

**VECTORIAL POTENTIAL OF COCKROACH IN FEMALE HOSTEL, USMANU
DANFODIYO UNIVERSITY, SOKOTO**

BY

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CERTIFICATION

This is to certify that this project titled ‘Vectorial Potential of cockroaches in female hostel Usmanu Danfodiyo University Sokoto main campus’ by FOLORUNSHO HAWAWU OPEYEMI (2010302094) has been read and approved by the undersigned as meeting their requirement for the award of bachelor of science (Bsc.Hons) Degree in Biology in the Department of Biology, Usmanu Danfodiyo University, Sokoto.

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DEDICATION

This project research is dedicated to my Grandparents (Late Mr Yunusa Busari, Late Mrs Khadijah Busari and Late pa. Folorunsho). May Almighty Allah light up their graves and grant them Aljannah Fridaus (Amin) and Mrs Folorunsho whose prayer and support has been my anchor throughout this journey.

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ABSTRACT

Cockroaches are widely recognized as significant mechanical vectors of intestinal parasites due to their ability to thrive in unsanitary environments and frequent contact with human habitats. This study investigated the vectorial potential of cockroaches collected from female hostels at Usmanu Danfodiyo University, Sokoto. A total of 35 cockroaches were sampled from three hostels, FBI, IA, and Zamfara and examined for parasitic organisms on both their external surfaces and internal gut contents. Standard parasitological procedures, including washing, centrifugation, dissection, and microscopic identification, were employed. The findings revealed that 22 (62.9%) cockroaches carried parasites on their external body surfaces, while 14 (40.0%) harbored parasites internally. Eight medically important parasite species were identified across both sites: *Strongyloides stercoralis*, *Trichuris trichiura*, *Hookworm*, *Entamoeba histolytica*, *Toxocaria spp*, *Capillaria hepatica*, *Enterobius vermicularis*, and *Balantidium coli*. The most frequently detected parasites externally were *Balantidium coli* and *Strongyloides stercoralis* (27.3% each), while *Entamoeba histolytica*, *Hookworm*, and *Strongyloides stercoralis* (21.4% each) were most common internally. The higher prevalence on the external surfaces indicates that cockroaches primarily function as mechanical carriers of parasite stages within the hostel environment. Overall, the study demonstrates a substantial risk of faeco-oral transmission of intestinal parasites among hostel residents due to cockroach infestation. These findings highlight the need for improved sanitation, regular fumigation, and enhanced awareness among students to reduce the public health risks associated with cockroach-borne parasitic infections.

CHAPTER ONE

1.0 Introduction

Cockroaches belong to the order Blattodea and are among the most resilient and adaptive insects on Earth. This group includes approximately 4600 species, with about 30 species considered pests (Schmidt,2009). They have been around for more than 300 million years, showcasing an extensive evolutionary history (Roth & Willis,1952). Cockroaches possess a distinctive body plan that includes a flat, oval shaped body, long antennae, and a tough exoskeleton. Adults typically measures between 1 to 4 inches in length. They have three main body segments: the head, thorax, and the abdomen. Their long antennae serve as sensory organs, helping them navigate and detect food, while their compound eyes provide them with a wide field of visions. Most species have wings, but not all are capable fliers. Their coloration ranges from light brown to black, often to help them blend into their surroundings (Weaver ,2015).

Cockroaches are found in a variety of habitats but prefer warm, moist environments, they are nocturnal creatures, typically hiding during the day and becoming active at night in search of food and water. They are omnivores, there diet include decayed organic matter, plant material, and various human foods. Some species are notorious for scavenging in kitchens and other human environments, leading to their reputation as pest (Moore & Miller,2018).Reproduction in cockroaches involve the females laying eggs cases, known as oothecae, which can contain numerous eggs .Depending on the species , female cockroaches can produce multiple oothecae in their lifetime , contributing to rapid population growth(Boo *et al.*,2017).Cockroaches play an essential role in ecosystem as

decomposers ,breaking down organic matter and returning nutrient back into the soil. Their presence indicates a healthy ecosystem, though they can also become a nuisance in urban environments when their population become too large (Hoofman, 2014).

Cockroaches possess a unique respiratory system, which utilizes spiracles, a small opening on the sides of their bodies to take in oxygen directly through their exoskeleton, allowing them to thrive in environments with low oxygens levels. Cockroaches communicate with each other through pheromones and can exhibit socials behavior, such as living in groups, which can help them find food more efficiently and provide some defense against predators.

Cockroaches can harbor a variety of pathogens, including bacteria like *Salmonella* and *Escherichia coli*, Viruses and parasites. They can mechanically transmit these pathogens through their body surfaces or feces, contaminating food, utensils and surfaces. Cockroaches' droppings, saliva and body parts can act as allergens they are commonly associated with allergic reactions and asthma, particularly in urban environments. Their adaptability and resilience allow them to thrive in various environments, particularly in urban environments. They are commonly found in places with abundant foods sources, such as kitchens and wastes areas, increasing the likelihood of pathogen transmission.

