UNIVERSITY OF ILORIN

THE THREE HUNDRED AND SEVENTH (307TH)
INAUGURAL LECTURE

"MICROBES: INVISIBLE ENEMIES OF HUMANS AND LIVESTOCK"

By

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UNIVERSITY OF ILORIN, NIGERIA

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This 307th Inaugural Lecture was delivered under the Chairmanship of:

The Vice-Chancellor

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Students of Faculty of Veterinary Medicine and other Faculties,
My Lord, Spiritual and Temporal,
Esteemed Invited Guests and Friends,
My Dear Wife and other Members of my Family,
Great Students of University of Ilorin,
Gentlemen of the Electronic and Print Media,
Distinguished Ladies and Gentlemen

Preamble

All praise is due to Almighty Allah, the Lord of the world, who has made today's presentation possible. I thank and praise Him for His countless favours and blessings upon me and my family. Glory be to Almighty Allah. I sincerely thank the Vice-Chancellor of this great University, Professor Wahaab Olasupo Egbewole, *SAN*, for approving the presentation of this Inaugural Lecture.

The first Inaugural Lecture from the Faculty, entitled "*Preventing Pesticides from Poisoning Our Health and Future:*

The Oxidative Approach," was delivered by Professor Suleiman Folorunsho Ambali on the 6th February, 2020. The second, titled "*The Matter of the Heart in the Survival of Animals and Humans*," was delivered by Professor Mistura Oyebisi Azeez on 21st November, 2024. The third Inaugural Lecture, titled "*The Public Health Veterinarian through Ticks, Snails, and Community Service*," was delivered by Professor Nusirat Elelu on 5th June, 2025. The fourth, titled "*Theriogenologists' Account: Insights into Gender Effects in Veterinary Reproduction*", was delivered by Professor Lukman Oladimeji Raji on 24th July, 2025.

Today, I feel highly honoured and privileged to deliver the 307th Inaugural Lecture of our great University, the University of Ilorin. My lecture, titled "**Microbes: Invisible Enemies of Humans and Livestock**," is therefore the fifth Inaugural Lecture from the Faculty of Veterinary Medicine and the first from the Department of Veterinary Microbiology, Faculty of Veterinary Medicine, University of Ilorin.

My Academic Journey and Background to Veterinary Medicine

I began my primary education at Community Primary School, Shasha-Ojoo, Ibadan, in 1973 and obtained my Primary School Leaving Certificate in 1979. I then proceeded to Ansar-ud-Deen College, Offa, in 1979, where I earned my Secondary School Certificate in 1984. Between 1984 and 1985, I attended the School of Basic Studies, Ahmadu Bello University (ABU), Zaria, and gained admission into the Faculty of Veterinary Medicine, ABU, Zaria, in 1985 and graduated with the degree of Doctor of Veterinary Medicine (DVM) in 1991.

My professional journey in Veterinary Medicine began immediately after graduating from ABU in 1991. I was posted to Borno State for the National Youth Service Corps (NYSC). Before leaving for Maiduguri, I received numerous discouraging stories from classmates and colleagues about the city. I was told that the weather was so extremely hot that water flowing from the tap could be used to prepare *eba*, and that swarms of flies

would welcome anyone entering the town. These stories were frightening and almost discouraged me from proceeding. However, by the grace of Almighty Allah, my experience in Maiduguri turned out to be rewarding and memorable.

Following my orientation at the NYSC camp, I was posted to Kasuwa Shanu, where I was warmly received by the late Alhaji Abdulkadir, the proprietor of Kadson Veterinary Drugs Store. He treated me like his own son and made my stay in Maiduguri quite comfortable. During this period, I initiated projects that earned me a Letter of Commendation from the Chairman of the NYSC, Borno State. Upon completion, I travelled to Ibadan, where I secured employment at Zarteck Farms, a poultry and fish enterprise, owned by some Lebanese investors. There, I successfully managed approximately 20,000 birds every six weeks. By the grace of God, the enterprise recorded excellent results under my supervision, and the owner requested that I recruit additional veterinarians, because of my performance. I politely informed him that the company might not be able to afford employing more veterinary doctors, considering that my monthly salary in 1992 was only nine hundred naira (₦900.00). The rest, as they say, is history.

Although I was doing exceptionally well at Zarteck Farms, my lifelong ambition had always been to pursue an academic career. Since my undergraduate days, I had developed a strong passion for teaching, research, knowledge generation, and mentorship. Mr. Vice-Chancellor, Sir, after completing the NYSC programme and my employment at Zarteck Farms, I applied for academic positions at several institutions, including ABU, Zaria, University of Ibadan, Usmanu Danfodiyo University, Sokoto, and the Maiduguri College of Agriculture, Borno State. I was invited for interviews by the Faculties of Veterinary Medicine at Usmanu Danfodiyo University, Sokoto, and the University of Ibadan, as well as by the College of Agriculture, Maiduguri. However, the invitation from Usmanu Danfodiyo University arrived too late for me to attend. Although I attended the interviews at Ibadan and Maiduguri, it became

apparent that preference was given to graduates of the University of Ibadan, and to indigenous applicants, respectively.

By the grace of Almighty Allah and with the invaluable support of my academic mentors, late Professor S.A. Ojo and Professor J.O. Adekeye, I was offered an appointment as Assistant Lecturer in the Department of Veterinary Microbiology, ABU, Zaria, in September, 1993, following a successful interview. I completed my Master degree in 1999 and was subsequently awarded a DAAD scholarship in 2002 to pursue a Ph.D. at the Sokoine University of Agriculture, Morogoro, Tanzania, under the DAAD African Network for Scientists and Technology. Upon completing my Ph.D. in 2005, I secured a postdoctoral fellowship in China under the TWAS programme. However, my employer was unable to release me, because of the acute shortage of academic staff in the Department of Veterinary Microbiology. I was advised that, having just completed my doctoral training, my services were urgently needed to strengthen teaching and research within the Department.

In 2011, I was promoted to the rank of Professor at ABU, Zaria, becoming the first Professor from the Doctor of Veterinary Medicine (DVM) Class of 1991 and the first Professor from the Ansar-Ud-Deen College Class of 1984. To Almighty Allah be all the glory for these remarkable achievements. I served at ABU from September, 1993 until November, 2015, where I was actively engaged in undergraduate and postgraduate teaching, research, and community service. In December 2015, I transferred my services to the University of Ilorin. The teaching experiences, research contributions, and academic exposure I gained at ABU, the University of Ilorin, and the Sokoine University of Agriculture have collectively formed the foundation of the work presented in this inaugural lecture.

Introduction

Microbes, or microorganisms, are organisms that cannot be seen with the naked eye, but can only be observed under a microscope. The term '*Microbes'* is a general expression that

encompasses a wide range of microscopic organisms, including fungi, protozoa, algae, bacteria, and archaea (Brooks *et al.*, 2004). *Microbes: The Invisible Enemies of both Livestock and Humans*, can justifiably be regarded as some of the most successful forms of life on earth. They have existed for far longer period than humans themselves. Scientific evidence indicates that microbes have inhabited the earth for approximately 3.8 billion years. The earliest forms of life are believed to have possessed characteristics similar to those of bacteria, most likely anaerobic bacteria. It is postulated that prokaryotes evolved from these primitive life forms and that the subsequent availability of oxygen through photosynthesis contributed significantly to microbial evolution and diversity (Nutman *et al.*, 2016).

Disease-causing microbes, despite being invisible to the naked eye, are responsible for enormous global losses through mortality, morbidity, food poisoning, reproductive failures, and reduced livestock productivity. Globally, an estimated 2.5 billion cases of zoonotic infections occur annually, resulting in approximately 2.7 million deaths (Bernstein *et al.*, 2022; Lv *et al.*, 2024). Zoonotic diseases account for about 25% of the infectious disease burden in low-income countries, where poverty, coupled with close contact between humans, livestock, and wildlife, substantially increases the risk of disease transmission (Bernstein *et al.*, 2022; Lv *et al.*, 2024).

