KNOWLEDGE AND PRACTICES OF BOVINE TUBERCULOSIS PREVENTION IN HUMAN AMONG BUTCHERS IN AKINYELE AND BODIJA MUNICIPAL ABATTOIRS IN NIGERIA

BY

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ABSTRACT

Tuberculosis is a chronic, wasting and debilitating disease of man and animals. Measures towards prevention of bovine tuberculosis are key to achieving global tuberculosis eradication. The study is conducted to determine the measures taken by butchers for bovine tuberculosis (BTB) prevention at Akinyele and Bodija Municipal Abattoirs within Ibadan metropolis, with a view to provide vital information for BTB control.

Four hundred and fifty (450) butchers from the two abattoirs were randomly selected for this study using simple random sampling technique The data were collected using structured questionnaires and analysed using SPSS version 12.0. The response rate was 97.1%.

The findings reveal that their approach towards preventing bovine TB transmission included practice of good hygiene which is less than 20% (17.6%), hand washing (15.6%) after each day's work, wearing protective materials like gloves and boots (14.4%), use of preventive medicine (14.2%), immunization (12.6%), prayer (10.1%), use of herbs (9.8%) and limited contact with animals or carcasses (5.7%). On limiting cattle to cattle spread of bovine tuberculosis, early isolation of infected animals (29.2%), avoidance of close contact with the infected animals (23.3%), prompt reporting to the veterinarians (22.2%), avoidance of overcrowding of cattle in the kraal (14.9%) and early notification by the cattle handlers (10.3%) were the practices highlighted. Age groups (p= 0.006), sex (p=0.019), level of education (p=0.088) and length of years spent in the livestock work (p=0.033) were significant factors associated with the butchers' preventive measures against the spread of bovine tuberculosis.

The study provides vital information for the stakeholders in the Public Health Sector in their drive towards eradication of tuberculosis including BTB. It gives them an opportunity for informed steps to be taken to better position the livestock workers especially butchers for effective measures required for the prevention of BTB in both animals and humans

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Blessed be the Lord who stood by me all through the thick and thin periods of my programme. He was always there and ever ready to lead, guide and guard me I appreciate the breadth of life, wisdom and understanding that I enjoyed all through.

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I also wish to appreciate my dear husband, and children for their prayers and support in kind towards making this work a reality. May you enjoy your journey in life in Jesus name (Amen). And to every member of my household, you are all wonderful special appreciation to my supervisor Dr (Mrs.) Ikeoluwa O. Ajayi. Thank you ma, for your professional advice and full support may the good Lord bless you.

CERTIFICATION

I CERTIFY THAT THIS WORK WAS CARRIED OUT BY OGUNMOJU COMFORT OLUWASEYI (MATRIC NO: 90302) IN THE DEPARTMENT OF EPIDEMIOLOGY AND MEDICAL STATISTICS, FACULTY OF PUBLIC HEALTH, COLLEGE OF MEDICINE, UNIVERSITY OF IBADAN.

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MAY, 2012.

DEDICATION

This work is dedicated to the glory and praise of the Lord, the one from whom life flows to the only one and true God, who rules and reign the affairs of men.

Also dedicated my lovely husband and kids, for their understanding

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1.0 CHAPTER ONE

1.1 BACKGROUND OF THE STUDY

Infectious diseases remain a major cause of death worldwide and also represent an incalculable source of human misery. More than 95% of these deaths occur in developing world (Lolch *et al.*, 2003). The three major infectious disease killers are HIV/AIDS, Tuberculosis and Malaria. Tuberculosis is the most frequent cause of death from a single infectious disease in persons aged 15 – 49 years, causing a total of 2 – 3 million deaths annually (Enarson and Chretien, 1999).

Tuberculosis is a chronic, wasting and debilitating disease of man and animals, characterized by fever, cough, night sweats, emaciation and general body weakness mostly in humans. Tuberculosis, also called *TB*, *phthisis*, *consumption*, and nicknamed *white plague*, is the leading cause of death due to a single infectious agent among adults in the world today. It is caused primarily by a bacterium, usually the *Mycobacterium tuberculosis* and any member of the *Mycobacterium tuberculosis* complex (MtbC); these include *Mycobacterium tuberculosis*, *Mycobacterium africanum*, *Mycobacterium bovis* (along with the *M. bovis*-derived bacillus Calmette-Guerin [BCG] vaccine strains), *Mycobacterium microti*, *Mycobacterium bovis* subsp. *caprae* (*M. caprae*), and "*Mycobacterium tuberculosis* subsp. *canettii*" (Brosch *et al.*, 2002; Mostowy *et al.*, 2002). Tuberculosis (TB) is humanities greatest killer which is out of control in many parts of the world. The disease is preventable but it has been grossly neglected and no country worldwide is immune to it (Shrestha *et. al.*, 2005). It is still a major health concern worldwide and the disease spreads more easily in overcrowded settings and in the conditions of malnutrition and poverty (Mycal *et. al.*, 2005).

TB is a neglected public health problem and accounts for about 25% of all avoidable adults deaths in developing countries (Murray *et al.*, 1990).

Tuberculosis remains a significant problem as the greatest cause of death globally from a bacterial pathogen, with the World Health Organization (WHO) declaring it an emergency, both worldwide and more specifically in Africa (Anonymous, 2006a). It is currently the world's second commonest cause of death from infectious disease, after HIV/AIDS (Frieden *et al.*, 2003). An estimated 8-9 million new cases of tuberculosis in the year 2000 occurred, fewer than half of which were reported; 3-9 million cases were sputum-smear positive, the most infectious form of the disease (Corbett *et al.*, 2003; Dye, 2006). The epidemiology of tuberculosis (TB) has been affected in recent decades by the upsurge in HIV infection, as many HIV – infected individuals are co-infected with tuberculosis (TB). The incidence of the disease may rise in the coming years. (Zumla *et al.*, 1999).

Nigeria was ranked fourth among the countries with highest burden of human tuberculosis (TB), with nearly 374,000 estimated new cases annually. According to WHO (2006), 33,755 or (57%) of the new tuberculosis (TB) cases in 2004 were pulmonary sputum smear positive (SS+) cases (Anonymous, 2006b).

The situation with animal tuberculosis is less clear, as no national control strategy exists and the degree of zoonotic transmission of tuberculosis from animals to humans is not well documented. However, cultural practices exist that could facilitate transmission between cattle and humans. For example, cattle are often kept in close proximity to the homes of farmers for fattening before they are sold off at the markets. Animals are taken from the market to nearby abattoirs for slaughter, where the butchers who perform this work wear minimal protective clothing or nothing at all and use their bare hands to process offal from diseased carcasses; afterwards they do not thoroughly wash their hands. The close association between farmers and animals is exemplified by the Fulani herdsmen who live their entire lives with their animals, offering ample opportunities for zoonotic transmission of infection. The habit of drinking unpasteurized milk by the herders further enhances transmission of infection.

Mycobacterium tuberculosis is the most common cause of human TB, but unknown proportions of cases are due to *Mycobacterium bovis (*Acha and Szyfres, 2001). In industrialized countries, animal TB control and elimination programmes, together with milk pasteurization, have drastically reduced the incidence of the disease caused by *M. bovis* in both cattle and humans. In developing countries, however, animal TB is widely distributed; control measures are not applied or are applied sporadically, and pasteurization is rarely practised. The direct correlation between *M. bovis* in cattle and disease in the human population has been well documented in industrialized countries. Whereas little information is available from developing countries (Collins and Grange, 1983; Cosivi *et al*., 1995), risk factors for *M. bovis* in both animals and humans also present . The epidemic of HIV infection in developing countries, particularly countries in which *M. bovis* infection is present in animals and the conditions favour zoonotic transmission, could make zoonotic TB a serious public health threat to persons at risk (Grange *et al*., 1994; Cosivi *et al*., 1995; Moda *et al*., 1996; Daborn *et al*., 1997).

It must also be emphasized that the Veterinary Public Health (VPH) unit of WHO has been particularly interested in the public health significance of *M. bovis* infections in humans and animals as it affects the safety of food of animal origin with regards to contamination by *M. bovis* (WHO, 1994a).

1.1The health and socio-economic implications of bovine TB in humans

Humans, especially those in the habit of drinking unpasteurised milk and ingesting infected meat and their products, are exposed to the risk of tuberculosis. Veterinarians, butchers and Fulani herdsmen are particularly exposed to high health risk and occupational hazards by their constant contact with infected and diseased animals.

As a result of the high level of interactions between infected animals, infected humans and the larger society, there is a high risk of exposure of susceptible individuals in the general public to tuberculosis. The effects of increased incidence of tuberculosis in the community will include reduced productivity and effective manpower in the country, due to loss of skilled and unskilled personnel, with resultant economic impoverishment of the nation. In addition, tuberculosis is associated with serious economic wastage resulting from money spent on purchase of drugs and diversion of meagre resources. For individual family units, there is socio-economic insecurity due to loss of the bread winner.

