

**ASSESSMENT OF COCKROACH INFESTATION LEVELS, AWARENESS AND
CONTROL PRACTICES OF VENDORS IN READY-TO-EAT FOOD PREMISES
IN KISUMU CITY, KISUMU COUNTY**

BY

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DECLARATION

I, Chrispine Ochieng Ngwawe do hereby declare that this thesis is my original work and has not been submitted for the award of a degree or diploma in any other University or college.

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DEDICATION

This study is dedicated to the Almighty God for His abundant love, grace and peace; and to The Holy Mary Mother of God for all her graces and kindness; and to my family for their moral, financial and physical support during my studies.

ABSTRACT

In the urban areas of the world, cockroaches constitute a public health threat in the ready-to-eat food premises because they spread diseases and contaminate food. Globally, food borne diseases transmitted by pests affect 600 million people annually with 48million in the USA. Developing countries have more cases but are underreported due to poor diagnostic facilities. In Botswana, more than 40% of cockroach population is in urban areas due to inadequate waste disposal and poor housing. In Kenya cockroach infestation is a neglected public health issue. Cockroaches are of significant epidemiological significance yet levels not known in Kisumu City. Assessing the level of cockroaches' infestation, awareness and control practices helps in getting empirical data necessary for instituting effective control practices. Limited studies have been conducted on cockroach infestation levels in RTEs in Kisumu City yet the city leads in occurrences of gastroenteritis spread by cockroaches. The City has a high population living in poverty and dense housing favoring pests. Using a cross-sectional design, this study assessed the level of cockroach infestation, established the vendors' awareness and the control practices in the RTE food premises. Researcher administered structured questionnaires; Key Informant Interviews, observation tools and photography were used to collect data. Sticky traps were installed overnight within the sampled premises. The study population consisted of 201 vendors of RTE premises. Some 145 respondents derived by Fisher's sample determination formula calculated at 50% picked by stratified random sampling proportionately from each of the 4 designated City's Public Health Zones was interviewed. The County Public Health Officer and the Zonal Public Health Officers were purposively enrolled for Key Informant Interviews. Data analysis was done by Chi-Square and descriptive statistics at a C.L=0.05%. Quantitative data was presented in frequency tables and percentages while qualitative data results were presented as descriptive texts. Cockroach infestation in Kisumu City was high at a mean of 16.13 on Wang and Bennet scale. Many respondents 62(56.9%) were aware of cockroach infestation dynamics. Chemical control method was the most preferred for control of cockroach infestation in Kisumu City at 67(49.5%), followed by physical and biological methods of control at 45(33%) and 14(10.1%) respectively while cultural control methods least preferred at 9(6.4%) at $p=0.027$. As a recommendation, the Department of Public Health should ensure improved sanitation of the external environment and sensitize vendors on the public health impacts of cockroaches' infestation and advice on appropriate cockroach infestation control practices.

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ABBREVIATIONS OR ACRONYMS

CI	Confidence Interval
CIEH	Chartered Institute of Environmental Health
CL	Confidence Level
DPH	Department of Public Health
FAO	Food and Agriculture Organization
IPM	Integrated Pest Management
KDHMR	Kisumu District Hospital Medical Records
KIIs	Key Informant Interviews
KNBS	Kenya National Bureau of Standards
PHO	Public Health Officer
RTE	Ready –to- Eat
SPSS	Statistical Package for Social Sciences
USA	United States of America
WHO	World Health Organization

OPERATIONAL DEFINITION OF TERMS

Awareness	Ability to directly know and perceive or be conscious of events, thoughts or patterns
Bacterial isolates-	a population of bacteria that has been separated
Food -borne disease	any illness resulting from the consumption of food Contaminated by pathogenic, bacteria, viruses or parasites or any other contaminants
Infestation level	the degree of presence or absence of the cockroach in a Premise
Interventions-	Activities that can be undertaken to alleviate cockroaches
IPM	Infestation Integrated Pest Management
Pathogenic bacteria-	refers to bacteria which may cause a disease or food Poisoning or any other contaminants
Pest Control Practice-	Regulation of a defined species of pest or the Process of minimizing undesirable pests from an area
Ready- to- eat food premises-	premises where food is ready for immediate Consumption at the point of sale
Signs of Infestation-	Discernible indicators of an infestation
Vector	Transmitter of a pathogen

CHAPTER ONE: INTRODUCTION

1.1. Introduction

The first chapter gives a brief background to the study highlighting the importance of determining the cockroach infestation levels, vendors' awareness and the control practices. It highlights the background information, statement of the problem, objectives, research questions and the significance of the study.

1.2 Background Information

The second half of the twentieth century and the beginning of the twenty first century has witnessed important changes in ecology, climate and human behaviour that favour the development of urban pests (Bonney *et al.*, 2008). In 1950, only 29% of world population lived in urban areas in the developing countries but between 1960 and 1980, urban population in developing countries doubled and is expected to reach 56% by 2025 (Hedges,1999).

In contrast, the developed countries population proportion in urban areas was already at 72% in 1985 and is expected to hit 79% by 2025 with corresponding pests and vector-borne diseases increments as challenges (Knudsen and Sloof, 1992). Urban planners are therefore faced with monumental task due to the expansion of urban sprawls where the suburbs' of the cities are growing into natural habitats of ticks, rodents and other pests (WHO, 2008). Owing to population growth, poor levels of hygiene and increasing urban poverty in many developing countries, the urban environment is rapidly deteriorating (Knudsen *et al.*, 1992). Amongst the insect pests in urban environments, cockroach are of significant public health importance (Bonney *et al.*, 2008). Cockroaches' infestation is a neglected public health problem yet the diseases caused or spread by cockroaches pose

a serious risk to public health (Cloarec *et al.*, 1992). Cockroaches search for food in food preparation and storage areas as well as dirty drains, sewerages and rubbish bins thus play a role as vectors for pathogens that cause intestinal diseases such as dysentery, typhoid and cholera (Rivault *et al.*, 1992). Cockroach infestation levels are highly variable in size and spatial distribution and are characterized by a complex of interplay of many ecological and social factors and the influence of the other unsanitary factors related to water and harborage (Brenner and Markowitz, 2003). Urban health authorities in many countries are alarmed by the rise of vector-borne diseases as a result of increased presence of cockroaches and other pests due to overcrowding resulting from population growth and rural-to-urban migration (Knudsen and Slooff, 1992).

Globally, food borne diseases transmitted by pests affect over 600 million people. In the USA, these diseases affect over 48 million people per year with as many as 70 deaths. In developing countries fewer cases are accounted for due to poor reporting and lack of diagnostic facilities for the diseases (Brender *et al.*, 1997). In Africa, studies conducted in Botswana reveal that more than 40% of cockroach population is in urban areas due to inadequate solid waste disposal, accumulated wastes, poor housing and inadequate water supplies (Allotey *et al.*, 2006).

Other studies conducted on the parasitic, bacterial and fungal profiles by Tafteng *et al.*, 2005 in Epkoma in Nigeria reported that isolates from the cockroaches were identical irrespective of the site of collection confirming that cockroaches are important reservoirs of infectious pathogens (Rivault *et al.*, 1992).

In the developing countries cockroach infestation is a neglected public health issue partly because the related health burdens are largely unknown and focus has been on other diseases that portend obvious dangers to the populace (WHO, 2008).

Despite the underreporting due lack of diagnostic facilities in many parts of the developing world, the increase in food-borne diseases, the emergence of new or newly recognized food-borne problems have been identified (Ventor, 2002). Another challenge in the developing countries is that a large number of outlets operate informally thus escaping scrutiny from public health authorities and this hampers proper documentation of accurate levels of cockroaches' infestation (Yasmeen, 1992).

Kisumu city in western Kenya has a large population of inhabitants and is a transit point in East Africa for trade, tourism and other cross-border activities (City Council of Kisumu, 2009). The densely packed housing, inadequate drinking-water supplies, garbage collection services the humid climate, high poverty index and surface-water drainage systems in Kisumu City combine to create favorable habitats for cockroaches (KNBS, 2013).

In Kisumu City, food-borne diseases generalized as gastroenteritis appear as number three among the top ten diseases among the in-patients at 3,884 and number five for outpatients with 340 (KDHMR,2002). This statistics motivate the choice of Kisumu. The study's target population was 201 adults operating the ready-to-eat food premises licensed vide County Government Single Business Permit within the City (City Council of Kisumu, 2015).

Most of the premises in the ready-to-eat food industry do not meet basic safety requirements against cockroaches' infestation due to large amounts of garbage accumulation in various points of the city that provides harbourage to insects and animal pests (FAO/WHO, 2005).

Operators in the ready- to-eat food industry are responsible for safeguarding the public health of consumers by ensuring that consumers are safe from food-borne illnesses and any other associated adverse public health effects (CIEH, 1999). Food consumers in large cities of developing countries rely on ready-to-eat food outlets for their supplies and are exposed to significant dangers of contracting diseases, allergies and other medical conditions if cockroaches' infestation levels are not controlled (Yasmeen, 1992).

Studies have been conducted on infestation cockroach infestation levels in girl's dormitories and residential buildings (Gholam, 2013). However, corresponding studies have not been undertaken in the RTE food Premises and this necessitated this study.

Several studies have established that high incidence of cockroach infestation occurs as a result of lack of knowledge on the factors encouraging cockroach infestation (Bradman *et al.* (2005), Wang *et al.* (2008) Bamigboye (2006) and Murphy *et al.* (2007). The earlier studies have also ascertained that the awareness levels were low on the involvement of rodent and cockroaches in transmission of life-threatening infections hence epidemiologically significant and could be responsible for increasing incidence of emerging infectious diseases (Hedges, 1999). These results called for an investigation into the awareness levels on cockroach infestation by the vendors in RTE food Premises

in Kisumu City, Kisumu County.

The importance of infestation prevention through good hygiene, stock management and exclusion practices should be emphasized yet the actual control practices utilized by vendors of the ready-to-eat premises have not been established (Lee and Lee, 2000). Control practices employed in a place have a significant effect on the levels of cockroach infestation with evidence that where appropriate control practices are used as the interventions, the levels are much lower yet studies have not been conducted in Kisumu City to reveal the practices. It therefore called for a research to ascertain the cockroach infestation control practices as used by vendors in the RTE food Premises.

