

**RETROSPECTIVE AND PROSPECTIVE STUDIES ON DIARRHOEA IN LAMBS AND  
KIDS IN A SMALL RUMINANT RESEARCH PROGRAMME IN  
ZARIA, KADUNA STATE, NIGERIA**

**BY**

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**JUNE, 2019**

## DECLARATION

I declare that the work in this Dissertation entitled “**Retrospective and Prospective Studies on Diarrhoea in Lambs and Kids in a Small Ruminant Research Programme in Zaria, Kaduna State, Nigeria**” has been carried out by me in the Department of Veterinary Medicine, Faculty of Veterinary Medicine, Ahmadu Bello University Zaria, under the supervision of Professor L.B. Tekdek, Professor A.K.B. Sackey and Professor J.O.O. Bale. The information derived from literature has been duly acknowledged in the text and a list of references provided. No part of this Dissertation has previously been presented for the award of a degree or diploma at any university.

Aliyu ADAJI

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Signature

\_\_\_\_\_  
Date

## CERTIFICATION

The Dissertation entitled **“RETROSPECTIVE AND PROSPECTIVE STUDIES ON DIARRHOEA IN LAMBS AND KIDS IN A SMALL RUMINANT RESEARCH PROGRAMME IN ZARIA, KADUNA STATE, NIGERIA”** by Aliyu ADAJI, meets the regulations governing the award of the degree of Master of Science of Ahmadu Bello University, Zaria and is approved for its contribution to scientific knowledge and literary presentation.

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## **DEDICATION**

This work is dedicated to my Father, Mother and The Lord God Almighty.

## ACKNOWLEDGEMENTS

I express my gratitude to Almighty God, my Creator and the source of my living. I am highly indebted to my supervisors, Prof. L.B. Tekdek, who despite his tight schedules attended to me and made this work a success, Prof. A.K.B. Sackey and Prof. J.O.O. Bale for their mentorship and providing the materials for this work and their immense contributions.

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## ABSTRACT

Retrospective and prospective studies of Yankasa lambs and Red Sokoto goat kids were evaluated for the prevalence of diarrhoea retrospectively over a ten year period and prospectively for two years in a Small Ruminant Unit of a Research Institute in Zaria. Data were collected and analysed using Pearson Test. Considering the retrospective studies; the total number of Yankasa lambs and Red Sokoto goat kids examined were 1569. Of these, the occurrence of diarrhoea in both species was 567 (36.2%). The occurrence in Yankasa lambs and Red Sokoto goat kids was 446 (38.8%) and 121 (28.9%) respectively. There was significant difference ( $P < 0.0001$ ) in the occurrence of diarrhoea among Yankasa lamb and Red Sokoto goat kids. The occurrence was higher in Yankasa lambs than in the Red Sokoto goat kids. Considering yearly occurrence of lambs and kids diarrhoea in the Research Institute, the occurrence was highest in 2005 (85.0%) and lowest in 2003 (10.0%) among lambs, while the occurrence among the kids was highest in 2009 (69.4%) and no case of diarrhea was reported in the years 2002 and 2004. The differences were statistically significant ( $P = 0.0001$ ). Considering seasonal variation, diarrhoea occurred throughout the period under study in Yankasa lambs and Red Sokoto goat kids, with the highest 187 (41.9%) occurrence in Yankasa lambs and 53 (43.8%) in Red Sokoto goat kids both in the wet season while the lowest 102 (22.9%) in Yankasa lambs and 25 (20.7%) in Red Sokoto goat kids both occurred in the dry season. The sex specific rates of diarrhoea was higher in females Yankasa lambs (42.8%) than in females Red Sokoto goat kid (25.4%). Similarly, it was also higher in male Yankasa lambs (34.9%) than in the male Red Sokoto goats kid (31.9%). However, there was no significant association ( $P = 0.2697$ ) between sex and the occurrence of diarrhoea in lambs and kids in the Research Institute. Considering the cause of diarrhoea, diarrhoea due to unknown aetiology (35.9%) had the highest occurrence of diarrhoea in Yankasa

lambs followed by coccidiosis (33.9%) while helminthosis (30.3%) being the least. Similarly, diarrhoea due to unknown aetiology (34.7%) had the highest occurrence in Red Sokoto goat kids followed by coccidiosis (33.1%) with helminthosis (32.2%) being the least (Table 4.5). There was no significant association ( $p>0.05$ ) between the enteric pathogens reported and the occurrence of diarrhoea in lambs and kids in the Research Institute. The prospective study was for the period of two years (2012 and 2013). A total of 300 samples, were examined, of which 247(82.3%) were for diarrhoeic lambs and kids consisting of 160(82.1%) Yankasa lambs and 87(82.9%) Red Sokoto goat kids. There was no significant ( $p>0.05$ ) association between prevalence of diarrhoea and age of lambs. These may be due to management practices. However, there was a statistically significant ( $p<0.05$ ) association between prevalence of diarrhoea and sex of animal species. The study revealed that there was a significant ( $p<0.05$ ) association between PCV and the prevalence of diarrhoea with the mean diarrhoeic PCV of 31.6% for goat kids and 28.3% for the lambs . There was also a statistically significant ( $p<0.05$ ) association between BUN and the prevalence of diarrhea with the mean BUN of 4.8mmol/L for the goat kids and 4,9mmol/L for the lambs. Diarrhoea caused by bacteria such as *Escherichia coli* alone 203(82.2%), combination of *Escherichia coli* and *Staphylococcus* sp 7(2.8%), protozoa such as *Coccidia* spp alone 25(10.1%), combination of protozoa and gastrointestinal worms like the *Coccidia* spp and *Strongyle* 11(4.45%), and combination of *Coccidia* spp, *Strongyle* and *Monezia* spp 1(0.4%). These could be attributed to management and environmental factors. It is recommended that good management practices should be strictly adhered to. This study revealed that the prevalence of diarrhea was higher among Yankasa lambs 1 to 4 weeks old and Red Sokoto Goat kids 1 to 3 weeks old. The high prevalence of diarrhea observed was attributed to season especially wet season.

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## **CHAPTER ONE**

### **1.0 INTRODUCTION**

#### **1.1 Background**

Sheep and goats are small ruminants that are widely distributed throughout the world and they are good sources of animal protein forming about 38% of Nigeria's total meat output or supply (Umohet *al.*, 1996; Williamson and Payne, 1978; Adu and Ngere, 1979). They are also used during festivals in Nigeria (Ijiet *al.*, 1995). Their skin is used by leather industries for making shoes, belts, footballs, bags, cloths and goat milk is good for human consumption because of its high protein content. (Umohet *al.*, 1996). Sheep and goats are highly prolific and they serve as a source of income to the rural household (Lakpiniyet *al.*, 2002; Oluwatomi, 2010). The Red Sokoto goat is predominant breed in the north while the West African Dwarf goats are predominantly in the southern part of Nigeria (Akpaetal., 1998). There are three major breeds of sheep in northern Nigeria: Yankasa, Balami and Ouda, these breeds differ in size, coat colour and shape of ears while the West Africa dwarf is predominant in the southern part of Nigeria (Adu and Ngere, 1979).

In Nigeria, sheep are kept mostly by Fulani pastoralists and some subsistence farmers, they also adapt well to the extensive system of management. Crop farmers keep goats where they adopt the management practice of housing them in the night and tethering them by day especially during the rainy season. Feed may be "cut-and-carry" to the goats before harvesting of food grain crops from farms, and they are then allowed to roam about freely after the harvest and during the dry season (Otchere and Nimo, 1976).

There are about 41.1 million sheep and 68.5million goats in Nigeria (National Bureau of Statistics, 2014). These populations of sheep and goats are low when compared to the ever

increasing human population placing high demand on meat and meat products. Diarrhoea occurs when there is increased frequency, fluidity or volume of faecal excretion and sometimes it may contain blood or mucus, with foul odour; the tail and hind quarters may be soiled. (Schoenian, 2009).

Diarrhoea of lambs and kids occurs when there is increased fluid volume in the gastro-intestinal tract either due to increased secretion or decreased absorption caused by enteropathogenic organisms such as *Escherichia coli*, Rotavirus, Coronavirus, Cryptosporidia, Coccidia, *Clostridium perfringens* type C in lambs and type D. enterotoxemia in kids, Salmonellosis and helminthes (Schoenian, 2009). The increased intestinal secretions are due to stimulations from enterotoxins of *Escherichia coli*, *Salmonella* species and Rotavirus while decreased absorption of fluid is due to the destruction of epithelial cells of the villi in the small intestine by protozoa and viruses (Klaus, 1993). It is therefore not possible to determine the aetiology of diarrhea of lambs and kids in a single study because of the complexity of its aetiology.

## **1.2 Statement of Research Problems**

Pre-weaning mortality of kids and lambs arising from diarrhoea has been a problem in Nigeria for a very long time, (Otesile *et al.*, 1983; Mousa-Balabel, 2010). Lughano and Dominic (1996) reported an outbreak of diarrhoea with mortality of up to 86% in Nigeria and 65% prevalence rate of diarrhoea in lambs and kids in the sub-humid zone of Nigeria. Adewuyi *et al.* (1989) reported high morbidity and mortality rates of diarrhoea in lambs and kids in farms and households located in Zaria and its environs. Trimnell *et al.* (1991) also reported a comprehensive cause and pattern of lamb and kid mortality in a Research Institute and observed a high mortality rate (85%) in lambs and kids caused by unknown aetiology, A study carried out by Schoenian

(2009) at the United State of America Sheep Experimental Station revealed 46% pre-weaning mortality of lambs and kids arising from diarrhoea and concluded that despite improvements in the management practices, prevention and treatment strategies, diarrhea was still the most common and costly problem affecting lambs and kids. This research work was therefore set out to determine the status of diarrhoea in lambs and kids, as well as to determine the effects of diarrhoea on Packed Cell Volume(PCV) and Blood Urea Nitrogen (BUN) values of lambs and kids at a Small Ruminants Research Institute in Zaria Kaduna State Nigeria.

### **1.3 Justification for the Study**

Diarrhoea had been reported among sheep flocks in Zaria, Nigeria ( Adewuyi *et al.*, 1989) as one of the possible reasons for high mortality of lambs and kids prior to weaning. Some diarrhoea causing pathogens are highly virulent, damaging and rupturing the cells of the intestinal lining, with death occurring as a result of loss of electrolytes and dehydration (Ernst and Benz, 1986).

These losses of lambs and kids may also present a major economic setback in the Research Institute as well as the livestock sector of the nation. Research on this is therefore justified with the aim of ascertaining the prevalence of diarrhoea and to provide measures of prevention and control of the situation. Osinowo and Adu (1985) had earlier advised farmers to rear breeds of sheep that predominate in particular agro-ecological zones because of the variations in the amount of rain fall, temperature and relative humidity in different zones. Akerejola *et al.* (1979) revealed that morbidity and mortality of lambs arising from diarrhoea were due to inadequate management practices, nutrition and other environmental variables. Not much work has been done on diarrhoeic problems of lambs and kids in the Institute under study. Also no research had been carried out to determine the effects of diarrhoea on packed cell volume and BUN in lambs

and kids in the Research Institute. From the afore mentioned, diarrhoea in farm animals has a complex aetiology which includes interactions of immune status of the host, age, enteric pathogens, weather, housing, hygiene, feed and feeding and personnel (Tekdek, 1994). Since young animals are replacers of adult and wasted stock, it is therefore important to research into how to minimize losses due to diarrhoea in these animals among other causes of loss.