1.2 RATIONALE FOR THE STUDY

This research is aimed at assessing the knowledge and practices of bovine TB prevention in humans among butchers in two distinct abattoirs within Ibadan Metropolis.The need to focus local, national and international attention on the continuing problem of tuberculosis in animals of economic interest, can hardly be over-emphasized. *Mycobacterium bovis*, is the most universal pathogen among the mycobacteria and produces progressive disease in most domestic animals (especially those of economic interest) and in humans. The prevalence of animal tuberculosis therefore, has relevance for both human and veterinary medical practitioners and decision makers on the strategic approach to be adopted in the control of the disease. There is the pathogen may be a remote occurrence. This perception could have a direct implication for the control of the disease at source, that is in domestic animals. The current epidemic of human immunodeficiency virus (HIV) infection raises the issue of what future impact this epidemic may have if the incidence of *M. bovis* infection in humans increases, when control in livestock especially cattle, is neglected by developing countries. Close physical contact between humans and potentially infected animals is present in some communities, especially in developing regions. For example, in many African countries cattle are an integral part of human social life; they represent wealth and are at the center of many events and, therefore, gatherings. In addition, with 65% of African, 70% of Asian, and 26% of Latin American and Caribbean populations working in agriculture, a significant proportion of the population of these regions may be at risk for bovine TB. Consumption of milk contaminated by *M. bovis* has long been regarded as the principal mode of TB transmission from animals to humans. In regions where bovine TB is common and uncontrolled, milk borne infection is the principal cause of cervical lymphadenopathy (scrofula) and abdominal and other forms of non-pulmonary TB. General poor sanitary conditions prompted by poor water supply, exposure of meat to microbes by butchers, use of unsterilized equipments, unhygienic slaughter slabs and tables and low enforcement of meat inspection laws due to inadequate numbers of vetenary personnel compare to enormous works on ground could also contribute as risk practices. Therefore, the need to understudy the various abattoir practices in Ibadan Metropolis especially as it relates to the prevention of bovine TB in humans among butchers in Akinyele and Bodija. Municipal Abattoirs would not be underestimated. This is necessary in order to evaluate their knowledge and perception on the prevention of the disease since these would eventually determine the risk exposure of the general public to the disease.

1.3 JUSTIFICATION

Bovine tuberculosis is of significant public health importance , apart from being the most important disease of intensification with a serious effect on animal production, (O'Reilly and Daborn, 1995)..

The actual impact of animal BTB on human health is generally considered low in developed country, and more so, zoonotic BTB is present in most developing countries where surveillance and control activities are often inadequate or unavailable. Currently, the BTB in humans is becoming increasingly important in developing countries, as humans and animals are sharing the same micro-environment and dwelling premises, especially in rural areas. Butchers and other livestock workers barely observe preventive measures in most abattoirs during meat processing.

The study will enlighten and increase the awareness of the livestock workers on the health risks associated with their occupation after completion.

1.4 GENERAL OBJECTIVE

To determine the knowledge and practices of bovine tuberculosis prevention in human among butchers, meat processors and cattle rearers in two different abattoirs within Ibadan metropolis.

1.5 SPECIFIC OBJECTIVES

This study is designed to:

i. To determine the knowledge of butchers in Akinyele and Bodija municipal abattoirs concerning bovine tuberculosis prevention in humans.

ii. To determine the attitudes of butchers to bovine tuberculosis prevention in humans.

iii. To assess the level of practices of butchers towards bovine tuberculosis prevention.

iv. To determine the health risk exposure of butchers, meat processors and other animals workers to bovine tuberculosis.

1.6 RESEARCH QUESTIONS

This study will answer the following questions:

1. What is the level of awareness of butchers about bovine tuberculosis?
2. What are the operational and marketing practices of butchers that prevent the spread of TB.?
3. Do butchers' attitudes and practices in Akinyele and Bodija abattoirs encourage prevention/spread of bovine tuberculosis to man?
4. Are the general public at risk of bovine tuberculosis through the knowledge, attitude and practices of abattoir workers?

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Historical perspectives

Tuberculosis is an infectious disease that spares no individual of any age, sex, race, nationality or social status. It is one of the most historically important diseases (Dormandy, 1999). In the early 19th century, the work of the French doctors, Gaspard Laurent Bayle and Rene Laennnec established the forms and stages of tuberculosis (TB) as a disease entity; both Bayle and Laennec died of the disease.

German microbiologist, Robert Koch discovered the causative organism, the tubercle bacillus in 1882; in 1890 he developed the tuberculin test for the diagnosis of the disease. In 1924, a vaccine called Bacillus Calmete Guerin (BCG) for individuals exposed to the disease was developed. The most common name for tuberculosis came from Dr. Sylvius, better known as Franciscus de la Boe, because of the tubercles found in infected patients (NJMS-NTC, 1996). Due in part to its widespread nature, TB has been known by many different names and symptoms .

2.2 Different names and symptoms ascribed to tuberculosis

Mycobacterium tuberculosis was first viewed in 1882 when Robert Koch discovered a special staining technique that allowed him to see the organism. It was then the fight against the organism truly began (NJMS-NTC, 1996). By this time sanatoria were widely in use throughout Europe and the United States. Not only did they aid the healing process by providing rest, good nutrition, and a healthy environment, but they also served to isolate the sick from the healthy population.

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In 1943 Selman A. Waksman, who had been working for decades to find an antibiotic that was effective against *Mycobacterium tuberculosis*, was finally successful. Streptomycin purified from *Streptomyces griseus* was first administered to a human on November 20, 1944. The results were quite impressive. The disease immediately stopped its progression, the bacteria disappeared from his sputum, and he recovered fully. In the years following, more and more anti-TB drugs were developed. This was very important in the light that antibiotic resistant mutants quickly began to appear. However, using combination therapies soon solved this problem (NJMS-NTC, 1996).

2.3 Prevalence of *M.bovis*

BTB is an infectious disease of cattle caused by *Mycobacterium bovis* and is characterized by the formation of tubercles in any tissue/organ of the animal. It is zoonotic, being transmitted to humans by an aerogenous route and/or through consumption of infected milk and other cattle products.

Bovine tuberculosis (BTB) is a disease of both economic and zoonotic importance and has resulted in the adoption of country-wide control programmes in western countries. Developing countries, in contrast, know little of the disease's prevalence, particularly as the contribution of BTB to human TB has received limited attention. Major constraints, including lack of resources to study the disease pattern and implement control measures, have led to the current situation in Africa (Sharp and Daborn, 1995).

Bovine tuberculosis is a chronic contagious respiratory disease of cattle spreading horizontally, within and between species, by the aerosol and ingestion (O'Reilly and Daborn, 1996). It is occurring in almost all developed and developing nations of world. The incidence of disease is not only higher in the developing nations but in the absence of any national control and eradication program, is also increasing worldwide particularly in the Asian, African and Latin American countries (Bonsu *et al.*, 2001). Bovine tuberculosis is a public health problem. *Mycobacterium bovis,* the cause of bovine tuberculosis and *M. tuberculosis*, the cause of classical human tuberculosis, are genetically and antigenically very similar and cause identical clinical disease in humans (Dakner *et al.*, 1993). There is considerable and continuing public health significance of *M. bovis* infection in humans and animals and the disease has emerged as a major zoonotic problem in many African countries (WHO, 1994). In humans, the *M. bovis* is the major cause of extra-pulmonary tuberculosis like tuberculosis of gastrointestinal tract and tuberculosis of cervical and mesenteric lymph nodes, the peritoneum, and the genito-urinary tract (Bonsu *et al.*, 2001; Dakner *et al.*, 1993). In countries where bovine milk is not pasteurized before use, bovine tuberculosis has emerged as the single major cause of extra-pulmonary human tuberculosis.

Bovine tuberculosis (BTB) is a chronic infectious disease of animals characterised by the formation of granulomas in tissues and organs, more significantly in the lungs, lymph nodes, intestine and kidney including others. BTB is caused by slowly growing non-photochromogenic bacilli members of the *Mycobacterium tuberculosis* complex: *M. bovis* and *M. caprae* species. However, *M. bovis* is the most universal pathogen among mycobacteria and affects many vertebrate animals of all age groups including humans although, cattle, goats and pigs are found to be most susceptible, while sheep and horses are showing a high natural resistance (Radostits *et al.*, 2000; Thoen *et al.*, 2006).