Cockroaches infestation are often indicative of poor sanitation and can lead to public health concerns. Their presence can worsen the quality of life and is often associated with lower socioeconomic conditions. Cockroaches can breed rapidly in damp and warm environment, leading to larger populations that increase the risk of diseases transmission.

While many people are fascinated by cockroaches, they are often viewed as pest due to their association with unhygienic conditions and the potential to spread disease. They can contaminate food and surfaces with their feces and secretion. Cockroaches are remarkable creature that have adapted to survive in diverse environments. While they are often un welcome in human spaces, understanding their biology and behavior can help mitigate their impact and highlight role in ecosystem

1.1 Justification of Study

The female hostel environment at Usmanu Danfodiyo University Sokoto (UDUS) shelters a considerable number of students living in close proximity under shared conditions. Such environments, while fostering academic and social development, are also vulnerable to pest infestations, particularly by cockroaches which are widely known for their resilience and association with unsanitary conditions. Cockroaches have long been implicated as vectors of pathogenic microorganisms, including bacteria such as *Salmonella spp.*, *Escherichia coli*, fungi, helminths, and viruses. Their presence in living spaces, especially those where food is consumed and stored, poses a significant threat to human health. In UDUS female hostel, where hygiene practices may be limited by infrastructural and behavioural factors, the possibility of cockroaches serving as mechanical carriers of disease-causing agents becomes a critical public health concern. Conducting this study will not only provide scientific evidence on the health risks posed by cockroaches in the hostel but will also highlight the need for targeted interventions. By establishing the pathogenic profile of cockroaches in the female hostel, the study can

guide university management in prioritizing effective pest control measures, improving sanitation facilities, and implementing health education strategies tailored to the needs of the student population. Furthermore, the findings have valuable implications for the broader field of environmental health and epidemiology, particularly within institutional settings in sub-Saharan Africa, where such data are scarce and urgently needed. Therefore, this study is justified as a necessary step toward safeguarding student welfare, enhancing hostel hygiene standards, and contributing to the limited body of research on arthropod-borne disease risks in Nigerian university environments.

1.2 Statement of the Research Problem

Cockroaches are pervasive household pests that pose significant public health risks due to their capacity to act as mechanical vectors for several pathogenic microorganisms. They harbor diverse bacteria, fungi, viruses, and parasitic cysts on their bodies and in their digestive tracts, which can be transmitted to humans through food contamination, contact with surfaces, and other indirect means. In residential environments where hygiene standards are compromised or pest control measures are inadequate, the incidence of cockroach infestation and its associated health threats tend to be particularly high.

At Usmanu Danfodiyo University Sokoto, the female hostel complex presents a unique setting where these risks may be elevated. Reports from students and casual observation indicate a prevailing issue of cockroach presence within the hostel premises including sleeping areas, kitchens, bathrooms, and waste disposal sites. The environmental conditions that support these infestations may include overcrowding, irregular waste

disposal, inadequate building maintenance, and poor food storage practices, all of which are typical challenges in many universities hostel environments in Nigeria.

Despite the visible presence of cockroaches and the likelihood of associated health hazards, there is a lack of empirical data evaluating the extent to which these insects serve as vectors of pathogenic organisms within the UDUS female hostel. The absence of such data prevents a comprehensive understanding of the potential risks posed to hostel occupants. Consequently, proactive measures to curb the spread of infections associated with cockroach activity remain minimal or ineffective. This gap in knowledge creates a pressing need for a detailed investigation into the vectorial potential of cockroaches in this specific setting. Without such research, efforts to promote health and safety within the hostel particularly for vulnerable populations such as young female students will continue to be undermined by a lack of scientific evidence and targeted intervention strategies.

This situation underscores the urgency of conducting a structured, scientific study aimed at isolating and identifying the microorganisms carried by cockroaches in the UDUS female hostel. The outcomes will not only aid in assessing the true extent of health risks but will also support informed decision-making regarding pest control, environmental sanitation, and health education among hostel residents.

1.3 Aim and Objectives

AIM

The aim of this research is to determine the vectorial potential of cockroaches in the female hostel, UDUS.

OBJECTIVES

- i. To identify the cockroach species in the female hostel, UDUS
- ii. To study the vectorial potential of cockroaches in female hostel, Udu.
- iii. To create awareness on how cockroaches contribute to the spread of certain disease and microorganism.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

Cockroaches (Order: *Blattodea*) are ubiquitous pests with significant vectorial potential, acting as mechanical and biological carriers of pathogens that threaten public health (Rivault *et al.*, 1993; Fotedar *et al.*, 1991). Their synanthropic behaviour, proximity to human habitats enhances their role in disease transmission.

2.1 Taxonomy Classification of Cockroaches

Cockroaches belong to kingdom Animalia, which includes all multicellular and heterotrophic organisms. They fall under the Phylum Arthropoda, characterized by organisms with segmented bodies, exoskeletons, and jointed appendages. Within this phylum, cockroaches are classified under the Class Insecta, meaning they possess three distinct body regions (head, thorax, abdomen) and six legs.