The World Health Organization (WHO) estimated that approximately 600 million cases of food-borne diseases occur annually, of which about 350 million are caused by pathogenic bacteria (WHO, 2015). Microbial diseases also constitute one of the major constraints to livestock production in Nigeria. They account for an estimated annual economic loss of about ₦2 billion in Nigeria (FAO, 2020; WHO, 2024) and approximately USD 16 billion globally (WHO, 2024; Deb, 2025). Their consequences include substantial economic losses arising from mortality, morbidity, high treatment costs, food-borne infections and intoxications, reproductive failures, reduced productivity,

and the condemnation of meat at abattoirs due to diseases such as Contagious Bovine Pleuropneumonia (CBPP), tuberculosis (TB), and Foot-and-Mouth Disease (FMD). Some of these diseases, including tuberculosis and brucellosis, are also zoonotic and pose significant public health threats.

Diseases affecting livestock cost Africa nearly 9 billion dollars annually, representing approximately 6% of the total value of the continent's livestock sector (WHO, 2020). Of the approximately 1,400 microorganisms known to cause human infections, more than 60% are also pathogenic to domestic or wild animals. Furthermore, these zoonotic pathogens are responsible for approximately 75% of emerging infectious diseases affecting humans (Deb, 2025). Zoonoses are diseases that are naturally transmitted between animals and humans. In most instances, animals play a crucial role in maintaining these infections in nature and contribute, to varying degrees, to their distribution and transmission within both human and animal populations.

These diseases may be transmitted directly, as in the case of rabies and anthrax, or indirectly through vectors, contaminated food, water, or the environment, as exemplified by bovine tuberculosis. Several zoonotic diseases, such as brucellosis, have multiple routes of transmission. With the increasing and inevitable interaction between humans and animals, zoonotic diseases continue to pose serious threats to human health, animal health, food security, and sustainable livelihoods (WHO, 2024).

In Nigeria, my research has identified several priority bacterial zoonotic diseases, including bovine tuberculosis, brucellosis, campylobacteriosis, salmonellosis, leptospirosis, and verotoxin-producing *Escherichia coli* (VTEC). One of the greatest challenges undermining the prevention and treatment of bacterial diseases is the emergence and spread of antimicrobial resistance (AMR). Consequently, one of my major research interests has focused on understanding the antimicrobial resistance patterns of bacterial pathogens and their implications for both animal and public health.

Mr. Vice-Chancellor, I have had the privilege of working closely with colleagues, postgraduate students and researchers across the globe. Together, we have isolated and characterised microorganisms from different animal species, determined the prevalence and patterns of antimicrobial resistance, and investigated the role of bacteria in toxin production in foods of animal origin intended for human consumption.

My Contributions to Bacterial-induced Food-borne Pathogens

Campylobacteriosis is the leading cause of acute gastroenteritis in human and animals throughout the world. Epidemiological studies have shown that *Campylobacter* species are spread within the animal kingdom both as pathogens and commensal. Avian species are well documented reservouirs for *Campylobacter*, and may play an important role in the epidemiology of human enteric diseases either directly or indirectly through consumption of contamination food items. The role of the domestic chickens in the epidemiology of human campylobacteriosis was highlighted by **Raji** *et al.* (1999) noted that avian species are reserviour of campylobacter.

The role of sheep in transmission of *Campylobacter* to humans in Kaduna State were also examined and characterised by **Raji** *et al.* (2000) into different species and bio-serogroups. A sample of 1100 was collected from Kaduna abattoir and National Animal Production Research Institute (NAPRI) Shika. The samples were from 250 gallbladder, 250 intestinal contents, and 100 fetal stomach contents, all from Kaduna abattoir while 250 rectal swabs and 250 vaginal swabs were from the NAPRI Small Ruminant Programme. Of a total of 1100 samples, 39(3.54%) yielded *Campylobacter* organisms. The highest isolation rate (6.8%) was from samples of intestinal contents followed by those from gall bladders (4.0%). Samples from the vaginal and fetuses had the lowest isolation rates. Of the 39 *Campylobacter* isolates from all the sources, 79% were characterised as *C. jejuni subsp jejuni*, *C. coli* (13%) and *C. lari* (8.0%), while co-infection of *C. coli* and *C. lari* were (2.0%)

each. The implication of this study is that consumption of contaminated under-cooked meats and meat products or consumption of contaminated water from abattoir may serve as sources of human infections.

Diseases of poultry caused by *Escherichia coli* are of economic importance in the poultry industry in Nigeria. The organism is responsible for 30-40% mortality in broiler industry and the losses do not take into consideration weight loss and poor carcass quality in birds infected with *E. coli* (**Raji,** 2014). We have documented the occurrence and characterised *Escherichia coli* isolated from poultry with colibacillosis and other conditions at postmortem by Kwaga Tekdek, Odama, **Raji** *et al.* **(**2004). A total of 20 *E. coli* isolates were confirmed from samples examined. Only four of the isolates were typeable and belonged to serogroups O8, O76 and O149. The serotyping was done by our collaborator in South Africa. This is one of few studies on the serotyping of *E. coli* of poultry origin in Northern Nigeria.

In another study by **Raji** *et al.* (2007) on *Escherichia coli* from two hatcheries in Zaria Nigeria, the isolation rate of *E. coli* from hatcheries studied were 4.67% and 7.50%. Twenty *E. coli* isolates from clinical cases of colibacillosis were included in this study. The major serovars recorded from clinical cases of colibacillosis were serovars O8:K50 and O9:K30. Serovars from the dead-in-shell embryos were O78:K80, O8:K50, O9:K30, & O26:K60. The antibiotic susceptibility test indicated that many of the isolates were resistant to more than one antibiotic. The majority of the isolates (85% of the clinical cases and 100% of hatcheries' isolates) were sensitive to ciprofloxacin.

Raji *et al.* (2003) documented the pathogenicity of *Escherichia coli* isolated from poultry in Zaria using *in vitro* and *in vivo* studies. The results showed that 40% of the isolates from clinical cases were Congo red positive, while 56% and 39% of the isolates from Farm A and Farm B were Congo red positive, respectively. All of the *E. coli* isolates were motile. *In vivo* pathogenicity test of all the serotyped *E.coli* were compared

using day-old-chicks. Strain differences in the response of the birds were noted in the mortality. Clinical cases, 91-2000 (O9:K30), 98-2000 (O8:K50) and 92-2000 (O9:K30), produced clinical signs of severe lameness, depression, diarrhoea, and loss of weight and 100% mortality. This study highlighted the serogroups of *E. coli* in this environment, and successfully demonstrated the pathogenicity of these isolates, using day-old-chicks.

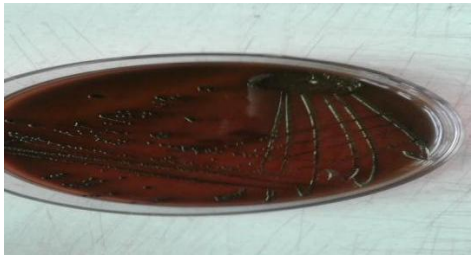


Fig. 1a: *Escherichia coli* on Eosin Methylene blue agar (**Raji** *et al.,* 2003)

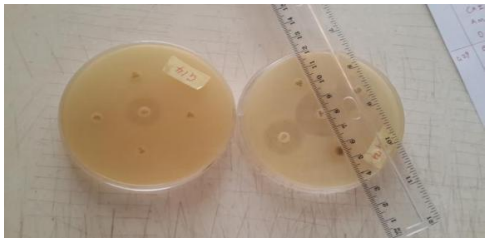


Fig. 1b: Antimicrobial resistant E.coli isolated from chicken (**Raji** *et al., 2003)*

Verotoxigenic Escherichia coli in Humans and Animals in Tanzania and Nigeria

Escherichia coli O157:H7 is an important agent of haemorrhagic colitis and haemolytic uraemic syndrome in children less than five years old, and elderly people. It is estimated that up to 10% of patients with VTEC infection may develop Haemolytic Uraemic Syndromes (HUS), with a case-fatality rate ranging from 3 to 5%. Overall, HUS is the most common cause of acute renal failure in young children. It can

cause neurological complications, such as seizure, stroke and coma in 25% of HUS patients and chronic renal sequelae, usually mild, in around 50% of survivors (**Raji,** 2005).