BTB has been significantly widely distributed throughout the world and it has been a cause for great economic loss in animal production. In developed countries, BTB in animals is a rarity with occasional severe occurrences in small groups of herds. In developing countries, however, such as in 46% of African, 44% of Asian and 35% of the South American an d the Caribbean countries, sporadic occurrences and (particularly in Africa 11%) enzootic occurrences of BTB have been reported (Cosivi *et al*., 1998). BTB, apart from being the most important disease of intensification with a serious effect on animal production, also has a significant public health importance (O'Reilly and Daborn, 1995). Although, the direct correlation between *M. bovis* infection in cattle and human populations is not well known (Collins and Grange. 1983; Cosivi *et al*., 1995), however, zoonotic BTB is present in most developing countries where surveillance and control activities are often inadequate or unavailable. The actual impact of animal BTB on human health is generally considered low in developed and developing countries, which may be based on the rare identification of *M. bovis* isolates from human patients (Amanfu, 2006). In addition, the occurrence of BTB due to *M. bovis* in humans is difficult to determine accurately because of technical problems in isolating the micro-organism (Collins and Grange. 1983). In most developed countries of the world, the disease in farmed animals is now relatively well controlled and supplementary precautions of regulated meat inspection and milk pasteurization have minimized the risk of human infection from *M. bovis*. Where human tuberculosis caused by *M. bovis* is encountered in countries of the developed world, it is relatively rare and estimated to be at around <1% of all tuberculosis cases (Grange 2001). In such instances, infection is often seen in the elderly, who have or have had agriculture associations, and disease has probably arisen from reactivation of dormant lesions. Aside from the farming community, abattoir workers are occupationally amongst those at highest risk, potentially contracting infection from aerosols generated through handling carcasses from infected cattle, resulting in pulmonary tuberculosis or more severe nonpulmonary manifestations following dissemination. Meat handlers are also prone to accidental *M. bovis* inoculation through the skin, resulting in self-limiting lesions known as Butcher's Wart. There is now a greater awareness of zoonotic risks amongst these occupational groups, as there is amongst other risk groups such as veterinarians and zoo employees. Definitive statements about the public health risk from bovine tuberculosis in developing countries cannot be made with such confidence. The precise epidemiology of this disease in animal and human populations in these countries has not been established and the contribution of *M. bovis* to human tuberculosis in most instances therefore remains largely unknown. However, the correlation between the prevalence of *M. bovis* infection in humans and in local cattle populations in Africa highlights the potential threat of bovine tuberculosis to humans in such countries (Daborn *et al*., 1996). Currently, the BTB in humans is becoming increasingly important in developing countries, as humans and animals are sharing the same micro-environment and dwelling premises, especially in rural areas. At present, due to the association of mycobacteria with the *HIV/AIDS* pandemic and in view of the high prevalence of *HIV/AIDS* in the developing world and susceptibility of *AIDS* patients to tuberculosis in general, the situation changing is most likely (Amanfu, 2006). Prevalence data on BTB infection in Africa is scarce. There is, however, sufficient evidence to indicate that it is widely distributed in almost all African countries and even is found at high prevalence in some animal populations (WHO, 1994; Ayele *et al*., 2004; Zinsstag *et al*., 2006a). Thus BTB is still a great concern in many developing countries and Nigeria is one of those where BTB is considered as prevalent disease in cattle populations. Currently after *HIV/AIDS*, human tuberculosis is responsible for the deaths of more people each year than any other single infectious disease, with more than 7 million new cases and 2 million deaths per year and it is responsible for one-third of all deaths of *HIV*-infected individuals in Africa (Zinsstag *et al*., 2006a). In Nigeria, the endemic nature of the human tuberculosis has long been documented (Alhaji, 1976).

2.4 Past studies in the human populations

Zoonotic TB is present in animals in many developing countries where surveillance and control activities are often inadequate or unavailable (Cosivi *et al.*, 1998). The global prevalence of human tuberculosis (TB) due to *M. bovis* has been estimated at 3.1% of all human tuberculosis (TB) cases, accounting for 2.1% and 9.4% of pulmonary and extra-pulmonary tuberculosis (TB) cases respectively. In industrialised countries, human tuberculosis (TB) due to *M. bovis* is relatively rare as a result of tuberculosis (TB) control in cattle. Nevertheless, an estimated <1% of all tuberculosis (TB) cases are reported to be caused by *M. bovis*, probably due to reactivation of dormant lesions among the elderly (Grange, 1996a).

Nigeria has the world fourth largest tuberculosis (TB) burden, with nearly 374,000 estimated new cases annually. According to WHO (2006), 33,755 or (57%) of the new tuberculosis (TB) cases in 2004 were pulmonary sputum smear positive (SS+) cases (Anonymous, 2006). Collins and Grange (1987) indicated that as TB spreads among cattle primarily by the aerogenous route, those working with cattle are more likely to develop pulmonary disease than the alimentary type of the disease. According to these workers, the apparent decline in the incidence of BTB in humans is the result of underreporting, because few clinical laboratories distinguish between the bovine strain and human strain. Under most circumstances, approximately 90% tuberculosis infections in cattle occur by the respiratory route (Francis, 1958).

Information on human disease due to *M. bovis* in developed and developing countries is scarce and the role of BTB causing tuberculosis in humans has not been studied adequately. However, very few studies have indicated the isolation of the causal agent of BTB from humans.

Kiros (1998) demonstrated that out of 85 sputum samples taken from 28 dairy farm workers and 57 tuberculous patients, 48 samples were positive for acid fast bacilli, of which 14 (29.2%) were niacin negative indicating *M. bovis* and 34 (70.2%) *M. tuberculosis* isolates. With a similar scenario, Regassa (2005) demonstrated that, out of 87 sputum and 21 fine needle aspiration (FNA) human samples, 42 mycobacteria species were identified by culture, of which, 7 (16.3%) and 31 (73.8%) were found as *M. bovis* and *M. tuberculosis*, respectively. Furthermore, the author indicated that a higher prevalence of BTB in cattle owned by tuberculous patients was found than in cattle owned by nontuberculous owners, which suggests the significant role of *M. bovis* in the incidences of tuberculosis in humans (Regassa, 2005). In addition, Kidane *et al.* (2002) indicated that *M. bovis* along with other *MTC* species were found to be a cause for tuberculous lymphadenitis in humans. The occurrence of *M. bovis* in humans against the background of the soaring *HIV/AIDS* incidence in Africa implies that the risk of spillover of zoonotic BTB to rural communities is rapidly increasing (Zinsstag *et al.*, 2006a); thus, the correlation between the prevalence of *M. bovis* infection in humans and that of local cattle population. Table 2.2 summarizes the findings of more recent reports of TB caused by *M. bovis* in industrialized countries.

2.5 Effect of HIV/AIDS epidemics on TB prevalence.

Available data suggest that the incidence of tuberculosis in humans has risen in recent years, partly as a result of the *HIV/AIDS* epidemic impact (WHO, 2005). In addition to this, the incidence of BTB in humans has also risen in recent years as a result of the impact of the *HIV/AIDS* epidemic (Cosivi *et al.*, 1998; Ayele *et al.*, 2004; Zinsstag *et al.*, 2006a). Tuberculosis and other mycobacterial infections are major opportunistic infections in *HIV/AIDS* infected individuals (Grange *et al.*, 1994; Raviglione *et al.*, 1995), while *HIV/AIDS* is a major predisposing factor for tuberculosis including reactivation of the disease. The current spreading pandemic of *HIV/AIDS* infection in developing countries, especially where BTB is prevalent in domestic and wild animals poses an additional serious public health threat (Grange and Yates, 1994; Grange *et al.*, 1994; Cosivi *et al.*, 1995; Pavlik *et al.*, 2002; Ayele *et al.*, 2004).

According to recent WHO global estimates, of the 9.4 million people infected with both HIV and TB in mid-1996, 6.6 million (70%) live in sub-Saharan Africa (Raviglione *et al.*, 1995). The greatest impact of HIV infection on TB is in populations with a high prevalence of TB infection among young adults. The occurrence of both infections in one person makes TB infection very likely to progress to active disease. In many developing countries, TB is the most frequent opportunistic disease associated with HIV infection. HIV seroprevalence rates greater than 60% have been found in TB patients in various African countries (Raviglione *et al.*, 1995). Persons infected with both pathogens have an annual risk of progression to active TB of 5% to 15%, depending on their level of immunosuppression; approximately 10% of non-HIV infected persons newly infected with TB become ill at some time during their lives. In the remaining 90%, effective host defenses prevent progression from infection to disease. TB cases due to *M. bovis* in HIV-positive persons also resemble disease caused by *M. tuberculosis*. Thus, they manifest as pulmonary disease, lymphadenopathy, or, in the more profoundly immunosuppressed, disseminated disease. *M. bovis* has been isolated from HIV-infected persons in industrialized countries. In France, *M. bovis* infection accounted for 1.6% of TB cases in HIV-positive patients.

2.6 Bovine tuberculosis: the status in Nigeria

Nigeria according to relevant data gathered over the years had roughly about 13.9 million heards of cattle in 1990; 11.5 million heads of cattle were kept with the pastoralists (commonly referred to as the Fulanis) and 2.4 million heards of cattle were kept in villages with vast majority of these resident in the northern part of the country (RIM, 1992). Over the years there have been a lot of crossbreeds produced; however, the most common breeds are: (1) the zebus (i.e. Bunaji or White-Fulani, Sokoto Gudali and Rahaji), which make up about 90% of the entire cattle population and (2) the taurines (i.e. the Keteku, Kuri, Muturu, and N'dama) making up about 115 000 heads of cattle. Bunaji's breed makes up about 7.7 million heads of the entire cattle population (Anonymous, 2003). In Nigeria, majority of these cattle are of dual purpose productivity; however, because of the inadequate disease monitoring and surveillance system regarding zoonotic diseases (especially tuberculosis), the people are at risk of exposure to contacting bovine tuberculosis through the food chain and direct co-habitation with these animals (in the case of the Fulani's). In Africa, cattle are important for food and as a cultural status symbol: the more cows you have the richer you must be. In a marriage transaction, for example, the groom's family will typically pay the bride's father a 'dowry' of as many as 11 cows. And some traditional ceremonial events involve the slaughter of a goat or cow. It is this close cultural and physical link with cattle that puts rural communities at risk of infection.

