

**ASPATIAL DISTRIBUTION STUDY OF ACUTE GASTROENTERITIS AND  
ASSOCIATED BACTERIAL ISOLATES FROM DOMESTIC WATER SOURCES IN  
ILE-IFE, NIGERIA**

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**B. Sc.(Akungba)**

**A THESIS SUBMITTED TO THE DEPARTMENT OF MICROBIOLOGY,  
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FOR THE AWARD OF THE DEGREE OF MASTER OF SCIENCE (M. Sc.) IN  
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NIGERIA**

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NIGERIA**DEGREE:** MASTER OF SCIENCE IN MICROBIOLOGY**YEAR:** 2017

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This is to certify that this research study was carried out by Omoyemi OGUNBODEDE as part of the requirements for the award of Master of Science (M. Sc.) degree in Microbiology of the Obafemi Awolowo University, Ile-Ife.

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## DEDICATION

This M. Sc. program is dedicated to the Almighty, the all Compassionate, Most Merciful, Most Gracious and Ever dependable God. I beseech him and glorify him for all he has been doing for me.

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## **LIST OF ABBREVIATIONS**

AGE	=	Acute Gastroenteritis
GIS	=	Geographical Information System
GPS	=	Global Positioning System
DO	=	Dissolved oxygen
BOD	=	Biological Oxygen Demand
PCR	=	Polymerase Chain Reaction
WHO	=	World Health Organization
EU	=	European Union
NAFDAC	=	National Agency for Food and Drugs Administration control
NIS	=	Nigerian Industrial Standards
EPA	=	Environmental Protection Agency for Safe Drinking Water
UNEP	=	United Nation Environment Programme
ESBL	=	Extended Spectrum Beta Lactamase
LISA	=	Local Indicators of Spatial Distribution
KD	=	Kernel Density
MPN	=	Most Probable Number
MAR	=	Multiple Antibiotic Resistance

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## ABSTRACT

This study determined the spatial distribution of acute gastroenteritis, isolated and characterized and determined the antibiotic susceptibility pattern of bacteria from the domestic water sources and soils from the implicated hotspots in Ile-Ife. It also determined the physical and chemical parameters of water quality of water from the identified hotspots. This were with the view to determining possible contamination of the domestic water from the implicated areas, detect the extended spectrum beta lactamase (ESBLs) and the resistance genes of the bacteria isolates and likely hotspots for acute gastroenteritis within the identified hotspots.

A Handheld Global Positioning System (GPS) receiver was used to obtain co-ordinates of the recorded households with fatalities of acute gastroenteritis from 2008-2012. The maps were scanned, imported into ArcView Geographical Information System (GIS) and geo-referenced using points with known geographical co-ordinates. Water and soil samples were collected from drinking water sources and soil sample from soil close to the drinking water sources respectively. Samples were collected every week from different sources between January to March, 2016. Antibiotic susceptibility pattern of the isolates were conducted using standard protocols while, the detection of the ESBL gene (SHV) was done using PCR based techniques, the results were statistically analysed using Graphpad Prism 6.

Using conventional biochemical kits, the bacteria isolates were identified as *Enterobacter* spp., *Serratia* spp., *Klebsiella* spp., *Shigella* spp., *Escherichia coli*, *Citrobacter* spp., *Yersinia* spp., *Proteus* spp., *Kluyvera* spp., *Aeromonasspp*. Physicochemical analysis showed the mean values of pH was in the range of  $5.12 \pm 0.11$  to  $7.30 \pm 0.43$  with Akarabata and Ireto 2 having the

highest and least pH values respectively. High values were noticed in water quality parameters such as: total dissolved solid with range  $55.50 \pm 16.24$  to  $501.80 \pm 60.2$  mg/L and electrical conductivity value range between  $7.56 \pm 0.83$  to  $151.09 \pm 23.16$ . The highest DO ( $1.467 \pm 0.133$  mg/L) and BOD ( $0.596 \pm 0.120$  mg/L) values were observed in Iremo 5 and Iremo 1 respectively. Bacteriological evaluation of water samples from Ife East Local Government, showed heterotrophic plate count (HPC) ranged between  $2.832 \pm 0.212$  and  $4.076 \pm 0.093$  Log cfu/mL. Total coliform count (TCC) ranged between  $19.60 \pm 5.144$  and  $758.60 \pm 359.8$  MPN index/100mL. Water samples from Ife Central Local Government had Heterotrophic plate count ranged between  $2.522 \pm 0.119$  and  $4.044 \pm 0.060$  Log cfu/mL. TCC ranged between  $0.00 \pm 0.00$  and  $861 \pm 466.0$  MPN index/100mL. Antibiotic susceptibility study showed 83.61% of the isolates were resistant to cefuroxime, (83.6%) cefixime, (81.1%) augmentin, (63.6%) ceftazidime, (58.2%) nitrofurantoin, (50.9%) ofloxacin and (38.2%) gentamicin. Nine (8.1%) of the isolates subjected to phenotypic detection of ESBL genes showed the presence of these genes. SHV gene was detected in 5 (55.6%) of the isolates.