Persons who experience bloody diarrhoea or severe abdominal cramps should seek medical care. Antibiotics are not part of the treatment of patients with VTEC disease and may possibly increase the risk of subsequent HUS. Infections often linked to the consumption of improper cooked beef, unpasteurised milk, faeces contaminated vegetable, water and direct transmission of VTEC from animals to humans (**Raji,** 2005) such infections often linked to direct contact with infected animals. **Raji** *et al.* (2009) investigated the prevalence of verotoxin-producing *E. coli* O157:H7 among human patients with diarrhoea in Morogoro, Tanzania using modified immunomagnetic separation on human fecal sample in Tanzania in 2005. Fecal samples originating from 275 human patients with diarrhoea were screened for the presence of *E. coli* O157:H7 and the isolation rates of 3.6% were obtained. The results showed that 2(20%) and 1(10%) of the isolates possessed both attaching and effacing (*eae* A) and enterohemolysin (*hly*) A gene, respectively. Our study was the first to use modified immunomagetic separation for screening diarrhoea patients in this region. It was the first isolation of *E. coli* O157:H7 in human in the region. The provision of safe potable water, good sanitation and personal hygiene and health education are required to reduce infection and other enteric pathogens.

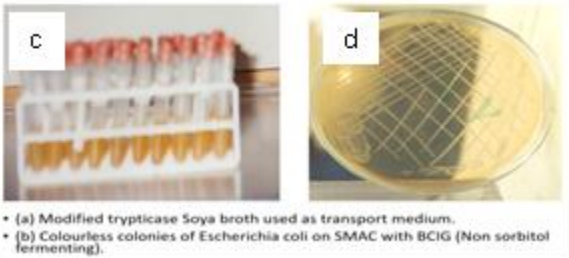


Fig. 1: c. Modified Tryptose agar **d.** Sorbitol Macconkey agar (SMAC) with BCIG (**Raji,** 2005)

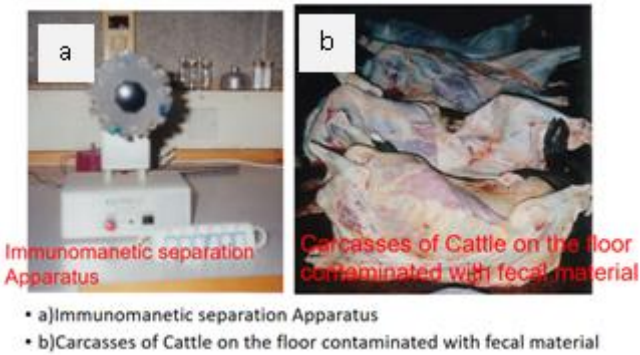


Fig. 2: a. Immunomagnetic separation b. Carcasses of cattle on the floor (**Raji,** 2005)

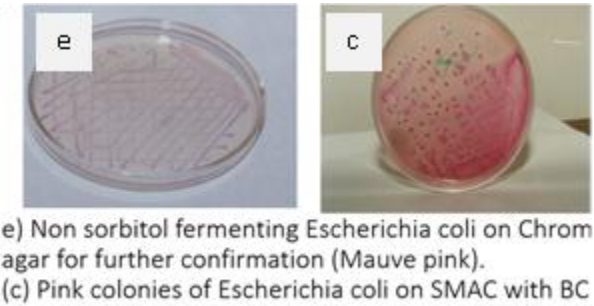


Fig. 3: e. *E. coli* O157 on Chromagar c. SMAC with BCIG with *E.coli* **(Raji,** 2005)

Strain of Verotoxin-producing *E.coli* O157:H7 from human (UMDL 29) and another one from cattle (MC 110) were used for pathogencity studies in day-old rabbits. All rabbits (n=8) inoculated orally with strain developed severe diarrhoea two days post inoculation. None of the control rabbits inoculated with PBS developed diarrhoea. The UMDL 29 and Morogoro cattle (MC 110) infected rabbits also developed ruffled coats by day two post inoculation. Mortality started to occur on day four post infection. The diarrhea, which started 24 hours post-inoculation was associated with loss of body mass and inflammation of the intestines.

At necropsy, the ceca and colons of inoculated rabbits were distended or filled with loose stool and fluids. The intestinal contents of the infected rabbits that died and of those that were euthanized were filled with watery content. A microscopic examination of colons showed mild inflammatory cell infiltration, thinning of the intestinal wall, or necrotic foci. The lungs of infected rabbits were congested. This study indicated that infant rabbits are useful model for investigation of the intestinal stage of VTEC pathogenesis and suggested that verotoxin and other virulence factors of *E. coli* O157 may play a critical role in causing diarrhea and inflammation in patients infected with VTEC (**Raji** *et al.,* 2008).

Verotoxigenic Escherichia coli O157 in Nigeria

It has been established that bacterial contamination has continue to be a major challenge to meat safety and it poses a danger of transmission of infection to human through exposure, handling and consumption of beef or animal products. We continued our studies on Verotoxigenic *Escherichia coli* in Nigeria to find out the extent of contamination of meat and meat products. Bello, Lawan, Kwaga and **Raji**…*et al.* (2011) carried out the assessment of the level of beef carcass contamination with *Escherichia coli* O157 strains before and after washing with water. Samples of water used for washing carcasses were collected and thirty beef carcasses were swabbed within a period of one month in each of three abattoirs located in North-Western states of Nigeria. A prevalence of 2.8% of *E. coli* O157 was detected in 360 swab samples from 90 beef carcasses examined in Kano (0.8%), Zaria (3.3%), and Sokoto (4.2%). Of the 72 water samples, 3(4.2%) were positive for *E. coli* O157. The study concluded that there was increased contamination of carcasses during processing of meat and the water used in washing carcasses might have contributed to carcass contamination in all the abattoirs studied due to the use of non-potable water. This might have contributed to human infections in these areas.

Our study in Suleja abattoir in Niger State on Verotoxigenic *E.coli* O157 involved a total of 515 rectal swab samples which were collected from cattle and subjected to conventional biochemical tests. The result showed that 2(0.4%) of the isolates were confirmed to be *E. coli* O157. This study was therefore, the first research work to confirm the presence of *E. coli* O157:H7 in cattle presented for slaughter in Suleja abattoir in Nigeria. Humans can contract the infection through exposure, handling and consumption of beef or animal products (Mailafia, Madubuke, **Raji**… *et al.,* 2017).

Similar study was also conducted in Bauchi abattoir for *E.coli* O157 isolation from meat and meat products using latex agglutination kit, the study found that only 3(1.2%) of the 240 Swabs of the Meat Contact Surface were positive for *E. coli* O157 (Zailani…& **Raji**, 2016). Bacterial contamination has continued to be a major challenge to meat safety and it poses a danger of transmission of infection to human through exposure, handling and consumption of beef or animal products. Another study was conducted on *E. coli* O157 in Kaduna State to determine the prevalence and the presence of *Escherichia coli* O157 serogroup in commercial cattle farms in Kaduna State, Nigeria. Musa, Kazeem, **Raji**…*et al.* (2016) detected two O157 serogroups from two apparently healthy cattle. The prevalence of *E. coli* O157 was found to be 0.8%. The study confirmed that cattle are important source of verotoxigenic *E. coli* and may pose a risk to humans, who come in contact with cattle faeces in areas of Kaduna State, Nigeria.