The presence of bovine tuberculosis in Nigeria can be traced back to 1932. Between 1937 and 1939 in Calabar abattoir, a total of 364 cases of tuberculous lesions in 2,306 bovine carcasses (15.8%) were reported and between 1939 and 1947, the same abattoir reported that 960 of 10,042 cattle slaughtered had local tuberculous lesions and that 58 had generalised lesions. Cases of bovine tuberculosis in both private resident and Fulani herds have been reported previously (Alhaji, 1976; Ayanwale, 1984). Recent and old reports from Nigerian abattoirs have confirmed the presence of bovine tuberculosis in all parts of Nigeria (Hall, 1932; Alhaji, 1976, Ayanwale, 1984; Dusai and Abdullahi, 1994; Cadmus et al., 1999 and 2003). Alhaji

(1976), however, reported that most of the tuberculous cattle slaughtered in southern Nigeria came from the Northern provinces and from the neighbouring francophone countries of Cameroon, Niger, and Chad.

The results of the tuberculin test in small selected herds in some of the states surveyed recently revealed the incidence of bovine tuberculosis to be 15.08% in Nassarawa, zero in Ogun and Jigawa, 10.50% in Oyo; while the abattoir results varied from 5.00% in Oyo, 0.69% in Ondo and 0.65% in Abuja. In Oyo and Ondo States where culture and isolation were attempted, *M. bovis* was isolated in about 98% of the cases identified while the remaining 2% were *M. tuberculosis* (Unpublished data Cadmus *et al.*).

2.7 Pathogenesis of Tuberculosis

About 90% of those infected with *M. tb* have asymptomatic latent tuberculosis infection (LTBI), with only a 10% lifetime chance that a latent infection will progress to tuberculosis (TB) disease. However, if untreated, the death rate for these active tuberculosis (TB) cases in more than 50% (Onyebujoh *et al.*, 2004).

Tuberculosis (TB) infection begins when the mycobacteria reach the pulmonary alveoli, where they invade and replicate within the alveolar macrophages (Houben *et al.*, 2006). The primary site of infection in the lungs is called the Ghon focus. Bacteria are picked up by dendritic cells, which do not allow replication, although these cells can transport the bacilli to local (mediastinal lymphnodes). Further spread is through the blood stream to the more distant tissues and organs where secondary tuberculosis (TB) lesions can develop in lung apices, peripheral lymph nodes, kidneys, brain and bones. (Herrmann and Lagrange, 2005) All parts of the body can be infected by the disease, though it rarely affects the hearts, skeletal muscles, pancreas and thyroid (Agarwal *et al.*, 2005).

Tuberculosis (TB) is classified as one of the granulomatous inflammatory condition. Macrophages, T – lymphocytes, B- lymphocytes and fibroblasts are among the cells that aggregate to form a granuloma, with lymphocytes surrounding the infected macrophages. The granuloma functions not only to prevent dissemination of the mycobacteria, but also provides a local environment for communication of cells of the immune system. Within the granuloma, T- lymphocytes (CD4+) secrete cytokins such as interferon gamma, which activates macrophages to destroy the bacteria with which they are infected (Kaufmann, 2002). T-lymphocytes CD8+ can also directly kill infected cells (Houben *et. al.*, 2006).

However, bacteria are not always eliminated within the granuloma, but can become dormant, resulting in a latent infection. Another feature of the granulomas of human tuberculosis (TB) is the development of cell death, also called necrosis, in the centre of tubercles. To the naked eye, this has the texture of soft white cheese and was termed caseous necrosis (Grosset, 2003).

If tuberculosis (TB) bacteria gain entry to the blood stream from an area of damaged tissue, they spread through the body and set up many foci of infection, all appearing as tiny white tubercles in the tissues. This severe form of tuberculosis (TB) disease is most common in infants and the elderly and is called military tuberculosis (TB). Patients with disseminated tuberculosis (TB) have a fatality rate of approximately 20% even with intensive treatment (Kim *et. al.*, 2003).

In many patients, the infection waxes and wanes. Tissues destruction and necrosis are balanced by healing and fibrosis (Grosset, 2003).

2.8 Transmission of *M. bovis*

Inhalation of *M. bovis* is the most probable and principal route to bovine infection and is facilitated by close, prolonged contact between infected and healthy animals. Ingestion of *M. bovis* directly from infected animals or from contaminated pasture, water or utensils may also be very common in some regions, while congenital infections and vertical transmission have been recorded, these routes, like genital transmission which occurs when reproductive organs are infected are now rarely seen in regions that have intensive eradication programmes (Neill, *et al.*, 1994). Infected cattle with *M. bovis* are the main source of infection for other cattle. *M. bovis* is excreted through aerosol, in sputum, faeces (from both intestinal lesions and swallowed sputum from pulmonary lesions), milk, urine, vaginal and uterine discharges and discharges from open peripheral lymph nodes (Radostits *et al.*, 1995).

Kleenberg (1984) indicated that one cow with tuberculous mastitis can excrete enough viable tubercle bacilli to contaminate the milk of up to 100 cows when milk pooling and bulk transportation is used. The same author noted tubercle bacilli has been found in milk products such as yoghurt and cheese made from non – pasteurised milk 14 days after processing and in butter as long as 100 days after processing. Also Grange and Yates (1994) reported that tuberculosis in cattle was principally a pulmonary disease; only 1% of the tuberculous cows excrete tubercle bacilli in their milk, which shows that cows transmit the disease by erogenous route. However, no evidence was found that water serves as a source of infection for tuberculosis (TB) or leprosy, because the bacterial species that cause these diseases have not been recovered from water sources (EPA, 1999).

2.8.1 Animal – Animal Transmission

Infectious animals may shed *M. bovis* in a number of ways; in faeces, milk, discharging lesions, saliva and urine. (Neill *et al.*, 1991) Intensive livestock farming promotes close contact between animals, favouring the spread of *M. bovis*. Extensive livestock farming, however, especially transhumance with no housing system, raises the question as to how Bovine Tuberculosis (BTB) transmission can take place (Ayele *et al.*, 2004).

2.8.2 Animal – Human Transmission

In industrialised countries, the incidence of Tuberculosis (TB) due to *M. bovis* in human is almost at zero level as a result of pasteurisation of milk and milk products and eradication of Bovine Tuberculosis (BTB) in cattle population (Radostits, *et al.*, 1995). However, in developing countries, Bovine Tuberculosis (BTB) in animals can be widely distributed in regions where control measures are not applied or are conducted sporadically and pasteurisation is rarely practised (Cosivi *et. al.*, 1998), and hence transmission to humans. The direct connection between *M. bovis* infection in cattle and disease in the human population has been well documented in industrialised countries whereas little information is available from developing countries. (Cosivi *et al.*, 1998).

2.8.3 Human – Animal Transmission

Reports of humans' infection of cattle are rare (O'Reilly and Daborn, 1995). The genitourinary tract in humans is a site of non – pulmonary tuberculosis (TB) due to *M. bovis*. Genitourinary tuberculosis (TB) may appear to be of little importance to epidemiologist in studying human infection, but this route of infection from man to cattle is well documented. Grange and Yates (1994) reported that farm workers urinating in cowsheds may represent a source of infection to animals

2.8.4 Human – Human Transmission

Human tuberculosis (TB) caused by *M. bovis* as a result of human to human was reported in Netherlands in 1994 (O'Relly and Daborn, 1995). Evidence of transmission of *M. bovis* between human is considered rare and largely anecdotal and the rarelity of transmission seems insignificant compared to animal – animal or animal – human infection (O'Relly and Daborn, 1995). Agricultural workers may acquire the disease by inhaling cough spray from infected cattle; they develop typical pulmonary TB. Such patients may infect others.

In industrialized countries, animal TB control and elimination programs, together with milk pasteurization, have drastically reduced the incidence of disease caused by *M. bovis* in both cattle and humans. In developing countries, however, animal TB is widely distributed, control measures are not applied or are applied sporadically, and pasteurization is rarely practiced. . Whereas little information is available from developing countries, risk factors for *M. bovis* in both animals and humans are present in the tropics. With this level of bovine tuberculosis prevalence, it is important that the farmers of all scales be aware of the prevention methods to employ in the control of the disease. The risk of developing active TB increases 7-10% in HIV patients who have latent TB. Since HIV patients are immunocompromised, they are more likely to experience symptoms in areas of the body other than the lungs (extrapulmonary TB) than the general population. The disease may affect the bones, joints, nervous system or urinary tract. Also, TB appears to make HIV infection worse. The epidemic of HIV infection in developing countries, particularly countries in which *M. bovis* infection is present in animals and the conditions favor zoonotic transmission, could make zoonotic TB a serious public health threat to persons at risk.

2.9 Clinical symptoms

It is characterized by fever, cough, night sweats, emaciation and general body weakness mostly in humans. Tuberculosis, also called *TB*, *phthisis*, *consumption*, and nicknamed *white plague*, is the leading cause of death due to a single infectious agent among adults in the world today.

2.10 Risk factors for the spreading of bovine tuberculosis infection in Nigeria

2.10.1 Risk Factors: Human Population

2.10.1.1 Cultures and traditions

In developing countries, particularly in Africa, patients' beliefs and cultural traditions are major obstacles to implement the designed tuberculosis control strategies. Tuberculosis is stigmatized in many cultures/traditions and it remains as powerful as that of *HIV/AIDS*, which further complicates the process of investigation by patients hiding their tuberculosis status due to discriminatory views about tuberculosis patients. Social discrimination based on tuberculosis status is thus more a matter of stigma than of appropriate public health precautions. Therefore, risk factor assessment and identification of this pathogen, both in humans and animals, primarily should be targeted towards adapting dependable preventive, therapeutic and control measures.