#### **1.4 Aim of the Study**

The aim of the work was to carry out retrospective and prospective studies of lambs and kids diarrhoea in a Research Institute in Zaria, Kaduna State, Nigeria.

#### **1.5 Objectives of the Study**

The objectives of the study were to:

1. Conduct a retrospective study on the prevalence of lamb and kiddiarrhoea in a Research Institute in Zaria, Kaduna State, Nigeria from January, 2002 to December, 2011 (10 years)
2. Conduct a prospective study on the prevalence of lamb and kiddiarrhoea in a Research Institute in Zaria, Kaduna State, Nigeria from January, 2012 to December, 2013 (2 years).
3. Determine the common pathogens in lamb and kid diarrhoea in a Research Institute in Zaria, Kaduna State, Nigeria.

4. Determine the relationship among species, year, season, sex, pathogens, Packed Cell Volume (PCV) and Blood Urea Nitrogen (BUN) values with diarrhoea in lambs and kids in a Research Institute in Zaria, Kaduna State, Nigeria between January, 2012 to December, 2013 (2 years).

### **1.6 Research Questions**

1. What was the prevalence of lambs and kids diarrhoea in a Research Institute in Zaria, Nigeria from January, 2002 to December, 2011 (10 years retrospective) ?
2. What was the prevalence of lambs and kids diarrhoea in a Research Institute in Zaria, Nigeria from January, 2012 to December, 2013 (2 years prospectively) ?
3. What were the common enteric pathogens found in lambs and kids diarrhoea in a Research Institute in Zaria, Nigeria?
4. What were the relationships among lambs and kids diarrhoea and species, year, season, sex, pathogens, Packed Cell Volume (PCV) and Blood Urea Nitrogen (BUN) PCV and BUN in a Research Institute in Zaria, Nigeria?

## CHAPTER TWO

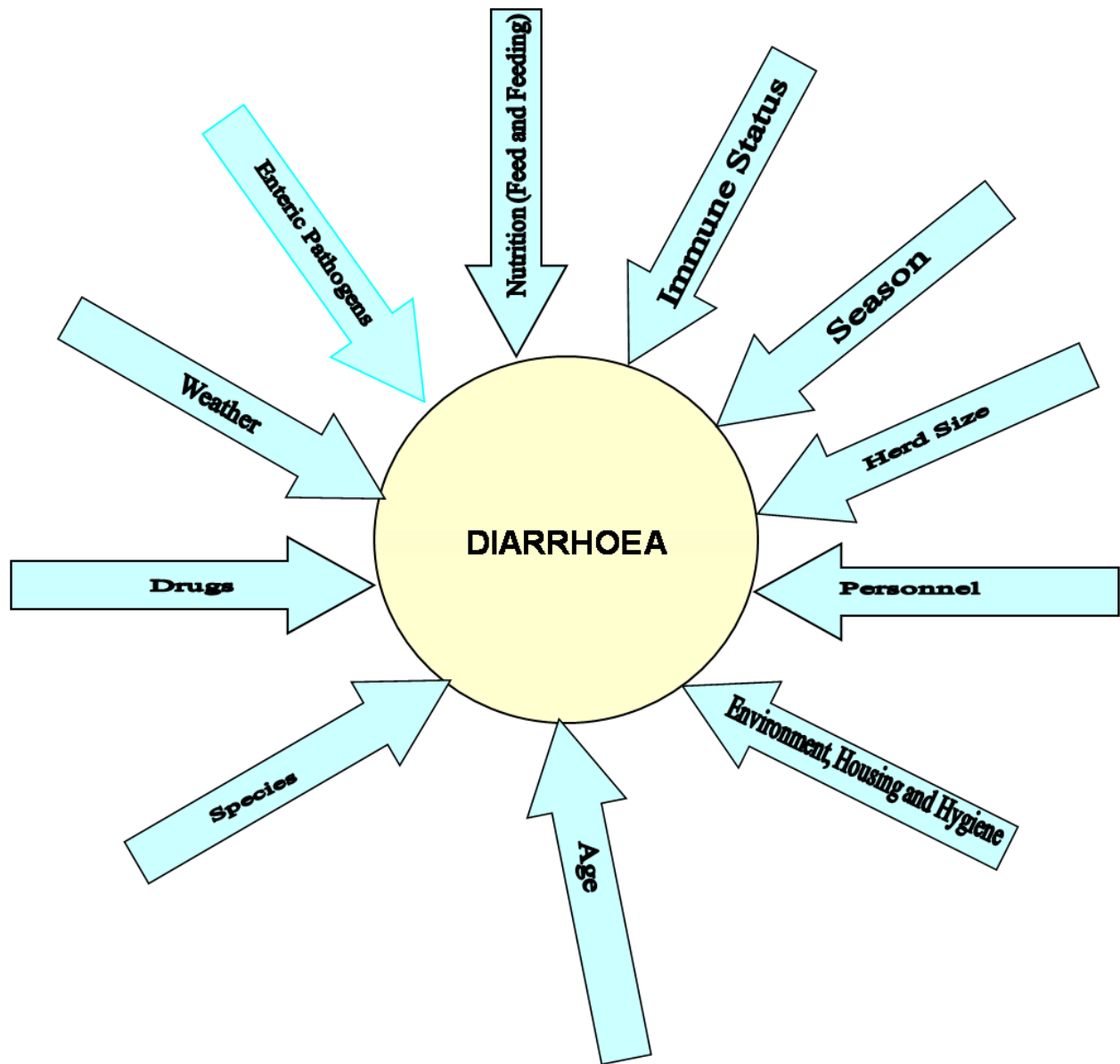
### 2.0 LITERATURE REVIEW

#### 2.1 Diarrhoea

Diarrhoea is the passage of liquid in faeces in relative excess proportion to faecal solid matter content, usually resulting in the increased frequency, volume and consistency of the excreted faeces (Schoenian, 2009). Diarrhoea is a symptom of enteric disease or condition with the major consequences of loss of electrolytes and acid base imbalance, acidosis, dehydration, impaired growth and eventually death (Klaus, 1993). Presence of blood, mucous, undigested feed (milk) as well as melena may be seen in animals with diarrhoea (Trimnelet *al.*, 1991; Tekdek, 1994). Normal faeces seen in lambs and kids are dark and firm, pea like pellets which do not soil the perineal area (Schoenian, 2009).

#### 2.2 Causes of diarrhoea

Diarrhoea may be caused by infections from bacteria such as *Escherichia coli* and *Salmonella* spp., viruses such as *Coronavirus* and *Rotavirus*; and protozoa such as *Cryptosporidium* sp, *Eimeria* sp, Gastro intestinal worms such as *Ostertagia circumcincta*, *Trichostrongylus* sp, *Cooperia* sp and *Nematodirus* sp as well as irritants in the pasture, mal-absorption and hyper-secretion (Tekdek, 1994). The causes of diarrhea are complex and they involve the interactions of age and immune status of the host, types of enteric pathogens, nutrition, weather, environment, drugs (toxins), housing and hygiene (Figure: 2.1).



**Fig. 2. 1: Schematic presentation of diarrhoea contributing factors in farm animals**  
(Source: Tekdek , 1994)

### 2.2.1 Colibacillosis

Colibacillosis is a disease of young animals like lambs and kids with the clinical signs of diarrhoea in lambs and kids of less than 1 to 6 weeks of age (John, 2010). Colibacillosis is caused by pathogenic strains of *Escherichia coli* (*E. coli*) which are usually isolated from the gastro-intestinal tract of animals, especially in the colisepticaemic form. The severity of the disease depends on the strain of *E. coli*, age of the host and lack of passive immunity acquired from colostrum (Tekdek, 1994). Lambs and kids one to four days old develop whitish or yellowish or gray coloured diarrhoea, weakness, dehydration and death occurs within 24 to 48 hours of ingestion of colostrums, while in colisepticaemic form of colibacillosis the lambs and kids develop high fever, dullness, incoordination, recumbency followed by death (Anseriet *al.*, 1978).

The causative agent, *E. coli* is shed in the faeces of both diarrhoeic and non-diarrhoeic animals, thereby contaminating the environment. The agent, *E. coli* is gram negative, non-spore forming, non acid fast, and varies in shape from coccoid to long rods. It may also occur singly in pairs or short chains (Ried, 1972). Colonies of *E. coli* possess a characteristic dark metallic sheen on Eosin and Methylene Blue Agar (Barnes and Gross, 1997), and usually fail to produce hydrogen sulphide, do not liquefy gelatine and give positive Methyl-red and negative Voges-Proskauer reactions. It ferments glucose and mannitol with acid and gas formation and also ferments lactose (Tekdek, 1994).

Enteric colibacillosis should be treated with appropriate antibacterial drugs followed by administration of fluid therapy (Klaus, 1993). Colibacillosis can be prevented by cleaning and disinfecting beddings and the contaminated environment thoroughly and isolation of sick animals to prevent contact with healthy animals (John, 2010).

### 2.2.2 Salmonellosis

This is an infectious disease of warm blooded animals caused by the gram negative bacteria *Salmonella*, which is a non-spore forming aerobic rod, frequently motile and grows on Brilliant Green Agar and MacConkey Agar (W.H.O, 1983). *Salmonella* organism has many serotypes isolated from diarrhoea of lambs and goat kids (Schoenian, 2009). Infected animals excrete the organism in their faeces which usually contaminate the environment and a healthy animal becomes infected after ingestion of faecal contaminated feed, in such situation they present the clinical signs like; dysentery, dehydration, septicaemia and death (Tabkuret *et al.*, 1995).

Falade (1976) isolated *Salmonella ploomna* from diarrhoeic goats in Nigeria. *Salmonella saint paul* was isolated from aborted foetal membrane of ewe and doe in Nigeria (Plowright, 1955). Also Johnson (1958) isolated *Salmonella* organism from sheep and goats slaughtered at Kano abattoir, *Salmonella typhimurium* and *Salmonella Dublin* occur in 2 to 6 weeks old kids. Colonies of *Salmonella* are non-lactose fermenters and medium in size, such colonies are transferred into Triple Sugar Iron (T.S.I) and Urea Agar slant, in which case the *Salmonella* colonies will give an opaque non- spreading surface growth on; T.S.I with alkaline slant, the acid at the bottom and hydrogen sulphide gas production and negative ureas reaction (El-Naker *et al.*, 2008).

### 2.2.3 Coccidiosis

This is caused by Coccidia organisms which are intracellular protozoan parasites of the genus *Eimeria*, that parasitize the intestinal tract of their host with a few exceptions that may be found in the kidneys and liver (Klaus, 1993). In sub-Saharan Africa the common species of *Eimeria* affecting goat kids are *E. ahjevi*, *E. arloingi*, *E. ninakohlyakimovae* and *E. christenseni*, *E. hirci*, *E. caprovina*, *E. jolchijevi* and *E. aspheronica*. (Adam *et al.*, 1971), and those affecting lambs are

*E.crandallis*, *E.ahsata*, *E. faurei*, *E .intricata*and *E. ovina*. Other species are *E.ovinoidalis*, *E.pallida* and *E.parva*(Adam *et al.*,1971).