Our research efforts were also extended to currency note (Mbaya, Junaidu, **Raji**…*et al.,* 2016). Currency note is a medium of exchange for goods and services; buying and selling of various products, including meat at meat markets. The study was designed to evaluate the occurrence of *Escherichia coli* O157:H7 from Nigerian currency notes (Naira) collected from butchers at the meat market in Karu Abattoir, Abuja. A total 189 currency notes sampled from the eight currency denominations were subjected to isolation, using Eosine methylene blue (EMB)

and Sorbitol-MacConkay (SMAC) agar. All the 189(100%) naira notes sampled from butchers at the meat market, were contaminated; 168(88.9%) had colonies that could be counted (≤ 300 cfu/cm^2), while 21(11.1%) of the samples collected produced colonies that were too numerous to count (TNTC) (>300cfu/cm^2). The contamination was found more in lower currency denomination (5-200 Naira notes) than in higher currency denomination (500-1000 Naira notes) with a prevalence of *E.coli* O157 of 2.6%, and this have public health implications. This could be attributed to the fact that these currency notes got into the hands of several people including butchers who may have contaminated the currency notes with blood that serves as a good medium for bacteria growth. Currency notes can potentially serve as formite in transmitting microorganisms such as *E. coli* O157:H7 which causes enteric diseases in humans. Also, poor handling practices of currency notes posed a critical threat to public health.

Mr. Vice-Chancellor, Sir, we conducted a study in Kaduna on non-O157 in which a total of two hundred and forty (240) faecal samples were collected from apparently healthy (233) and diarrhoeic (7) cattle in 8 randomly selected commercial farms in Kaduna State, Nigeria (Musa, **Raji**…*et al.,* 2012). The isolates revealed three heterogeneous serogroups (O111, O118 and O126) from 6 apparently healthy cattle, while no *E. coli* serogroup was isolated from diarrhoeic cattle. The prevalence of non-O157 isolates was 4.5 %. The O126 serogroup isolated from apparently healthy cattle occurred more frequently, followed by O118 and O111. Most of these serogroups identified from apparently health cattle (O126, O118, O111) are well known for damage kidney and colon in humans globally.

Salmonellosis is a food-borne zoonotic disease caused by the bacteria of the genus *Salmonella.* It is one of the most common and widely distributed food-borne diseases, and the presence of antimicrobial-resistant *Salmonella* in poultry and poultry products is a global public health problem. It is transmitted from animals to humans and vice versa. The

symptoms in humans include acute abdominal pain, diarrhoea, nausea, fever, and sometimes vomiting. When present in animals, the clinical signs are similar diarrhoea, fever and vomiting, but infection in animals is often asymptomatic. Transmission from animals to humans is usually through contaminated food products of animal origin such as meat, eggs, milk, fish, shell fish and contaminated plant material, such as lettuce.

In a study conducted in Zaria, Kaduna State of Nigeria to isolating and identifying *Salmonella* species from raw and locally fermented milk ("Nono"), the results showed that out of the 350 milk samples examined, 14 (4.0%) were positive for *Salmonella*. The prevalence of *Salmonella* was higher in raw milk (4.6%) than in fermented milk (3.4%) with no statistical difference ($p>0.05$). *Salmonella* isolates were 100% resistance to lincomycin, 85.7% to erythromycin (E), 85.7% to ampicillin and 78.6% to amoxicillin (AML). The antibiotic resistance pattern of 14 *Salmonella* isolates from raw and fermented milk showed 9 different resistance patterns. The Minimum Inhibitory Concentration (MIC) test showed that only 1 (7.1%) of the isolate was sensitive to Amoxicillin with <0.12 while the remaining 9 (98.9%) were resistant to the two antibiotics used (AML and E) with > 256 (Tamba, Bello & **Raji,** 2016). The milk for human consumption must be free of *Salmonella*. This study, therefore, recommended that milkers should practice personal hygiene by wearing clean clothing and by washing their hands regularly with soap and water before and after milking the animals. There should be public health education to the fulani herds men on the need to practice personal hygiene by washing their hands regularly with soap and water before and after milking their animals.

Raji *et al.* (2021) conducted a cross-sectional study from November 2016 to July 2017 with the aim of determining the isolation rates of *Salmonella* species from the intestinal contents of slaughtered chickens and ready-to-eat gizzards, and to determine the most common serotypes that invade the tissues of

chickens in Ilorin. The isolates were subjected to commonly used antibiotics in the area. Four hundred samples of intestinal contents from apparently healthy slaughtered chickens and one hundred ready-to-eat chicken gizzards were examined for the presence of *Salmonella* and their serovars. A total number of forty-three (43) *Salmonella*, consisting of 33 from intestinal contents and 10 from ready-to-eat chicken gizzards, were isolated and identified. There was an overall *Salmonella* prevalence rate of 8.6%, and the isolates were distributed as follows: gizzard, 2% (n = 10) and intestinal contents, 6.6% (n = 33). The predominant serovars were *Salmonella enterica* subsp. *enterica serovar* 45: d: 1, 7 (16) and *S*. Haifa (5). All ready-to-eat chicken gizzards were associated with *S. enterica subsp. enterica* serovar 45: d: 1, 7 (5). The *Salmonella* from intestinal contents belong to *Salmonella enterica subsp. enterica* serovars 45: d: 1, 7 (11) and *S*. Haifa (5).

Salmonella species isolated were also 100% resistant to ciprofloxacin, ampicillin, and ceftazidime. This is followed by cloxacillin (81%), tetracycline (75%), and sulfamethoxazole (67%). The *Salmonella* isolates were, however, 100% sensitive to enrofloxacin, 74% to streptomycin, and 72% to gentamycin antibiotics. The virulence genes of invasion *(invA)* and enterotoxin (*stn)* were possessed by the *Salmonella* isolated. The *Salmonella* enterica subsp. *enterica* serovar 45: d: 1, 7 and S. Haifa, possess virulence genes, so, they are potentially pathogenic to humans in this area. These pathogens are major causes of food-borne illnesses that may lead to human gastrointestinal infections. *S enterica* subsp. *enterica* and Haifa are the food-borne bacterial pathogens that contaminate a diversity of foods and are a leading cause of food-borne illnesses and mortality globally.

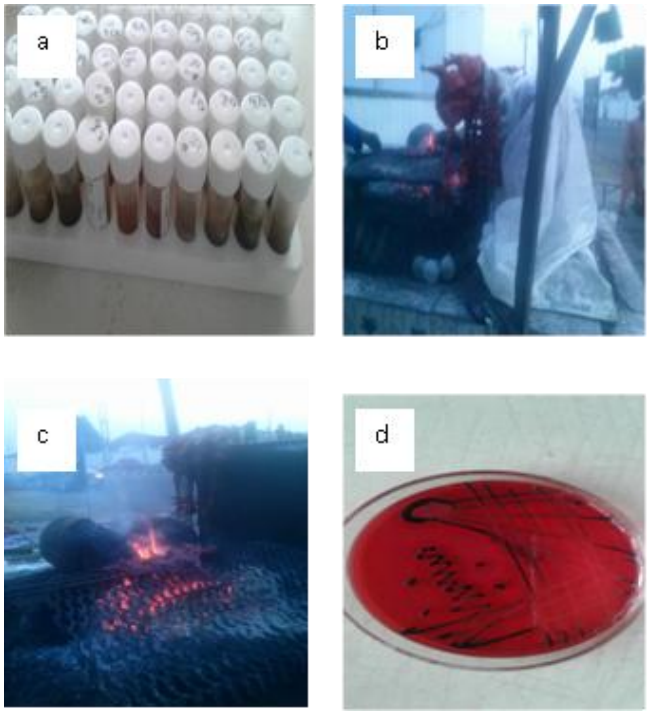


Fig. 4: **a.** Modified Tryptose soya broth with intestinal content of chicken **b.** Suya palace close to fire **c.** Gizzard chicken closed to the open fire **d.** Salmonella Shigella Agar with salmonella colonies (**Raji** *et al.*, 2021)