2.10.1.2 Illiteracy

Like in most African countries, in Nigeria, illiteracy is yet another unsolved problem in most rural communities in particular. Inability to read and write, and failure to utilize modern methods of communication (Ayele *et al*., 2004), and the limited knowledge of the community related to the epidemiology of BTB infection, makes prevention and control programmes difficult and often impossible to apply.

2.10.1.3 Demography, socio-economic status and feeding habits

From the total population of Nigeria, about 75% of the people are engaged in agriculture. To this effect, very close contact with potentially infected animals may be high, which eventually leads to exposure of the BTB infection. For the urban residents, milk is considered as the main source of BTB infection, while abattoir workers and farmers are predominantly exposed to the aerosol infection as a result of close contact with infected animals (WHO, 1994). The major factors among which contribute to the acquisition of the infection in both urban and rural populations are family ownership of cattle, previous livestock ownership, sharing of the house with animals, consumption of non-pasteurized milk (raw milk) or poorly cooked meat (WHO, 1994; Kazwala *et al*., 1998; Pavlik *et al*., 2003; Ayele *et al*., 2004). All these causalities and/or habits are the daily practices most notably of rural communities in Nigeria. In particular, milk borne infection is the main cause of non-pulmonary tuberculosis in areas where BTB is common and uncontrolled (Daborn *et al*., 1996; Kiros 1998). Professional occupation or workers such as, abattoir workers, veterinarians and laboratory technicians, animal care taker in zoos and those who are working in animals reservations and at national parks can also acquire the infection in due course of regular work (Grange and Yates, 1994; Liss *et al*., 1994; Pavlik *et al*., 2002). Furthermore demographic factors, such as income, education, age, number of family, number of individuals dwelling per m^2 and sanitation are also contributing to the epidemiology of BTB (Ayele *et al*., 2004). Families with low income often face malnutrition which, when associated with the burden of *HIV/AIDS* infection, increases susceptibility to various infectious diseases such as tuberculosis by the impaired immune system, in particular the lymphocyte function which plays an important role in containing mycobacterial infections (Macallan, 1999). Moreover, reports indicated that infants are more vulnerable to food-borne *M. bovis* infection, whereas older individuals averting BTB may occur as a result of endogenous reactivation (Grange and Yates, 1994; Grange 1995; Thoen and Steele, 1995; Pavlik *et al.*, 2002).

2.10.2 Risk factors: animal population

In Nigeria some infected cows are killed outside the abattoir premises to avoid inspection and when condemned by vetenarian, they may still steal out to sell it, cheap meat are more to be bought than wholesome expensive meat

2.11 Diagnostics

On-farm *in vivo* skin testing of cattle, with subsequent abattoir inspection and laboratory monitoring for disease has been pivotal in all national programmes for control and eradication of bovine tuberculosis. Diagnostic accuracy (i.e. test sensitivity and specificity) is therefore of paramount importance, particularly where there is potential for immune exposure to environmental, non-tuberculosis causing mycobacteria, or where there is the possibility of mycobacterial vaccines being used. Delayed type hypersensitivity reactions, demonstrated using intradermal skin testing with tuberculin purified protein derivatives, have proved effective for diagnosis in most instances, as this highlights CMI responses, the primary reactions following *M. bovis* infection in cattle (Pollock *et al.* 2001). Where cattle trade is important, tuberculin skin testing remains the definitive diagnostic assay for tuberculosis.

2.12 Treatment of TB

All isolated strains were resistant to isoniazid (Dupon and Ragnaud, 1992). Taking into consideration the intrinsic resistance of *M. bovis* to pyrazinamide, two of the first-line anti-TB drugs were not effective. WHO-recommended standard treatment for new TB cases includes, in the initial phase, isoniazid, rifampicin, pyrazinamide, and streptomycin or ethambutol. In situations of high primary resistance to isoniazid and streptomycin, the intrinsic resistance of *M. bovis* to pyrazinamide may severely limit the efficacy of treatment of TB caused by *M. bovis*. In a Paris hospital, a source patient with pulmonary TB due to a multidrug-resistant strain of *M. bovis* led to active disease in five patients. Disease occurred 3 to 10 months after infection (Bouvet *et al.*, 1993). This observation led to three concerns: 1) human-to-human *M. bovis* transmission leading to overt disease, 2) a short interval between infection and overt disease, and 3) disseminated multidrug-resistant *M. bovis*.

2.13 Control measure and programmes

As Cousins (2001) suggested, there are various reasons for attempting to eradicate bovine tuberculosis (TB): (i) the risk of infection to the human population, (ii) loss in productivity due to infected animals and (iii) animal market restrictions set by countries with advanced eradication programmes.

The basic strategies required for control and elimination of bovine TB are well known and well defined (WHO, 1967). However, because of financial constraints, scarcity of trained professionals, lack of political will, as well as the underestimation of the importance of zoonotic TB in both the animal and public health sectors by national governments and donor agencies, control measures are not applied or are applied inadequately in most developing countries. Successful conduct of a test-and-slaughter policy requires sustained cooperation of national and private veterinary services, meat inspectors, and farmers, as well as adequate compensation for services rendered. Only a few developing countries can adhere to these requirements. In addition, bovine TB does not often justify the emergency measures required for other zoonotic diseases (e.g., Rinderpest, East Coast fever, and foot and mouth disease). The full economic implications of zoonotic TB are, however, overlooked in many developing nations where the overall impact of the disease on human health and animal production needs to be assessed. According to recent estimates, annual economic loss to bovine TB in Argentina is approximately 63 million US dollars (Maggi *et al*., 1998). In a study recently conducted in Turkey, the estimated socioeconomic impact of bovine TB to both the agriculture and health sectors was approximately 15 to 59 million US dollars per year (Barwinek and Taylor, 1996). Several Latin American countries, through agreements between governments and cattle owners associations, have made the decision to control and eliminate bovine TB. Where foot and mouth disease has been eliminated, bovine TB and other existing infections such as brucellosis become important because of their impact on the meat and live animal export trade. Bovine TB and brucellosis also limit the development of the dairy industry and its expansion at the regional level.

In human tuberculosis (TB), prevention and control takes two parallel approaches. In the first, people with tuberculosis and their contacts are identified and then treated. In the second approach, children are vaccinated to protect them from tuberculosis. Unfortunately, no vaccine is available that provides reliable protection for adults. However, in tropical areas where the incidence of atypical mycobacteria is high, exposure to non-tuberculous mycobacteria gives some protection against tuberculosis (Fine *et al*., 2001). Many countries use BCG vaccine as part of their tuberculosis control programmes, especially for infants. This was the first vaccine for tuberculosis and developed at the Pasteur institute in France between 1905 and 1921 (Bonah, 2005).

Bovine Tuberculosis (BTB) can be eliminated from a country or region by implementing a test-and-slaughter policy, which is likely to remain the backbone of national elimination programmes. The policy has numerous constraints in developing countries. Alternative strategies (e.g. programmes based on slaughter house surveillance or trace back of tuberculosis (TB) animals to herds of origin) may be technically and economically more appropriate in these countries (Cosivi *et al.*, 1998).

Hygienic measures to prevent the spread of infection should be instituted as soon as a reactor is detected. Feed troughs should be cleaned and thoroughly disinfected with hot, 5% phenol or equivalent cresol disinfectant. Water troughs and drinking cups should be emptied and similarly disinfected (Radostits, 1995).

Although not usually considered relevant to eliminated programs in livestock, vaccination of animals against tuberculosis (TB) would be a viable strategy in two disease control situations: In domesticated animals in developing countries and in wildlife and feral reservoirs of disease in industrialized countries where test- and-slaughter program have failed to achieve elimination of the disease (Cosivi *et al.*, 1998).

Commercial and home pasteurization of milk and milk products will help in the control of tuberculosis. An irony is that many in the past boiled milk to preserve it. This was probably a factor in lowering the incidence of tuberculosis in humans. However, when refrigeration became available, man stopped boiling milk, a change that may cause rise in the rate of infection.

Meat inspection has definitely been a major factor in removing much of the infected meat products that would otherwise be consumed by human. However inspection of abattoir meat is limited to urban areas due to lack of infrastructures. As in milk pasteurization thoroughly cooking meat would reduce human tuberculosis (TB) due to *M. bovis* and other food-borne infectious diseases (Ayele *et. al.*, 2000).