1.3 Statement of the Problem

Cockroaches' infestation constitutes a major contributor to ill-health among the consumers of food in the ready-to-eat food premises yet the infestation indicators are poorly studied. The quality and safety problems arising from cockroaches' infestation pose serious concern to public health and thus the need to institute safety limits in food and related industry coupled with an adequate capacity for Acts and Regulations for assurance and control. However studies have not been conducted in Kisumu City to assess the infestation levels, the vendors in the ready-to-eat food premises awareness of cockroach infestation and the cockroach infestation control practices as currently used. The involvement of cockroaches in transmission of diseases cannot be understated for the fact that they also inhabit unhygienic places such as dumping sites, toilet premises and sewer lines which are highly contaminated with disease causing bacteria, fungal and viral pathogens as well as protozoa's. Interventions need to be tailored to the baseline

knowledge which is always unique to the target populations yet currently no clear data on cockroach infestation levels, vendors' awareness and control practices in Kisumu City, Kisumu County to define and understand the target population has been documented. Therefore a properly formulated and executed cockroaches' infestation control policy that is evidence-based is needed in place the need for a study to determine specific areas for intervention. However studies have not been conducted to establish the cockroach infestation levels in the ready-to-eat food premises, vendors' awareness and to ascertain control practices currently being used which forms our basis for this study.

1.4. Objectives

1.4.1 General objective

To assess cockroaches' infestation levels, the vendors' awareness of cockroach infestation and the cockroach infestation control practices used by vendors in the ready-to-eat food premises in Kisumu City, Kisumu County.

1.4.2 Specific objectives

- i. To assess the cockroaches infestation levels in ready-to-eat food premises in Kisumu City, Kisumu County.
- ii. To establish the awareness of vendors on cockroaches' infestation in ready-to-eat food premises in Kisumu City, Kisumu County.
- iii. To ascertain the cockroaches control practices used by the vendors in ready-to-eat food premises in Kisumu City, Kisumu City.

1.5 Research Questions

- i. What is the cockroach infestation level in the ready-to-eat food premises in Kisumu City, Kisumu County?
- ii. What is the vendor's awareness on cockroaches' infestation in ready-to-eat food premises in Kisumu City, Kisumu County?
- iii. What are the cockroaches control practices being used by vendors in ready-to-eat food premises in Kisumu City, Kisumu County?

1.6 Significance of the Study

Findings from this study are useful in helping the County Government's public health programmes to initiate effective and efficient cockroach control strategies. Assessing the cockroach infestation levels, vendors 'awareness levels on cockroach infestation and the control practices of operators' enhanced understanding of risks thus guiding the choices of control strategies. The general public significantly benefit from better cockroach infestation control mechanism as a means of preventing diseases outbreaks. The data from this study is useful in augmenting the enactment of legislative frameworks to guide the operations of cockroaches' infestation control in the ready-to-eat food premises. The study outcomes have broadened the understanding on cockroaches' infestation levels, causes and possible public health outcomes. Information from this study provides evidence for basing cockroach infestation control policies in the ready-to-eat food through effective implementation of appropriate strategies in Kisumu City.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter reviews literature relevant to the research study. It critically examines the existing body of knowledge related to the study area. The chapter is divided into sections as follows: Cockroaches -description, biology and ecology; Levels of cockroach infestation in Ready-to-Eat food premises; Awareness of the cockroach infestation by the vendors in the Ready-to-Eat food premises, Cockroaches infestation control practices, Public health risks associated with cockroach infestation in urban areas and the conceptual framework of the study.

2.2 Cockroaches: Description, Biology and Ecology

Possession of refined knowledge of the biology, ecology and behavior of cockroaches and of the epidemiology of cockroach-borne diseases is needed to help instituting efficient and specific tools and active ingredients for pest control (WHO, 2008).

Cockroaches are an ancient insect species that has always lived amongst humans. They are insects, flattened from top to bottom usually with two pairs of wings folded flat over the back. Most species rarely fly but they walk quite fast. Their color varies from light brown to black and species vary from 2-3 mm to over 80 mm in length. Common species in Africa include *Periplaneta americana*, *Periplaneta australasiae*, *Blatta orientalis* and *Blattella germanica* (Robinson, 1996a).

Based on fossil records, cockroaches have little changed for 200 million years. There are over 4000 different species of cockroaches worldwide and not all are regarded as pests with the most common in domestic environment as the German cockroach and the

Oriental cockroach (Cochran, 1983). The cockroach species that are now classified as pests originated in tropical climates but have now become cosmopolitan in temperate zones having been distributed by commercial activities and are omnivorous (Webb *et al.*, 1999).

Their activity peaks during hours of darkness. They are omnivorous with feeding habits that bring them into contact with foods as well as different kinds of biological wastes (Cloarec *et al.*, 1992). They exhibit incomplete metamorphosis; the juvenile stages or nymphs resemble the adults. Each cockroach moults several times in its life cycle producing a larger nymph and eventually moulting to the adult stage. The females of those cockroaches classed as pests all produce egg cases which contain eggs, which hatch inside the case from which nymph cockroaches emerge (Cochran, 1983). They also produce an aggregation pheromone, which is a chemical messenger to other cockroaches of the same species, which respond by being attracted to the source of the pheromone. As this pheromone is present in cockroach faeces, cockroaches will also be attracted to areas previously contaminated by cockroaches (Robinson *et al.*, 1985).

The development of cockroaches is affected by food quality, humidity, temperature, and day length (Gholam, 2013). The advent of heating and cooling systems in buildings and also indoor cooking has contributed to cockroaches spread especially in the food and allied industries (Robinson, 1996a). Cockroaches foul their environment with faeces, regurgitated food and they taint materials with their characteristic smell. The air in infested premises may contain fragments of their exoskeletons and cockroach excrement (Cochran, 1983). Cockroaches also contaminate food directly as they move from filth to food indiscriminately and are therefore implicated in the mechanical transmission of

many pathogens, such as those causing food poisoning and wound infections (Rivault, 1992). The residual allergens can remain as active contaminants for some time following a treatment therefore a thorough cleaning regime should be carried out afterwards (Hedges, 1999).

Diseases can be picked up and transferred onto food products and surfaces (Tafteng *et al.*, 2005). The success of cockroaches in inhabiting human structures can be attributed to certain biological characteristics such as eating almost anything, such as their own cast skins, live or dead plant material, leather, glue, hair, wallpaper, fabrics and starch in book bindings and almost any human food (Cochran, 1983). Cockroaches have a high reproductive potential with some adult female species being able to survive up to 90 days on water without food (Appel, 1995).

2.2 Level of Cockroach's Infestation in Ready-to-Eat food Premises

The presence of even a cockroach is not to be overlooked as they can multiply and spread very fast (Gholam, 2013). The infestation levels seem to be higher in urban low income places where there is poor disposal of waste, overcrowding and non-compliance to cockroaches' prevention practices (Wang and Bennet, 2009). Poor fecal and garbage disposal systems contribute to the proliferation of cockroaches (Cochran, 1983). Infestations are often the result of broken drains, building defects and areas that provide dark harbourages such as under stoves, behind refrigerators and in close proximity to food and water (Rivault&Cloarec, 1997). Cockroaches can even be transferred between locations, for example by eggs or adults being within products purchased from infested shops (Wang, 2010).

Kisumu city in western Kenya has a large population of inhabitants and is a transit point in East Africa for trade, tourism and other cross-border activities (City Council of Kisumu, 2009). The densely packed housing, inadequate drinking-water supplies, garbage collection services the humid climate, high poverty index and surface-water drainage systems in Kisumu City combine to create favorable habitats for cockroach (KNBS, 2013).

In Kisumu, most of the premises in the ready-to-eat food industry do not meet basic safety requirements against cockroaches' infestation due to large amounts of garbage accumulation in various points of the city that provides harbourage to insects and animal pests (FAO/WHO, 2005).

Gholam (2013) did an evaluation of sanitation in an IPM program for cockroach infestation in a girls' dormitory. The correlation coefficient between the sanitation rates and infestation rates showed that there was a significant positive relationship ($n=23$, Spearman correlation coefficient $r=0.445$, $p < 0.05$) between sanitation rate and intensity of infestation (according to the cockroach index) at the surveyed units (the girls' dormitory). The same result was achieved for the residential building ($n=11$, $r=0.636$, $p < 0.05$). Thus, poor sanitation was associated with the intensity of cockroach infestation at the residential building and girls' dormitory. For the boys' dormitory, the correlation was not significant ($n=19$, $r=0.36$, $p > 0.05$). In this dormitory", the bathrooms were located inside the units, while in the "girls dormitory", they were outside the units. This difference in location might affect the correlation between sanitation and infestation at the girls and boys dormitories.

The main sources of infestation include toilets, kitchen, rubbish containers and neighborhoods but the level of tolerance in a premise contributes significantly to the levels of infestation (Cochran, 1983).

The study by Gholam *et al.* (2013) established that cockroach infestation is a real problem from a total of 573 sampling units inspected using trapping (i.e., apartments, units, or housings), (225 units) 39.3% were infested with cockroaches. The results established that 37%, 59%, 26%, 18%, and 12% of the sampling units in the surveyed dormitories, hospitals, housing building complexes, official places, and hotel, respectively, were infested with cockroaches.

Shahraki *et al.*, 2013 therefore noted that the hospitals had the highest frequency of infested units via trap monitoring. Plumbing facilities (i.e., wash basin), heating source, and openings in the roof for 84, 43.5, and 21% of units ($N = 69$ units) at the hospitals, respectively, obtained from the questionnaire, could be detected as effective factors for survival of cockroach which explained the high rate of infestation for the hospitals.

A survey on 97 private houses throughout the city by means of questionnaires showed that 80% of residences complained of cockroach infestation (Wang, 2010). The survey by cockroach trap monitoring found that all surveyed locations (22 areas) in these cities were infested with cockroaches, although infestation rates varied throughout the urban communities. Brenner and Markowitz (2003) reported different rates of cockroach prevalence for residential apartments from questionnaire and trapping.

Shahraki *et al.*, 2013 established a correlation between unsanitary factors related to food, water, and harborage (for cockroach survival), and cockroach infestation for 88 surveyed units and 19 dormitory kitchens. The effects of unsanitary factors, associated with food such as food debris (for the kitchens), leftover foods exposed on the table, as well as unwashed dishes left overnight, contributed to the higher infestation rates ($p < 0.05$) in this study as well as in the study by Lee and Lee (2000).

Further to this, compounding positive impact of dirtiness and clutter on infestation with cockroaches is pointed in this study and the others (Shahraki *et al.*, 2013). A key aspect is the levels of hygiene and sanitary conditions observed by operators as well as their behaviors towards cockroaches and exchanges between the surrounding environments, food premises and other building are a frequent occurrence (Gholam *et al.*, 2013).

The infestation levels seem to be higher in urban low income places where there is poor disposal of waste, overcrowding and non-compliance to cockroaches' prevention practices Wang and Bennet, 2009).

Studies in Thailand have shown that cockroaches as the most common pest in urban are with highest densities in kitchens followed by bedrooms and lastly in the outside of the dwellings (Tawatsin *et al.*, 2001). Agrawal and Tilak (2006) reported more cockroach counts based on visual counts method compared to sticky trap method. However, the traps (baited with mouse pellets) were reported as a best way to determine cockroach infestation (Smith & Appel, 2008; Wang & Bennett, 2006).

