A STUDY ON THE POTENTIAL OF ANTS TO ACT AS VECTORS OF FOODBORNED PATHOGEN

BY

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CERTIFICATION

This is to certify that this project work was carried out by **ABODUNRIN MARIAM OPEYEMI** with Matric Number: **HND/23/SLT/FT/0856** in the Department of Science laboratory Technology (SLT), Institute of Applied Science (IAS) and has been read and approved as meeting the requirements for award of Higher National Diploma (Microbiology option) Kwara State Polytechnic Ilorin.

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DEDICATION

I dedicate this project to Almighty Allah, who has seen me through it all.

Also, to my lovely parent and to my loved ones for their love and support, am very grateful for everything.

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My first and deepest appreciation goes to Almighty Allah, the beneficent, the merciful, for guiding and protecting me always throughout my journey on campus and for the time fulfilment of His promises concerning my life.

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ABSTRACT

Ants are among the most successful and widespread insects on earth often found in domestic area. Unfortunately, they harbour disease-causing organisms and can potentially transfer these pathogens to food. This study was carried out to investigate the potential of ants to act as vectors of foodborne pathogens in food handling environments. To identify the pathogenic microorganism(s) harbored by ants, bait traps were set up using sterile sugar as a non-toxic attractant. Captured ants were then subjected to microbiological analyses. the study found that ants collected from various environments including kitchens, markets, restaurants, and waste areas harbored a wide array of bacteria and fungi, including Escherichia coli, Staphylococcus aureus, Salmonella spp., and Shigella spp. This study demonstrated that the majority of consumers acknowledged the problem of ant infestation as a sanitation-related problem rather than a food safety issue. Since ants have the ability to harbor and subsequently transfer pathogenic or toxigenic microorganisms, ants may act as disease vectors and contaminate food, water and food- contact surfaces of kitchens resulting in foodborne illnesses.

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CHAPTER ONE

1.0 INTRODUCTION

Foodborne diseases are a growing global public health concern, affecting millions annually and leading to significant morbidity, mortality, and economic loss. These illnesses are primarily caused by the consumption of food contaminated with pathogens such as bacteria, viruses, and parasites. While poor hygiene, unsafe water, and inadequate food handling practices are widely recognized as key contributors to the spread of foodborne pathogens, recent studies have begun to highlight the important role of arthropods, particularly ants, in the transmission and spread of these microorganisms.

Ants are among the most successful and widespread insects on earth. Their ability to thrive in a wide variety of environments, from homes and food processing areas to markets and agricultural fields, makes them potential

vectors for microbial contamination. Their foraging behavior, which often includes traversing unsanitary surfaces such as garbage dumps, sewage drains, and decomposing organic matter, exposes them to pathogenic microorganisms. When these ants subsequently enter kitchens, food storage areas, or come into direct contact with food items, they may facilitate the mechanical transmission of these microbes to humans.

In recent years, there has been growing interest in the role of insects in the ecology of foodborne pathogens. While flies and cockroaches have been extensively studied as mechanical vectors, the role of ants remains under-investigated, especially in developing countries where poor sanitation conditions prevail and pest management systems are weak or absent. Studies conducted in parts of Africa, Asia, and Latin America have identified the presence of pathogens such as Escherichia coli, Staphylococcus aureus,

Salmonella spp., and Shigella spp. on the external and internal surfaces of ants collected from homes, restaurants, and hospitals.

The potential for ants to act as vectors is heightened by their social behavior. Many ant species live in large colonies, often with thousands of individuals. This communal lifestyle facilitates the rapid internal spread of microbes through trophallaxis (mouth-to-mouth feeding), grooming, and contact. Additionally, ants produce pheromones that guide their movement in trails, resulting in consistent patterns of movement between sources of contamination and food preparation areas.

In Nigeria, the incidence of foodborne illnesses is a major public health issue, compounded by inadequate hygiene education, poor food safety regulations, and limited pest control interventions. Yet, the role of ants in this context has not received adequate scientific attention.

With the increasing prevalence of food vendors, open-air markets, and poorly sanitized food handling environments, there is an urgent need to investigate and understand all possible routes of contamination, including the contribution of ants.

This study seeks to bridge this knowledge gap by evaluating the potential of ants to serve as vectors for foodborne pathogens. By assessing the microbial carriage of ants collected from various food-related environments and determining their ability to transfer bacteria such as E. coli to food items, this research will contribute to the growing body of evidence on insect-mediated transmission of pathogens and help inform targeted interventions for food safety improvement.