2.14 World Health Organizations and Zoonotic TB

The public health importance of animal TB was recognized early by WHO, which in its 1950 report of the Expert Committee on Tuberculosis (WHO, 1950) stated: "The committee recognizes the seriousness of human infection with bovine tuberculosis in countries where the disease in cattle is prevalent. There is the danger of transmission of infection by direct contact between diseased cattle and farm workers and their families, as well as from infected food products". Since then, TB in animals has been controlled and almost eliminated in several industrialized countries but in very few developing countries. More recently, WHO has been involved in zoonotic TB through the activities of the Division of Emerging and other Communicable Diseases Surveillance and Control at WHO in Geneva (WHO/EMC) and the Veterinary Public Health program of the WHO Regional Office for the Americas, Pan American Health Organization (PAHO/HCV). WHO/EMC has organized and coordinated a working group of experts from countries worldwide (WHO, 1992; 1993b; 1994a). Their subjects are epidemiology, public health aspects, control, and research on zoonotic TB. In addition, a joint WHO, Food and Agriculture Organization of the United Nations (FAO), and Office International des Epizooties (OIE) Consultation on Animal Tuberculosis Vaccines was held to review current knowledge on TB vaccine development for humans and animals and make recommendations for animal TB vaccine research and development (WHO, 1994b). Promising results of cattle vaccination with low doses of BCG were reported. It is also planned for field trial cattle vaccination to commence early in 1998 in Madagascar in collaboration with national and international research institutions, OIE and WHO. In the framework of the working group activities, the guidelines for speciation within the *Mycobacterium tuberculosis* complex (Grange *et al.*, 1996) have been prepared to respond to the growing need for reliable differentiation between *M. tuberculosis*, *M. africanum*, and *M.*

bovis and to promote and strengthen surveillance. A Plan of Action for the Eradication of Bovine Tuberculosis in the Americas (WHO, 1993a) has been developed by PAHO in collaboration with member countries of the region. PAHO/HCV, in cooperation with the Pan American Institute for Food Protection and Zoonosis (INPPAZ), Buenos Aires, Argentina, and other technical institutions (e.g., FAO), provides technical support to the regional plan. PAHO/HCV activities train specialists in diagnosis, reporting, surveillance systems, and quality control of reagents, as well as supporting the planning and implementation of national programs. INPPAZ acts as a reference center for these activities. The first phase of the regional plan is expected to lead, in the next 10 years, to the elimination of bovine TB from countries with more advanced national programs. In the remaining countries, the objectives will be to strengthen epidemiologic surveillance, defining areas at risk and setting up control and elimination programs.

2.15 Economic importance of bovine tuberculosis

The economic importance and public health significance of tuberculosis has been established in many countries (Konhya *et al*., 1980; Jaumally and Sibartie, 1983). Recently, Zinsstag *et al*. (2006b) reviewed the economic effects of BTB on cattle productivity, the burden of disease in different settings and at different stages of public health development and the trans-sectoral (Public health, Agricultural, Environment) economic analysis of BTB control. However, in Nigeria, the economic impact of BTB on cattle productivity, BTB control programmes and other related economic effects of the disease are not yet well documented or studied. Few abattoir meat inspection surveillances have shown the condemnation rate of the total or partial carcass and organs. To this end, Alonge and Fasanmi (1979) in a survey of the abattoirs in 10 selected towns in Nigeria showed that about 41.9 per cent of whole carcasses condemned between 1975 and 1977 were due to tuberculosis. In another study, Alonge and

Ayanwale, (1984) reported that a conservative estimate of N14.24 million naira is lost annually due to bovine tuberculosis. Antia and Alonge (1982) opined that 28.9% of cattle slaughtered were infected with tuberculosis while Wekhe and Berepubo (1989) reported a prevalence of 8.2% in an abattoir in the same part of the country. Cadmus (2003) and Cadmus (2007) demonstrated that 28 out of 416 and 159 out of 1,805 cattle slaughtered respectively in Bodija abattoir in Ibadan were confirmed to have tuberculosis. Therefore, tuberculous lesions that cause condemnation of carcasses and/or organs have also been found to be highly significant economically.

CHAPTER THREE

3.0 MATERILAS AND METHODS

3.1 Study site

Two major abattoirs located in Akinyele and Ibadan North LGAs were purposely selected for the study, these are: Cattle Kraal and Bodija Municipal Abattoir respectively.

The work will be carried out at Akinyele cattle market and Bodija Municipal Abattoir, Ibadan, Oyo State, South-western Nigeria. Akinyele cattle market forms the main livestock depot in the Southwest from where prospective buyers make their purchase of livestock. It is located in Akinyele Local Government area of Ibadan metropolis . On the other hand, Bodija Municipal abattoir is the largest abattoir in the State. It is about one kilometer from the University of Ibadan along the road to the State Government's Secretariat which is also about one kilometer away. It is the main recipient and distributor of cattle moved from different parts of northern states to Ibadan metropolis and some parts of the Yoruba south west. Although Bodija remains the main cattle market in Ibadan, the main Kraal for initially receiving cattle from the northern states was moved to Akinyele about 19 kilometers north on the Ibadan – Oyo road after the 1999 Bodija ethnic conflict.

Most of the cattle received at Akinyele cattle market come from the Northern parts of the country as well as the neighbouring African countries of Burkina Faso, Cameroon, Chad and Niger, some of which are later transported to Bodija market for slaughter. Like every other abattoirs in the country, it has little facilities and personnel for proper ante-mortem and post-mortem inspections. This is compounded by overcrowding, deplorable water supply system and lack of proper effluent disposal system.

3.2 Ethical consideration

Ethical approval would be obtained from ethical committee at the Ministry of Health, Oyo State Secretariat, Ibadan. Participants consent would be obtained using verbal consent before commencement of interview among the respondents.

3.3 Study design

A descriptive cross-sectional survey would be carried out.

3.4 Study population

The study respondents would be butchers, meat processors and other livestock workers from both the Akinyele cattle kraal and Bodija Municipal Abattoir. Inclusion Criteria: are any of the above who consent to the interview administered through the language they understand. Exclusion Criteria could be the buyers and other livestock carers.

3.5 Sampling procedure

3.5.1 Sample size estimation

Using the formula for estimating sample size for single proportions

$$N = \frac{Z\alpha^2 pq}{d^2}$$

Where:

N = the minimum sample size

Z = the critical values of alpha at 0.05 to estimate a 5% precision

P = the proportion of butchers with knowledge of BTB infection. This is because not much has been done on this study and 50% is assumed.

$q = 1-P$

d= Degree of precision

$$N = \frac{1.96^2 \times 0.5 \times 0.5}{0.05^2} = 380$$

Allowing for a non-response rate of 10%.

$$\text{Adjusted Sample size} = \frac{100 \times N}{100-r} = \frac{100 \times 380}{100-10}$$

The minimum sample size = 418.

A total of 420 respondents would be interviewed using a structured questionnaire.

3.5.2 Sampling Technique

Using a random sampling technique, study participants would be drawn from different shed in both abattoirs premises.210 respondents from each site since the total sample size is 420.

First stage: Selection of sheds where butchers, meat processors and other cattle carers settle would be done as follows:

Second stage: Random selection of four sheds out of ten located in each selected site.

Third stage: Systematic selection of respondents in the selected sheds, that is, minimum of 50 respondents per shed.

Fourth stage: All respondents who consented would be interviewed.

3.6 Data collection

Socio-demographic data including age, gender, and other information on the various abattoir practices and knowledge about bovine TB would be obtained from the respondents. This would be carried out by using a semi-structured questionnaire, through administration of closed ended questionnaires. The questions shall be administered by the researchers and two trained assistances in a language the respondents understand after obtaining a verbal consent. As much as possible, the butchers would be interviewed in their mother tongue to enable accuracy of information that would be given.

3.7 Structure of questionnaire

The questionnaire would be structured to cater for the following areas:

1. The knowledge of abattoir workers on Bovine Tuberculosis in terms of the aetiology and pathogenics.
2. Determination of attitudes of abattoir workers about the bovine tuberculosis prevention.
3. The operational and marketing practices of abattoir workers towards prevention of bovine TB.

3.8 Pre-test and validation

A pre-test would be carried out at Attan abattoir in Ijebu North Local Govt Area, Ogun State among 10 butchers to check for errors or ambiquous questions that might be asked during the research.

Validation of the questionnaires would be through my supervisor.

3.9 Data analysis

The data collected were checked for completeness and errors, and entered into the Statistical Program for the Social Science SPSS version. This was used to determine various descriptive frequencies of the different variables obtained. Analysis included descriptive statistics such as means, median and standard deviation which was used to summarize quantitative variables while qualitative variables were summarized by proportions. Knowledge about BTB prevention in humans was scored with reference to answers to questions on causes, symptoms and effects of the disease. Positive responses were scored 1 and negative 0. Scores ranged between 0 and 3. Scores ≥ 2 was taken as good knowledge while scores < 2 was taken as poor knowledge.

Also, practices of butchers about BTB prevention in humans was scored with reference to answers to four questions. Positive practice responses were scored 1 and negative 0. Scores ranged between 0 and 4. Scores ≥ 2 was taken as good practice while scores < 2 was taken as poor practice. The chi-square test was used to investigate association between qualitative variables.

CHAPTER FOUR

4.0. RESULTS

4.1 Demographic Characteristics

A total of 437 butchers comprising 315 males and 122 females responded to the questionnaires. The various age groups of the responded were age group less than 30 years (9.4%), 30-39 years (38.2), 40-49 years (31.6%), 50-59 years (13.7%) and 60 years and above (7.1%). Majority of them had either secondary 212 (48.5%) or primary education143 (32.7%) while a few 82 (18.8%) did not have any formal education. About 295 (68%) of the butchers were of Islam religion and 115 (26.3%) were Christians; the least 27 (6.2%) being of traditional religion. A highest proportion 394 (90.2%) was married while others were either single 18 (4.1%), divorced 11 (2.5%) or widow/widower 14 (3.2%). With reference to the years of experience in the abattoir work, 65(14.9%) had spent more than 30 years.

With respect to the types of animals they traded in, 380 (87.0%) traded in cattle only, 31 (7.1%) in goats, 21 (4.8%) in cattle and goats and 5 (1.1%) in pigs. Most 425 (97.3%) of the butchers kept their animals in the kraal while the rest 12 (2.7%) kept their animals close to their residence (Table 4.1).