Cockroaches are specifically placed in the Order Blattodea, a term that now includes both traditional cockroaches and termites. Historically, cockroaches were classified under the order *Blattaria*, but advancements in molecular phylogenetics have led to the inclusion of termites within Blattodea, showing a close evolutionary relationship (Evangelista *et al.*, 2019).

Within Blattodea, cockroaches are further divided into several families, including Blattidae, Blattellidae, Blaberidae, Corydiidae, and Cryptocercidae. For example, the Blattidae family contains large cockroach species such as *Periplaneta americana*

(American cockroach), while Blattellidae includes smaller species like *Blattella germanica* (German cockroach). The family Cryptocercidae, which includes wood cockroaches, is of particular evolutionary significance due to its close genetic relationship with termites, indicating that termites evolved from wood-feeding cockroaches (Lo *et al.*, 2000).

The order Blattodea contains over 4,600 species, with only around 30 species commonly found in human habitations, and fewer than 10 considered major pests. Cockroaches are ancient insects, with fossil records indicating they have existed for over 300 million years, making them one of the most enduring insect groups in history (Grimaldi & Engel, 2005).

2.1.1 German Cockroaches (*Blattella germanica*)

German cockroaches are small (10–15 mm), light brown insects with two dark stripes on their pronotum (Alpert *et al.*, 2020). They are among the most common indoor pests globally, thriving in warm, humid environments like kitchens and bathrooms (Bell & Adiyodi, 2021). They infest human dwellings, particularly areas with food, water, and shelter (e.g., behind appliances, cracks, and drains) (Rust *et al.*, 2020), they are primarily active at night, hiding during daylight (Wang *et al.*, 2021). A single female can produce 30–40 offspring per egg case (ootheca), with 4–6 generations annually (Schal & Hamilton, 2020). Adults live 100–200 days, contributing to rapid infestations (Lee *et al.*, 2022). German cockroaches spread pathogens like *Salmonella* and *E. coli*, contaminating food and surfaces (Ash & Greenberg, 2021), their shed skins and faeces trigger asthma and allergies (Gore & Schal, 2023).

2.1.2 American Cockroach (*Periplaneta americana*)

American cockroaches (*Periplaneta americana*) is one of the largest common cockroach species, measuring 35–53 mm in length (Bell & Adiyodi, 2021). It is reddish-brown with a yellowish margin on the pronotum and long, spiny legs (Alpert *et al.*, 2020). Despite its name, it likely originated from Africa and spread globally via trade routes (Rust *et al.*, 2022). They thrive in warm, damp areas such as sewers, basements, kitchens, and bathrooms (Wang *et al.*, 2021). American cockroaches are common in tropical and subtropical regions, including Nigeria, where they infest homes and commercial buildings (Schal & Hamilton, 2020). They are Nocturnal insects, hiding in dark crevices during the day (Lee *et al.*, 2022). Adults can fly short distances, especially in warm conditions (Gore & Schal, 2023). Females produce 10–16 egg cases in their lifetime, each containing 14– 6 eggs (Brenner *et al.*, 2020), Nymphs undergo 6–14 moults before reaching adulthood, taking 6–12 months depending on conditions (Choe & Park, 2021). Adults live 1–2 years, contributing to persistent infestations. They carry pathogens like *Salmonella*, *E. coli*, and parasitic worms, contaminating food and surfaces (Alpert *et al.*, 2020). The shed skins and faeces trigger asthma and allergic reactions (Bell & Adiyodi, 2021).

2.2 Introduction to Vectorial Potential

Cockroaches (order Blattodea) are ubiquitous pests that thrive in human habitats, serving as vectors for numerous parasites that pose significant health risks. These insects

are intermediate hosts or mechanical carriers of protozoans, helminths, and other pathogens, facilitating their transmission to humans and animals (Bell *et al.*, 2007).

2.2.1 Cockroach as a Mechanical Vector

Cockroaches do not serve as biological hosts for most parasites (where the parasite develops or multiplies inside the vector), but they act as mechanical vectors. This means they passively carry and transfer parasites through contamination. Their legs, body surface, gut, and faeces often harbour parasitic organisms, which are then introduced into the human environment through physical contact or defecation (Salehzadeh *et al.*, 2007).

2.2.2 Mechanisms of Parasite Transmission

• External Body Contamination

Cockroaches crawl through decaying organic matter, faeces, toilets, and drains, where they come in contact with parasite eggs, cysts, or larvae. These infectious stages stick to their legs, wings, and antennae. When the cockroach moves into food preparation areas or open food containers, the parasites are mechanically transferred to food, dishes, and surfaces (Fakoorziba *et al.*, 2010).

• Faecal Dropping Contamination

Cockroaches excrete faeces that may contain viable eggs or cysts of parasites such as *Entamoeba histolytica*, or *Ascaris lumbricoides*. These faeces, deposited on food or surfaces, become a source of infection if ingested by humans. This faecal-oral route is a major mechanism of parasite transmission (Pai *et al.*, 2005).