Ahmed, **Raji**…*et al.* (2019) investigated the level of *Salmonella* contamination and determine the resistance pattern of isolates obtained from selected poultry farms in Kwara State, Nigeria. A total of 900 samples were collected between January and August 2017, from the poultry environment and from apparently healthy and dead birds. A total of 58 (6.4%) *Salmonella* isolates were obtained and the isolation rate was only statistically significant ($p < 0.05$) in live birds. The isolates comprised of 13 serovars. The three predominant serovars, *Salmonella enterica* ser. 6.7:d:- (29.0%), *Salmonella* Agama (28.0%) and *Salmonella* Typhimurium (16.0%), were isolated

from all the three sample types. Rare serovars like *Salmonella* Albany, *Salmonella* Colindale, *Salmonella* Istanbul, *Salmonella* Larochelle, *Salmonella* Nigeria and *Salmonella* Orion were also isolated in this study.

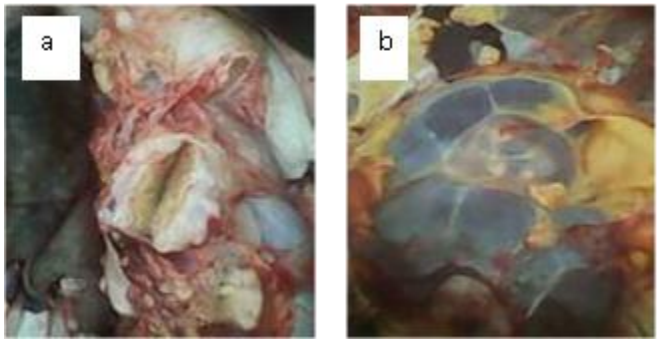
A high frequency of resistance was generally observed with all the isolates exhibiting 100% resistance to ampicillin, cefotaxime and ceftazidime. This study documented the first predominant isolation of *S. enterica* ser. 6.7:d:- and *S.* Agama from chickens. It also documented the high frequency of fluoroquinolone and cephalosporins resistance of the isolates, indicating the abuse of antibiotics in the environment. We also observed that *fimA* gene is widely distributed among *Salmonella* irrespective of the serovars. However the *Sef*C gene appears to be serovars specific (*S.* Enteritidis). The presence of the *fim*A and *SefC* genes in all the clinical isolates highlights the role of the *fim A* and *Sef C* genes in the adhesion, which is responsible for causing acute gastroenteritis in human.

Zoonotic Bovine Tuberculosis in Markudi, Nigeria

Vice-Chancellor, Sir, Bovine tuberculosis (bTB) is a chronic infectious disease of animals and humans caused by *Mycobacterium bovis* (*M. bovis*) of the *M. tuberculosis* complex. It is widely distributed throughout the developing world. In humans, tuberculosis caused by *M. tuberculosis* as well as by *M. bovis* has become increasingly important due to its association with HIV/AIDS. Symptoms in humans include fever, weight loss, night sweats, and in the most common form of pulmonary tuberculosis, coughing and blood-stained sputum. The clinical signs in animals are coughing, dyspnea, gastrointestinal problems, bone deformation, and emaciation. The principal route of human infection with *M. bovis* is by ingestion of contaminated products such as infected milk and meat. The economic impacts of bTB in humans result from treatment costs such as treatment of sick patient and the price of medicines; while in livestock, economic impacts are related to production losses, such as reduced milk yield, weight loss, and the cost of surveillance and control programmes.

As a result of this, Ejeh, **Raji**…*et al.* (2014a) conducted a retrospective study to investigate the prevalence of bovine tuberculosis and to determine direct economic losses (DEL) from tuberculosis in cattle slaughtered in Makurdi abattoirs from 2008 to 2012, using abattoir records. Out of 61654 cattle slaughtered during the study period, 1172 (1.90%) were positive for tuberculosis lesions. The annual prevalence of bovine tuberculosis ranged from 0.90% in 2008 to 4.04% in 2012. It was also observed that there was no seasonal difference in the prevalence of bovine tuberculosis. A total of 1935 affected organs by bTB weighing 3046.50 kg, amounting to #2.9 million, were condemned within the study period. It was concluded that bovine tuberculosis was prevalent in Makurdi and accounted for heavy economic losses due to condemnation of edible offals.

Ejeh, **Raji**…*et al*. (2014b), in another study in Otukpo abattoir, Markudi, Nigeria, using Ziehl-Neelsen stain, a prevalence of 6.5% was recorded by the Ziehl-Neelsen microscopy (ZNM) out of 248 pathological lesions suggestive of bTB collected.. In addition, the cows (4.8%) were more affected than bulls (1.6%).There was also a significant association between bTB prevalence and body condition scores ($p < 0.05$) of the cattle screened. Our findings showed that bTB is endemic in cattle slaughtered in Otukpo abattoir, and portend potentials for zoonotic transmission, especially abattoir workers and consumers.



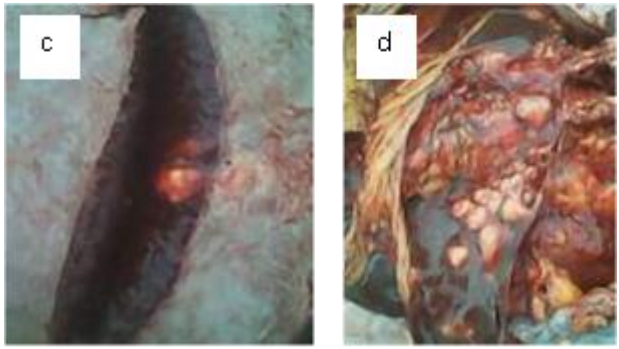


Fig. 5: a&b. Cattle heart with tubercle lesions c&d. Liver with tubercle lessions (Ejeh, **Raji**…*et al.*, 2014a)

Brucellosis is a highly infectious, chronic disease of livestock and humans caused by *Brucella* species. The major clinical signs in cattle are repetitive abortions, premature births, retained placental, orchitis and epididmitis. The symptoms in humans are a profuse undulant fever with muscle and joint pain, headache, hepatomegaly and spleenomehgaly to mention a few. Brucellosis transmission from cattle to humans is usually from ingesting unpasteurized milk, and milk products or raw meat, and direct contact with infected blood, vaginal discharge or other secretions. Animal to animal transmission is usually from direct contact with infected body secretions. The economic consequences of brucellosis are a significant reduction in livestock productivity due to decreased milk production, loss of appetite, loss of calves, as well as the impact of severe trade restrictions imposed on affected farms and countries.

Buhari, **Raji**…*et al.* (2015a) identified the role of milk as a source of brucellosis. A total of 202 milk samples from apparently healthy lactating cows were collected and subjected to the Milk Ring Test (MRT) between July, 2013 and January, 2014, with 77(38.1%) were positive for brucellosis. This has serious public health significance since pastoralists are known to use milk as their main source of food and that pastoralists' children have the habit of consuming milk directly from the

udders of milking cows. The increase in the demand for milk and its products could lead to an increase in the spread of milk-borne diseases including brucellosis in the study areas, which could lead to a very serious health hazard in humans.