The study concluded that acute gastroenteritis was endemic in the study area, with greater vulnerability in areas where clean water and proper sanitary conditions were inadequate.

## CHAPTER ONE

### INTRODUCTION

#### 1.1 Background to the Study

Water is one of the indispensable natural resources useful for developmental purposes in both urban and rural areas. Despite this, most of the rural communities in the developing countries, especially Nigeria, lack access to potable water supply. They depend commonly on rivers, streams, wells, and ponds for daily water needs (WHO, 2015). However, World Health Organization (WHO, 1993) maintained that water from most of these sources was contaminated, yet they are used directly by the inhabitants. Agricultural wastes such as pesticides, fungicides and fertilizers, human and animal wastes, seepage from pit latrines and septic tanks, refuse dump, industrial, domestic and municipal wastes released into water bodies are often responsible for surface water contamination (Vanni *et al.*, 2005). Most water resources accessible to households in rural areas are subjected to chemical and biological contaminations which may come from animals, septic tanks, storms water runoff (Sawant *et al.*, 2013). Contaminated water is associated with high public health risks. It leads to the spread of diseases such as cholera, typhoid and diarrhoea. According to Grabow (1996), the diseases associated with most water supplies include acute gastroenteritis, campylobacteriosis, shigellosis, salmonellosis, cholera and a variety of other bacteria as well as fungal, viral, and parasitic infections.

Water provided for direct consumption and ingestion as food should be of a quality that does not represent a significant risk to human health. The failure to provide safe drinking water and adequate sanitation services to people is perhaps the greatest development failure of the

20<sup>th</sup> century. The most egregious consequence of this failure is the high rate of mortality among young children from preventable water-related diseases (Gleick, 2002). Although water-related diseases have largely been eliminated in most developed nations, they remain a major concern in much of the developing world. The World Health Organization estimated in year 2013 that there are 1.7 billion cases of diarrhoea each year in addition to millions of other cases of illness associated with lack of access to clean water. Since many illnesses are undiagnosed and unreported, the true extent of these diarrhoea diseases is unknown. Diarrheal diseases have been reported to cause 1.5 million deaths in the year 2012 (WHO, 2014). A wide range of estimates is available in public literature, ranging from 2 million to 12 million deaths per year (Gleick, 2002). Many a times when domestic water source is contaminated with faecal material and then ingested by human being, it results into various forms of illness.

Diseases primarily transmitted through the faecal-oral route include diarrhoea, typhoid, cholera and infectious hepatitis. Diseases acquired through faecal-oral routes are associated with acute symptoms (with a probability of death). Transmission may occur through a variety of mechanisms, including consumption of contaminated water and food as well as through person to person contact (João, 2010). Other factors apart from water and sanitation facilities and hygiene may significantly influence acute gastroenteritis (Vanderslice and Briscoe, 1995; Al-Ali *et al.*, 1997).

## 1.2 Gastroenteritis

The term *gastroenteritis* refers to several conditions affecting the gastrointestinal system that exhibits watery or unformed stools and are usually caused by infections or intoxications with a biological agent (Gilbert, 2008). Gastroenteritis is an inflammation of the intestines that causes

diarrhoea, abdominal cramps, nausea, loss of appetite, and other symptoms of digestive upset. In adults, the two most common causes of gastroenteritis are viral and bacterial infections.

Gastroenteritis contribute significantly to the burden of illness from infectious diseases worldwide. Diarrhoea is the second leading cause of preventable illness in children under age five (Kosek *et al.*, 2003; Black *et al.*, 2010 and Wardlaw *et al.*, 2010). It has been reported that a strong association between gastroenteritis with factors such as poor sanitation, inadequate access to safe drinking water and other risk factors exist (Wardlaw *et al.*, 2010; WHO, 2013). The risk factors however appear to be distributed differently between developed and developing countries and as a result, the type of organism may differ between each setting (Fletcher *et al.*, 2013). Developing countries often experience poor sanitation and poverty related risk factors, which predisposes their population to diarrhoea illnesses. However, the incidence of illness in developed countries tend to be less generic and more related to seasonality, travel and food borne transmission (WHO, 2013). Several enteric micro-organisms are responsible for gastroenteritis and can be either bacterial, viral or parasitic in nature (Schmidt *et al.*, 2003). A review of the literature world-wide indicates that a causative organism is identified in about 50% of symptomatic cases (Georges *et al.*, 1984; Dutta *et al.*, 1991; Boga *et al.*, 2005 and Abba *et al.*, 2009).

Gastroenteritis can be either acute self-limiting infections or chronic idiopathies (Lamps, 2007). Both acute and chronic infections can be caused by pathogenic bacteria, viruses and parasites. Gastroenteritis can also be caused by idiopathic diseases arising from internal dysfunctions of gastrointestinal tract and this include diseases such as Idiopathic bowel disease, Crohn's disease and ulcerative colitis (Pintér and Kolesárová, 2004; Lamps, 2007).