Coccidiosis occurs when lambs and kids ingest sporulated oocysts (Tabkuret *al.*;1995). Development of coccidial oocyst to infective stage is determined by the temperature, moisture and oxygen tension (Faizal and Rajapakse, 2001). Some of the clinical signs of coccidiosis include; foul smelling diarrhoea which may contain mucous and tarry dark stains of blood or streaks of blood, anorexia, weakness, dehydration, inefficient weight gain and serious economic losses arising from death of lambs and kids prior to weaning or in a stressful or crowded unhygienic conditions (Foreyt, 1986). Prevalent rate of coccidiosis of sheep and goats is usually very high during the rainy seasons in Zaria (Voh and Bida, 1982).

#### **2.2.4 Helminthic diarrhoea**

Presence of helminths such as nematodes, tape worms and flukes presents symptoms of gastroenteritis, anaemia and rough hair coat in small ruminants (Faizal and Rajapakse, 2001) as well as economic loss arising from loss of weight and death (Agyei *et al.*, 2004), and delay in sexual maturity (Moagabo and Baipoledi, 2008).

The following roundworms are commonly seen in small ruminants: *Haemonchus contortus*, *Trichostrongylus axei*, *Trichostrongylus colubriformis*, *Cooperia* species and *Oesophagostomum radiata*, *Paramphistomum* species, *Nematodirus* species and *Strongyloides papillosus* (Kagira and Kanyarim, 2001).

Sheep and goats are easily infected by helminthic endoparasites because factors like warm temperatures, poor farm management practices and inadequate health control measures encourage their transmission from one animal to another (Akhtar *et al.*, 2002).

The prevalence of helminths is high within the age group of 5 months old, and is higher in lambs when compared to goat kids, probably because of their feeding habits. The sheep tends to graze on grasses close to the ground, which contains a large number of ova and larvae of worms, while goats merely browse while feeding and the lambs and goat kids may become infected with helminthic larvae when suckling the dam (Moagabo and Baipoledi, 2008).

### **2.2.5 Diarrhoea arising from viral infections**

Viruses such as *Coronavirus*, *Rotavirus* and *Morbillivirus* present clinical signs of diarrhoea in lambs and kids.

#### *2.2.5.1 Pestes des petits ruminants (PPR)*

This is a viral disease of sheep and goats, sometimes it infects cattle and wild ruminants, it is transmitted by morbillivirus secreted in tears, nasal discharges, cough and faeces of infected animal when they come in contact at water, feed troughs and bedding, it is characterized by fever, sores in the mouth, pneumonia and severe diarrhoea resulting in dehydration, loss of weight and death in five to ten days in lambs and kids (OIE, 2018).

### **2.2.6 Other causes of diarrhoea**

Diarrhoea may occur after feeding lambs and kids with large amount of milk or poorly formulated milk replacers (Thompson *et al.*, 1993), or administering oral antibiotics to lambs and goat kids for a period of 3 to 5 days, these may cause change in the villi leading to malabsorption of feed in the small intestine and diarrhoea occurs (Thompson *et al.*, 1993).

### 2.3 Pathogenesis of Diarrhoea

Diarrhoea is an important problem in young animals because its pathogenesis is not well understood since several causative agents may be involved concurrently (Munoz et al., 1996). Diarrhoea is a common symptom in animals as a result of defective absorption of fluid, increase in fluid secretion associated with increased or decreased intestinal motility. Viruses like the Coronavirus and Reovirus attack and destroy columnar epithelial cells of the villi (Goatgyan, 2017). *Chlamydia* spp destroys the epithelial cells of the villi with their crypts and all these result in malabsorption of fluid thereby causing diarrhoea. Enterotoxic colibacillosis manifests primarily by diarrhoea. Enterotoxic strain of *E.coli* predilates the upper part of the small intestine of lambs and goat kids where it adheres to the epithelial cells of the small intestine. This is mediated by bacteria pili (Goatgyan, 2017).

The bacteria fimbriae attach to the specific receptor sites on the villous epithelial cells, where it colonizes and proliferates to form micro colonies covering the villous surface to produce enterotoxins. The enterotoxins in turn stimulate the mucosal adenylase activity leading to increased cyclic adenylyl monophosphate which increases the membrane potential of small intestine mucosa and consequently increases secretion of fluid and electrolytes from the systemic circulation through the intestinal epithelium into the intestinal lumen (Goatgyan, 2017). The secreted fluid has alkaline pH. The loss of fluid results in dehydration, electrolyte imbalance, acid-base imbalance, acidosis and hyperkalaemia (Goatgyan, 2017). Prognosis is usually good following early treatment, but in severe cases, death may occur due to hypovolemic shock arising from acidosis, electrolyte imbalance, hypoglycaemia and dehydration (Goatgyan, 2017).

## **2.4 Clinical Pathology**

Total and differential leukocyte counts are used to determine the level of septicaemia or severe infection of the intestine (Tekdek, 1994). The degree of dehydration is determined by the levels of PCV and total solid concentration in the blood (Goatgyan, 2017). There is inadequate renal perfusion and kidney dysfunction in severe cases, which is determined by high BUN values (Cole, 1999). In severe acidosis, there is increased serum potassium and decrease in bicarbonates, sodium and chlorine (Goatgyan, 2017). The high level of serum potassium (hyperkalaemia) increases the conduction of the potential membrane of the cardiac muscles leading to cardiac shock (Tekdek, 1994). BUN determination is used to predict nitrogen excretion and efficient utilization of nitrogen in ruminants and is very important in cases of dehydration associated with chronic diarrhoea (Robert and Peter, 1972).

## **2.5 Necropsy**

It is important to carry out post-mortem examination immediately after death because autolysis of intestinal mucosa and invasion of tissue by intestinal microflora occurs rapidly after death (Goatgyan, 2017). Changes that are observed in lambs and kids that die of enteric colibacillosis, include; dehydration, distended intestine filled with yellowish watery content and gas, and petechial haemorrhages in the distended abomasum (Tekdek, 1994).

Microscopically, the jejunum looks stunted and adhered to the ileum and infiltration of neutrophils and isolation of pathogenic strain of *E. coli* from intestinal samples (Goatgyan, 2017).

## 2.6 Diagnosis

The definitive diagnosis of enteric colibacillosis can be made from the clinical, epidemiological, microbiological, and pathological findings (Rollin *et al.*, 1986). Enteric colibacillosis needs to be differentiated from dietary diarrhoea in which the faeces are voluminous, pasty to gelatinous, and the animal is bright and alert rather than depressed as in enteric colibacillosis (Klaus, 1993; Goatgyan, 2017).

There are a number of diseases and disease conditions that present symptoms of diarrhoea, such as causative agents can be diagnosed on the basis of laboratory isolation of *E. coli*, salmonellosis, listeriosis, pasteurellosis, streptococcosis, and pneumococcosis in lambs and goat kids. (Goatgyan, 2017). Isolation and identification of the causal agent by culture and determination of virulence are important in enteric colibacillosis of farm animals. The commonly used specific laboratory tests to identify enterotoxigenic *E. coli* K 99+ antigen include direct fluorescent antibody technique (FAT) and enzyme-linked immunosorbent assay (ELISA). For culture, either faeces or intestinal contents are used. Subsequent antibiograms of the isolates are also valuable (Tekdek, 1994; Goatgyan, 2017). For definitive diagnosis of the disease, serological tests like FAT, ELISA and serum neutralization test (SNT) may be used. Reduced blood pH and bicarbonate values may be detected through blood gas analyzer and haemato-biochemical studies reveal increased total plasma or serum proteins and BUN (Goatgyan, 2017).

A rotavirus Enzyme-Linked Immunosorbent Assay (ELISA) test or radioimmunoassay can be performed on a fresh faecal sample to detect *rotavirus* antigen, histopathology of the intestine reveals damage of the villi or carry out fluorescent antibody staining of frozen intestinal sections to demonstrate the presence of *coronavirus*. ELISA test is employed to detect beta toxin of

*Clostridium perfringens* type C while definitive diagnosis of *Clostridium perfringens* type D is made using epsilon toxin ELISA test (Goatgyan, 2017).

Diagnosis of Cryptosporidiosis and Coccidiosis is made by faecal floatation in sheather's solution (a sucrose solution with a specific gravity of 1.27) to reveal massive number of oocysts on faecal smear (El-Nakeret *al.*, 2008).

## **2.7 Management of Diarrhoea**

The management approach of lambs and kids diarrhoea is aimed at changing the diet, correction of fluid deficit and electrolytes loss and acid-base imbalance; treating with appropriate antimicrobial therapy and isolation of the sick animals (Rollin *et al.*, 1986; Goatgyan, 2017), restriction of feeding of milk may prove beneficial because of inability of the sick animal to digest milk because of variable response for digestion of lactose are deficient in the small intestinal mucosa of sloughed off mucosa. Instead, fluids containing readily absorbable energy (glucose) may be given. Milk may be introduced gradually after recovery. Dilution of milk by adding water is to be avoided so that the normal clotting mechanism in the abomasum is not disturbed (Tekdek, 1994; Goatgyan, 2017).

The change in fluid and electrolyte balance as reflected by dehydration, acidosis and electrolyte imbalances can be corrected either by parenteral administration or by oral supplementation. Parenteral administration of fluid and electrolytes is helpful in managing severe and acute colibacillosis. In severe dehydration and acidosis, solutions containing bicarbonate ions are preferred over solutions containing lactates as the latter has to be converted to bicarbonate by the

liver, which may not be functioning normally (Klaus, 1993; Goatgyan,2017). The simple and the best way to use the parenteral fluid is to administer an equal mixture of isotonic saline (0.85%), isotonic dextrose (5%) and isotonic bicarbonate (1.3%) solution. The requirement of bicarbonate ions can be calculated by using the formula: body weight (kg) x base deficit (mmol/L) x 0.3 (a factor for extracellular fluid space (Goatgyan,2017).

The base deficit varies between 5 and 20 mmol/L with an arbitrary average of about 15 mmol/L. Accordingly, a kid weighing 25 kg would require  $25\text{kg} \times 15\text{mmol/L} \times 0.3 = 112.5 \text{ mmol/L}$  bicarbonate. Sodium bicarbonate 1 g, would yield 12 mmol of bicarbonate and thus, about 9.4 g of sodium bicarbonate or about 723 ml of isotonic (1.3%) sodium bicarbonate solution will be required. This amount may, however, be altered depending upon the exact clinico-pathological condition of the animal (Klaus,1993; Goatgyan, 2017).

The commonly used drugs include neomycin sulphate, tetracyclines, sulphonamides, cotrimoxazoles and ampicillin. Parenteral administration of the antimicrobial drugs is preferred over oral administration because of the advantage that the entero-hepatic circulation provides a concentration of drug in the intestinal lumen. These drugs, however, should not be continued for more than five consecutive days so that the drug sensitive intestinal flora are not expelled out and replaced by pathogenic bacteria or fungi (Goatgyan, 2017).

## **2.8 Prevention and Control Measures**

This is best done by isolating diseased animals and by keeping the paddocks clean and dry. This is achieved by regular removal of faeces from the paddocks and by fixing leaking troughs. Rotate

paddocks if sheep and goats are on irrigated pastures because sheep and goats on irrigated pastures have a higher risk of coming down with coccidiosis and helminthosis(Foreyt, 1986). Immunization of lambs and kids against colibacillosis by vaccination of pregnant ewes and does at 6 to 8 weeks before parturition, to enhances the production of antibodies that prevent the occurrence of enterotoxigenic strain of *E. coli*, the antibodies get to the lambs and kids when they suckle colostrums in milk. Also, farm management should avoid putting too many lambs and kids together in a small house (Klaus,1993; Walter 2014).