Adamu, **Raji**…*et al.* (2018) conducted a cross sectional study to determine the seroprevalence and risk factors of brucellosis and Q fever in cattle in Maigana and Birnin Gwari agro-ecological zone of Kaduna State, Nigeria. A total of 400 sera samples were collected and screened for brucellosis, using Rose Bengal Plate test (RBPT) and competitive enzyme linked immunosorbent assay (cELISA) for brucellosis and indirect enzyme-linked immunosorbent assay (iELISA) for Q fever. A structured questionnaire was used to collect data on the sampled animals from the study population. Sera analysis revealed that 18.5 and 6.8% were seropositive by RBPT and cELISA for brucellosis, respectively, while 6.2% was seropositive by iELISA for Q fever. The study indicated that brucellosis and Q fever exist with high prevalence, particularly among cows. This indicated a serious public health problem, calling for greater awareness among stakeholders and for coordinated surveillance for diseases among cattle populations in Nigeria.

Buhari, **Raji**…*et al.* **(**2015b) assessed the knowledge, attitude and practices of the pastoralist regarding bovine brucellosis in the North Senatorial District of Kaduna State, where 42 pastoralists' herds were interviewed. A structured questionnaire was used. Most of the pastoralists interviewed were aware of bovine brucellosis while a few were not. The majority of the pastoralists reported recognising abortion as the major clinical sign of brucellosis in cattle, while some of them reported recognising hygroma and retained placenta as signs of bovine brucellosis. With respect to abortion, most of the pastoralists reported that they had abortion in their herds while the remaining did not. In addition, those that had abortion histories reported feeding those aborted foetuses to dogs, burying them, hanging the foetuses on trees and throwing them away.

The majority of the pastoralists had no knowledge on how brucellosis is transmitted among animals, while some others

believed mating, consumption of contaminated water and feed were the ways in which animals could contract brucellosis. A large number of the respondents believed brucellosis is not transmissible from animals to man. Only few of the pastoralists were aware of the zoonotic nature of brucellosis. This study revealed that pastoralists in the study area had very little knowledge about the zoonotic impact of brucellosis and their attitudes and practices promoted its spread.

Zoonotic Leptopsirosis in Cattle in Zaria, Kaduna State Nigeria

Leptospirosis i**s** an occupational zoonosis caused by pathogenic leptospirales. The infection is responsible for considerable financial losses in the cattle industry as a result of agalactia, abortion, still birth, birth of weak calves and reduced fertility. Leptospirosis in human is a disease that presents with clinical manifestation such as fever, headache, vomiting and myalgia. These signs mimic those of other diseases such as malaria, typhoid, hepatitis, Lassa fever, Dengue, Yellow fever, Tuberculosis and Brucellosis (Yanagihara *et al.*, 2007), which are endemic in Nigeria. These non-specific symptoms exhibited makes diagnosis of leptospirosis difficult.

Leptospira serovar Hardjo seroprevalence was investigated in apparently healthy above 1 year old cattle from 8 farms in Zaria, Nigeria, using a commercial Enzyme Linked Immunoassay (ELISA) kit. Twenty (8.44%) out of the 237 cattle sampled were seropositive. A high seroprevalence was found in older animals (more than 5 years old), but age influence was not statistically significant. Indigenous breeds appeared significantly more frequently seropositive than exotic and cross breeds. *Leptospira* spp. serovar Hardjo was present in apparently healthy cattle in farms in Zaria and may contribute to the disease spread in other animals and humans (Ngbede, **Raji**…*et al.*, 2012a).
Ngbede, **Raji**…*et al.* (2012b) evaluated the seroprevalence of antibodies specific to *Leptospira* spp. serovar Hardjo in 142 cattle slaughtered between June and July 2011, using the ELISA in Zango, Zaria abbottir. Five (3.50%) of the 142 cattle sampled

were seropositive for antibodies to *Leptospira* spp. serovar Hardjo. The study showed that leptospirosis was present in cattle slaughtered in the Zango abattoir; butchers and abattoir workers were exposed to infected animals and were at risk of being infected by *Leptospira* spp. serovar Hardjo.

Another study by Ngbede, **Raji**…*et al.* (2012c) was designed to assess the presence of risk practices and level of awareness of leptospirosis among abattoir workers. The study was conducted in an abattoir located in Northwestern Nigeria. Pretested questionnaires were administered via interview to 73 of the abattoir workers willing to participate in the study. There was a low level (5.48%) of awareness of leptospirosis among the abattoir workers. There were also the visible practices such as exposures to urine, body fluid, aborted materials 79.45%]. It was also documented that 50.70% of the abattoir workers did not wash their hands at end of their daily work. 94.30% work with wound on their hands, 38.40% did not use boot and did not protect their hands (94.50%), which were the major risk factors for infection by *Leptospira*. This study showed that the abattoir workers are at risk of infection by *Leptospira* in the course of their work due to the low level of awareness of the disease.

Fish and fish products have been documented as a major source of food-borne pathogens of which bacteria and fungi play major roles. The fungal organisms, contaminating apparently healthy and diseased *Clarias gariepinus* in Zaria, Kaduna State, were investigated. The fungal organism isolated from the skin and gills of diseased fish were 13.1% *Aspergillus fumigatus*, 12.6% *A. flavus*, 18.1% *Aspergillus niger*, 18.7%, *Penicillium species*, 7.1% *Mucor* species, 2.0% for *Rhizopus* species, 14(7.1%) *Trichophyton* sp., and 42(21.2%) yeast isolates. The diseased *C. gariepinus* were characterised with skin ulcer, fin and tail rots. The study showed the majority of the isolates belonging to *Aspergillus* sp. and potential aflatoxin producers. Isolation of pathogenic fungi from skin and gills of *C. gariepinus* from cultured fish meant for human consumption is alarming, which can be a source of fish-borne infections (Salawudeen, **Raji**…*et al.*, 2017).

State of Abattoirs in Northern Nigeria

The Federal Government has allocated N259 million for the construction and rehabilitation of abattoirs across six states. According to the plan, six abattoirs will be constructed and rehabilitated in Lagos, Adamawa, Enugu, Bayelsa, Benue and Anambra. This is a welcome development and there was a need to extend the funding to abattoirs in other States of the nation (Federal Government, 2025). Zailani…& **Raji** *(*2014) did a thorough assessment of six major abattoirs, all registered slaughter houses and slaughter slabs of Bauchi State to determine status of infrastructure, and operational processes. The results as at the time of the assessment indicated that there were 26 functional abattoirs and slaughter slabs, and one meat processing plant registered and licensed with Bauchi State government.

Facilities at the various abattoirs were found to be obsolete, dilapidated and in a deplorable conditions. Only the meat processing plant had source of electricity. Diseases such as tuberculosis, CBPP, helminthosis, multiple liver abscesses were encountered during meat inspection in some of the abattoirs during the study. It was concluded that none of the abattoirs studied meet the minimum international standard regulations and there were public health dangers associated with production and processing of meat for human consumption at the slaughter houses.

Fig. 6a: Means of transporting meat in the abattoir (Zailana **Raji** *et al.,* 2014)

Fig. 6b: Heap of fecal material and presence of strayed dog (Zailana, **Raji** *et al.,* 2014)

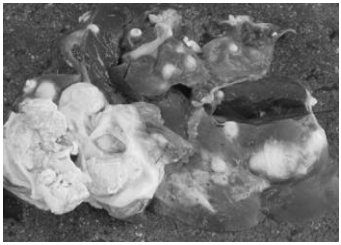


Fig. 6c: Liver abscesses & cysticercocic (Zailana, **Raji**… *et al.,* 2014)

Fig. 6d: Use of rope to hang meat (Zailana, **Raji**…*et al.,* 2014)

Lawan, **Raji**…*et al.* (2013) conducted a study to evaluate the physical facilities of four major abattoirs in North-western states of Nigeria. These are: Mayanka abattoir in Kano, Kara abattoir in Sokoto, Zango abattoir Zaria and Kawo abattoir in Kaduna. The facilities of these abattoirs were evaluated based on their presence and functional status. Pictures were taken, using digital camera, to document conditions of the infrastructure and activities of the butchers. The study showed that the basic components were in a deplorable state. The dilapidated conditions of the abattoirs were as a result of the failure to enforce the use of standard facilities in carrying out abattoir operations and general maintenance. It was similarly observed that there was no proper record keeping, no formal ante-mortem and post-mortem meat inspection. Hygiene and sanitation were largely absent in these abattoirs.