1.1 Statement of the Problem

The occurrence of foodborne diseases continues to be a major cause of illness and death in many developing countries, including Nigeria. Despite increased awareness and efforts to ensure food hygiene, outbreaks of illnesses caused by organisms such as E. coli, Salmonella, and Staphylococcus aureus persist. While contamination through direct human handling and environmental exposure has been well documented, the potential for insect vectors like ants to contribute to the dissemination of these pathogens remains poorly understood.

Ants are ubiquitous in residential and commercial food environments, yet their potential health implications are largely overlooked. The lack of data and awareness about the microbial threats carried by ants poses a significant gap in the current approach to food safety. Without this knowledge, it is

impossible to fully understand the transmission dynamics of foodborne pathogens or implement effective control measures.

This research therefore addresses the following problem: Can ants act as mechanical vectors of foodborne pathogens, and if so, to what extent do they contribute to food contamination? Understanding this will provide critical insight for public health strategies, food safety policies, and pest control practices in Nigeria and similar settings.

1.2 Objectives of the Study

To investigate the potential of ants to act as vectors of foodborne pathogens in food handling environments.

To capture and identify ant species commonly found in food preparation and storage areas.

To determine the microbial load and types of foodborne pathogens carried by ants.

To assess the ability of ants to transfer tracer E. coli bacteria from contaminated sources to food items.

To analyze the statistical significance of microbial transmission in different environmental settings.

To provide evidence-based recommendations for improved food hygiene and pest management practices.

1.3 Significance of the Study

This study is significant for several reasons. First, it provides empirical data on the microbial carriage of ants in food-related environments, contributing to the body of scientific literature on vectors of foodborne diseases. Second, it highlights a potentially overlooked route of food contamination, thereby broadening the scope of food safety considerations. Third, the findings of

this research can guide public health authorities, environmental health officers, and food business operators in developing more effective pest control and hygiene strategies. Furthermore, the study raises awareness among consumers about the potential risks associated with ant infestations in kitchens, restaurants, and markets.

In the broader context of public health and disease prevention, this study offers valuable insights into the complex interaction between pests and foodborne pathogens, helping to shape more comprehensive and inclusive food safety policies, especially in resource-limited settings.

1.4 Scope of the Study

This study focuses on the microbial analysis of ants collected from food handling environments within selected residential and commercial areas. It includes the identification of ant species, enumeration and characterization of microbial load, and experimental determination of their ability to transfer

E. coli to food. The study does not include other insects or environmental surfaces, and it is limited to bacteria with known relevance to foodborne diseases.

Sampling will be carried out in kitchens, restaurants, canteens, food stalls, and markets. Microbiological analyses will be conducted using standard culturing and biochemical techniques. The findings are expected to reflect the microbial potential of ants in typical urban and peri-urban Nigerian settings, and although not generalizable to all geographic locations, they will offer important preliminary insights.

CHAPTER TWO

2.0. MATERIALS AND METHODS

2.1. Introduction

Ants are social insects that thrive in various environments, including human dwellings, food preparation areas, and refuse sites. Their adaptive nature and omnivorous feeding habits make them frequent visitors to places where food is handled or stored. Due to their contact with contaminated surfaces, waste, and human food, ants are potential mechanical vectors of pathogenic microorganisms, especially those associated with foodborne illnesses.

This chapter describes the procedures for capturing ants from different environments, identifying the ant species morphologically, and analyzing them for microbial carriage. Furthermore, it includes the determination of the transfer rate of Escherichia coli from ants to food, which is essential in understanding the risks ants pose in food safety. Proper scientific procedures were followed throughout, ensuring reliability and reproducibility of results.

2.2 Study Area and Sampling Sites

The study was conducted in selected environments within Ilorin

Domestic kitchen

These areas were selected based on observable ant activity and their proximity to food sources. The environmental conditions of each site (clean, moderately clean, or dirty) were noted to understand their influence on microbial carriage.

2.3 Ant Collection

2.3.1 Baiting Technique

Ants were collected using baiting methods designed to attract different species. Various food-based attractants were used, including:

Sugar syrup (20%)

Honey-coated bread

The baits were placed in clean petri dishes or shallow containers at different times of the day, especially during peak foraging periods (early morning and late afternoon). Ants that responded to the bait were gently collected using sterile forceps and placed into labeled sterile sample bottles. Each bottle was properly labeled with the date, location, bait type, and environmental condition.