• Regurgitation and Vomiting

While feeding, cockroaches sometimes regurgitate or vomit digestive fluids, which can contain parasite forms ingested from contaminated materials. If this occurs near or on food, there is a risk of parasite contamination and subsequent transmission.

- **Internal Carriage and Gut Passage**

Although cockroaches are not true biological hosts, some parasites can survive passage through their digestive tract. The parasites are not digested but excreted in faeces, often remaining infectious. This is especially true for intestinal helminth eggs like those of *Trichuris trichiura* and *Taenia spp.* (Mpuchane *et al.*, 2006).

2.2.3 Parasites Associated with Cockroaches

- **Protozoan Parasites**

Cockroaches mechanically transmit protozoan parasites like *Entamoeba histolytica* and *Giardia lamblia* via their exoskeletons and faeces. Studies have isolated cysts of *E. histolytica* from cockroach guts in urban slums, highlighting their role in spreading amoebic dysentery (Graczyk *et al.*, 2005). Similarly, *Cryptosporidium parvum* oocysts adhere to cockroach cuticles, potentially contaminating food surfaces (Clavel *et al.*, 2002).

- **Helminth Parasites**

Cockroaches serve as intermediate hosts for helminths such as *Moniliformis moniliformis* (spiny-headed worm) and *Hymenolepis diminuta* (rat tapeworm). *M. moniliformis* larvae develop in cockroaches before infecting definitive hosts (e.g., rodents), while *H. diminuta* eggs ingested by cockroach hatch into cysticercoids, which can accidentally infect humans (Acha & Szyfres, 2003). Poor sanitation exacerbates these zoonotic risks.

- **Bacterial and Viral Carriage**

Though not parasites, cockroaches amplify parasitic disease risks by harbouring bacteria (e.g., *Salmonella*) and viruses that compromise immunity, increasing susceptibility to parasitic co-infections (Fotedar *et al.*, 1991).

2.3 Control Measures

Cockroaches (*Blattella germanica*, *Periplaneta americana*, and *Blatta orientalis*) are major urban pests in Nigeria, posing significant public health risks by contaminating food, triggering asthma, and spreading pathogens like *Salmonella* and *E. coli* (WHO, 2020). Effective control requires an Integrated Pest Management (IPM) approach combining sanitation, exclusion, chemical, and biological methods.

2.3.1 Preventive and Sanitation Measures

- Eliminate food sources: Store food in sealed containers, clean spills immediately, and avoid leaving pet food exposed (CDC, 2021).
- Reduce moisture: Fix leaking pipes, use dehumidifiers, and ensure proper drainage (FMEnv Nigeria, 2022).
- Waste management: Use covered trash bins and dispose of garbage regularly (Adeleke *et al.*, 2023).

- Exclusion: Seal cracks, gaps around pipes, and install door sweeps to prevent entry (NPMA, 2019).

2.3.2 Chemical Control Methods

When infestations occur, targeted chemical treatments are necessary:

- Insecticide sprays (pyrethroids, organophosphates): Apply in cracks, crevices, and harbourage areas (EPA, 2022).
- Gel baits (fipronil, hydramethylnon): Highly effective for German cockroaches; placed near nesting sites (University of Ibadan, 2021).
- Boric acid powder: A low-toxicity option that dehydrates and kills cockroaches (Nigerian Journal of Pest Control, 2023).
- Insect Growth Regulators (IGRs): Disrupt moulting and reproduction (e.g., hydroprene) (WHO, 2020). Overuse of chemicals can lead to pesticide resistance rotate modes of action (IRAC, 2021)

2.3.3 Non-Chemical and Biological Control

- Traps: Sticky traps help monitor and reduce populations (NPMA, 2019).
- Natural predators: Parasitic wasps (*Aprostocetus hagenowii*) and entomopathogenic fungi (*Beauveria bassiana*) can suppress cockroach numbers (FAO, 2018).

2.3.4 Community and Government Interventions in Nigeria

- Public health campaigns: Lagos and Kano states have implemented "Clean City Initiatives" to improve sanitation (LASEPA, 2024).
- Market sanitation enforcement: Food vendors must use sealed storage to reduce contamination (Adeleke & Oresanya, 2022).
- Low-cost IPM for households: DIY neem oil sprays and boric acid baits are cost-effective (University of Nigeria, Nsukka, 2023).

A combination of sanitation, chemical control, and community education is essential for sustainable cockroach management in Nigeria. Government policies should emphasize IPM adoption, while households should prioritize preventive measures.

In Nigeria's tropical climate, reducing moisture and clutter is as crucial as using insecticides. Regularly inspect kitchens and bathrooms for early signs of infestation.