The condition of the infrastructure is another effective factor in determining levels of infestations as older buildings register more infestation than new ones and studies have

revealed a correlation between the age of a building and infestation levels of cockroaches (Shahraki *et al.*, 2013). From the foregoing, studies on levels of cockroach infestation have mainly been conducted in dormitories and residential buildings but not in eateries. Therefore this study proposed to determine the level of cockroach infestation in ready-to-eat food premises in Kisumu City. It aimed at highlighting the gaps in cockroach infestation control to inform the development of best standards for cockroaches' infestation management strategies that beneficially reduce the adverse impacts of cockroaches to public health.

2.3 Awareness of Cockroaches' Infestation by the Operators of the Ready-To-Eat Premises

Studies by Bradman *et al.* (2005), Wang *et al.* (2008) and Bamigboye (2006) established that disproportionately high incidence of pest infestation occurs, arising from poor hygiene and improper storage and disposal of waste as a result of lack of knowledge on the factors encouraging cockroach infestation. Murphy *et al.* (2007) established that the awareness levels were low on the involvement of rodent and cockroaches in transmission of life-threatening infections is epidemiologically significant and could be responsible for increasing incidence of emerging infectious diseases (Hedges,1999). Findings show that there are many parasites of public health significance carried and harbored by cockroaches in Calabar (Tafteng *et al.*, 2005). Unfortunately, the people did not consider presence of cockroaches and parasitic infections as a serious problem, even though they did not like the sight of cockroaches (Schal, 1988).

The isolation of these parasites from the cockroaches indicated that these pests could pose health problems to humans who may overlook their potential role in the spread of these parasites (Tafteng *et al.*, 2005).

Although it is difficult to prove the direct involvement of cockroaches in the direct transmission of pathogenic agents, it is important to note that since they carry pathogenic organisms that are of public health and medical importance inside and on their bodies, they can be incriminated in the mechanical transmission; these organisms then they move about from faeces to food (Schal, 1988). Cockroach infestation control measures may include legal action against individuals or companies that fail to comply (WHO, 2008). Cockroaches' infestation is viewed as a symptom of a vulnerable and degraded environment and a manifestation of poor quality food and services (Tawatsin *et al.*, 2001).

Most people are unaware of cockroaches' ability to carry pathogens and that simple personal hygiene measures can help avoid contact with pests (Knudsen *et al.*, 1992). They are also unaware of safe pesticides usage in environmental friendly ways (Webb *et al.*, 1999). Another study by Agbo and Akosu (2013) on cockroach and rodents infestation in Benue State University students' hostel in Makurdi and their epidemiological implications found that overcrowding, and refuse accumulation provide suitable breeding grounds for cockroaches and rodents. It has been reported that because of the increasing environmental concerns and more regulatory restrictions on the use of insecticides, there will be an increased interest in environmentally acceptable concepts, including trapping, the latter not only for monitoring infestations, but also as an integral part of the cockroach management program (Hedges, 1999). The presence of cockroaches

in large numbers in homes could serve as a source of these insects in vending sites by being transported on the utensils (Schal, 1988). At the vending sites, such populations could thrive due to the poor disposal of left-overs, lack of proper sanitation and ideal temperature conditions (Hedges, 1999). Cockroaches, rats, and mice are major problems in the urban built environment especially in multifamily dwellings where excessive moisture, extensive cracks and crevices, abundant food sources, overcrowded closets, and stacks of paper provide them nutrition and shelter (Bonney *et al.*, 2005).

According to Tafteng *et al.*, 2005 cockroach infestation levels is still poorly investigated in Africa yet it poses serious public health outcomes. Studies have not been conducted to establish vendors of ready-to-eat food premises' awareness of cockroach infestation in Kisumu City, Kisumu County. This study therefore aimed at exposing the awareness levels of vendors in the ready-to-eat premises on factors of cockroach infestation to assist in developing awareness and educational programs to minimize cockroaches' infestation.

2.4 Cockroaches Infestation Control Practices in the Ready –To-Eat Food Premises

The importance of infestation prevention through good hygiene, stock management and exclusion practices should be emphasized (Robinson, 1996a). It is not possible to completely eradicate cockroaches without cooperation of all affected players contributing sanitation efforts and communicating with authorities about new and recurring pest problems (Shahraki *et al.*, 2013). Sanitation is a key concept in relation to control of pests in urban environments and it has been noted that insanitary conditions results into proliferation of cockroaches (Rivault *et al.*, 1992).

The focus of IPM is to eliminate the source of pest problems – that is the conditions conducive to the establishment, survival and reproduction of pests (Wang and Bennet,

2009). In doing so, IPM controls cockroaches' infestations and cockroaches' access to people and their dwellings (Robinson, 1996a). Studies have shown that an IPM approach incorporating bait and other non-chemical methods can provide a high level of cockroach control (Wang and Bennett 2006). IPM relies on nonchemical approaches plus education and uses comprehensive information on the lifecycles of pests and their interactions with the environment to guide pest control is an alternative to conventional, chemical-based pest control (Schal, 1988). The concept underlying IPM is that pest populations can be controlled by removing their basic survival elements, such as air, moisture, food, and shelter, by blocking their access to apartments is also stated by Hedges, 1999.

Baiting alone resulted in a more than 95 percent reduction of cockroaches in heavily infested houses by sealing cracks and crevices and by the careful placement of least toxic baits and gels (Schal, 1988). Maintenance, sanitation, education, and training are the cornerstones of IPM (Hedges, 1999). Insecticides are the major tool used by professionals and residents for German cockroach control (Koehler *et al.*, 1995). The advent of highly effective bait products in the early 1990s significantly reduced the overall cockroach infestations in the United States (Greene 1996, Gooch 1999, Hedges 1999).

In a study conducted by the U.S.A. General Services Administration, use of cockroach bait products dramatically reduced liquid insecticide use from 1988 to 1999 (Greene and Breisch, 2002). Like human beings, cockroaches need food, water and shelter to survive. By removing elements needed to sustain cockroaches' populations, infestations can be controlled (Wang and Bennet, 2009).

The control practices in place have a significant effect on the levels of cockroach infestation with suggestions that where appropriate control practices are used as the

interventions, the levels are much lower (Bonney *et al.*, 2008).

Despite this evidence, studies have not been conducted in Kisumu City to reveal the cockroach control practices being currently utilized by vendors in RTE premises in Kisumu City. In addition to these, few systematic studies of IPM have been undertaken in the urban setting of which some have produced positive results, but others report limited success in the infested apartments (Wang and Bennett 2006, Wang 2010).

This study was therefore undertaken to establish cockroach infestation control practices and to identify gaps in control practices being utilized to inform the development of best standards for cockroaches' management that beneficially reduce the levels of cockroach infestation.

2.5 Public Health Risks Associated With Cockroaches in Urban Areas

Cockroach infestation must be controlled to enable humans live disease free and economically productive lives (Tatfeng *et al.*, 2005). They consume and also contaminate food by transmitting yeasts such as *Candida spp.* and *Pichia spp.* from contaminated sources to food preparation and storage areas (Rivault *et al.*, 1992). They also cause allergies and even transmit pathogens such as *Bacillus spp.*, *Salmonella spp.*, *Enterobacter spp.*, *E Coli*, *Entamoeba histolytica* that cause gastro-intestinal diseases such as dysentery, diarrhoea and typhoid (Allotey *et al.*, 2006).

The risks also include physical contamination of food products by cockroaches' droppings, parts or other foreign bodies and the introduction of microorganisms (Gholam, 2013). Additional health consequences of rodent and cockroach infestation are the

resultant increase in use of pesticides (Gholam, 2013). Frequent pesticide use results in environmental pollution and poor air quality within rooms (Wang, 2010). Empirical studies reported that high percentage of student resorting to insecticides to control infestation could cause accidental contamination of foods stuff inside students' rooms and increase indoor pesticide residue (Majekodumi *et al.*, 2002; Bamigboye, 2006; Wang *et al.*, 2008).

The preposition of risks posed by cockroaches consumption include contamination of food, allergic and gastrointestinal diseases through mechanical transmission of bacteria and other pathogens by moving contaminants from unsanitary areas of a building to food storage or preparation areas is also reinforced by (Webb *et al.*, 1999). They carry bacteria which can be responsible for gastroenteritis, dysentery and typhoid (Rivault *et al.*, 1997). They also give out an unpleasant odour, giving many people allergies as significant risks indoor public health risks (Brenner *et al.*, 1995). The public health risks associated with these pathogens and the severities of the diseases caused vary greatly depending on interactions between the cockroaches, pathogen natural hosts and the environment (Omu, 2013).

Transmission of pathogens may be biological or mechanical with the former being more common (Allotey *et al.*, 2006). In the biological transmission the vector picks up the pathogen from an infected host (human or other animals), the pathogen undergoes some form of growth within the vector and is then transmitted to a human via infected to uninfected hosts through contamination of the cockroaches body typically the external mouthparts (Cloarec *et al.*, 1992). The fact that food contamination is a significant public

health aspect of cockroaches' infestation through their droppings and cast skins has also been emphasized by Brenner *et al.*, (1995). When the population is high, the cockroaches or their body parts may contaminate stored products and maybe accidentally consumed, leading to allergic reactions of other human (Rivault *et al.*, 1997).The potential risks of bacteria was also confirmed by a study done by Cloarec *et al* in 1992 which revealed that pathogenic and potentially pathogenic bacteria represented 54% of the bacterial isolates from cockroaches. The presence of cockroaches increases the risk of transmission either as opportunistic or potential pathogens (Tafteng *et al.*, 2005).

Studies carried out to investigate the links between bacteria carried by cockroaches in a hospital set up suggested the possibility of step by step proximity contamination between contagious floors depending on cockroaches' population and their movements from one area to another (Rivault *et al.*, 1992). Other risks to public safety and the environment are due to irresponsible or inaccurate use of pesticides that may present hazards to technicians, site staff and members of the general public, as well as to the environment through contamination of water, damage to plants and the effect on non-target species of animals (Bonneyoy *et al.*, 2008).

Therefore the need for a study to determine the levels of infestation, the vendors awareness and the control practices as presently being used must be emphasized as a basis of “ Information for Action” in reducing cockroach infestation and thereby averting the possible risks associated with cockroach infestation.

2.6 Conceptual Framework

The conceptual framework employs an empirical approach to explore the relationship between the independent variable (vendors) and dependent variables such cockroach

infestation levels, vendors' awareness and control practices in the ready-to-eat food premises.