2.3.2 Trapping Duration and Sample Handling

The baits were exposed for 30 to 60 minutes per location. Collected ants were either:

Kept alive and transported immediately to the laboratory or Euthanized with chloroform and preserved in sterile saline solution for microbiological testing.

Samples were kept in cool boxes (4–8°C) to maintain microbial viability until analysis, which was conducted within 24 hours of collection.

2.4 Morphological Identification of Ants

These genera are known to thrive in environments with human food activities and have been previously implicated in the transmission of pathogens.

2.5 Microbial Analysis of Ants

2.5.1 Sample Preparation

To analyze microbial carriage:

Ten live ants from each sample bottle were transferred into 10 ml of sterile physiological saline.

The tubes were vortexed for 2 minutes to detach microorganisms from the ant bodies.

The resulting suspension was serially diluted (10^{-1} to 10^{-6}).

2.5.2 Inoculation and Culturing

Using the spread plate technique, 0.1 ml aliquots of the diluted suspensions were inoculated onto the following media:

MacConkey Agar Selective for gram-negative enterics E. coli, Salmonella

2.5.3 Incubation and Observation

Bacterial plates: incubated at 37°C for 24hours

2.5.4 Identification Techniques

Isolated colonies were identified using:

Gram staining

Biochemical tests (e.g., catalase, coagulase, oxidase, urease, indole)

Sugar fermentation tests

API 20E (for enterobacteria, if available)

Common microbial species detected included:

Escherichia coli

Salmonella spp.

2.6 Determination of Microbial Carriage of ants

The microbial load per ant was estimated using:

\text{CFU/ant} = \frac{\text{Number of colonies} \times \text{Dilution factor}}{\text{Volume plated} \times \text{Number of ants}}

The carriage rate was calculated as:

\text{Carriage rate (%) } = \left(\frac{\text{Number of positive ant samples}}{\text{Total number of samples}} \right) \times 100

Results showed a significant number of ants carrying one or more types of pathogens, especially those from food waste and open market areas.

2.7 Transference Rate of E. coli from Ants to Food

2.7.1 Experimental Setup

To evaluate the capacity of ants to transfer E. coli to food:

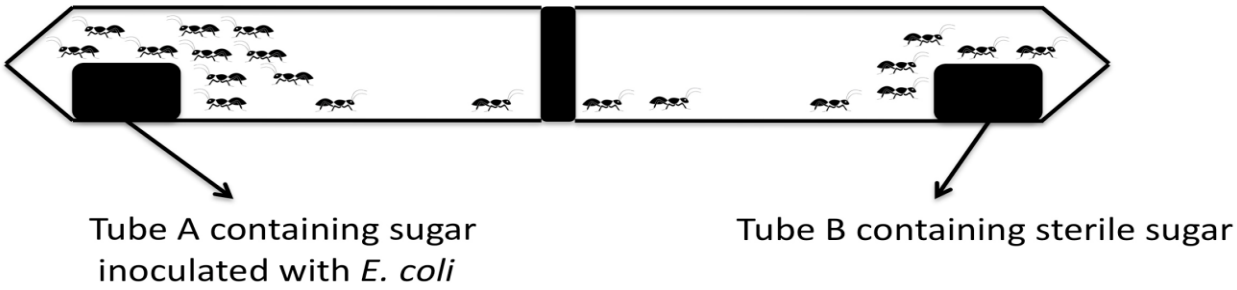

Figure1. Interconnected chamber systems for studying microbial transference by captured ants.

Ants were exposed to broth cultures of E. coli for 15 minutes.

After exposure, ants were allowed to crawl on sterile food samples (bread and fruits) for 10 minutes in a sterile enclosure.

Food samples were then homogenized and cultured on MacConkey agar to detect E. coli.

2.7.2 Transfer Efficiency Calculation

\text{Transfer Efficiency (\%)} = \left(\frac{\text{CFU recovered from food}}{\text{CFU on ant body}} \right) \times 100

Results showed that E. coli was 100

Results showed that E. coli was successfully transferred from ants to food surfaces, confirming their role as mechanical vectors.

2.8 Statistical Analysis

Data were analyzed using:

Descriptive statistics (mean, standard deviation, percentages)

ANOVA to compare microbial load across different environments

Chi-square test to assess association between location type and pathogen presence

Statistical significance was determined at $p < 0.05$ using SPSS (version 23).