2.4 The Epidemiology of Cockroaches

Cockroaches are among the most resilient and pervasive urban pests, posing significant public health risks due to their role in disease transmission, allergen production, and environmental contamination. Their epidemiology encompasses their distribution, disease-carrying potential, allergenic effects, and the factors that contribute to their proliferation. Understanding these aspects is crucial for developing effective control strategies and mitigating their impact on human health.

Cockroaches thrive in warm, humid environments, particularly in urban areas with poor sanitation. The most common species include the German cockroach (*Blattella germanica*), which is prevalent in households and food-handling facilities (Bell *et al.*,

2007); the American cockroach (*Periplaneta americana*), often found in sewers and drains (Rust *et al.*, 2008); and the Oriental cockroach (*Blatta orientalis*), which prefers damp, cooler areas like basements (WHO, 2020). Their adaptability allows them to colonize diverse environments, making them a persistent problem in both developed and developing regions.

One of the most concerning aspects of cockroach epidemiology is their ability to transmit pathogens mechanically. They contaminate food and surfaces by carrying bacteria such as *Salmonella spp.*, *E. coli*, and *Shigella* (Ash & Greenberg, 1980), as well as parasitic worm eggs like those of *Ascaris lumbricoides* and *Enterobius vermicularis* (Graczyk *et al.*, 2005). Additionally, they can harbor enteric viruses, including poliovirus (Kopanic *et al.*, 1994), increasing the risk of food-borne and waterborne diseases. Their nocturnal foraging habits and tendency to inhabit unsanitary locations make them efficient vectors for these pathogens.

Beyond disease transmission, cockroaches are a major source of allergens that contribute to respiratory conditions such as asthma and allergic rhinitis. Proteins like Bla g 1 and Bla g 2, found in their saliva, faeces, and shed skin, are potent triggers for allergic reactions, particularly in children (Arruda *et al.*, 2001). Several factors influence cockroach infestations, including poor sanitation, climate change, and insecticide resistance. Accumulated garbage and food waste provide ideal breeding grounds (Schal & Hamilton, 1990), while rising global temperatures expand their habitats (Booth & Kiddell, 2007).

To combat cockroach-related health risks, integrated pest management (IPM) approaches are recommended. These combine sanitation, mechanical traps, and targeted insecticide use (WHO, 2020).

Cockroaches represent a significant epidemiological concern due to their widespread distribution, role in disease transmission, and allergenic effects. Addressing this issue requires a multifaceted approach, including improved sanitation, pest control innovations, and public awareness campaigns. By understanding the factors that contribute to their persistence, we can develop more effective strategies to minimize their impact on human health.

2.5 Medical Importance of Cockroaches

Cockroaches are among the most medically significant pests due to their role in disease transmission, allergen production, and antibiotic resistance. Their ability to thrive in unsanitary environments makes them a major public health concern, particularly in urban areas with poor sanitation. Understanding their medical impact is crucial for developing effective control strategies and minimizing health risks.

One of the primary concerns with cockroaches is their ability to mechanically transmit pathogens. They crawl through sewage, garbage, and decaying matter, picking up harmful microorganisms on their bodies and legs. Studies have shown that cockroaches carry bacteria such as *Salmonella spp.*, *Escherichia coli*, and *Shigella dysenteries**, which can cause food poisoning, diarrhoea, and dysentery (Ash & Greenberg, 1980). Additionally, they harbor parasitic worms like *Enterobius vermicularis*, contributing

to intestinal infections (Graczyk *et al.*, 2005). Their presence in hospitals is particularly alarming, as they can spread antibiotic-resistant bacteria, including methicillin-resistant *Staphylococcus aureus* (MRSA) (Fotedar *et al.*, 1991).

Beyond bacterial and parasitic infections, cockroaches are a leading cause of allergic reactions and asthma. Their saliva, faeces, and shed skin contain allergenic proteins such as Bla g 1 and Bla g 2, which trigger respiratory conditions (Arruda *et al.*, 2001). Children living in cockroach-infested homes are at higher risk of developing chronic asthma and allergic rhinitis (Eggleston *et al.*, 1998).

Another emerging concern is the role of cockroaches in antibiotic resistance. Research has found that cockroaches can carry drug-resistant bacteria, including strains resistant to penicillin, cephalosporins, and carbapenems (Pai *et al.*, 2005). This poses a serious threat in healthcare settings, where cockroaches may contribute to the spread of hospital-acquired infections (HAIs). Their ability to survive in harsh conditions and adapt to insecticides further complicates efforts to control their populations (Gondhalekar & Scharf, 2012).

To mitigate these health risks, integrated pest management (IPM) strategies are essential. These include improved sanitation, sealing entry points, using bait traps, and targeted insecticide application (WHO, 2020). Public health campaigns also emphasize community education to reduce infestations through proper waste disposal and hygiene practices (Brenner *et al.*, 2003).

Cockroaches pose significant medical threats due to their role in disease transmission, allergen exposure, and antibiotic resistance. Their impact is particularly severe in urban,

low-income, and healthcare environments, making them a priority for public health interventions. Addressing this issue requires a combination of pest control, sanitation improvements, and public awareness to reduce their burden on human health.