Table 4.1: Distribution of the socio-demographic characteristics of the respondents

N = 437

CHARACTERISTICS	FREQUENCY	PERCENT
Sex		
Male	315	72.1
Female	122	27.9
Age in years		
<30	41	9.4
30-39	167	38.2
40-49	138	31.6
50-59	60	13.7
60+	31	7.1
Level of education		
None	82	18.8
Primary	143	32.7
Secondary	212	48.5
Religion		
Islam	295	67.5
Christianity	115	26.3
Traditional	27	6.2
Marital status		
Single	18	4.1
Married	394	90.2
Divorced	11	2.5
Widow/widower	14	3.2
Years of experience		
<10	34	7.8
10-19	181	41.4
20-29	112	25.6
30+	65	14.9
Animals type traded		
Cattle only	380	87.0
Goats	31	7.1
Cattle and goats	21	4.8
Pigs	5	1.1
Animal housing		
Kraal	425	97.3
Close to residence	12	2.7

4.2 Knowledge of butchers about tuberculosis infection in cattle

Most 421 (96.3%) of the butchers were aware of Bovine Tuberculosis in cattle and the source of their knowledge about the disease were through veterinarians 290 (48.1%), workshops/seminar 149 (34.1%), recent exposure to infected cattle 54 (11.9%), colleagues 24 (5.5%) and mass media 2 (0.4%).

Cough 177 (40.4%), loss of weight118 (27.1%), abnormal breathing 106 (24.2%) and loss of appetite 36 (8.3%) were the signs the butchers opined they would see in animals suffering from bovine tuberculosis. The butchers believed that tuberculosis can occur through inhalation of droplets 150 (34.3%), skin contact 102 (23.3%), contact with infected carcasses 101 (23.1%) and mating 84 (19.2%). However, many 280 (64.1%) said BTB cannot be transmitted to man while the numbers who believed that it could be transmitted to man said that transmission could be through ingestion of infected meat 190 (43.5%), inhalation (34.3%) or contact with infected animals or carcasses (22.2%) (Table 4.2).

Table 4.2: Knowledge of butchers about tuberculosis infection in cattle N = 437

	FREQUENCY	PERCENT
Do you know that TB can occur in cattle?		
Yes	421	96.3
No	7	1.6
I don't know	9	2.1
Sources of information on BTB		
Veterinarians	210	48.1
Workshops/seminar	149	34.1
Recent exposure to infected cattle	52	11.9
Colleagues	24	5.5
Mass media	2	0.4
Signs and symptoms of BTB		
Coughing	177	40.5
Loss of weight	118	27.0
Abnormal breathing	106	24.2
Loss of appetite	36	8.2
How is the disease transmitted from animals to animals?		
Inhalation	150	34.3
Skin contact	102	23.3
Contact with infected carcasses	101	23.1
Mating	84	19.2
Do you know the disease can be transmitted to man?		
Yes	79	18.1
No	280	64.1
Don't know	78	17.8
How BTB is transmitted from animals to man		
Ingestion of infected meat	190	43.5
Inhalation	150	34.3
Contact with infected animals or carcasses	97	22.2

4.3 Knowledge of bovine tuberculosis in humans

Out of the 437 butchers who responded to the questionnaires, 282 (64.5%) reported that they had not known anybody infected with tuberculosis before, 133 (30.4%) claimed to have seen infected tuberculosis patients while 22 (5.0%) were not sure. Symptoms reported in humans by the butchers included cough 138 (31.6%), wasting 121 (27.7%), night sweat 98 (22.4%) and body weakness 70 (16.0%) while 10 (2.3%) of them said they did not know. Although 25 (5.7%) believed that bovine tuberculosis in humans could be caused by spiritual attack, others attributed its cause to unhygienic environment 146 (33.4%) and bacterial infection 266 (60.9%). When asked whether or not tuberculosis can be cured, 401 (91.8%) of the butchers said it can be cured and majority 269 (61.6%) believed that the best treatment was modern medicine (Table 4.3)

Table 4.3 Knowledge of butchers on bovine tuberculosis in humans

	FREQUENCY	PERCENT
Do you know anybody with TB now or before now?		
No	282	64.5
Yes	133	30.4
Not sure	22	5.0
Symptoms of BTB in infected humans		
Cough	138	31.6
Wasting	121	27.7
Night sweat	98	22.4
Body weakness	70	16.0
Don't know	10	2.3
Cause of BTB in humans		
Bacterial infection	266	60.9
Unhygienic environment	146	33.4
Spiritual attack	25	5.7
Do you think TB can be cured?		
Yes	401	91.8
Don't know	26	5.9
No	10	2.3
Treatment thought best for BTB		
Modern medicine	269	61.6
Both modern and traditional medicine	71	16.2
Traditional medicine	40	9.2
Prayer/faith healing	22	5.0
Modern medicine and prayer	4	0.9
Immunization	1	0.2

4.4. Practices of bovine tuberculosis prevention in humans by butchers

Most 422 (96.6%) of the butchers said that the veterinarians, carried out routine meat inspection on their animals; out of these, 366 (83.8%) confirmed that these veterinarians did their work on a daily basis. When asked what the butchers would do if their animals were condemned for having tuberculosis, 274 (62.7%) said that they would pour chemical on it and then bury the carcasses. Their approach towards protecting themselves from being infected with bovine tuberculosis included practice of good hygiene 77 (17.6%), hand washing 68 (15.6%), wearing protective materials like gloves and boots 63 (14.4%), use of preventive medicine 62 (14.2%), immunization 55 (12.6%), prayer 44 (10.1%), use of herbs 43 (9.8%) and limited contact with animals or carcasses 25 (5.7%).

On limiting cattle to cattle spread of bovine tuberculosis, the butchers said they employed early isolation of infected animals for treatment 128 (29.2%), avoidance of close contact with the infected animals 102 (23.3%), prompt reporting to the veterinarians 97 (22.2%), avoidance of overcrowding of cattle in the kraal 65 (14.9%) and early notification by the cattle handlers 45 (10.3%).

Moreover, 325 (74.4%) of the butchers said that they would use modern medicine if they had tuberculosis. Meanwhile, 152 (34.8%) reported symptoms of tuberculosis (prolonged cough, wasting, tiredness and chest pain) as disease conditions they recently experienced. Majority 261 (59.7%) of the butchers had never been screened for tuberculosis and the main reason being that they felt they could not have tuberculosis (Table 4.4).

Table 4.4 Practices of bovine tuberculosis prevention in humans by butchers N = 437

	FREQUENCY	PERCENT
Do veterinarians carry out routine meat inspection?		
Yes	422	96.6
Indifferent	14	3.2
No	1	0.2
Frequency of routine meat inspection by Veterinarians		
Daily	366	83.8
Quarterly	21	4.8
Indifferent	19	4.3
Weekly	15	3.4
Monthly	10	2.3
Occasionally	5	1.1
Yearly	1	0.2
Actions taken when an animal is condemned for BTB infection		
Pour chemical and bury the infected carcasses	274	62.7
Pour chemical on it	50	11.4
No response	48	11.0
Bury the condemned animal alive	42	9.6
Sell the condemned animal alive	12	2.7
Bribe the inspector	8	1.8
Remove the infected parts	3	0.7
Actions taken to protect themselves from BTB		
Good hygiene practices	77	17.6
Washing of hands after touching live or processed animals	68	15.6
Wearing of protective gloves, mask and boot	63	14.4
Use of preventive medicine	62	14.2
Immunization	55	12.6
Prayer	44	10.1
Use of herbs	43	9.8
Limited contact with animals or carcasses	25	5.7
Prevention of BTB in cattle population by:		
Early isolation	128	29.2
Avoidance of human contact with infected animal	102	23.3
Prompt reporting to veterinarians	97	22.2
Avoidance of overcrowding	65	14.9
Early reporting by cattle handlers	45	10.3
Treatment thought best for BTB		
Modern medicine	325	74.4
No response	48	11.0
Both modern and traditional medicine	48	9.6
Traditional healing	19	4.3
Faith healing	3	0.7
Have you ever been screened for tuberculosis		
No	261	59.7
Yes	106	24.3
No response	70	16.0

4.5 Determinant of knowledge and prevention practices

4.5.1 Knowledge of Bovine Tuberculosis among butchers and socio demographic characteristics

A total of 313 (71.6%) and 124 (28.4%) of the respondents had good and poor knowledge of BTB prevention in humans respectively. The results show that the butchers within the age group 30-39 years had highest score for knowledge with respect to age (P= 0.015) and the male also demonstrated higher scores for knowledge than the female (P=0.13) . However, there was no significant difference in the knowledge of the butchers at the different abattoirs. Although butchers with either primary or secondary education had better knowledge about BTB than those who did not have formal education, the difference was not statistically significant. Similarly, the difference in years of practice experience of the butchers did not show any significant difference with regard to knowledge on BTB (Table 4.5).