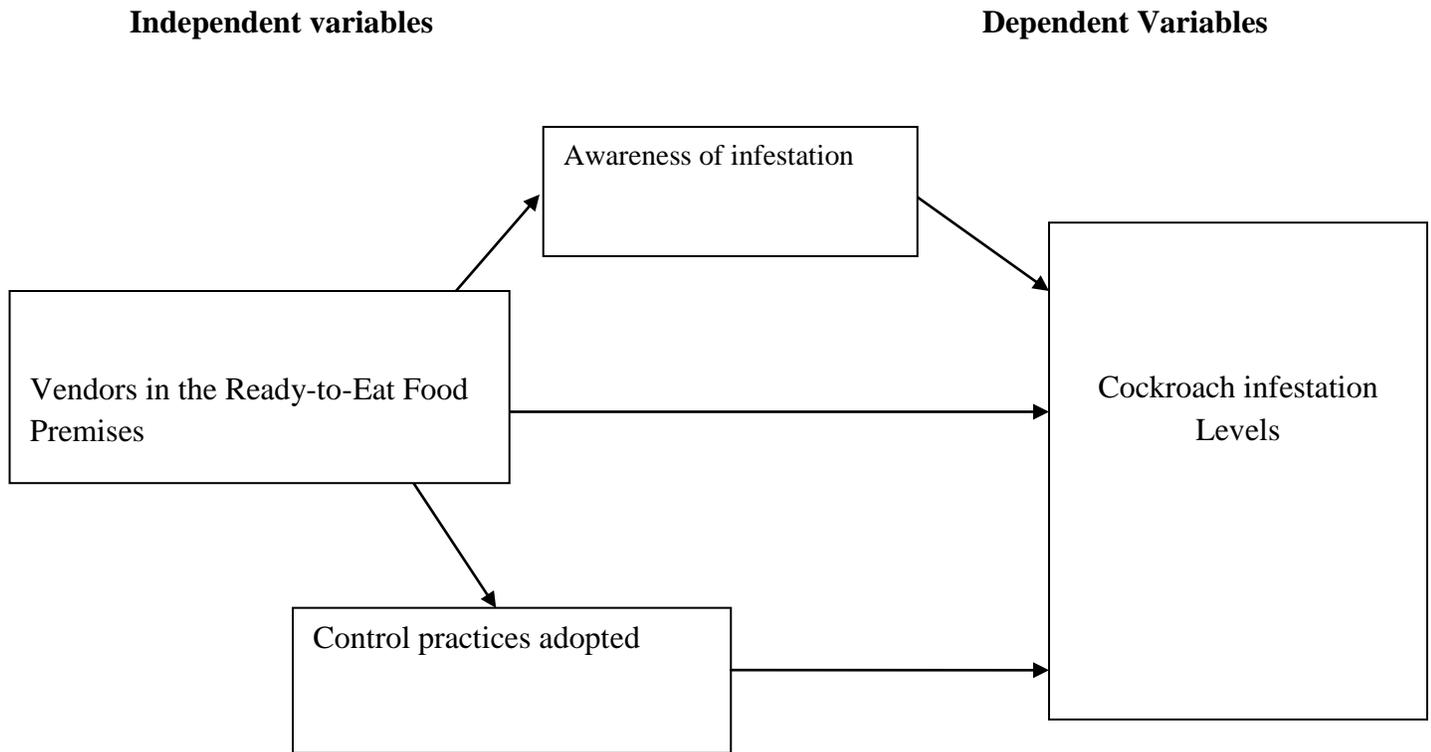


Figure 2.1: A Conceptual model for the study

Source: Modified from John Hopkins Bloomberg School of Public Health Model, 2006

CHAPTER THREE: METHODOLOGY

3.1 Introduction

This chapter describes the study population, study area, sample size, study design, sampling procedures, data collection, analysis and presentation, study limitations as well as the ethical considerations.

3.2 Study Area

This study was conducted in Kisumu City, Kisumu County. This is a port city situated within the Lake Victoria Basin (LVB) of Kenya. Kisumu City has a population of 409,928 persons, a population density of 828 per square km and a population growth rate of 2.8% per annum (KNBS, 2013). It is the leading commercial, industrial, communication and administrative centre in the LVB serving as a confluence centre for the Great Lakes Region namely Tanzania, Uganda, Rwanda and Burundi. The city has an area of approximately 417 of which 297 sq. km is dry land with approximately 120 square km under water with undeveloped land and vegetation both within and around urban sub-locations (Government of Kenya, 1996).

Kisumu city is located 10km south of the equator at longitude of 34° 45'E and latitude is 00° 03'S. Kisumu County's mean rainfall is 1280 mm and its mean annual temperature ranges between 200° C and 300° C. The region's continued population growth accelerates the depletion of natural resources exacerbating the effects poor living conditions of the inhabitants. The city has high levels of skilled and unskilled labour with 30% unemployment rate and 52% of the working population engaged in informal activities (City Council of Kisumu, 2009). In the poverty index, 48% of urban population

live in absolute poverty without adequate shelter with 60% urban population in peri-urban informal settlements lacking basic services. Their main economic activities include wage employment in manufacturing and processing plants, petty /informal trading and non-motorized public transportation (KNBS, 2013).

3.3 Study Design

The study design was a cross-sectional design (Kothari, 2003).It involved conceptualization of the cockroaches' infestation situation and entailed quantitative and qualitative data collection from primary and secondary sources (Mugenda and Mugenda, 2003). Qualitative methods provided in-depth explanations of the infestation (Orodho, 2004). Researcher administered structured questionnaires were used to gather quantitative data and Key Informants Interviews were conducted with Chief County Public Health Officer and the Zonal Public Health Officers. Sticky cockroach traps (Edge Leaf Manufacturers, China) were placed at selected places overnight to enumerate cockroaches. Observation checklists and photography were also be used to gather data.

3.4 Study Population

The study's respondents were derived from a target population of 201 adults who operate the ready-to-eat food premises licensed vide County Government Single Business Permit within the City (City Council of Kisumu, 2015).

3.5 Sample Size Estimation

The sample size was determined from the target population of 201 adults operating the ready-to-eat food premises within Kisumu City Kisumu County Appendix VIII (City

Council of Kisumu, 2015) The formula as used by Fisher's *et al* (1998) was used in sample size estimation as shown below. A confidence level of 95% was assumed.

$$n = \frac{z^2 pq}{d^2}$$

n= minimum sample size

z = Standard normal deviate at the required confidence level (error 5% z = 1.96)

P= Proportion of subject in the sample population estimated to be infested by cockroaches. [Since the percentage cockroaches' infestation from studies in Kisumu is not established, 50% was taken as the proportion of subjects in the sample population infested by cockroaches].

d = 0.05 as the level (degree) of accuracy desired (statistical significance set)

q=1-p = the proportion in the sample population not expected to be infested

The desired Sample size was calculated as follows:

$$n = \frac{z^2 pq}{d^2}$$

$$n = \frac{(1.96)^2 (0.5) (0.5)}{(0.05)^2} = 384.16$$

Modified as below since size less than 10,000 (Mugenda and Mugenda, 2003)

$$nf = \frac{n}{1 + \frac{n}{N}}$$

$$n = \frac{384.16}{1 + (384.16/201)}$$

Sample size =132.

In the above formula N is the target population. To cater for sampling error and data inconsistencies as proposed by Niang *et al.*, 2006, 10% of 132 RTE food premises were added and so the adjusted sample size was 145.

3.6 Sampling Procedures

The RTE food premises were stratified along the four existing Public Health designated zones namely the Eastern, Western, Southern and Northern. A sample frame comprising an exhaustive list of the RTE food Premises in Kisumu City was then drawn. From the strata in the sample frame 34, 42, 30 and 39 respondents were randomly selected for Eastern, Western, Southern and Northern respectively making the total of 145 respondents (a lottery system was applied to generate the sample). The selection was therefore done proportionately using stratified random sampling. For each of the selected RTE food premise, only one consenting adult respondent was given a questionnaire to fill in. Demographic details e.g. ages, gender, employment or other sources of income, socio-economic status and educational level of all the respondents was recorded. Kisumu County Public Health officer and the 4 in charges of the respective Public Health zones were purposively selected for Key Informant Interviews. Observation checklists and photography were also used to gather qualitative data.

3.7 Inclusion and Exclusion Criteria

This study was limited to the list of ready-to-eat food premises licensed vide County Government Single Business Permit within the City (Appendix VIII).

Respondents were limited to consenting operators only. Categorized hotels were omitted.

3.8 Data Collection

Both primary and secondary data were collected. The study utilized both qualitative and quantitative data collection methods.

3.8.1 Questionnaires

Primary data were collected using interviewer-administered structured questionnaires (Appendix II) to the 145 respondents. These were used to gather information on awareness and the control practices adopted. The questionnaires were carefully drafted to ensure that each question covered a specific area or objective of the study and they are used in research due to their ability to give similar or standardized questions to the subjects thereby allowing triangulation by comparing responses from different subjects on same questions (Kerlinger, 1973). The questionnaires had both open-ended and closed ended questions which were administered with utmost confidentiality (Mugenda and Mugenda, 2003).

3.8.2 Observation Checklists

According to Mugenda and Mugenda (2003) the use of observation checklists (Appendix III) required the researcher to define and develop a list of items to be checked off during data collection and improves the accuracy of study findings. These were used to provide and ascertain the information on the realities on the ground from the selected RTE food premise. This information enhances accuracy since it is a current observation without complications of past or future projections of the respondents (Orodho, 2004).

3.8.3 Key Informant Interviews (KII)

Key informant schedules (Appendix III) were used to gather data from Kisumu County Public Health officer and also from the 4 in charges of the Public Health zones who were purposively selected. Structured questions were administered to the KII on face-to-face to provide in-depth information on the infestation and dynamics.

3.8.4 Photography

Photography was used to provide more information on levels of infestation, awareness and control practices presented as Plates 1 and 2.

3.8.5 Sticky Traps

Information on the infestation levels in the premises was obtained by use of sticky traps (Edge Leaf Manufacturers, China) measuring 16 by 9 sq cm (Plate 3), which were installed overnight at various locations (a trap for an area of 10sq metre) of the selected ready-to-eat food premises. Infestation level was ascertained by enumerating cockroaches trapped on cockroach traps placed overnight in the kitchen, food cabinets, table tops and floors of the food premises and counting the number of cockroaches over a period of five days (Allotey *et al.*, 2006).

After counting cockroach population in the traps over a 5-day period, the daily averages the levels of cockroach infestation were determined by plotting the values on the Wang and Bennet (2006) Scale (Appendix VII).

3.8.6 Secondary Data Collection

Information on the infestation levels, awareness and control practices was obtained from the Kisumu County Public Health Department using retrospective investigations to

determine cockroaches' infestation patterns within Kisumu City. Additional material was obtained from local and international journals, articles, books, newspapers and electronically stored information. Libraries in Maseno University and other institutions of higher learning were visited for more reference material.

3.9 Validity and Reliability

Validity is the measure of the accuracy and meaningfulness of inferences based on the results and measures the extent to which results obtained from the analysis of data represent the phenomenon under study (Mugenda and Mugenda, 2003).