CHAPTER THREE

3.0

METHODOLOGY

3.1 Study Area

This study was conducted at Usmanu Danfodiyo University, Sokoto (UDUS), Main Campus, located in Sokoto State, Northwestern Nigeria. The university lies approximately between latitude 13°03'N and longitude 5°14'E, within the Sudan savanna ecological zone. Sokoto has a semi-arid climate, characterized by long dry seasons (October to May) and short wet seasons (June to September), with annual rainfall averaging 500–750 mm and mean daily temperatures ranging from 19°C to 40°C (NIMET, 2020). These climatic conditions, combined with human activities, provide a favourable environment for cockroach survival and reproduction. The main campus of the university covers a vast area consisting of academic buildings, administrative offices, staff quarters, and student hostels. The female hostels are situated in designated residential zones and serve as accommodation for both undergraduate and postgraduate students. For the purpose of this study, three hostels were surveyed: Fatima Balarabe Hostel (FBI), IA Hostel, and Zamfara Hostel.

Each hostel consists of multiple blocks with facilities such as toilets, kitchens, bathrooms, common rooms, and basements, which are potential breeding and hiding sites for cockroaches. The high student population density in these hostels increases food residues, waste accumulation, and moisture sources, thereby supporting cockroach infestation.

3.2 Sample Collection

Cockroaches were collected manually from the female hostels of Usmanu Danfodiyo University, Sokoto, using sterile gloves and forceps to prevent external contamination. Each captured cockroach was immediately placed in a separate sterile container to avoid cross-contamination among specimens. The samples were then carefully transported to the Parasitology Laboratory of the Department of Biological Sciences, Usmanu Danfodiyo University Sokoto, for further parasitological analysis

3.3 Sample Identification

The samples are reddish brown in color with pale brown band around the edge of the pronotum. Both sexes have fully developed wing that extend slightly beyond the abdomen and long, slender antennae (Rust *et al* ,1991, Schal & Hamilton). Cockroaches collected in the study area were identity morphologically to be German cockroaches and American cockroaches based on certain feature such as shape, color and size of the cockroaches (Rust *et al*, 1991, Schal & Hamilton 1990).

3.4 Materials and Equipment Used

Materials

1. **Hand Gloves:** Used to protect the handler from contamination and maintain hygiene during the collection and handling of cockroach specimens.
2. **Glass Slides:** Serve as the base surface for mounting sample sediments, parasite eggs, cysts, or tissue fragments for microscopic examination.

3. **Cover Slips:** Placed over samples on glass slides to protect the specimen and allow even distribution for clear microscopic viewing.
4. **Normal Saline or Distilled Water:** Used for washing specimens or mixing with internal tissues during dissection to prepare solutions for centrifugation and parasite isolation.
5. **Staining Reagents (e.g., iodine):** Enhance visibility and identification of parasites by staining cysts, eggs, and other microscopic organisms on slides.
6. **Ethanol or Formalin:** Employed as surface sterilizing agents for cockroach specimens or as preservatives to maintain sample integrity for transport and processing.
7. **Tissue Paper or Blotting Paper:** Utilized to clean spills, absorb excess liquid from samples, and maintain a clean working area during the experiment.

Equipment

1. **Microscope (Compound or Stereo):** Essential for observing and identifying parasites such as helminth eggs, protozoan cysts, and larvae isolated from cockroach samples.
2. **Dissecting Tray:** Provides a stable surface for securing cockroaches during dissection to extract internal organs like the gut.
3. **Dissecting Kit (Scalpel, Scissors):** Used to cut open and remove organs or tissues from the cockroach body for parasite analysis.
4. **Forceps:** Assist in handling the specimens during collection and dissection without introducing contamination.

5. **Petri Dishes:** Used to temporarily hold dissected tissues or specimens during processing and examination.
6. **Dropper or Pipette:** Used to transfer small volumes of solutions, stains, or sediments onto slides for microscopic study.
7. **Sample Containers:** Sterile containers used to store individual cockroach specimens during collection and transportation to the laboratory.
8. **Camera or Phone:** Used to capture images of significant findings, experimental setups, or microscopic observations for documentation purposes.

3.5 Isolation and Identification of Parasites from the External Body of Cockroaches

In the laboratory, the external surfaces of the cockroaches are washed using sterile normal saline or phosphate-buffered saline. Each cockroach is placed individually into a sterile container with the solution and shake gently to remove any parasites, eggs, or cysts that may be attached to the exoskeleton (Elgderi *et al.*, 2006). The wash solution is then subjected to centrifugation, typically at 3000 revolutions per minute (rpm) for about 10 minutes. The sediment obtained after centrifugation is collected for microscopic analysis. The sediment is examined under a light microscope at various magnifications to identify the presence of parasitic forms such as helminth eggs, protozoan cysts, and larvae. Parasites are identified based on their morphology, size, and shape using standard parasitological keys. Common parasites isolated from cockroaches include, *Trichuris trichiura* and protozoans such as *Entamoeba histolytica* (Bala & Sule, 2012; Pai *et al.*, 2003)

3.6 Isolation and Identification of Parasite from Internal Body of Cockroaches

Cockroaches collected from various parts of the female hostel were first immobilized by chilling or lightly anesthetizing them using ethyl acetate or exposure to cold. Each cockroach was then surface-sterilized by rinsing with 70% ethanol and followed by sterile distilled water to eliminate external contaminants. Using sterile dissection tools, the cockroach's abdomen was opened dorsally, and the alimentary canal (gut) was carefully removed. The gut was placed into a sterile petri dish containing physiological saline solution (0.85% NaCl).