## **CHAPTER THREE**

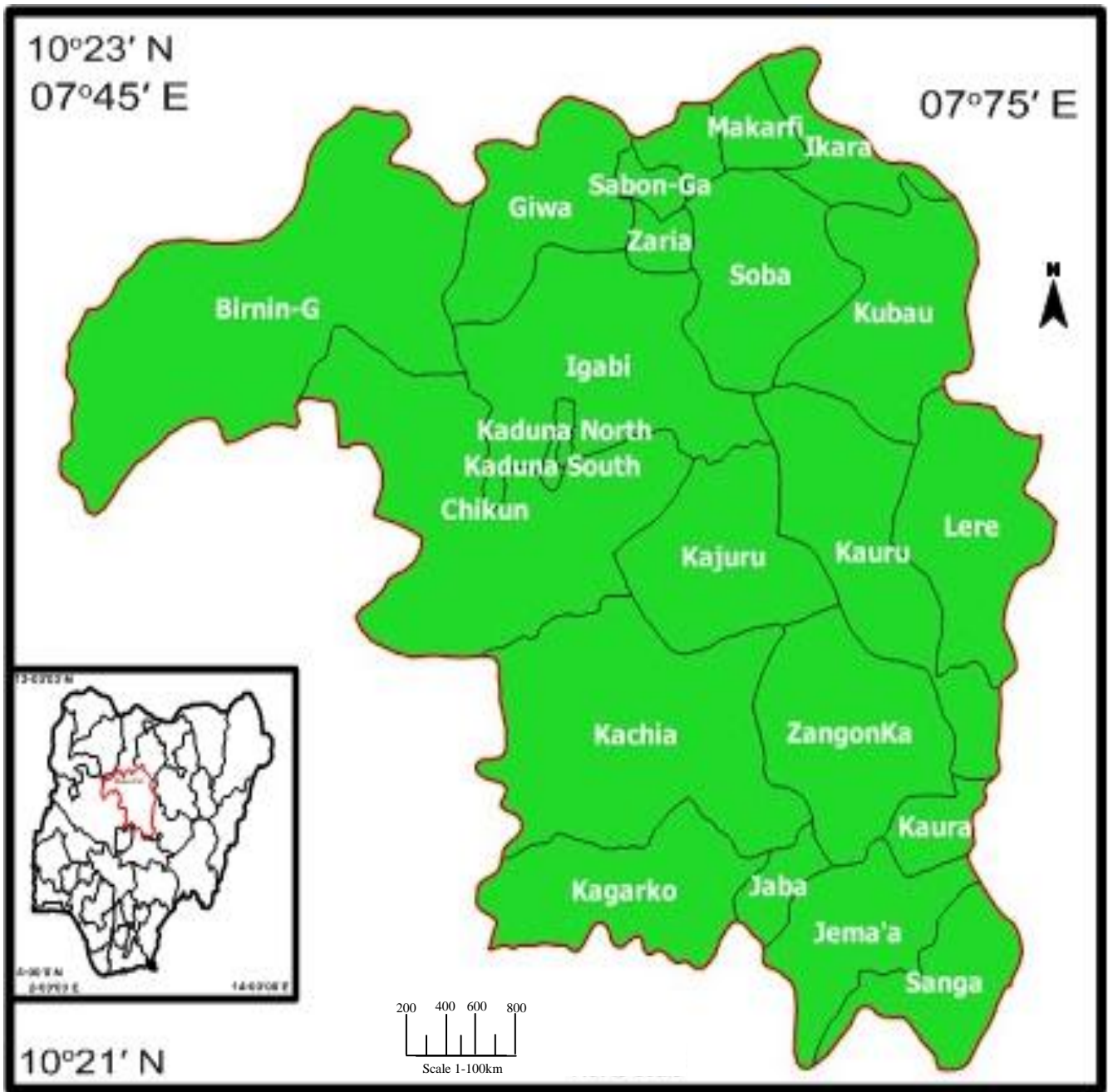
### **3.0 MATERIALS AND METHODS**

#### **3.1 Study Location**

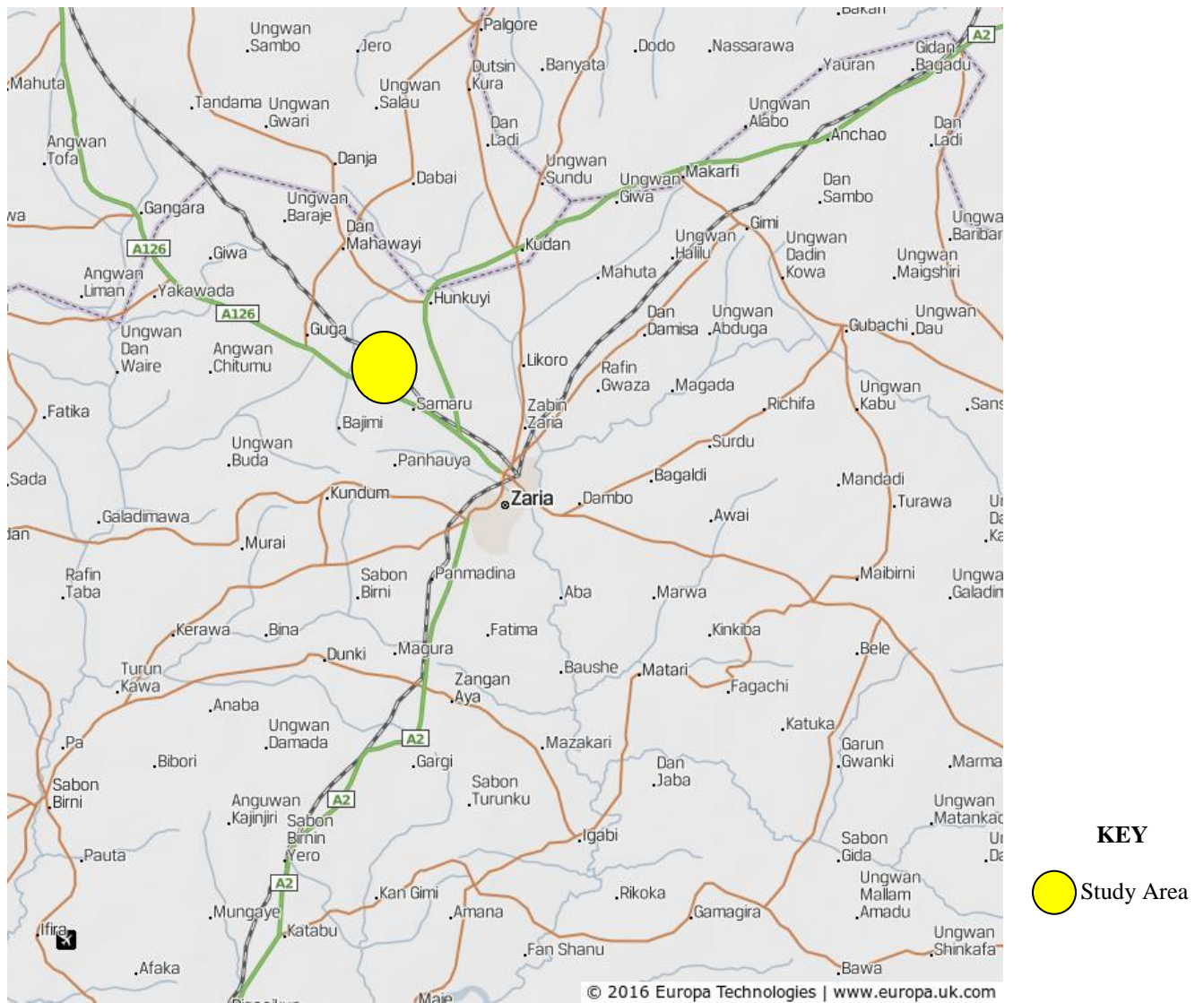
The study was carried out at a Research Institute in Zaria Kaduna State, Nigeria. Zaria is situated at longitude 7°42`E and latitude 11°30`N, and on altitude 640 m above sea level (Mortimore, 1970). Zaria is within the Northern Guinea Savannah zone, with a sub-humid tropical climate and an average annual rainfall of 1100 mm, which starts from late April or early May to mid-October (Figures: 3.1 and 3.2). The peak of the rainy season is between June and September, followed by the harmattan period of cool and dry weather which lasts from October to February (post-rain). This is followed by hot dry weather from March to early May. The mean maximum temperature varies from 26°C to 35°C depending on the season, while the mean relative humidity during the harmattan period and wet season are 21% and 72% respectively (Oladimeji *et al.*, 1996).

#### **3.2 Study Design**

The study was carried out in two phases namely: retrospectively and prospectively. The retrospective study involved the examination of Animal Health Treatment Records of the Research Institute, from January, 2002 to December, 2011 to identify the common causes of diarrhoea in lambs and kids by age, sex and season in the Research Institute at Zaria. The prospective study was conducted on all lambs and goat kids within ages 1 day to 150 days old between January, 2012 and December, 2013.



**Figure 3.1: Kaduna State Showing the Study Area (Source: Bureau for Land and Survey Kaduna).**



**Figure 3.2: Zaria and its environs (Source: 2016 Europe Technologies1 www.europa.uk.com)**

### **3.3 Samples Collection**

#### **3.3.1 Retrospectivestudy**

The retrospective study was carried out by the examination of Animal Treatment Records of the Research Institute in Zaria Kaduna State Nigeria. from the year 2002 to 2011 (10 years). Records of lambs and kids with diarrhoea by species, age and sex were taken accordingly (Appendix D). The aetiologies of such diarrhoea where available, were also recorded.

#### **3.3.2 Prospective study**

An average of 400 lambs and kids were lambed / kidded every year in the Institute in Zaria. All the lambs and kids born in the programme during this period (January, 2012 – December, 2013) were used in the prospective study for the presence or absence of diarrhoea for the two-year study period. Semi intensive management system (Fraser and John, 1999). is use in the Institute. Each lamb and kid was ear tagged and left in its natural environment where it was being raised within the study period. Every diarrhoeic lamb and kid was sampled twice a week (Mondays and Wednesdays). corresponding numbers of non-diarrhoeic lambs and kids were randomly sampled at the same time.