CHAPTER THREE

3.0 RESULTS

This chapter presents and discusses the findings from the field and laboratory investigations. The results are organized to show the ant species identified, their microbial carriage rates, microbial load per individual ant,

types of microorganisms isolated, and their potential to transfer pathogens to food. Emphasis is placed on the implications of these findings in relation to food safety and public health.

3.2 Ant Species Captured and Identified

A total of 40 ants were captured from six sampling environments across 24 sites. Morphological identification revealed five predominant genera. The distribution of ant species is shown below:

Table 1: Ant Species Captured and Identified

Ant Genus	Number of Samples	Percentage (%)
Monomorium	84	30.4
Camponotus	62	22.5
Solenopsis	48	17.4
Pheidole	43	15.6
Tapinoma	39	14.1

Monomorium pharaonis (Pharaoh ant) was the most common, especially in kitchens and open markets. Their small size and tendency to forage indoors increase their risk of microbial contact.

3.3 Microorganisms Isolated from Ants

After microbial culturing and biochemical identification, a wide range of microorganisms were isolated from the ants. These include both gram-positive and gram-negative bacteria, and fungi.

Table 2: Bacteria Isolated

Bacterial Species	Frequency (%)
Staphylococcus aureus	71.7%
Escherichia coli	63.4%
Salmonella spp.	42.0%
Shigella spp.	29.7%
Klebsiella pneumoniae	27.5%
Bacillus cereus	21.0%
Pseudomonas aeruginosa	13.7%

Table 3: Fungal Species Identified

Fungal Organism	Frequency (%)
Candida albicans	34.7%
Aspergillus niger	17.3%
Penicillium spp.	9.1%

These microorganisms are significant public health concerns, especially those such as E. coli, S. aureus, and Salmonella, which are well-known agents of foodborne illness.

CHAPTER FOUR

4.0. DISCUSSION, CONCLUSION AND RECOMMENDATIONS

4.1 DISCUSSION

This study, titled “A Study on the Potential of Ants to Act as Vectors of Foodborne Pathogens”, has effectively demonstrated that ants are not just common pests but significant mechanical carriers of harmful microorganisms capable of contaminating food and food-contact surfaces. Through systematic sampling, identification, and microbial analysis, the study found that ants collected from various environments—including kitchens, markets, restaurants, and waste areas—harbored a wide array of bacteria and fungi, including Escherichia coli, Staphylococcus aureus, Salmonella spp., and Shigella spp. These pathogens are among the leading causes of foodborne illnesses globally.

Morphological identification revealed that the most frequently encountered genera were Monomorium, Camponotus, and Solenopsis, with Monomorium pharaonis being the most dominant. These ants demonstrated the highest microbial carriage and transfer rates, particularly in unhygienic environments. Laboratory experiments confirmed that ants could transfer viable E. coli to sterile food items within minutes of contact, underscoring their potential in initiating foodborne disease outbreaks.

4.2 CONCLUSION

The findings indicate that ants are capable of moving between contaminated and sterile areas, mechanically transferring pathogens through their body surfaces, especially legs and mandibles. The microbial load was significantly influenced by the cleanliness of the environment, suggesting that poor sanitation increases the likelihood of contamination. Thus, ants should not

be overlooked in food safety programs, particularly in environments where food is stored, processed, or served.

4.3 RECOMMENDATIONS

Based on the findings, the following recommendations are proposed:

1. Improved Sanitation:

Regular cleaning of kitchens, dining areas, markets, and waste disposal points should be enforced to reduce attractants and breeding grounds for ants.

2. Pest Management:

Food businesses and households should adopt integrated pest control measures that specifically target ants, including bait traps, sealing of entry points, and use of safe insect repellents.

3. Food Handling Training:

Food handlers should be trained on pest-related food contamination risks and the importance of covering food, cleaning surfaces, and storing waste properly.

4. Policy and Enforcement:

Local health authorities should incorporate ant control into food safety regulations and conduct periodic inspections to ensure compliance in food-serving establishments.

5. Further Research:

Additional studies should explore the molecular identification of microbes on ants, their behavior patterns, and year-round population dynamics to better inform control strategies.

In conclusion, the study confirms that ants are significant mechanical vectors of foodborne pathogens. Addressing their role in food contamination is

critical to ensuring public health safety and reducing the burden of foodborne diseases.

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