides to harbourage sites. Such insecticides include organophosphates, carbamates and botanicals such as pyrethrins and pyrethroids.
- Use of baits with active insecticide ingredients
- Use of insect growth regulators (IGRs) which can be juvenile hormone analogues and/or chitin synthesis inhibitors.

- (d) Improvement in building architecture to maximally reduce cracks and crevices.
- (e) Improvement on sanitation and hygiene
- (f) Use of integrated pest management which comprises various control techniques that involve non-toxic agents. IPM is regarded as the most effective control method as no single product and/or application method is recommended.

5. Conclusion

Considering the enormous health challenges posed by cockroach-borne human parasitic infections, it is wise to positively change the public health orientation of people as it concerns the management of cockroach infestations, so as to adequately address the issue. Prevention of home infestation by cockroaches through personal hygiene, adequate housekeeping, environmental cleanliness, source reduction and application of IPM in situations where infestation has already occurred are strongly recommended strategies.

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