Diseases, such as tuberculosis, contagious pleuropneumonia, fasciolosis and hydatidosis, were most frequently encountered during the study. The results of focus-group interaction revealed that only 40% of butchers supported the use of standard operating facilities during operation, while the remaining rejected the idea. It was concluded that all the major abattoirs in Kaduna, Kano and Sokoto states of North-western Nigeria were in a deplorable state and the dilapidated infrastructure could not support the production of safe and wholesome meat and meat products for human consumption.

Fig. 7a: Washing meat inside gutter Zango (Lawan, **Raji**…*et al.,* 2013)

Fig. 7b: Lairage for cattle inspection their not using it (Lawan, **Raji**…*et al.,* 2013)

Fig. 7c: Hang rail in Sokoto abattoir vandalised (Lawan, **Raji**… *et al.,* 2013)

Fig.7d: Cold room in Kano working (Lawan, **Raji**…*et al.,* 2013)

Antimicrobial Resistance and Implication for Health

Alternative to antimicrobial agents are the use of herbs, probiotics (*Saccharomyces cerevisiae)* and Lactic acid bacteria for animal production and diseases prevention in Nigeria. The number of global deaths directly attributable to antibiotic-resistant bacterial infections is predicted to rise from 1.27 million in 2019 to 1.91 million in 2050 (Wang *et al.,* 2021). In total, antibiotic resistance is expected to kill 39 million people

between now and 2050, but more than one third of that number could be averted if we take action (Jaime *et al.*, 2022). **Raji** *et al. (*2021) documented *Salmonella* species that are resistant to ampicillin, chloramphenicol, streptomycin, sulfonamides, tetracycline, nalidixic acid and cotrimoxazole, which are categorised as 'first line' drugs in the treatment of typhoid fever in Ilorin, Kwara State Nigeria. This study also demonstrated that poultry meat and meat products are a source of antibiotic-resistant *Salmonella* strains and this is a serious concern for public health and food safety.

In a similar study carried out in Ilorin, Kwara State, Babatunde, Ahmed, Shuaib, **Raji**…*et al.* (2022) on antimicrobial profiles of *Salmonella* species isolated from ruminants slaughtered at the two major abattoirs in Ilorin, Nigeria, it was affirmed that multi-drug resistant *Salmonella* isolates from ruminants slaughtered for human consumption exist, but low, compared to poultry. The occurrence, antimicrobial resistance and virulence of *Enterococcus* from poultry and cattle farms were investigated (Ngbede, **Raji**…*et al.*, 2016). Three hundred and ninety samples were processed for recovery of Enterococcus species. Enterococcus was recovered from 167 (42.8%) of the 390 samples tested with a predominance of Enterococcus faecium (27.7%). Other species detected were Enterococcus gallinarum, faecalis, hirae, raffinosus, avium, casseliflavus, mundtii and durans.

All the isolates tested were resistance to tetracycline, erythromycin, ampicillin and gentamicin. Sixty (53.1%) of the isolates were multidrug resistant. In addition to expression of virulence traits (haemolysin, gelatinase, biofilm production), antibiotic resistance (tetK, tetL, tetM, tetO and ermB) and virulence (asa1, gelE, cylA) genes were detected among the isolates. Also, *in vitro* transfer of resistance determinants was observed among 75% of the isolates tested. Our data revealed poultry, cattle and manure in this area are hosts to varying Enterococcus species harbouring virulence and resistance determinants that can be transferred to other organisms and also

are important for causing nosocomial infection (Ngbede, **Raji**…*et al.*, 2016).

Ngbede, **Raji**…*et al. (*2017) investigated the resistance pattern from Enterococcus spp that have been isolated from various sources such as vegetables, soil, farm animals and manure. Five (7.9 %) and 35 (94.6 %) of the *E. faecium* isolates tested expressed ampicillin and gentamicin MIC equal to or >16 µg ml and 500 µg ml recommended resistance breakpoints for each antibiotic, respectively. To our knowledge, this was the first study to characterised high level ampicillin- and aminoglycoside -resistant species of the genus Enterococcus from non-hospital sources in Nigeria, and one of the few reports from Africa.

The Use of Herbs on Resistant Bacteria in Nigeria

The emergence of Campylobacter strains resistant to most common antibiotics highlights the need to explore new methods for therapeutics against Campylobacter infections. **Raji** *et al.* (2002) carried out investigation on the *in vitro* activity of the extracts of *Acacia nilotica* and *Vitex doniana* against *Campylobacter jejuni, C. coli,* and *C. lari* isolated from sheep in Zaria and Kaduna. Ethanol extract of *A. nilotica* at concentration of 200mg/ml and 20mg/ml had inhibitory diameters zone of 6mm and 4mm respectively. Water extract of the same plant at concentrations of 200mg and 20mg had diameters of only 2mm and 1mm, respectively. There was very little or no inhibitions with *Vitex doniana* water and ethanol extracts. Ethanol extract of *A. nilotica* can be used against resistant campylobacter species.

The inhibitory effect of aqueous and methanol extract of *Mangifera indica* (Mango) was examined against *Aeromonas caviae* from fish (Talba, Suleiman, **Raji**…*et al.* (2014). Methanol extract used at different concentrations showed varying degrees of inhibition against *A. caviae* (ranging from 16±2.41mm to 24±0.58 mm) but the aqueous extract was found to be slightly active against the organism at lower concentrations with zones of inhibition ranging from 8±1.22 mm to 11±1.23 mm with measurable zones of inhibition at higher

concentrations. The aqueous extract of *Mangiferea indica* was active against *A.caviae i*n fish.

The Use of Probiotics as Antibacteria and to Improve Weight Gain in Poultry and Weaned Pigs in Nigeria

Microorganisms are constantly developing resistance against commonly used antibiotics, and as such, there is the need for alternatives 'probiotics', which promote health without conferring resistance to the microbes. Yeast has been used traditionally to improve weight gain and immune response. The investigation of effect of supplemental probiotic preparation on performance indices and serum biochemistry of broiler chickens was done in Zaria. Two hundred day-old Marshall broiler chicks were randomly selected and distributed based on the level of supplementation into four groups of 50 chicks each (Control, C; E_1 0.5%, E_2 1.5% and E_3 2.0%). Chickens fed with 2.0% probiotic had a significantly higher body weight when compared with the control group. Activity of alanine aminotransferase differed significantly in the group E_1 and in the group E_2. Alkaline phosphatase activity decreased significantly ($p<0.05$), when compared with that of the control group. Blood glucose concentration was significantly different ($p<0.05$) in E_2 probiotic supplemented group when compared with control. Cholestérol concentration in broiler chickens decreased significantly ($p<0.01$) in E_1 experimental group (Aluwong, **Raji**…*et al*., 2012). In conclusion, administering yeast probiotic supplement increased body weight, decreased cholesterol level and enhanced serum anti-oxidant enzyme activities of broiler chickens (Aluwong, **Raji**…*et al.,* 2013).