To ensure instrument validity and relevance to the variables under study with a high degree of accuracy, the content selected and included in the data collection tools were confirmed by an expert. Content validity was determined by evaluating test items against the test specifications, drawn up through a thorough examination of the subject domain so as to ensure that it covers a representative sample of the items to be measured.

The sampling tools were pre-tested in a pilot study on 10 respondents who were drawn from the study area but not included in the study sample to ensure accuracy of the instruments, clarity of words and questions and to detect and correct any biasness. Necessary changes were made in the sampling tools before final administration.

Joppe (2002) defines reliability as the extent to which the results obtained are consistent over time and an accurate representation of total population under study. The results gathered from the pilot study are plotted on Crouchback's alpha scale (Nunnaly, 1978). These must be capable of being reproduced under a similar methodology with acceptable reliability. The values range from 0 to 1 with values approaching 1 suggesting higher

reliability and those approaching zero suggesting lower reliability. This questionnaire rated at 0.7 which was reasonably reliable. According to Kombo and Tromp (2006) respondents may give incorrect answers to impress the interviewer, a situation known as respondents' effect. This type of error was surmounted by supplementing the responses with secondary data obtained from reports.

3.10 Data Analysis and Presentation

Statistical Packages for Social Science (SPSS) version 22 program was used are used at Confidence Level 0.05%. The levels of cockroach infestation, vendors' awareness of the infestation and the control practices being used by the vendors were determined by descriptive statistics and Chi-Square from the closed ended questionnaires and the qualitative information obtained from observation checklists. Data was presented in the form of frequency tables and percentages. Qualitative data from open-ended questions were coded and included for analysis. Observation data was used to triangulate quantitative data. Photography data was analyzed through pile sorting and emerging themes on environments/surroundings of the premises that would provide cockroach habitats presented as plates 1 and 2.

3.11 Ethical Considerations

Informed consent of all the study respondents was sought and obtained before their participation in the study (Appendix VI). The participants were furnished with detailed information about the study before seeking their consent. To help ensure anonymity, the respondent's names were not captured. Clearance for the collection of data was sought and obtained from Maseno University School of Graduate Studies (Appendix X).

The proposal went through the University Ethics Review Committee and clearance given (Appendix IX) of the appendices section. Participation in the study was voluntary by reading and signing a consent form (Appendix VI).

3.12 Study Limitations and biases

Limitations are the factors that may influence the interpretation of a study. In this study purposive selection of KII may restrict the possibility of generalization of results. The lack of sufficient secondary data on similar studies in the local area denied the researcher a baseline for infestation levels. These findings however will form the basis for future research.

CHAPTER FOUR: RESULTS

4.1 Introduction

This chapter presents the analyses of the data collected from the respondents. The response rate and the demographics are presented first; each objective is then addressed in its own section. In this chapter, the sections are: Level of cockroaches' infestation in ready-to-eat food premises in Kisumu City, Kisumu County, and awareness of cockroaches' infestation by vendors of ready-to-eat food premises in Kisumu City, Kisumu County, and Cockroaches control practices in ready-to-eat food premises in Kisumu City Kisumu County.

4.2 Questionnaire Response Rate

The researcher calculated questionnaire response rate and the findings were as shown in Table 4.1.

Table 4.1 Response Rate

Category of respondent	Sample	Questionnaire returned	Return rate
Vendors	145	135	93%

According to Mugenda and Mugenda, (2003); 60% response return rate is recommended for a study. This study recorded a (93%) return rate which was considered adequate for analysis, interpretation and generalization. The high response rate among the respondents can be attributed to support, cooperation and diligence from vendors in the ready-to-eat food premises in Kisumu City, Kisumu County.

4.3 Demographic Information

This section presents data and interprets data on the designation of the interviewee, sex of the respondent, age of the respondent, level of education and, work experience and is as presented in Table 4.2.

Table 4.2: Demographic information of the respondents

Variable	Categories	Frequency and proportion
Designation of interviewee	Owner	52(38.5%)
	Manager	83(61.5%)
Gender	Male	53(39.4%)
	Female	82(60.6%)
Age	25-29	62(45.9%)
	30-34	32(23.9%)
	35-39	9(6.4%)
	40 and above	32(23.9%)
Level of education	Primary	53(39.4%)
	Secondary	41(30.3%)
	College	41(30.3%)
Work experience	<-12-Months	43(32.1%)
	>12 Months	92(67.9%)

The respondents were able to state their designation, majority were managers at 83(61.5%) while a minority at 52(38.5%) were owners. This presented a balanced view on infestation levels, awareness and control practices in ready-to-eat food premises in

Kisumu City, Kisumu County. The respondents were able to state their sex, majority at 82(60.6%) were female and least respondents 53(39.4%) were male. Being that the respondents were picked randomly, this meant that the ready-to-eat premises are largely dominated by female operators. Using Chi-Square, the researcher also established that sex of the owner or the manager was important in explaining whether a premise would be infested with cockroaches or not, $p=0.001$, C.L. = 0.05, $df=1$.

The respondents were able to provide their ages, many the respondents at 62(45.9%) were between 25-29 years, 32(23.9%) respondents were of ages between 30-34 and 35-39 years whereas the least respondents at 9(6.4%) and another 32(23.9%) aged 40 and above by using descriptive statistics. The age variation was important in the study in that it gave an impartial view in relation to the modern and traditional pest control methods. The researcher established that the age of the manager or owner was important in explaining whether a premise would be infested with cockroaches or not, $p=0.003$, $df=3$, C.L. = 0.05. The respondents were able to record their level of education, most of them at 53(39.4%) had only primary level of education while the minority at 41(30.3%) each were post-primary level of education possessing secondary and tertiary college level of education. These results indicated that all the respondents had the basic education and were able to clearly comprehend the question, process them and give valid responses. The researcher established that the level of education of the manager or owner was important in explaining whether a premise would be infested with cockroaches or not at $p=0.006$, $df=2$, C.L= 0.05. The respondents stated their work experience, majority at 92(67.9%) had worked for years in the hotelier industry while 43(32.1%) had worked just 12 months and below. This indicated that the respondents had a good feel of what goes

on in relation to cockroach infestation and control, they gave rich insights that enabled the researcher to answer the research questions. Using Chi-Square it was found out that work experience of the manager or the owner was important in explaining whether a premise would be cockroach infested with cockroaches or not $p=0.031, df=1, C.L=0.05$.

4.3 Level of Cockroaches Infestation in Ready-To-Eat Food Premises

The respondents were asked questions on several aspects of cockroach infestation to determine the level of cockroach infestation in the ready-to-eat food premises. Sticky traps were placed overnight in the premises for five consecutive days and number of cockroaches sticking on it recorded; the averages were then worked out per zone and interpreted using the Wang and Bennett (2006) scale. The results are as shown in Table 4.3.

Table 4.3: Level of infestation Indicators and infestation levels

Variable	Category	Frequency and proportion
Spotted a cockroach in premise	Yes	127(94.0%)
	No	8(6%)
Cockroach feces spotted	Yes	77(56.9%)
	No	58(43.1%)
Variable	Category	Mean and Rating
Zone	East	27.1 (Very High_
	Southern	7.94 (Moderate)
	Northern	8.17 (High)
	Western	21.32 (High)

Using descriptive statistics it was observed that majority at 127(94.0%) had seen them in their premises while 8(6.0%) respondents said they had not seen them. This meant that cockroaches are fairly common in the ready to eat food premises in Kisumu. Respondents were able to indicate whether they are able to see cockroach feces and the quantities, majority at 77(56.9%) while a minority of the respondents at 58(43.12%) had not seen the feces in their premises. This confirmed that there was high cockroach infestation in ready to eat food premises in Kisumu City with 77(56.88%) of the facilities being infested at various levels of infestation. It was established that the Eastern zone had the highest mean at 27.1(Very High), the Western zone premise had a mean of 21.32(High), the northern premises gave a mean of 8.17(High) with the Southern zone having the least mean of 7.94(Moderate). The overall mean was 16.13 interpreted as High, this mean that the cockroach infestation in Kisumu city was noted as high.

4.5 Awareness of cockroach infestation signs by vendors in the ready-to-eat food premises

The respondents were asked whether they were aware of any cockroach infestation signs; the locations where cockroaches were spotted, damages caused, and awareness of possible outcomes of infestation and the results were shown in Table 4.4.

Table 4.4: Awareness of Cockroaches Infestations Signs, Locations, damages related to cockroach infestation and Awareness of possible infestation outcomes

Variable	Category	Frequency and proportion
Awareness of infestation signs	Yes	102(75.2%)
	No	33(24.8%)
Spots in the premises were seen	Kitchen	19(14.0%)
	Corners	18(13.0%)
	All over	63(47.0%)
	Food store	5(4.0%)
	Eating area	23(17.0%)
	N/A	7(5.0%)
	Damages related to cockroach Infestation	No damage
	Small damage	60(44.4%)
	Large damage	67(49.6%)
Awareness of possible outcomes of infestation	Yes	108(80.0%)
	No	27(20.0%)
Nature of outcomes	Reduced Clientele	32(23.7%)
	Disease outbreak	55(40.7%)
	Compromised aesthetics	20(14.8%)
	Poor hygiene indicator	28(20.7%)

The respondents stated whether they were aware of any cockroach infestation signs, majority of them at 102(75.2%) said that they were aware with only 33(24.8%) of the

respondents saying that they were not aware. The awareness on the infestation signs is a plus towards controlling cockroach infestation in the ready to eat food premises. The respondents were able to indicate the locations of the premise in which they mostly saw the cockroaches, majority at 63(47.0%) saw them during the day, 23(17.0%) mostly saw the cockroaches in the feeding area, 19(14.0%) saw them in the kitchen mostly, 18(13.0%) saw the cockroaches mostly in the corners of the premise while a minority of the respondents at 5 (4.0%) saw the cockroaches mostly in the food store while 7(5%) did not respond to the question because it was not applicable to them. This results is an indication that most of the ready to eat food premises are likely to be infested since cockroaches are seen everywhere.

Table 4.5: Observation Checklist Results-Premise Cleanliness, Presence and Proportion of Roaches, Presence of Feces and Amount of Feces Observed.

Variable	Category	Frequency	Proportion
Premise storage areas clean	Yes	99	73.3%
	No	36	26.7%
Roaches Present	Yes	87	64.4%
	No	48	35.6%
Roaches present in entire kitchen	Yes	48	35.6%
	No	87	64.4%
Faeces present	Yes	77	57.0%
	No	58	43.0%
A lot of faeces present	Yes	37	27.4%
	No	98	72.6%
A little faeces present	Yes	40	29.6%
	No	95	70.4%
Valid		135	100.0%
Missing		0	
Total		135	

The observation checklist indicated that majority of the premises at 87(64.4%) did have roaches. Cockroaches were spotted in the entire kitchens for 48(35.6%) premises.