##### *3.3.2.1 Faecal Collection*

Three hundred rectal swabs were first obtained using sterile cotton swabs from all diarrhoeic cases present at each visit and from all non- diarrhoeic lambs and kids. This was followed by collection of about 3 grams of faeces from the rectum of 300 lambs and kids in labelled new polythene bags. The rectal swabs were immediately immersed into an enrichment medium of

Brain Heart Infusion Broth, conveyed to the Microbiology Laboratory, Faculty of Veterinary Medicine, ABU, Zaria and incubated for 18 hours at 37°C for culture of *E.coli* and *salmonellasp.*

#### 3.3.2.2 Blood Collection

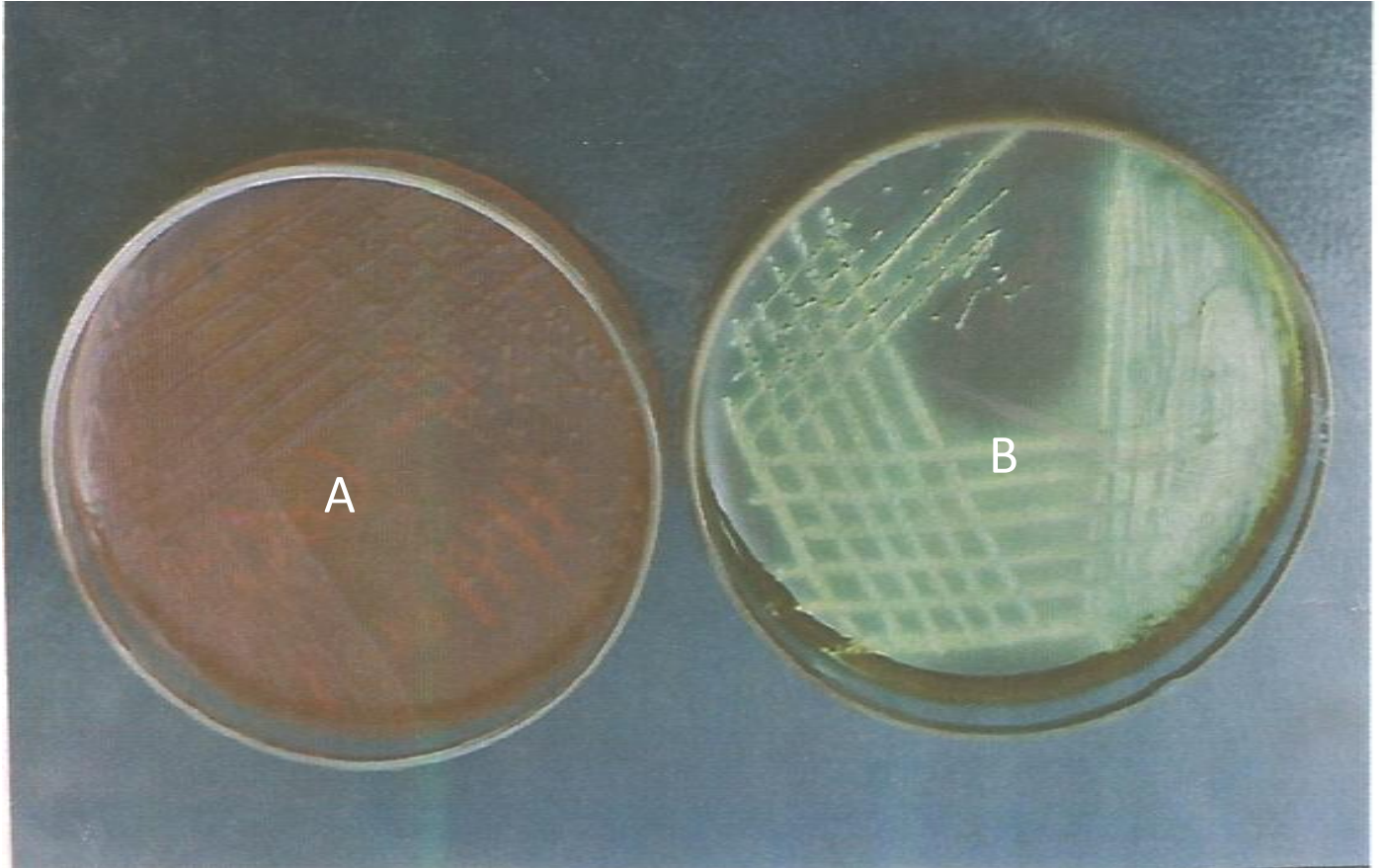
Two milliliters (2ml) of blood were drawn from the jugular vein, using 22 Gauge needle attached to a 5 millilitre syringe from each of the same sampled diarrhoeic and non-diarrhoeic lambs and kids. onemillilitre of each blood was placed into vacutainer tube containing ethylene di-amine tetra-acetic acid (EDTA) as anticoagulant and the remaining one millilitre into a vacutainer tube without anticoagulant

### 3.4 Laboratory Investigations

#### 3.4.1 Faecal examination

##### 3.4.1.1 Microbiological examination

A loopful of the enriched sample was streaked on to 7% sheep blood agar plates and incubated for 24 hours at 37°C. This was later subcultured unto selective media of MacConkey Agar and incubated for 24 hours at 37°C. All colonies that were lactose fermenters were later subcultured unto Eosin Methylene Blue (EMB) Agar for a further 24 hours at 37°C. Any colony showing green metallic sheen was considered as *Escherichia coli* suspect (Plate I) Non-lactose fermenters were subjected to biochemical tests to identify other gastro-intestinal tract bacteria, *E.coli* is gram negative, non-spore forming, usually fails to produce hydrogen sulphide, does not liquefy gelatine and gives positive Methyl-red and negative Voges-Proskauer reactions, ferments glucose and mannitol with acid and gas formation and also ferments lactose (Tekdek, 1994). Biochemical tests were carried out on the isolated colonies according to Cowan and Steels (1995).



**Plate I: *E.coli* on Mac Conkey agar (A) and also on Eosin Methylene Blue (EMB) agar (B) plates**

#### *3.4.1.2 Parasitological examination*

Only 2 grams of each faecal samples collected were processed at the Helminthology Laboratory, Department of Veterinary Parasitology and Entomology, Faculty of Veterinary Medicine A.B.U, Zaria, for the presence of helminths and protozoa parasites, using faecal floatation method in Sheathers solution as described by El-Nakeret *al.*(2008). The presence of helminth eggs and protozoa oocysts was observed under light microscope at X40 magnification (PlateII).

#### **3.4.2 Blood examination**

The blood samples containing EDTA and those without EDTA were used for the analyses of the Packed Cell Volume (PCV) and Blood Urea Nitrogen (BUN) respectively. The blood samples with EDTA were analysed for PCV in the Clinical Pathology Laboratory, Faculty of Veterinary Medicine, ABU, Zaria using a micro-haematocrit method as described by Stockham and Scott (2002), while the blood samples without EDTA were analysed for BUN at the Chemical Pathology Laboratory, A.B.U Teaching Hospital, Zaria, as described by Robert and Peter (1972).

##### *3.4.2.1 Packed Cell Volume determination*

This was carried out using a micro- hematocrit method involving the filling of capillary tubes prior to centrifugation at 14.786G for 3 minutes as described by Stockham and Scott (2002). PCV values were read in percentage from Hawksley micro-hematocrit reader.



**Plate II: Strongyle egg**

#### 3.4.2.2 *Blood Urea Nitrogen determination*

BUN values were determined at the Chemical Pathology Laboratory, A.B.U Teaching Hospital, Zaria. Separated serum was assayed completely within 48 hours, this is to prevent deterioration of serum sample. A Minimum of 0.6 mL serum is placed in to the multi-analyte panel of the instrument (Beckman SynchronLX20) containing BUN reagent. TheSynchron LX systems perform all calculations internally to produce the final result (David, 2004).

### **3.5 Data Analyses**

The prevalence of diarrhoea was calculated by dividing the number of diarrhoeic lambs and kids by the overall total number of lambs and kids examined multiplied by 100 (Schwabe *et al.*, 1977). Chi square was used to test for any association of variables with diarrhoea.

The data were presented in tables and figures.

Association between diarrhoea and species, year, season, sex, pathogens, PCV and BUN were determined by Fisher`s Exact Test (Appendix IV) Pearson test (SAS, 1998). P-Values of less than 0.05 were considered significant at 95% confidence interval as described by Thrusfield (1997).

## CHAPTER FOUR

### 4.0 RESULTS

#### 4.1 Retrospective Study

A total of 1,568 Yankasa lambs and Red Sokoto goat kids were examined, with an overall prevalence of those with diarrhoea in both species being 36.2%. The prevalences in Yankasa lambs and Red Sokoto goat kids were 38.8% and 28.9% respectively and there was significant association ( $P < 0.0003$ ) between species and occurrence of diarrhoea in lambs and kids. The prevalence was higher in Yankasa lambs than in the Red Sokoto goat kids (Table 4.1).

On yearly prevalence basis, the prevalence of diarrhoea was highest in 2005 (85.0%) and lowest in 2003 (10.0%) among lambs, while among the kids, it was highest in 2009 (69.4%) and no case of diarrhoea reported in the years 2002 and 2004 (Table 4.2). Appendix IV shows that, there was significant association ( $P = 0.0001$ ) between year and occurrence of diarrhoea in lambs and kids.

Considering seasonal variation, diarrhoea occurred throughout the seasons in Yankasa lambs and Red Sokoto goat kids with the highest prevalences of 41.9% in Yankasa lambs and 43.8% in Red Sokoto goat kids in the wet season while the lowest prevalences of 22.9% in Yankasa lambs and 20.7% in Red Sokoto goat kids occurred in the dry season (Table 4.3).

The sex specific rates of diarrhoea (Table 4.4) was higher in females Yankasa lambs (42.8%) than in females Red Sokoto goat kids (25.4%). Similarly, it was also higher in male Yankasa lambs (34.9%) than in the male Red Sokoto goats (31.9%). However, there was no significant association ( $P = 0.2697$ ) between sex and the occurrence of diarrhoea in lambs and kids in the Research Institute.

Regarding the cause of diarrhoea, diarrhoea due to unknown aetiology (35.9%) had the highest occurrence in Yankasa lambs followed by coccidiosis (33.9%), while helminthosis (30.3%) being the least. Similarly, diarrhoea due to unknown aetiology (34.7%) had the highest occurrence in Red Sokoto goat kids followed by coccidiosis (33.1%) while helminthosis (32.2%) had the least (Table 4.5). There was no significant association ( $p > 0.05$ ) between the enteric pathogens reported and the occurrence of diarrhoea in lambs and kids in the Research Institute.

## **4.2 Prospective Study**

### **4.2.1 Species prevalence of diarrhoea in Yankasa lambs and Red Sokoto goat kids of less than 1 to 20 weeks of age in a Research Institute in Zaria, Kaduna State, Nigeria**

A total of 300 samples were collected for a period of 2 years (Jan'2012 to Dec'2013), with the overall prevalence of diarrhoea as 82.3% consisting of 82.1% from Yankasa lambs and 82.9% from Red Sokoto Goat Kids. There was no statistically significant association ( $P > 0.05$ ) in the occurrence of diarrhoea with species (Table 4.6).

### **4.2.2 Sex distribution of diarrhoea in Yankasa lambs of 1 to 20 weeks of age in a Research Institute in Zaria, Kaduna State, Nigeria**

Sex distribution of diarrhoea in Yankasa lambs up to 20 weeks of age is shown in Table 4.7. Out of the 195 lambs sampled, 160 (82.1%) were diarrhoeic consisting of 29 (65.9%) ram lambs and 131 (86.8%) ewe lambs. The sex specific rate was higher in ewe lambs (86.8%) than in the ram lambs (65.9%). There was statistically significant association ( $P < 0.05$ ) in the occurrence of diarrhoea and the sex of lambs.