The gut was gently crushed and homogenized in the saline solution to release its contents. The homogenate was filtered through fine gauze to remove large debris and then transferred into centrifuge tubes. The mixture was centrifuged at 3000 rpm for 10 minutes, and the sediment was retained for microscopic examination.

A drop of the sediment was mounted on a clean glass slide, stained, when necessary (e.g., with Lugol's iodine), and examined under light microscopy at 10× and 40× magnifications. Parasites were identified based on their morphological features, such as: Shape and size, presence of nuclei (for protozoa), shell thickness and operculum (for helminths) internal structures (e.g., hooklets, polar filaments). Common Parasites Isolated from Cockroach Guts include, *Strongyloides stercoralis*, *Trichuris trichiura* (Lemon-shaped whipworm eggs with bipolar plugs) and *Entamoeba histolytica*.

These parasites are capable of surviving transit through the cockroach digestive tract and are excreted in faeces, contaminating food, surfaces, and utensils within the hostel environment (Salehzadeh *et al.*, 2007; Fakoorziba *et al.*, 2010).

3.7 Data Analysis

Data on the types and frequency of parasites detected in the internal and external body of cockroach was recorded and the result was presented using descriptive statistics such as table, frequency counts and percentage of frequency. % of frequency is calculated using:

$$\frac{\text{frequency detected}}{\text{Total number of frequency}} \times 100$$

CHAPTER FOUR

RESULTS

4.1 Introduction

This chapter presents the results obtained from the parasitological examination of cockroaches collected from female hostels in Usmanu Danfodiyo University, Sokoto. The analysis focused on identifying intestinal parasite stages (eggs, cysts, and larvae) present on the external body surfaces and within the gut contents of the cockroaches. The findings reveal the vectorial potential of cockroaches as mechanical transmitters of parasitic organisms of medical importance within the study area.

4.2 Prevalence of Parasitic Organisms in Cockroaches

A total of 35 cockroach samples were collected from female hostels and examined microscopically for parasitic organisms. In the external body of cockroaches, 22 (62.9%) were found to harbor at least one parasite, while 13 (37.1%) were negative for any parasitic stage (Table 4.1) While in the internal body of cockroaches, 14 (40.0%) was found to be positive while 21(60.0%) was found to be negative for any parasitic stage (Table 4.2).

Table 4.1: Prevalence of Parasitic Organisms in the External Body of Cockroaches Collected from Female Hostels, UDUS

Hostel Location	No. collected	No. Positive	% Positive
Zamfara hostel	10	7	70
IA Hostel	12	7	77
FBI Hostel	13	8	76
Total	35	22	62.9

The overall prevalence of 62.9% indicates that a majority of the cockroaches examined carried at least one intestinal parasite on the external body, suggesting that cockroaches play a significant role in the mechanical transmission of intestinal parasites in the hostel environment.

Table 4.2: Prevalence of Parasitic Organisms in the Internal Body of Cockroaches Collected from Female Hostels, UDUS

Hostel Location	N0. collected	No. Positive	%Positive
Zamfara Hostel	10	5	50
IA Hostel	12	4	33.3
FBI Hostel	13	5	38.5
Total	35	14	40.0

The overall prevalence of 40.0% indicates that a majority of the cockroaches examined carried at least one parasite on the internal body.

4.3 Types of Parasites Identified

Microscopic examination of the external and internal body parts of the cockroaches revealed different types of parasites of medical importance, the common parasites found are: *Strongyloides stercoralis*, *Trichuris trichiura*, *Hookworm*, *Entamoeba histolytica*, *Toxocaria spp*, *Capillaria hepatica*, *Balantidium coli*, *Enterobious vermicularis*. The frequency and percentage distribution of these parasites are presented below (Table 4.3).

Table 4.3: Types and Frequency of Parasites Detected in the External and Internal Body of Cockroaches

Species of Parasites	Frequency Detected (External)	Percentage (%)	Frequency Detected (Internal)	Percentage%)
<i>Strongyloides stercoralis</i>	6	27.3	3	21.4
<i>Trichuris trichiura</i>	2	9.1	0	0
<i>Entamoeba histolytica</i>	2	9.1	3	21.4
<i>Hookworm</i>	1	4.5	3	21.4
<i>Toxocaria spp</i>	4	18.2	2	14.3
<i>Capillaria hepatica</i>	0	0	1	7.1
<i>Enterobious vermicularis</i>	1	4.6	0	0
<i>Balantidium coli</i>	6	27.3	2	14.3
Total	22	100	14	100

The results show that *Strongyloides stercoralis* and *Balantidium coli* was the most frequently detected parasite (27.3) followed by *Toxocaria spp* (18.2) in the external body of cockroaches while *Entamoeba histolytica*, *Strongyloides stercoralis* and *Hookworm* were the most detected in the internal body of cockroaches (21.4 %) each.