Additionally, the checklist showed that their storage areas of most premises at 99(73.3%) were clean whereas those of 36(26.7%) premises were observed not to be clean. Respondents were able to indicate whether they are able to see cockroach feces and the quantities, majority at 77(57.0%), among these 40(29.6%) were able to see a little amount of feces while 37(27.4%) a lot of feces. This study confirmed that there was high cockroach infestation in ready to eat food premises in Kisumu City with 77 (57.0%) of the ready-to-eat premises being infested as indicated by presence of the feces.

4.5.1 Awareness of factors that aggravate the presence of cockroach in the premise

The respondents were asked whether they were aware of the factors that aggravated the presence of cockroaches in their premises; the results are as shown in Table 4.6

Table 4.6: Awareness of factors aggravating cockroach infestation in Ready-to-Eat Food Premises

Variable	Category	Frequency and proportion
Aware of factors aggravating infestation	Yes	77(56.9%)
	No	58(43.1%)
List of factors aggravating infestation	cracks on the wall/ floors	21(27.2%)
	Food spillage	12(15.6%)
	State of drainages	14(18.1%)
	Food storage systems	3(3.9%)
	Garbage emptying frequency	9(11.7%)
	Cockroaches control practices	18(23.4%)

Respondents were able to indicate whether they were aware of the factors that aggravated the presence of cockroaches in their premises, majority at 77(56.9%) were aware and the least at 58(43.1%) not aware. Among those who were aware, some 21(27.2%) indicated that the existence of cracks on the walls and floors aggravated infestations, another 12(15.6%) mentioned food spillages in the premises as a contributing factor with yet others indicating state of drainages, food storage systems, garbage emptying frequency and control practices at 14(18.15%), 3(3.9%), 9(11.7%) and 18(23.4%), respectively. This meant that the respondents were in a position control cockroach infestation in the ready to eat food premises but were seemingly not doing much since the earlier findings pointed to the fact that the cockroach infestation was high. The respondents explained that the factors that aggravated cockroach infestation were darkness, filthiness, careless dumping of wastes, decomposing food stuff and untimely cleaning of utensils.

4.6 Cockroaches Control Practices Adopted in Ready-to-eat Food Premises in Kisumu City

4.6.1 Control practices used, preferences and experts involvement to control cockroaches in the premise

The respondents were asked to state whether they have tried any mechanisms to control cockroaches, their preferences and involvement of experts in their premises; the results are as shown in Table 4.7.

Table 4.7: Control practices, preferences and experts involvement in infestation control by vendors in the Ready-to-eat premises

Variable	Category	Frequency and proportion
Ever used cockroach control mechanism	Yes	97(71.6%)
	No	38(28.4%)
Ever involved experts in controlling cockroaches	Yes	21(15.6%)
	No	114(84.4%)
Control methods in use	Biological	14(10.1%)
	Chemical	67(49.5%)
	Physical	45(33%)
	Cultural	9(6.4%)
Preferred method	Biological	4(2.8%)
	Chemical	109(80.7%)
	Physical	22(16.5%)
	Cultural	0(0.00%)

The respondents were able to state whether they have tried mechanisms to control cockroaches in their premises, majority at 97(71.6%) said yes, whereas the least at 38(28.4%) said no, this meant that awareness on cockroach control practices among the respondents may have been translated into control practices.

There was a significant relationship between trial of mechanisms to control cockroaches and the level of infestation of cockroaches in the ready-to-eat premises in Kisumu City, $p=0.001$, $df=1$, $C.L =0.05$. This meant that the application or non-application of mechanisms to control cockroaches was important in explaining the level of cockroach infestation. The respondents were able to mention the control mechanisms that they use including burning the cockroaches with hot water, cleaning/sweeping dirty surfaces, spraying/application of chemicals, proper food handling, rearranging the premise, Physical killing, proper handling of food wastes, use of traps and keeping cats. Respondents indicated whether they have sought expert advice on how to deal with cockroaches, majority at 114(84.4%) had not sought expert advice only a minority of the respondents at 21(15.6%) had sought advice expert. The respondents who had sought expert advice were concerned with the most effective and less costly cockroach control method that they could adopt. The respondents who had not sought expert advice on cockroach control explained that they lack the consultation fee, some are not aware of the availability of the experts. Respondents were able to state the most preferred method of controlling cockroaches, majority at 109(80.7%) preferred chemical, minority at 22(16.5%) preferred physical and least respondents at 4(2.8%) preferred biological.

This showed that chemical method is the most popular cockroach control method in ready to eat food premises in Kisumu City. The least preferred cockroach control method was biological. There was a significant relationship between the most preferred method of controlling cockroaches and the level of cockroach infestation in ready-to-eat premises in Kisumu City, $p=0.027$, $df=1$, $C.L.=0.05$. This meant that the most preferred method of

controlling cockroaches is important in explaining whether a premise would be infested with cockroaches or not.

4.6.2 Perceived effectiveness of cockroach control practices and frequencies of their application

The respondents were asked to state their perceived effectiveness of the cockroach control practice that they used (Table 4.8).

Table 4.8: Perceived effectiveness of cockroach control practices

Variable	Category	Frequency and proportion
Perceived effectiveness		
Biological	Very effective	9(6.4%)
	Less effective	5(3.7%)
	N/A	121(89.9%)
Chemical	Very effective	57(42.2%)
	Less effective	10(7.3%)
	N/A	68(50.5%)
Physical	Very effective	25(18.3%)
	Less effective	20(14.7%)
	N/A	90(67.0%)
Cultural	Very effective	4(2.8%)
	Less effective	5(3.7%)
	N/A	126(93.6%)
Frequency of application		
Biological	Frequency	5(3.7%)
	Rarely	9(6.4%)
	N/A	121(89.9%)
Chemical	Frequency	31(22.9%)
	Rarely	36(26.6%)
	N/A	68(50.5%)
Physical	Frequency	30(22.0%)
	Rarely	15(11.0%)
	N/A	90(67.0%)
Cultural	Frequency	9(6.4%)
	Rarely	0(0.0%)
	N/A	126(93.6%)

On the biological cockroach control methods, majority at 121(89.9%) did not use it hence not applicable, 9(6.4%) of the respondents said it was very effective with 5(3.7%) respondents saying it was less effective. The chemical methods was not used by a majority of the respondents at 73(54.1%), 57(42.2%) respondents said it was very effective with only 10(7.3%) respondents saying it is less effective. Majority of respondents at 126(93.6%) did not use the cultural methods system, 5(3.7%) respondents said it was very effective while 4(2.8%) respondents opined that it was less effective.

A majority of the respondents at 95(70.6%) did not apply the physical control, 25(18.3%) respondents said that it was very effective with 20(14.7%) saying it is less effective. An inferential analysis by Chi-Square established that there is a significant relationship between the level of effectiveness of cockroach control practices and the level of cockroach infestation in the ready to eat food premises $p=0.041$, $df=1$, $C.L.=0.05$. This meant that the effectiveness or ineffectiveness of cockroach control practices is important in explaining the level of cockroach manifestation in the ready-to-eat food premises in Kisumu City.

The respondents were able state how often they used each of the cockroach control practices, it was established that chemical control was the most frequently used by majority of the respondents at 31(22.9%). The least applied cockroach control practice was the cultural method with 126(93.6%) premises, Biological method were not used by 121(89.9%), physical method was not applied by 90(67%) while chemical was not applied by the least number at 68(50.5%). This showed that the chemical method were the most popular cockroach control method with the least popular being the cultural control method. It was established by Chi-Square that there was a significant relationship

between how often a cockroach control practice was used and the level of cockroach manifestation in the ready-to-eat food premises ($p=0.019$, $df=1$, $C.L.=0.05$). This meant that how often a cockroach control practice is used is important in explaining the level of cockroach infestation.

CHAPTER FIVE: DISCUSSION

5.1 Introduction

This chapter presents the discussions in light of the findings and those from empirical studies done by other scholars in previous studies done on the same themes to establish areas of convergence and divergence.

5.2 Discussions

5.2.1 Levels of cockroach's infestation in ready-to-eat food premises in Kisumu City.

The infestation levels as manifested by the zones corroborate a study by Agbo and Akosu (2013) on cockroach and rodents infestation in Benue State University students' hostel in Makurdi and their epidemiological implications found that overcrowding and refuse accumulation provide conducive breeding grounds for cockroaches and rodents. This is more so because the most densely populated and overcrowded Eastern zone reported the highest infestation levels with the least being Southern zone which has a comparatively lower population density and better environmental care in terms of garbage collection and related activities.

It was observed that the cockroach infestation was very high in the Eastern zone, this converges with the findings of Gholam (2013) that the correlation coefficient between the sanitation rates and infestation rates had significant positive relationship ($n=23$, Spearman correlation coefficient $r=0.445$, $p<0.05$) between sanitation rate and intensity of infestation to mean that the cleaner sections were less likely to be infested as manifested in premises in the Southern zone.

The results for higher levels of infestation in the feeding areas than the kitchen however contradict studies in Thailand have shown that cockroaches as the most common pest in urban are with highest densities in kitchens followed by bedrooms and lastly in the outside of the dwellings (Tawatsin *et al.*, 2001). The higher levels in the Eastern zone seems to be aggravated by the existing poor sanitation poor access to safe water, low education levels are poor hygiene practices and waste disposal practices and they are similar to findings in a study done in Tafteng *et al.*, 2015 in Nigeria.

The condition of the infrastructure is another effective factor in determining levels of infestations as older buildings with more crevices and cracks register more infestation than new ones and studies have revealed a correlation between the age of a building and infestation levels of cockroaches as witnessed by Shahraki *et al.*, 2013. Both of these findings suggest a similar pattern to the one observed in results from this study and as such add substance to the viability.

Results from observation checklists indicated that cockroaches could be seen in the day in most ready to eat food premises. These results converge with Swadner (1995) assertion that cockroaches are nocturnal and are rarely seen during the day unless populations are very high thus a sign of high levels of infestation.

The respondents said that cockroach feces are usually visible in the premises. These again were signs of infestation as stated by Rivault & Cloarec (1997) who noted that visibility of cockroach faeces and foul smell in the environment from faeces is a sign of heavy cockroaches' infestation.

5.2.2 Awareness on cockroach infestation by vendors of ready-to-eat food premises in Kisumu City.

Results indicate that vendors are fairly aware of the cockroach infestation factors. This meant that the respondents were in a position control cockroach infestation in the ready to eat food premises but were seemingly not doing much since the earlier findings pointed to the fact that the cockroach infestation was high. This finding contradicts observation Robinson, 1996a that awareness of the infestation factors translates into efforts that substantially reduce the cockroach infestation levels.