**Table 4.1: Retrospective Study on the Prevalence of diarrhoea in Yankasa lambs and Red Sokoto goat kids for Ten-Year (January, 2002-December, 2011) in a Research Institute in Zaria, Kaduna State, Nigeria**

<b>Species of animal</b>	<b>Number of cases reported</b>	<b>Number diarrhoeic</b>	<b>Species specific rate of diarrhoea (%)</b>
Yankassa lambs	1149	446	38.8
Red Sokoto goat kids	419	121	28.9
<b>Total</b>	1568	567	36.2

$X^2=13.14$   $p=0.0003$  (significant association)  $df=1$



**Table 4.2: Retrospective Study on the year Prevalence of diarrhoea in Yankasa lambs and Red Sokoto goat kids for Ten-Year (January, 2002- December, 2011) in a Research Institute in Zaria, Kaduna State, Nigeria**

<b>Year</b>	<b>Number of Lamb cases Reported</b>	<b>Number of Lambs with diarrhea</b>	<b>Specie specific rate of diarrhoeic Lambs</b>	<b>Number of kid cases reported</b>	<b>Number of kid with diarrhoea*</b>	<b>Specie specific rate of diarrhoeic kids.</b>
<b>2002</b>	<b>124</b>	<b>25</b>	<b>20.2</b>	<b>40</b>	<b>0</b>	<b>0.0</b>
<b>2003</b>	<b>130</b>	<b>13</b>	<b>10.0</b>	<b>37</b>	<b>1</b>	<b>2.7</b>
<b>2004</b>	<b>115</b>	<b>21</b>	<b>18.3</b>	<b>29</b>	<b>0</b>	<b>0.0</b>
<b>2005</b>	<b>120</b>	<b>102</b>	<b>85.0</b>	<b>37</b>	<b>20</b>	<b>54.1</b>
<b>2006</b>	<b>112</b>	<b>26</b>	<b>23.2</b>	<b>30</b>	<b>15</b>	<b>50.0</b>
<b>2007</b>	<b>115</b>	<b>21</b>	<b>18.3</b>	<b>73</b>	<b>7</b>	<b>9.6</b>
<b>2008</b>	<b>100</b>	<b>52</b>	<b>52.0</b>	<b>57</b>	<b>13</b>	<b>22.8</b>
<b>2009</b>	<b>117</b>	<b>19</b>	<b>16.2</b>	<b>36</b>	<b>25</b>	<b>69.4</b>
<b>2010</b>	<b>106</b>	<b>88</b>	<b>83.0</b>	<b>43</b>	<b>18</b>	<b>41.9</b>
<b>2011</b>	<b>110</b>	<b>79</b>	<b>71.8</b>	<b>37</b>	<b>22</b>	<b>59.5</b>
<b>Total</b>	<b>1149</b>	<b>446</b>	<b>38.8</b>	<b>419</b>	<b>121</b>	<b>28.9</b>

\*Fisher`s Exact Test: 121.762, P = 0.000 (significant association) df=9

**Table 4.3: Retrospective Study on seasonal distribution of diarrhoeic cases in Yankasa lambs and Red Sokoto goat kids for Ten-Year (January, 2002- December, 2011) in a Research Institute in Zaria, Kaduna State, Nigeria**

Season (Months)	Yankasa Lambs				Red Sokoto Goat Kids			
	Number. of cases	Number Diarrhoea	percentage Frequency	Season Specific Rate	Number of cases	Noumber Diarrhoea	Percentage Frequency	Season Specific Rate
Dry (February- May)	193	102	22.9	52.9	87	25	20.7	28.7
Wet (June- September)	644	187	41.9	28.3	215	53	43.8	24.7
Early Dry (October- January)	312	157	35.2	50.3	117	43	35.5	36.8
<b>Total</b>	<b>1149</b>	<b>446</b>	<b>100.0</b>	<b>38.8</b>	<b>419</b>	<b>121</b>	<b>100.0</b>	<b>28.9</b>

$X^2 = 121.8$        $p < 0.0001$  (significant association)       $df = 2$

**Table 4.4: Retrospective Study on sex prevalence of diarrhoeic cases in Yankasa lambs and Red Sokoto goat kids for Ten-Year (January, 2002- December, 2011) in a Research Institute in Zaria, Kaduna State, Nigeria**

	<b>Yankasa Lambs</b>				<b>Red Sokoto Goat Kids</b>			
<b>Sex</b>	<b>Number of cases reported</b>	<b>Number with Diarrhoea</b>	<b>percentage Diarrhoeic</b>	<b>Sex Specific Rate(%)</b>	<b>Number of cases reported</b>	<b>Number with Diarrhoeic</b>	<b>percentage Diarrhoeic</b>	<b>Sex Specific Rate(%)</b>
Male	586	205	45.9	34.9	222	71	58.7	31.9
Female	563	241	54.0	42.8	197	50	41.3	25.4
<b>Total</b>	<b>1149</b>	<b>446</b>	<b>100.0</b>		<b>419</b>	<b>121</b>	<b>100.0</b>	

$X^2=3.931$   $P = 0.2697$  (No significant association )df=1

**Table 4.5: Retrospective Study on the enteric pathogens reported in diarrhoeic of Yankasa lambs and Red Sokoto goat kids for Ten-Year (January, 2002- December, 2011) in a Research Institute in Zaria, Kaduna State, Nigeria**

Pathogen	Yankasa Lambs				Red Sokoto Goat Kids			
	Number of cases reported	Number with Diarrhoea	percentage Diarrhoeic	Cause Specific Rate(%)	Number of cases reported	Number with Diarrhoeic	percentage Diarrhoeic	Cause Specific Rate(%)
<i>Coccidia</i>	334	151	33.9	45.2	186	40	33.1	21.5
<i>Helminths</i>	190	135	30.3	71.1	155	39	32.2	25.2
Unknown	625	160	35.9	25.9	78	42	34.7	58.9
<b>Total</b>	<b>1149</b>	<b>446</b>	<b>100.0</b>		<b>419</b>	<b>121</b>	<b>100.0</b>	

$X^2 = 0.5833$        $p = 0.9649$  (no significant association)       $df = 2$

#### **4.2.3 Sex distribution of diarrhoea in Red Sokoto goat Kids of less 1 to 20 weeks old in a Research Institute in Zaria, Kaduna State, Nigeria**

Sex distribution of diarrhoea in Red Sokoto goat kids up to 20 weeks of age is shown in Table 4.8. Out of the 105 kids sampled, 87 (82.9%) were diarrhoeic consisting of 19 (73.1%) males and 68 (86.1%) females. The sex specific rate was higher in females (86.1%) than in males (73.1%). The statistical association was not significant ( $P>0.005$ ) in the occurrence of diarrhoea and the sex of the kids.

#### **4.2.4 Age distribution of diarrhoea in Yankasa lambs of less than 1 to 20 weeks of age in a Research Institute Zaria, Kaduna State, Nigeria**

From the study, the number of diarrhoeic lambs tends to increase from one week old gradually two and three weeks old with the highest at four weeks old. The diarrhoea was least for lambs that were 15 to 18 weeks old. However, lambs of 19 and 20 weeks also exhibited diarrhoea as shown in Figure 4.1.

The highest (100.0%) age specific rate was observed in the age groups 3, 4, 6, 7 and 15 weeks old, while the age group 19 weeks had the lowest (20.0%) age specific rate. There was no statistical significant association ( $P>0.05$ ) in the occurrence of diarrhoea with the different age groups of lambs (Appendix I).

#### **4.2.5 Age distribution of diarrhoea in Red Sokoto goat kids of less than 1 to 20 weeks old in a Research Institute Zaria, Kaduna State, Nigeria**

From the study, the red Sokoto goat kids had the highest diarrhoea at 3 weeks old followed by those at 2 and 6 weeks (Figure: 4.2). The diarrhoea was least in those that were 15 to 20 weeks old with one kid having diarrhoea among them in each week. However, kids of 8, 10 to 12 and 14 weeks also exhibited diarrhoea.

The age distribution of diarrhoea in Red Sokoto Goat Kids up to 20 weeks old is shown in Appendix II. Out of the 87 diarrhoeic Red Sokoto goat kids, 100.0% age specific rate of age group 3 weeks had the highest number (17) of diarrhoeic kids, while the age groups 9, 15 and 20 weeks all had the lowest (50.0% each) age specific rate. There was no statistical significant association ( $P > 0.05$ ) between the occurrence of diarrhoea and age of red Sokoto goat kids.

#### **4.2.6 Enteric pathogens associated with diarrhoea in Yankasa Lambs and Red Sokoto goat kids of less than 1 to 20 weeks of age in a Research Institute Zaria, Kaduna State, Nigeria**

Of the 247 diarrhoeic lambs and kids studied, diarrhoea was mainly caused by *E. coli* 203 (82.0%) from less than one week to four weeks of age in lambs and kids. The diarrhoea was also seen to be due to *E. coli*, but in conjunction with other pathogens in lambs and kids older than 4 weeks old. Multiple causes of diarrhoea that include *E. coli*, *Staphylococcus* sp and *Coccidia* were seen to result in diarrhoea for 7 weeks up to 20 weeks old lambs and kids (Table 4.9).

**Table 4.6: Prospective study on the prevalence of diarrhoea in Yankasa lambs and Red Sokoto goat kids of less than 1 to 20 weeks of age in a Research Institute in Zaria, Kaduna State, Nigeria**

<b>Species Sampled</b>	<b>Number Sampled</b>	<b>Number Diarrhoeic</b>	<b>Specie Specific Rate (%)</b>
Yankasa lambs	195	160	82.1
Red Sokoto goat kids	105	87	82.9
<b>Total</b>	<b>300</b>	<b>247</b>	<b>82.3</b>

$X^2=0.03047$      $P= 0.8614$  (no significant association)  $df=1$

**Table 4.7 Prospective study on sex distribution of diarrhoea in Yankasa Lambs of less than 1 to 20 weeks of age in Research Institute in Zaria, Kaduna State, Nigeria**

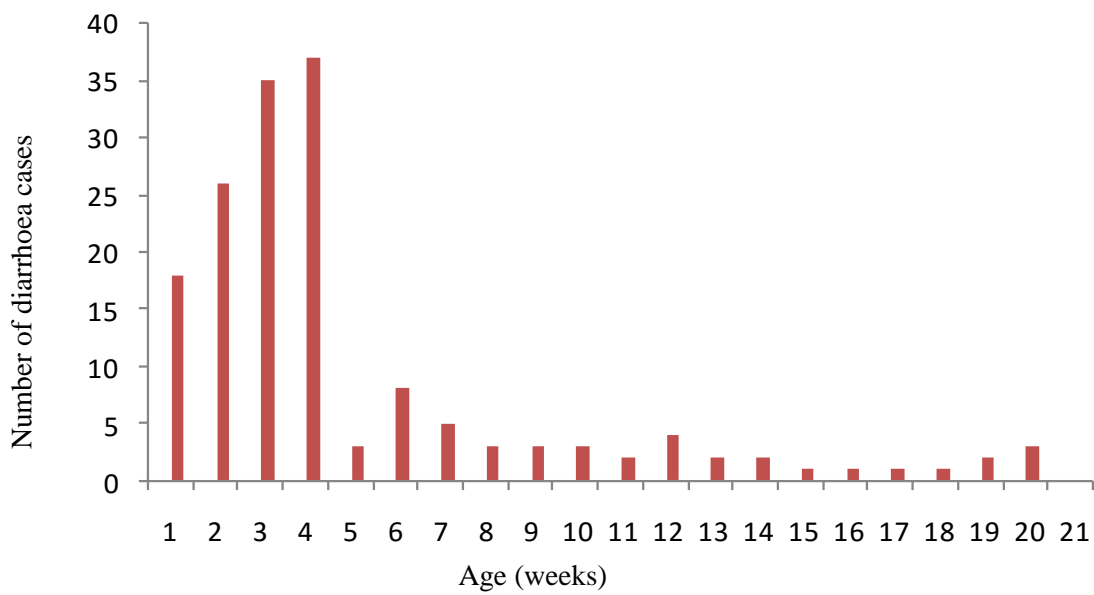
<b>Sex of animal</b>	<b>Number Sampled</b>	<b>Number with Diarrhoea</b>	<b>Sex Specific Rate (%)</b>
Males	44	29	65.9
Females	151	131	86.8
<b>Total</b>	<b>195</b>	<b>160</b>	<b>82.1</b>