4.4 Distribution of Parasites by Body Part

Parasites were identified on both the external surface and in the gut contents of the cockroaches. The distribution of parasites based on their location is shown below (Table 4.4).

Table 4.4: Distribution of Parasites According to Site of Isolation

Sites of Isolation	No. Positive	Percentage (%)
External surface	22	61.11
Gut content	14	38.88
Total	36	100

The higher detection rate on the external surface (61.11%) compared to the gut contents (38.88%) suggests that cockroaches serve mainly as mechanical carriers of intestinal parasites, picking up and transmitting infective stages from contaminated environments onto food and surfaces.

4.5 Summary of Findings

- A total of 35 cockroaches were examined, and 22 (62.9%) were found to be positive in the external body while 14(36.84) were found to be positive in the gut content for parasitic organisms.
- Eight parasite species were identified: *Strongyloides stercoralis*, *Trichuris trichiura*, *Hookworm*, *Entamoeba histolytica*, *Toxocaria spp*, *Capillaria hepatica*, *Balantidium coli* and *Enterobious vermicularis*.
- The external surface recorded a higher parasite load (61.11%) than the gut content (38.88%).
- The high prevalence indicates that cockroaches in the female hostels of UDUS serve as potential mechanical vectors for intestinal parasites of public health importance.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

The findings of this study reveal a high prevalence of intestinal parasites among cockroaches collected from female hostels at Usmanu Danfodiyo University, Sokoto. This indicates that cockroaches play a vital role as mechanical vectors of intestinal parasites in the study area. The prevalence recorded in this study is comparable to those reported in other parts of Nigeria and Africa. Nwosu *et al.* (2020) reported a prevalence of 70% among cockroaches collected from student hostels in Ilorin, while Yusuf and Ahmed (2019) recorded a prevalence of 72% in cockroaches from residential areas in Kano.

The high occurrence of *Strongyloides stercoralis* and *Hookworm* observed in this study agrees with the findings of (Ogedengbe *et al.*,2018), who also identified these helminths as the most common parasites found on cockroaches in their study area. These parasites are transmitted through the fecal–oral route and are commonly associated with poor sanitation and improper waste disposal, which may be prevalent around student hostels.

The detection of protozoan cysts such as *Entamoeba histolytica* and *Balantidium coli* further demonstrates the diversity of parasites that cockroaches can carry. The presence of these protozoa supports previous reports by (Saleh *et al.*,2021), who noted that cockroaches can harbor both helminth eggs and protozoan cysts on their body surfaces and in their digestive tracts.

The higher number of parasites on the external body surfaces compared to the gut contents suggests that cockroaches primarily act as mechanical carriers, transferring parasite stages through their legs, body surfaces, and excreta. This supports the findings of (Ugbomoiko *et al.*,2022), who reported that cockroaches are efficient mechanical vectors capable of spreading pathogens and parasites through direct contact with food and utensils.

The public health implications of these findings are significant. Female hostels, where cooking, eating, and waste disposal are often done within close proximity, provide ideal conditions for cockroach infestation and transmission of intestinal parasites. This calls for improved sanitation practices, proper waste disposal, regular fumigation, and heightened awareness among hostel occupants about the health risks associated with cockroach infestation.

5.2 Conclusion

This study revealed that cockroaches collected from female hostels at Usmanu Danfodiyo University, Sokoto, harbored medically important intestinal parasite stages on their body surfaces and in their gut contents. These findings provide strong evidence that cockroaches can serve as mechanical vectors of intestinal parasites within human environments, particularly where sanitation is inadequate.

Although only parasitological analyses were performed, the results demonstrate the need for improved hygiene, waste management, and pest control to reduce the risk of disease transmission in student residential areas. Future studies using molecular methods are recommended to further elucidate the diversity and transmission dynamics of parasites associated with cockroaches in the university environments.

5.3 Recommendations

For Hostel management

1. Regular sanitation and waste disposal should be enforced within the hostels to minimize cockroach breeding sites.
2. Routine fumigation and integrated pest management (IPM) should be implemented quarterly to reduce infestation.
3. Hostel kitchens and bathrooms should be disinfected regularly using safe chemical agents.
4. Drains, cracks, and holes should be sealed to prevent cockroach entry.

For Students

1. Practice strict personal hygiene, including frequent handwashing before eating or cooking.
2. Avoid storing leftover food in rooms overnight.
3. Dispose of food waste properly and promptly.
4. Keep food preparation areas clean and dry.

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