The results explained that the factors that aggravated cockroach infestation were darkness, filthiness, careless dumping of wastes, decomposing food stuff and untimely cleaning of utensils. These outcomes converge with earlier studies by Hedges, 1999 which posted similar results.

It was also established that vendors in the ready to eat food premises were aware of cockroach control mechanism and that 77(56.9%) were involved in cockroach control this was in line with Ruben (2013) assertions that pest management requires participation of the hotel management and staff not just the pest control contractors. He notes that when functioning well, the hotel management and the workforce communicate regularly and have clear responsibilities of monitoring and controlling the pests' infestation in their premises.

It was also established that vendors were aware that the cockroach infestation could have adverse effects of which 55(40.7%) emphasizing that cockroach infestation may result into an increase in enteric diseases transmission; this corroborates the findings of Murphy

et al. (2007) that the involvement of rodent and cockroaches in transmission of life-threatening infections is epidemiologically significant and could be responsible for increasing incidence of emerging infectious diseases.

Fewer respondents indicated that infestation of a premise by cockroaches would lead to a decline in clientele with others positing that the presence of cockroaches is an indicator of poor hygiene status of the premises. These findings support earlier studies by CIEH, (2009) which revealed that consequences of high levels of cockroaches' infestation in the ready-to-eat food premises may include prosecutions by environmental health departments, stopped production and the adverse publicity thus resulting in direct economic losses.

5.2.3 Cockroaches control practices in ready-to-eat food premises in Kisumu City.

The use of physical killing, proper handling of food wastes, use of traps and keeping cats converges with Rivault *et al* (1992) who postulated that sanitation is a key concept in relation to control of pests in urban environments and it has been noted that insanitary conditions results into proliferation of cockroaches.

Many 114(84.4%) had not sought expert advice on cockroach control with most of them saying that they have the basic knowledge on cockroach infestation and control. These findings are supported by Webb *et al* (1999) assertion that managers of the ready-to-eat food premises are unaware of safe pesticides usage in environmental friendly ways.

This showed that chemical method is the most popular cockroach control method in ready to eat food premises in Kisumu City while the least preferred cockroach control method was biological. This findings concur with observations by Gooch, 1999 that chemical control is the most effective cockroach infestation control mechanism against German cockroach is the chemical.

CHAPTER SIX: SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter presents the Summary of findings, Conclusions and Recommendations arrived at based on the study findings.

6.2 Summary of Findings

The mean level of cockroaches' infestation in the ready to eat food premises in Kisumu City is high as reflected on the Wang and Bennet Scale. The study revealed that the vendors are quite aware of cockroach infestation signs, factors aggravating infestation and possible control practices. The four most common cockroach control methods used in controlling cockroach infestation were chemical, physical, biological and cultural. The most effective and preferred cockroach infestations control was chemical method while the least preferred control method is the cultural.

6.3 Conclusions

6.3.1 Level of cockroach's infestation in ready-to-eat food premises in Kisumu City.

In regards to the first objective that determined the level of cockroach's infestation in ready-to-eat food premises in Kisumu City, there was a high mean level of cockroaches' infestation in the ready to eat food premises in Kisumu City as reflected on the Wang and Bennet Scale.

6.3.2 Awareness on cockroach infestation by vendors of ready-to-eat food premises in Kisumu City.

The study revealed that the vendors are quite aware of cockroach infestation signs, factors aggravating infestation and possible control practices; this puts them at an

advantaged position in fighting cockroach infestation the ready to eat food premises in Kisumu City.

6.3.3 Cockroaches control practices in ready-to-eat food premises in Kisumu City.

Four most common cockroach control methods used in controlling cockroach infestation were chemical, physical, biological and cultural. The most effective and preferred cockroach infestations control was chemical method while the least preferred control method is the cultural.

6.4 Recommendations

6.4.1 Level of cockroach's infestation in ready-to-eat food premises in Kisumu City.

There is need to improve the sanitation of the external environment through effective garbage collection and clearance and drainage systems to reduce possibilities of infestation and or re-infestation by both the ready-to-eat premises management teams and City's Public Health Department.

6.4.2 Awareness on cockroach infestation by vendors of ready-to-eat food premises in Kisumu City.

Regular sensitization sessions for the ready-to-eat food premises vendors on the possible adverse public health outcomes of cockroaches' infestation as well as cockroach control mechanisms and what works best at different levels of manifestation by Public Health Department.

Capacity building for the vendors on knowledge of cockroaches, their biology, ecology and associated potential public health outcomes is fundamental since it contributes to

prevention of infestations by aiding identification as well as shaping attitudes and practices of the workforce in the industry.

The need for continuous monitoring of cockroaches with traps on a regular basis to avert infestation and or re-infestation must be underscored in the premises.

6.4.3 Cockroaches control practices in ready-to-eat food premises in Kisumu City.

A properly formulated and executed cockroach's infestation policy is an investment in the future of this City to mitigate the consequences of disease burdens which may result from the cockroaches' infestation. Addressing the infestation factors calls for innovative strategies coupled with executive commitment. The IPM should be widely adopted in ready-to-premises in Kisumu City incorporating bait and other non-chemical methods to provide a high level of cockroach control.

6.5 Recommendations from the study for further research

A study should therefore be done on the various characteristics that result in the differential cockroach infestation in the ready to eat food premises in Kisumu City. Similar studies should be conducted in other urban Cities to compare the outcomes in terms of infestation levels, awareness levels and the control practices to provide deeper understanding of the cockroach infestation dynamics.

In addition to this study, it would be important to conduct a broader study on other pests' infestation levels, awareness and control practices of vendor in all the food and allied industries in Kisumu City since pests do not exist as very isolated entities.

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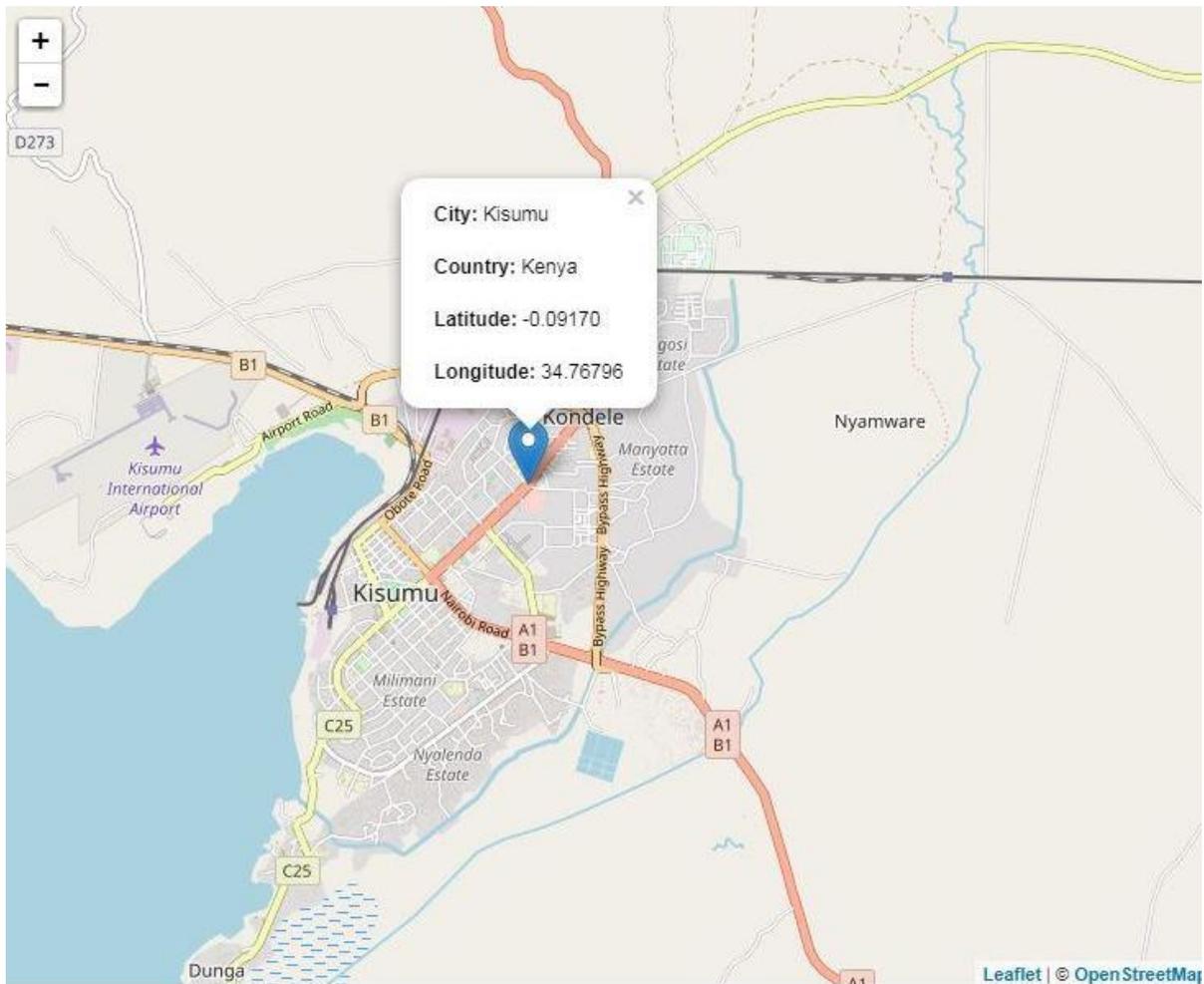
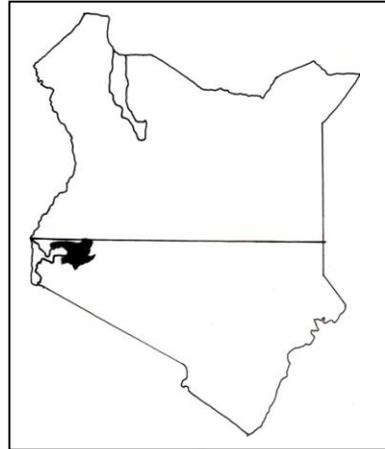
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APPENDICES

APPENDIX I : MAP OF KENYA SHOWING KISUMU CITY



APPENDIX: II QUESTIONNAIRE

Form track number/code:

Hello, my name is a researcher from Maseno University. You have been chosen to help get information about levels of cockroaches' infestation, knowledge and control practices adopted in the ready-to-eat food premises in Kisumu City. Your participation is voluntary, and you are free to decline or withdraw anytime. A consent form is attached separately for you to sign in confirmation of your acceptance to participate. The information you give will be kept absolutely confidential, and only used for the purpose of this research. Your name and/or your identity will not be revealed or mentioned to anyone. So PLEASE DO NOT write your name anywhere on this form.