$X^2=10.05$  P= 0.0015 (Significant association) df=1

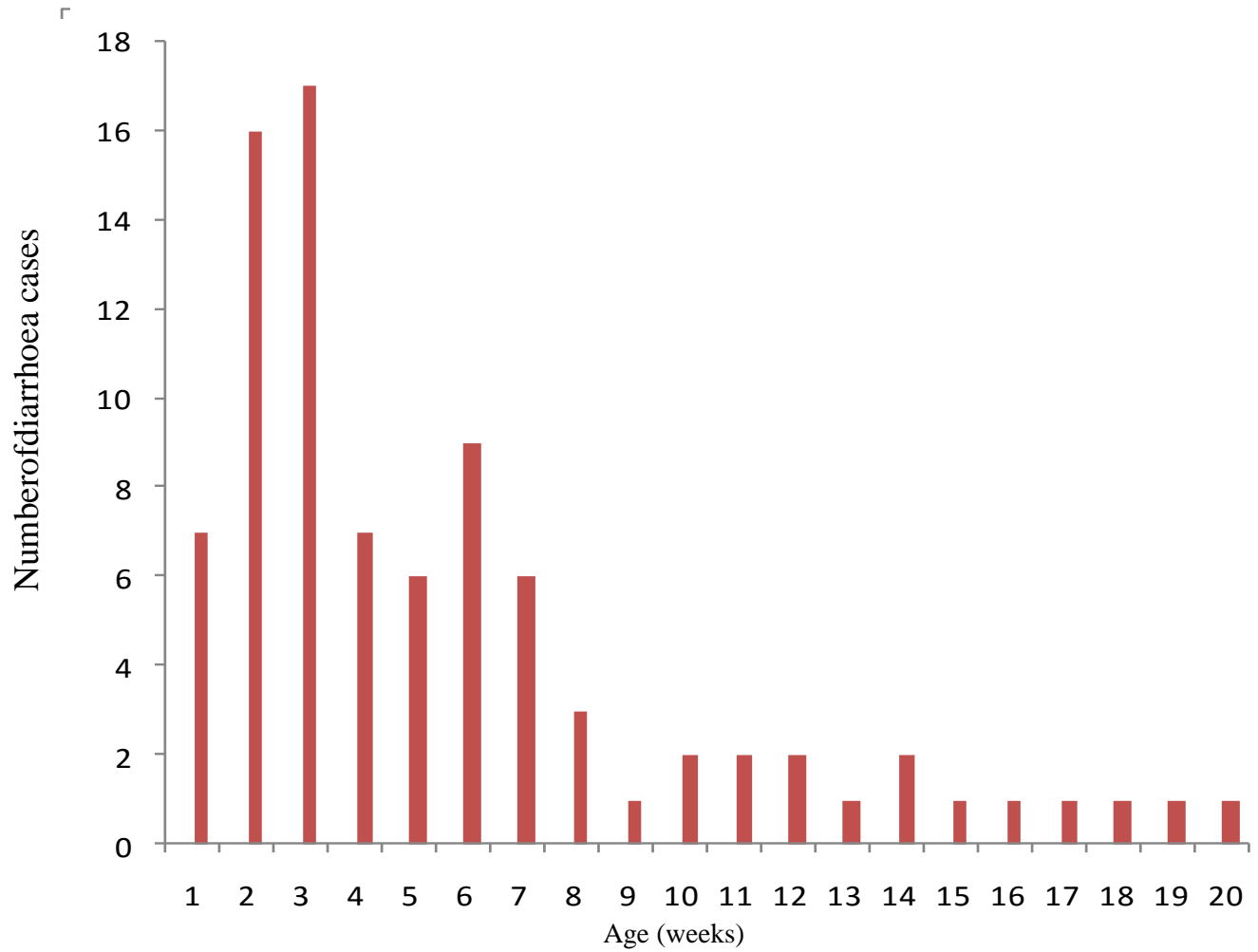
**Table 4.8** Prospective study on sex distribution of diarrhoea in Red Sokoto goat kid of less than 1 to 20 weeks of age in a Research Institute in Zaria, Kaduna State, Nigeria

<b>Sex</b>	<b>Number Sampled</b>	<b>Number with Diarrhoea</b>	<b>Sex Specific Rate (%)</b>
Males	26	19	73.1
Females	79	68	86.1
<b>Total</b>	<b>105</b>	<b>87</b>	<b>82.9</b>

$X^2=2.327$      $p= 0.1271$     (No significant association)     $df=1$



**Figure 4.1: Age distribution of diarrhoea in Yankasa lambs (<1 to >20 weeks old) in a Research Institute Zaria, Kaduna State, Nigeria**



**Figure 4.2: Age distribution of diarrhoea of Red Sokoto goat kid (<1 to >20 weeks old) in a Research Institute Zaria, Kaduna State, Nigeria**

**Table 4.9: Common enteric pathogen associated with diarrhoea in Yankasa Lambs and Red Sokoto goat kids of less than 1 to 20 weeks of age in a Research Institute Zaria, Kaduna State, Nigeria**

Age Group (Weeks)	Pathogens Sample	Lambs	Kid	Number With Diarrhoeic	Percentage Diarrhoeic
<1	<i>E.Coil</i>	18	7	25	10.1
2	<i>E.Coil</i>	26	16	42	17.0
3	<i>E.Coil</i>	35	17	52	21.1
4	<i>E.Coil</i>	37	7	44	17.8
5	<i>E.Coil+ Staph</i>	3	6	9	3.6
6	<i>E.Coil+ Staph</i>	8	9	17	6.9
7	<i>E.Coil+ Staph+ Coccidia</i>	5	6	11	4.5
8	<i>E.Coil+ Staph+ Coccidia</i>	3	3	6	2.4
9	<i>E.Coil+ Staph+ Coccidia</i>	3	1	4	1.6
10	<i>Coccidia+ Strongyle+ E. coil</i>	3	2	5	2.0
11	<i>Coccidia+ Strongyle+ E. coil</i>	2	2	4	1.6
12	<i>Coccidia+ Strongyle+ E. coil</i>	4	2	6	2.4
13	<i>Coccidia+ Strongyle+ E. coil</i>	2	1	3	1.2
14	<i>Coccidia+ Strongyle+ E. coil</i>	2	2	4	1.6
15	<i>Coccidia+ Strongyle+ E. coil</i>	1	1	2	0.8
16	<i>Coccidia+ Strongyle+ E. coil</i>	1	1	2	0.8
17	<i>Coccidia+ Strongyle+ E. coil</i>	1	1	2	0.8
18	<i>Coccidia+ Strongyle+ E. coil</i>	1	1	2	0.8
19	<i>Coccidia+ Strongyle+ E. coil</i>	2	1	3	1.2
20	<i>Coccidia+ Strongyle+ Moniezia</i>	3	1	4	1.6
<b>Total</b>		<b>160</b>	<b>87</b>	<b>247</b>	<b>99.8</b>

$X^2=6.243$  P=0.3901 (no significant association)

### **4.3 Relationship of PCV, BUN and diarrhoea in Yankasa Lambs and Red Sokoto goat kids in a Research Institute Zaria, Kaduna State, Nigeria**

#### **4.3.1 Relationship between PCV and diarrhoea of Yankasa Lambs and Red Sokoto Goat kids in a Research Institute Zaria, Kaduna State, Nigeria**

The mean PCV as observed in the study were  $28.3 \pm 1.1$  and  $31.6 \pm 1.0$  for lambs and kids respectively. There was significant association ( $P < 0.05$ ) between PCV and diarrhoea in Yankasa lambs and Red Sokoto goat kids (Table 4.10).

#### **4.3.2 Relationship between BUN and diarrhoea of Lambs and kids in a Research Institute Zaria, Kaduna State, Nigeria**

The mean BUN as observed for Yankasa lambs and Red Sokoto goat kids were  $4.9 \pm 0.1$  and  $4.8 \pm 0.2$  respectively. There was significant association ( $P < 0.05$ ) between BUN and diarrhoea in these lambs and kids (Table 4.11).

**Table 4.10 Species Based Pack Cell Volume (PCV) Values in Diarrhoeic and Non-Diarrhoeic Yankasa Lambs and Red Sokoto goat kids in a Research Institute Zaria, Kaduna State, Nigeria**

<b>Animal</b>	<b>Number</b>	<b>Number</b>	<b>Mean PCV(%)</b>	
<b>Species</b>	<b>Examined</b>	<b>Diarrhoeic</b>	<b>Diarrhoeic</b>	<b>NonDiarrhoeic</b>
Yankasa lambs	195	160	28.34±1.10	23.36±0.52
Red SokotoGoat kids	105	87	31.61±1.00	24.53±0.64

All differences in each species significant ( $p < 0.05$ )

**Table 4.11 Species Based Blood Urea Nitrogen (BUN) Values in Diarrhoeic and Non-Diarrhoeic Yankasa Lambs and Red Sokoto goat kids in a Research Institute Zaria, Kaduna State, Nigeria**

<b>Animal</b>	<b>Number</b>	<b>Number</b>	<b>Mean BUN (mmol/L)</b>	
<b>Species</b>	<b>Examined</b>	<b>Diarrhoeic</b>	<b>Diarrhoeic</b>	<b>NonDiarrhoeic</b>
Yankasa lambs	195	160	4.96 ± 0.1	3.44 ± 0.2
Red Sokoto Goat kids	105	87	4.79 ± 0.2	3.25 ± 0.4

All differences in each species significant (p < 0.05)

## CHAPTER FIVE

### 5.0 DISCUSSION

The current study revealed that, diarrhoea occurred in lambs and kids from a Research Institute in Zaria and it is found that the animals were infected with a wide variety of gastro-intestinal parasites associated with diarrhoea, namely; strongyles, moniezia and coccidiaspp. This observation is similar to the report of Kagira and Kanyarim, (2001).

The retrospective study showed that, the prevalence of diarrhoea in lambs and kids from the year 2002 to 2011 in a Research Institute in Zaria. The overall prevalence of diarrhoea in lambs and kids in this study (36.8%) is much lower than the 65% prevalent rate of diarrhoea in lambs and kids reported by Adewuyi *et al.* (1989). This might be due to different determinants of diarrhoea in both farms and households in Zaria. The study also revealed that the highest prevalence of diarrhoea was in the year 2005, This might be due to heavy rain fall throughout that year resulting to high humidity content in the environment (Fraser and John, 1999), or poor hygienic conditions in the few pens with overcrowded lambs in that year as also observed by Munoz *et al.*, (1996), in another study Poor hygienic conditions in overcrowded pens could lead to build up of micro-organism in the pens and paddocks and. this is in agreement with the reports of Fraser and John (1999), which revealed that high prevalence of diarrhoea in neonates and weaned animals is related to overcrowding and close contact with their dams, due to the build up of diarrhoea causing agents such as bacteria, viruses and protozoa in the pens.