Karaye, **Raji**…*et al.* (2019) compared Lactobacillus species (LAB) from "burukutu" and pig hindgut with patented probiotics, using the body weight and hemogram in *E. coli* infected weaned pigs. White blood count, lymphocytes, neutrophils and total protein values were significantly high ($p<0.01$) in the treatment groups from 4 to 9 weeks, the wet form of the feed in each treatment produced significantly heavier animals ($p<0.01$) with an average weight of 25 kg. All dietary

treatments showed significant reduction ($p<0.05$) in *E. coli* counts. The study demonstrated that lactobacillus species was able to improve weight gain and performance of weaned pigs. Therefore, isolated bacteria from "burukutu" and pig hindgut can serve as potent probiotics and growth promoters.

Contributions to Manpower Development

I joined the services of Ahmadu Bello University (ABU), Zaria, as Assistant Lecturer in September, 1993 and rose through the academic ranks to become a Professor of Veterinary Microbiology in 2011. While in Zaria, I served on several University committees, notable among which were Representative, University Board of Research (2012), Elected Congregation Representative, University Senate (2014), Member, Standing Committee to Senate (2015), Faculty Research Manager, Faculty Representative, Research and Postgraduate Committee (2015–2017), 400-Level Academic Adviser (2008), and Acting Head of Department of Veterinary Microbiology.

I participated in the training of Veterinary Medical Students at ABU, Zaria from 1993- 2015, at the University of Ilorin 2015-till date and at the University of Maiduguri, as a Sabbatical staff in 2011 and 2019. I supervised and co-supervised 10 Ph.D. and 25 M.Sc. students at ABU, Zaria, and the University of Ilorin; some of whom are now Professors and Readers in their various institutions. I served as an External Examiner at the Department of Veterinary Microbiology at Usmanu Danfodiyo University Sokoto (2015-2016), University of Agriculture, Makurdi (2011--2014), University of Nigeria, Nsukka (2014-2017), University of Maiduguri (2015-2017), University of Jos (2017-2019), Micheal Okpara University of Agriculture, Umudike (2017-2020), University of Benin (2023-2025), and ABU, Zaria.

Also, I am an Assessor to a number of universities in Nigeria (ABU, Zaria, Usmanu Danfodiyo University Sokoto, Federal University of Agriculture, Abeokuta, University of Ibadan, University of Abuja, University of Jos, Michael Opkara

University, Umidike, and University of Nigeria, Nsukka), for the promotion or appointment to the professorial cadres.

Community Services

Vice-Chancellor, Sir, some of my major community services include:

University of Ilorin

1. Chairman, Sports Council (2025-Date)
2. Dean, Faculty of Veterinary Medicine (2021-2023)
3. Head, Department of Veterinary Microbiology (2016-2019)
4. Member, Faculty Promotion Committee (2015-2026)
5. Pioneer Editor-in-Chief, Savannah Veterinary Journal (2017-2019)
6. Pioneer Faculty Postgraduate Coordinator (2017-2019)
7. Representative, Faculty of Veterinary Medicine in Business Committee of Senate (2016-2018)
8. Chairman, Faculty Students Practical Charges (2019)
9. Member, Library and Publications Committee (2020)
10. Member, UNILORIN Internal Accreditation Committee (2018)
11. Commissioner, Examination Monitoring in the Faculties of Basic Medical Sciences (2017) Clinical Sciences (2018) Education 2022 & 2025)
12. Chairman, Ad-Hoc Committee on Proposal for Private Public Partnership on UNILORIN Zoo (2022)

National Assignments

1. Member, NUC Accreditation Teams to many institutions in Nigeria
2. Resource Person, Fellow of College of Veterinary Surgeon of Nigeria (CVSN)

Community Services

1. Chairman, Kite Club of Offa Quiz Compétition (2022-2025)
2. President, Olalomi Elite Club, Zaria (2012-2014)

Conclusion

Mr. Vice-Chancellor, distinguished ladies and gentlemen, this Inaugural Lecture has focused on the impact of harmful microorganisms on humans and livestock with the title: ***Microbes: Invisible Enemies of Humans and Livestock***, with particular emphasis on food contamination, zoonotic diseases, and antimicrobial resistance. It has highlighted how they adversely affect public health, food security, and livestock production. Zoonotic pathogens circulating in livestock constitute a continuous threat to human health, particularly among farmers, abattoir workers, livestock handlers, and consumers of raw or inadequately processed animal products. Apparently healthy animals can carry and shed pathogens such as *E. coli*, Salmonella, Brucella, Leptospira, and *Mycobacterium bovis* into the food chain. Poor awareness, inadequate personal protection, and unsafe occupational practices increase the risk of zoonotic disease transmission. Multidrug-resistant bacteria are an increasing public health threat, because they can cause infections that are difficult and expensive to treat.

Meat, milk, poultry, fish, and other foods of animal origin can harbour pathogenic bacteria and fungi, making them important vehicles of food-borne infections. Poor slaughterhouse hygiene, contaminated water, inadequate processing, and unsafe food handling are major sources of contamination. Food safety therefore, requires routine microbiological monitoring, hygienic processing, potable water, proper cooking, milk pasteurization, and effective food-handling practices to combat the pathogenic microbes that are invisible enemies of humans and livestock.

Recommendations

The Vice-Chancellor, Sir, arising from the issues raised in this lecture, I want to make the following recommendations:

1. *Strengthen National Disease Surveillance and Diagnostic Capacity*: The Federal, State, and Local Governments, in partnership with the private sector, should invest substantially in modern diagnostic

laboratories and integrated disease surveillance systems. A coordinated national surveillance programme should be established and sustained to monitor disease incidence, identify epidemiological risk factors, monitor seasonal disease trends, and provide real-time surveillance of antimicrobial resistance to enable rapid public health interventions.

2. *Institutionalise Inter-sectoral Collaboration*: A formal and sustainable mechanism should be established for routine collaboration and information sharing among the Federal Ministry of Agriculture and Food Security, the Federal Ministry of Health, the Nigeria Centre for Disease Control and Prevention (NCDC), the National Agency for Food and Drug Administration and Control (NAFDAC), and Veterinary Teaching Hospitals (VTH). Such collaboration is essential for effective disease surveillance, outbreak investigation, and coordinated emergency response.

3. *Improve Food Safety, Biosecurity, and Environmental Sanitation:* Governments, livestock producers, and livestock market associations should enforce strict hygiene, sanitation, and biosecurity standards throughout the production chain. Modern slaughterhouses, reliable water supply, effective waste disposal systems, routine inspection, and strict compliance with food safety regulations are essential to reduce food-borne diseases and safeguard public health.

4. *Increase Investment in Animal and Public Health*: Governments at all levels should significantly increase funding for disease surveillance, laboratory infrastructure, vaccine development, antimicrobial resistance monitoring, and research. The private sector, development partners, and philanthropic organisations should complement these efforts through strategic

investments and public-private partnerships that strengthen national health security.

5. *Strengthen Regulation of Veterinary Drugs and Vaccines*: Regulatory agencies should intensify the enforcement of laws governing the production, importation, distribution, sale, and use of veterinary drugs and vaccines. The manufacture and circulation of counterfeit and substandard veterinary products should attract severe sanctions. The prescription and administration of restricted veterinary medicines should remain the exclusive responsibility of licensed veterinary practitioners to promote responsible antimicrobial stewardship.

6. *Promote Digital Health and Veterinary Telemedicine*: Governments and private technology companies should expand digital health infrastructure to support telemedicine and tele-veterinary services. Remote consultation, disease monitoring, electronic reporting, and digital advisory platforms will improve access to veterinary and public health services, particularly in rural and underserved communities.

7. *Strengthen Public Awareness and Community Engagement*: Governments, educational institutions, professional bodies, civil society organisations, and the media should intensify public education campaigns on food hygiene, responsible antimicrobial use, vaccination, environmental sanitation, and zoonotic disease prevention. Community participation is indispensable for achieving sustainable disease prevention and control.

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