SECTION 1: Socio-demographic information

1.1 Designation of interviewee.....

1.2 Name of premise or facility.....

1.3 Sex of respondent

0. Male

1. Female

1.4 Age of respondent

1. 25-29

2. 30-34

3. 35-39

4. 40-above

1.5 Level of education

1-Primary

2-Secondary

3-College

4-University

5-None

1.6 Work Experience

-Months

--Years

SECTION TWO; LEVELS OF INFESTATION AND AWARENES

2.1. Are you aware of any cockroach infestation signs in your RTE food premise?

Yes No

2.2 If yes in 1, in which areas of your premise have you seen cockroaches?

.....

2.3. Are you able to see cockroach feces?

Yes No

2.4. What has been the extent of damages on foodstuffs by cockroaches?

No extent Small extent large extent

2.5. Are you aware of possible health outcomes of cockroach infestation in your premise?

Yes No

2.6.If yes in 2.5, name them

.....

2.7 .Has a client complained about cockroaches in you premise?

Yes No

2.8. If yes in 2.7, what was the complaint about?

.....

.....

.....

2.9. Are you aware of factors that aggravate the presence of cockroaches in the premises?

Yes No

22. If yes in 2.9, list them.....

SECTION 3: Cockroach control Practices

1. Have you ever tried any mechanism to control cockroaches in your premise?

Yes No

2. What cockroach control mechanism are you familiar and how often do you use them

Mechanism	Frequency of use(Frequently, Rarely)	Perceived effectiveness(Very effective, Less Ineffective)
Biological		
Chemical		
Physical		
Cultural		

.....

3. Which of the following is your most preferred method of controlling cockroaches and the mechanism perceived most effective

Biological Chemical Physical Cultural

Explain your answer.....

4. To what extent are your staffs involved in controlling cockroaches?

No extent Small extent Large extent

5. What cockroach control measures are your staff involved in?

.....

6. Have you ever sought expert advice on how to deal with cockroaches?

Yes No

Explain your answer

.....

7. What are some of the challenges that you have faced in controlling cockroaches in your premises?

APPENDIX III: OBSERVATIONAL CHECKLIST

Checklist for assessing Cockroach Infestation in Ready to eat-food premises

	Statement	Yes	No
1.	The room is well light		
2.	Presence of cracks in the wall or floors		
3.	Unusual roach related odor in the room		
4.	There are wet surfaces in the room		
5.	Presence of food spillage on the floor		
6.	State of drainage system		
7.	Foodstuff stored in sealed containers		
8.	Storage areas are clean		
9.	The room is spacious		
10.	Keep indoor garbage in lined, covered containers.		
11.	Garbage emptied daily		
12.	Roach droppings spotted in the rooms		
13.	Can you spot a cockroach in the premise in the day		
14.	Roach eggs spotted under surfaces or anywhere in the rooms		
15.	Any form of roach control spotted		
16.	Roaches in entire kitchen area, under sinks, refrigerator, dishwasher, stove, microwave oven, other cooking appliances, , basement		

APPENDIX IV: KEY INFORMANT INTERVIEW GUIDE

A. Identification

1.0	Designation of interviewee	
1.1	Interview venue	
1.3	Station of work	
1.4	Date of interview	
1.5	Name of interviewer	

Explain the extent to which ready-to-eat food premises in Kisumu City are infested by cockroaches?

What factors accelerate cockroach infestation in ready-to-eat food premises in Kisumu City?

Explain the level of knowledge on cockroach infestation by the owners of ready-to-eat premises?

Explain the extent to which cockroach control practices have been adopted in ready-to-eat food premises in Kisumu City?

What are some of the barriers to cockroach control in ready-to-eat food premises in Kisumu?

What have been the consequences of poor cockroach control in ready-to-eat food premises in Kisumu City?

What is currently being done and what more needs to be done by the ready-to-eat food premises in Kisumu City in order to control cockroaches?

APPENDIX V: STICKY TRAP COCKROACH COUNT TOOL

This tool will be used to capture information on the count of cockroaches stuck on the sticky traps placed in the premise over night for a period of 5 days.

Name of the Premise.....

	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5
Number of cockroaches counted on the stick trap					

APPENDIX VI: RESPONDENTS CONSENT FORM

Name _____ of _____ the _____ respondent

.....

Address

.....

Telephone.....

Premise.....

I hereby accept to voluntary participate in this study being conducted in Kisumu City on: *Assessment of cockroaches infestation levels, awareness and control practices in the ready-to-eat food premises in Kisumu City, Kisumu County*, being conducted by Mr. Chrispine Ochieng Ngwawe,a Master of Public Health student of the School of Public Health and Community Development, Maseno University.

I fully understand the nature of study and believe the information given will be kept confidential and used for intended purpose only.

Signature

.....

Date:.....

APPENDIX VII: COCKROACH INFESTATION LEVELS INDEX

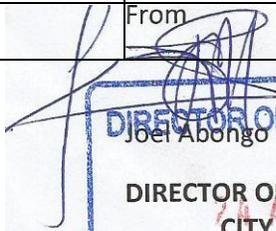
$0 \leq x < 1$	Clean
$1 \leq x < 3$	Low
$3 \leq x < 8$	Moderate
$8 \leq x < 26$	High
$26 \leq x < 50$	Very high
$x \geq 50$	Abundant

Wang and Bennett (2006)

APPENDIX VIII: PUBLIC HEALTH DEPARTMENT CITY OF KISUMU FOOD PREMISES

EASTERN ZONE	SOUTHERN ZONE	NORTHERN	WESTERN
Memories	Palmers Hotel	Highway	Akamba Lane Hotels-18
Hiramagrin	Kellys Hotel	Comrade	Kisumu Hotel
Obama	Whilspring	Mamba Hotel	Pentagon
GorMahia	Royal City	Tamiez	Dal International
Yasin	East View Hotel	Outlets at Wayside -11	Hotels Behind Sport Ground- 12
Semos	Park View	Le Savanna	Ramogi
Cosmos	Eco Lodge	Buffalo	Lake View
Joventure	Public Service Club	Geohasmi	New Victorian
Sweet Melon	Sunset Hotel	Metro Park	Awala
Stead View	Sovereign	Vunduba	Riversand
Silver	Nyanza Club	Ethiopian Restaurant	Kaurai
Yasmin	Mama Safi	Perch Hotel	Scottish Tan Tan
T. Grill	Hotel RingroadNyalenda	Hotel Miriam	Bostoncafe
Mama Millies	Yanga	Lwangni	Royal City
Silverwan	Museum Hotel	Tilapia Beach Hotel	Buccaneers
Dubai Complex	Twiga Sanctuary	Ranch Investment	Pankies
Lakebreeze	Classic Hotel	Neighbor Joint Pub	Samba
Chacalica	Kika Hotel	Victoria Oneko	Octopizo
Gross Over	Dream House	Kisumu Rose Garden Inn	Signature
Hang Over	Acacia	Eateries along the beach-22	Swan Centre Hotel
Jublee	Victoria Comfort		Kusumu Fried Chicken
Lewin	Railway Institute		Italian Woodfire Pizza
Suedoy	Dunga Hill Camp		Centre Cafeteria

Stanbradox	Metropolitan		St. Ann Guest House
Nassalica	Dunga Hill Camp		Kisumu Park Center
Bismillah	Club Chez		Alnort Cafeteria
Harambee	Buddys		Whistles Club
Tin Toler	Family Kitchen		Bacadia Club
Geneva Guest House	Duke Of Breeze		Labella Hotel
Embassy Hotel	Omino Crescent		Ukwala Hotel
			Eateries Behind Varsity Plaza(25)
	From		


DIRECTOR OF PUBLIC HEALTH
 Joel Abongo
DIRECTOR OF PUBLIC HEALTH
 20 AUG 2015
CITY OF KISUMU
CITY OF KISUMU

APPENDIX IX: LETTER FROM MUREC



MASENO UNIVERSITY ETHICS REVIEW COMMITTEE

Tel: +254 057 351 622 Ext: 3050
Fax: +254 057 351 221

Private Bag – 40105, Maseno, Kenya
Email: muerc-secretariate@maseno.ac.ke

FROM: Secretary - MUERC

DATE: 2nd November, 2015

TO: Chrispine Ochieng Ngwawe
EL/ESM/0421/2013
Department of Public Health
School of Public Health and Community Development, Maseno University
P. O. Box, Private Bag, Maseno, Kenya

REF: MSU/DRPI/MUERC/00193/15

RE: Assessment of cockroach infestation levels, knowledge and control practices in ready to eat food premises in Kisumu County, Kenya. Proposal Reference Number MSU/DRPI/MUERC/00193/15

This is to inform you that the Maseno University Ethics Review Committee (MUERC) determined that the ethics issues raised at the initial review were adequately addressed in the revised proposal. Consequently, the study is granted approval for implementation effective this 2nd day of November, 2015 for a period of one (1) year.

Please note that authorization to conduct this study will automatically expire on 1st November, 2016. If you plan to continue with the study beyond this date, please submit an application for continuation approval to the MUERC Secretariat by 2nd October, 2016.

Approval for continuation of the study will be subject to successful submission of an annual progress report that is to reach the MUERC Secretariat by 2nd October, 2016.

Please note that any unanticipated problems resulting from the conduct of this study must be reported to MUERC. You are required to submit any proposed changes to this study to MUERC for review and approval prior to initiation. Please advise MUERC when the study is completed or discontinued.

Thank you.

Yours faithfully,

Dr. Bonuke Anyona,
Secretary,
Maseno University Ethics Review Committee



Cc: Chairman,
Maseno University Ethics Review Committee.

MASENO UNIVERSITY IS ISO 9001:2008 CERTIFIED



**APPENDIX X: LETTER FROM MASENO UNIVERSITY SCHOOL OF
GRADUATE STUDIES**



**MASENO UNIVERSITY
SCHOOL OF GRADUATE STUDIES**

Office of the Dean

Our Ref: EL/ESM/0421/2013

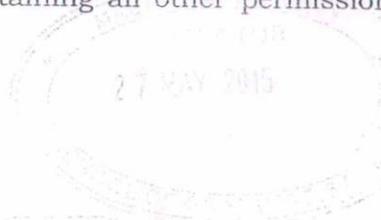
Private Bag, MASENO, KENYA
Tel:(057)351 22/351008/351011
FAX: 254-057-351153/351221
Email: sgs@maseno.ac.ke

Date: 26th May, 2015

TO WHOM IT MAY CONCERN

**RE: PROPOSAL APPROVAL FOR NGWAWO OCHIENG CHRISPINE —
EL/ESM/0421/2013**

The above named is registered in the Master of Public Health in the School of Public Health and Community Development, Maseno University. This is to confirm that his research proposal titled "Assessment of Cockroaches Infestation Levels, Knowledge and Control Practices in the Ready to Eat Food Premises in Kisumu City, Western Kenya" has been approved for conduct of research subject to obtaining all other permissions/clearances that may be required beforehand.




Prof. P.O. Owuor
DEAN, SCHOOL OF GRADUATE STUDIES