The study further revealed that diarrhoea occurred more frequently in lambs (38.8%) than in goat kids (28.8%) and this might be due to genetic differences in resistance to enteric pathogens

causing diarrhoea in neonates. Sherif *et al.* (2005) reported that *E.coli* causes more diarrhoea in lambs than in kids. Kids are reported to be more hardier than lambs (Terres-Acosta *et al.*, 2004) and that kids were capable of developing more protective mechanism against infection at a faster rate than lambs. It is reported that lambs of 3 to 5 month of age were mostly affected with gastrointestinal problems, especially helminthosis when compared to kids (Voh and Bida., 1982). Moagaboand Baipoledi (2008) also reported that sheep graze close to the ground which may contain large number of helminths and coccidian ova and larvae while the goats are merely feed browsers. Fraser and John (1999) reported similar findings where they concluded that these pathogens may eventually infect the lambs due to close contact with their dam while suckling milk.

Diarrhoea due to unknown aetiology had the highest prevalence (58.9%) in the Research Institute, this is in agreement with the work of Trimmellet *al.* , (1991), where they reported high prevalence (85.0%) of undiagnosed cause of neonatal mortality in the Research Institute.

The prospective study revealed no significant association ( $P > 0.05$ ) in the occurrence of diarrhoea in lambs and kids age group 3 weeks and each had 100 % age specific rate for diarrhoea. This is in agreement with the report of El-Naker *et al.* (2008) who observed variable degrees of diarrhoea from mild to profuse, watery faeces and colour from whitish yellow to greenish colour and sometimes tinged with blood or mucus.

The study also revealed a higher value of diarrhoeic in female lambs 131 (86.8%) higher than male lambs 29 (65.9%). Similarly, the value is also higher in female kids 68 (86.1%) than in male

kids 19(73.1%). This is not in agreement with the finding of Desta, 2008 where he reported diarrhoea occurring more in males than females because weaning of lambs and goat kids may be at 4 weeks old resulting in diarrhoea arising from weaning shock which occurs more in males than in females. The study further revealed a very high (100.0%) age specific rate of the occurrence of diarrhoea for age groups 3 weeks, 4 weeks, 15 weeks. This might be due to coccidiosis and nutritional diarrhoea. This is in agreement with the work of Lisa, (2002) and Tzipori, (1981) where it was reported that commonly seeing signs of coccidiosis in 4 weeks old animals as watery or foamy, pasty dark or bloody scours and foul smelling diarrhoea

This high age specific rate might also be due to poor management practices that encouraged contamination of paddock with ova and larvae of helminths from sick animals as reported by Kagira and Kanyarim (2001) who observed that the sheep and goats became affected by a wide variety of gastrointestinal parasites such as; strongyles, moniezia and coccidia prior to weaning. The prospective study also revealed that the common bacterial agent isolated was *E. coli* (82.2%). This is in agreement with the finding of Sherif *et al* (2005), where they reported that colibacillosis was caused by *E. coli* and was the most common cause of diarrhoea in lambs and kids. They further concluded that *E. coli* was the major culprit causing diarrhoea of lambs and goat kids, in sheep and goats farms in Jordan. This was supported by El-Nakeret *al.* 2008 who reported that diarrhoea occurred as a result of nutritional and management factors or some bacteria causing pathogens such as *E. coli*, *Salmonella* species and *Staphylococcus* species.

A 2.8% combination of *E. coli* and *Staphylococcus* species (not typed) was also isolated during the prospective study. This is possible as agreed by El-Nakeret *al.* (2008), where they isolated

*Staphylococcus aureus* from milk of ewe and doe goat suffering from mastitis. This might be, because the lambs and goat kids are always in close contact to their dam when suckling milk as reported by Fraser and John, (1999).

The prospective study showed that the mean PCV in diarrhoeic lambs ( $28.3 \pm 1.1$  %) was significantly higher ( $P < 0.05$ ) than that of the non diarrhoeic lambs ( $23.4 \pm 0.5$  %). Also mean PCV in diarrhoeic kids ( $31.6 \pm 1.0$ %) was significantly higher ( $P < 0.05$ ) than that of non diarrhoeic goat kids ( $24.5 \pm 0.6$  %). Dehydration was demonstrated by increased haematocrit values (Fisher and de la Fuente, 1972) as the presence of numerous enteropathogens cause damage and inflammation when they attach to intestine, these consequently lead to electrolyte imbalance and fluid loss, the animal show sunken pupil of the eye in chronic diarrhoea. Furthermore, fluid loss in chronic diarrhoea lead to decrease in blood plasma (haemoconcentration) which lead to increase in PCV due to relative polycythemia, this is in agreement with the report of Anosa,(1988), Okaiyeto *et al.* (2010) and Gokce *et al.* (2010). The high levels of PCV in diarrhoeic animals agreed with Santos *et al.* (2002) to be due to haemoconcentration with progression of dehydration caused by decrease in fluid intake.

The mean BUN in diarrhoeic lambs ( $4.9 \pm 0.1$ mmol/L) was significantly higher ( $P < 0.05$ ) than that of the non diarrhoeic lambs ( $3.4 \pm 0.2$ mmol/L). Furthermore, the mean BUN in diarrhoeic kids ( $4.8 \pm 0.2$ mmol/L). was significantly higher ( $P < 0.05$ ) than that of non diarrhoeic goat kids ( $3.3 \pm 0.4$ mmol/L). This high BUN (dehydration) in diarrhoeic lambs and goat kids is in agreement with the report of Jain, (1993) and Cole, (1999) where they assessed the degree of dehydration from severe diarrhoea and reported that inadequate renal perfusion leading to

kidney disfunction, may reflected as high BUN values. This is also in agreement with the work of Santos *et al.* (2002) where they concluded that high levels of BUN in diarrhoeic animals is associated with progressive dehydration which resulted in inadequate renal perfusion.

## **CHAPTER SIX**

### **6.0 CONCLUSION AND RECOMMENDATIONS**

#### **6.1 Conclusions**

From the result obtained in this work, it is concluded that:

- 1.** The retrospective study has revealed diarrhoea prevalence rate of 36.2% while the prospective study revealed diarrhoea to be 82.3% in lambs and kids in a Research Institute in Zaria, Kaduna State, Nigeria.
- 2.** Diarrhoea was higher in lambs (97.5%) and kids (87.0%) of less than four weeks old, but decreased in older lambs (60.0%) and kids (71.4%).
- 3.** Diarrhoea was higher in the wet season for lambs (41.3%) and kids (43.8%) than in the dry season for lambs (21.3%) and kid (20.7%).
- 4.** Diarrhoea was higher in female lambs (81.9%) and kids (78.2%) than in male lambs (18.1%) and kids (21.8%).
- 5.** The PCV was higher in the diarrhoeic lambs and kids than in non-diarrhoeic lambs and Kids due to fluid loss.
- 6.** The common enteric pathogens observed in the retrospective study were coccidia in Lambs (33.9%) and kids (33.1%) while enteritis (unknown) was the highest for lambs (35.5%) and kids (34.7%), while the prospective study revealed coccidia and strongyles (23.5%) were the common enteric pathogens in lamba and kids diarrhoea greater than seven weeks old, while E.coli and Staphylococcus sp (76.5%) had the highest occurrence of diarrhoea in lambs and kids up to six weeks of age.

## **6.2 Recommendations**

- 1.** Serotyping of *E. coli* and *Salmonella* Spp should be carried out on the farm among diarrhoeic lambs and kids to know the type of strain for effective control measures.
- 2.** There should be deworming of lambs and kids from the age of one month old and above.
- 3.** The animal pens should as much as possible be kept dry, especially during the wet season to avoid increasing incidence of diarrhoea.

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## APPENDICES

**Appendix 1: Age distribution of diarrhoea in Yankasa lambs (<1–20 weeks old) in a Research Institute Zaria, Kaduna State, Nigeria**

Age Group (Weeks)	No Sampled	No. Diarrhoeic	Age Specific Rate
<1	20	18	90.0
2	27	26	96.3
3	35	35	100.0
4	37	37	100.0
5	6	3	50.0
6	8	8	100.0
7	5	5	100.0
8	4	3	75.0
9	4	3	75.0
10	4	3	75.0
11	5	2	40.0
12	5	4	80.0
13	3	2	66.7
14	4	2	50.0
15	1	1	100.0
16	2	1	50.0
17	3	1	33.3
18	2	1	50.0
19	10	2	20.0
>20	10	3	30.0
<b>Total</b>	<b>195</b>	<b>160</b>	

**Appendix 2: Age distribution of diarrhoea in Red Sokoto goat kids (<1–20 weeksold) in a Research Institute Zaria, Kaduna State, Nigeria**

Age Group (Weeks)	No Sampled	No. Diarrhoeic	Age Specific Rate
<1	9	7	77.8
2	17	16	94.1
3	17	17	100.0
4	11	7	63.6
5	8	6	75.0
6	10	9	90.0
7	8	6	75.0
8	4	3	75.0
9	2	1	50.0
10	3	2	66.7
11	2	2	100.0
12	2	2	100.0
13	1	1	100.0
14	3	2	66.7
15	2	1	50.0
16	1	1	100.0
17	1	1	100.0
18	1	1	100.0
19	1	1	100.0
>20	2	1	50.0
<b>Total</b>	<b>105</b>	<b>87</b>	

**Appendix 3: Enteric pathogens isolated from prospective study of diarrhoeic Yankasa lambs and Red Sokoto goat kids (< 1 to 20 weeks old) in a Research Institute Zaria, Kaduna State, Nigeria**

<b>Pathogens</b>	<b>Number with Diarrhoea (%)</b>
<i>Coccidia</i> oocyst	25(10.12)
<i>Coccidia</i> and <i>Strongyle</i>	11 (4.45)
<i>Coccidia</i> , <i>Strongyle</i> and <i>Momiezia</i>	1 (0.41)
<i>Escherichia coli</i>	20 (82.19)
<i>Escherichia coli</i> and <i>Staphylococcus</i> spp	7 (2.83)
<b>Total</b>	<b>247 (100)</b>

**Appendix 4: Year \* diarrhoea cross-tabulation**

		Diarrhoea		Total
		Diarrhoeic	Non-diarrhoeic	
Total	Count	121	298	419
	% within Year	28.9%	71.1%	100.0%

**Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	121.762 <sup>a</sup>	9	.000	<sup>b</sup>	
Likelihood Ratio	141.771	9	.000	<sup>b</sup>	
Fisher's Exact Test	<sup>b</sup>			<sup>b</sup>	
Linear-by-Linear Association	52.126 <sup>c</sup>	1	.000	.000	.000
N of Valid Cases	419				

**Chi-Square Tests**

	Point Probability
Pearson Chi-Square	
Likelihood Ratio	
Fisher's Exact Test	
Linear-by-Linear Association	.000
N of Valid Cases	

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 8.37.

b. Cannot be computed because there is insufficient memory.

c. The standardized statistic is -7.220.

>Warning # 3211

>On at least one case, the value of the weight variable was zero, negative, or

>missing. Such cases are invisible to statistical procedures and graphs which

>need positively weighted cases, but remain on the file and are processed by

>non-statistical facilities such as LIST and SAVE.