Table 4.5. Knowledge score of BTB causes, symptoms and effects

	N=278	N=114	N=392	
Age group	Good (%)	Poor (%)	Total (%)	χ2, P value
<30	24 (7.7)	17 (13.7)	41 (9.4)	12.33; 0.015
30-39	121 (38.7)	46 (37.1)	167 (38.2)	
40-49	107 (34.2)	31 (25.0)	138 (31.6)	
50-59	45 (14.4)	15 (12.1)	60 (13.7)	
60 and above	16 (5.1)	15 (12.1)	31 (7.1)	
Sex				
Male	215 (68.7)	100 (80.6)	315 (72.1)	6.308; 0.13
Female	98 (31.3)	24 (19.4)	122 (27.9)	
Location of abattoir				
Akinyele	156(49.8)	55 (44.4)	211 (48.3)	1.070; 0.340
Bodija	157 (50.2)	69 (55.6)	226 (51.7)	
Level of education				
No formal education	60 (19.2)	22 (17.7)	82 (18.8)	0.187; 0.911
Primary	103 (32.9)	40 (32.3)	143 (32.7)	
Secondary	150 (47.9)	62 (50.0)	212 (48.5)	
Years of experience				
<20	149 (53.6)	66 (57.9)	215 (54.8)	0.603; 0.503
20+	129 (46.4)	48 (42.1)	177 (45.2)	

4.6 Prevention practices and demographic characteristics of butchers about BTB

More people in the age group 30-39 years, and the males exhibited good practices towards BTB prevention in humans and this was statistically significant. The location of the abattoir and the level of education of the butchers did not have any significant positive influence on their practices of BTB prevention. However, more of those who had spent more than 20 years in the business mentioned correct practices towards BTB prevention (Table 4.6).

Table 4.6: Practice ratings of butchers on BTB prevention in humans

Age groups (yrs)	Good n (%)	Poor n (%)	Total n (%)	$\chi 2$, P value
<30	10 (4.8)	31 (13.5)	41 (9.4)	14.6; 0.006*
30-39	76 (36.7)	91 (39.6)	167 (38.2)	
40-49	75 (36.2)	63 (27.4)	138 (31.6)	
50-59	34 (16.4)	26 (11.3)	60 (13.7)	
60 and above	12 (5.8)	19 (8.3)	31 (7.1)	
Sex				
Male	138 (66.7)	177 (77.0)	315 (72.1)	5.7; 0.019*
Female	69 (33.3)	53 (23.0)	122 (27.9)	
Location				
Akniyele	94 (45.4)	117 (50.9)	211 (48.3)	1.3; 0.292
Bodija	113 (54.6)	113 (49.1)	226 (51.7)	
Level of education				
No formal education	46 (22.2)	36 (15.7)	82 (18.8)	4.9; 0.088
Primary	71 (34.3)	72 (31.3)	143 (32.7)	
Secondary	90 (43.5)	122 (53.0)	212 (48.5)	
Experience (yrs)				
<20	92 (49.2)	123 (60.0)	215 (54.8)	4.6; 0.033*
20 and above	95 (50.8)	82 (40.0)	177 (45.2)	

*Significant at 5% level of significance

4.7 Effects of the overall knowledge of butchers about BTB on their practices of its prevention in humans

Generally, the knowledge of the butchers was highly significantly associated with their practices towards BTB prevention in humans (Table 4.7). Those with good knowledge have good practices.

Table 4.7: Effect of butchers' knowledge on their practices of bovine tuberculosis prevention

Knowledge	Practice		Total (%)	χ2. p value
	Good	Poor		
	n (%)	n (%)	n (%)	
Good	188 (90.8)	125 (54.3)	313 (71.6)	71.3; 0.000*
Poor	19 (9.2)	105 (45.7)	124 (28.4)	
Total	207 (100.0)	230 (100.0)	437 (100.0)	

*Significant at 5% level of significance

CHAPTER FIVE

5.0 DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1. DISCUSSION

5.1.1 Knowledge of butchers on BTB prevention in humans

Approximately 85% of cattle and 82% of human populations in Africa have been estimated to live in areas where animal TB is either partly controlled or uncontrolled [Ayele et al., 2004; Shitaye et al., 20067, 41]. Detection of *M. bovis* through isolation from patients with pulmonary TB has been reported in various parts of Africa including Nigeria [Cosivi et al., 1998; Niobe-Eyangoh et al., 2003; Kazwala et al., 2001; Zinsstag et al., 2006] while an epidemiologic association between tuberculosis in cattle and human TB has been reported in Nigeria [Cadmus, 2007]. The transboundary transmission of bovine TB in Africa and threats of zoonotic TB due to *M. bovis* to human health are very real. Therefore, the knowledge of those at risk particularly the butchers is essential to the control of the disease.

Lack of knowledge about the cause, mode of transmission, and symptoms, as well as appropriate treatment of TB not only affect the health-seeking behaviour of patients, but also could affect control strategy, thereby sustaining the transmission of the disease within the community [11-14]. For these reasons, assessing general awareness and practices about BTB, a major cause of human TB among communities such as those working in the abattoirs is essential for the control of the disease. This approach makes up one of the six basic components of the "Stop TB Strategy" of the World Health Organization (WHO) [15].

The results of this study highlight the knowledge and practice of butchers in the prevention of bovine tuberculosis in humans in Ibadan. According to WHO (2002), it is important to have an understanding of the interaction on prevailing food safety beliefs, knowledge and practices of food handlers including butchers in order to minimize foodborne outbreaks. As buttressed by Mortlock et al. (1999), good levels of knowledge towards food safety and the effective practices of such knowledge in food handling are imperative in ensuring the safe production of food in any food processing operations.

Some previous studies have established the fact that the butchers and other livestock workers play a major role in tuberculosis transmission and prevention (Adesokan, 2008; Mfinanga et al. (2003a). This is further buttressed by the reports of other workers which indicated the fact that the professional occupation or workers such as, abattoir workers could facilitate either the transmission or prevention of the infection in due course of regular work (Grange and Yates, 1994; Liss et al., 1994; Pavlik et al., 2002). This therefore indicates that the good knowledge and practices of the butchers in this study would facilitate prevention of the BTB transmission to humans in this study area.

In a study conducted among livestock workers in Ibadan, Adesokan (2008) isolated *M. bovis*, the principal causative agent of bovine tuberculosis from some of the people working with livestock in a cattle market. This is of serious public health importance since the knowledge and practices of these workers would go a long way to affect the quality and safety of meat being made available to the public for consumption.

5.1.2 Socio-demographic factors and butchers' knowledge of BTB prevention in humans

This study showed that more of the butchers were male. This is in agreement with the reports of some previous workers who found that the males are more involved in livestock or food handling business (Siow and Norrakiah, 2011; Adesokan, 2008; Mfinanga et al. (2003a). It was observed that most of the butchers were between ages 30 and 40 years of age. This is corroborated by the findings of Mfinanga et al. (2003a) whose results showed that those between ages 30 and 50 years are the principal people involved in livestock business.

Although Yadav et al (2006) indicated that sex and age did not have any significant role in the knowledge about tuberculosis, this study showed a positive significant association with sex and age. This might be due to the fact that more male respondents than females were involved in this study since most of the people engaging in abattoir operations in Nigeria are usually males.

Furthermore, the location of abattoir and education status of butchers had no significant association with their knowledge. This may be explained by the fact that the two abattoirs used were both in the urban centres and hence no significant difference in their levels of exposure that might influence their knowledge. According to Yadav et al (2006), education status of people influences their knowledge about tuberculosis. However, the reports of Angelillo et al. (2001) and Askarian et al. (2004) showed the different levels of education did not play any significant role in the knowledge of butchers about bovine tuberculosis prevention. This could be as a result of the fact that health education on food safety and handling and not just the general class room education as it were is the right tool to be employed in impacting knowledge about a disease to people. Therefore, there is need for a continuing health education for butchers about the disease and its prevention without necessarily relying on their formal educational status judging from the fact that Mfinanga et al. (2003b) and Cleaveland et al. (2007) found that poor access to public health education and lack of knowledge of preventive health measures are risk factors for tuberculosis infection in man. Education on food safety should be given to all butchers and other staff in food processing businesses so as to bring adoption of positive attitudes coupled with behavioral changes (Coleman and Roberts 2005; Powell et al. 1997).

It is also interesting to observe that the years of experience of these workers did not significantly influence their knowledge about bovine tuberculosis prevention. This is contrary to the result of Siow and Norrakiah (2011) who reported that people with more years of working experience had better knowledge than those who had just spent few years in food handling business. This is probably because most of these butchers who have been in the business for years may be used to tradition and as a result , they often find it difficult to change their knowledge.

In addition, the results of this study suggest that the significant presence of knowledge impacts significantly on the practices of butchers about bovine tuberculosis prevention in humans. This was indicated in the significant positive association between the knowledge of these butchers and their practices. This finding is in agreement with the reports of Toh dan Birchenough (2000) who showed that there were strong correlations between knowledge and food handling practices in a similar study. Although the years of experience of these workers in the business was not positively significantly associated with their knowledge of bovine tuberculosis prevention, it was observed that a significant positive association occurred between the years of experience and their practices of bovine tuberculosis prevention as similarly reported by Siow and Norrakiah (2011). The plausible reason for this might be due to the fact that most of these livestock workers might not know the reasons for doing certain things and might not bother to find out since those practices were handed over to them by their predecessors.

5.2 CONCLUSION

The results of this study highlight the knowledge and practice of butchers in the prevention of bovine tuberculosis in humans in Ibadan. The age groups of the butchers were significantly associated with knowledge of BTB prevention while the age groups, sex, and length of years of practice significantly influenced their practices of BTB prevention in humans.

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