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An Overview of Camels Tuberculosis and Its Public Health Consequences

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ABSTRACT

Ethiopians in the Somali, Afar, and Oromia regions (Kereyu, Borena, and Guji) breed camels (Camelus dromedarius), which are valuable animals. Transport, drawing power, plowing land, festivals, and competition (like dashing) are only a few of their many uses. Products like milk and meat are used by the pastoral community. But they are also vulnerable to a number of illnesses that could compromise their wellbeing. For camels, TB is one of the most serious illnesses. In camel TB, granulomas develop within the airway and nearby lymph nodes; this illness progresses over time. Once released from the granulomas, the mycobacteria may infect more susceptible animals. The chronic illness known as camel TB is marked by the growth of granulomas in the lymph nodes and respiratory system. These granulomas secrete mycobacteria, which may infect other vulnerable animals. Infected camels suffer from a long-term illness called TB, which affects their respiratory systems and lymph nodes. Additionally, it might be a public health concern in regions where raw camel milk is consumed or where camels are often handled. Several species of mycobacteria, including M. bovis, M. TB, and M. caprae, are responsible for the illness. Bacteriological and molecular approaches, in addition to clinical symptoms, history, tuberculin skin tests, post-mortem investigations, and bacteriological testing, may be used to diagnose camel TB. Reducing the economic burden and the propagation of the illness requires public awareness campaigns and control measures.

Keywords: Epidemiology, Control, Ethiopia, Public health, Camel tuberculosis, and Zoonosis.

INTRODUCTION:

Livestock such as camels are vital to the economy of Ethiopia's pastoral and agro-pastoral populations. As a result of their hardiness and adaptability, they find widespread employment in a variety of contexts, including transportation, plowing, celebration, and competition (Yirda et al., 2020). Somalia, Niger, Kenya, Ethiopia, and Chad are home to the vast bulk of the world's 35 million camels, according to Babege et al. (2021). This includes Mauritania, Pakistan, and Mali. More than half of the world's camels live in these five bordering countries: Djibouti, Somalia, Sudan, Kenya, and 84% of Africa's camels (Mwinyihija and Mekonnen, 2016). More and more camel-rearing regions, particularly in Africa, are opening up as a result of climate change (Faye et al., 2012). Domesticated animals of great importance that have evolved to thrive in dry and Camel species (Camelus dromedaries) inhabit arid and semiarid parts of the world (Faraz, 2020). A total of 1.42 million dromedary camels are kept in dry and semi-dry parts of Ethiopia, with the bulk of these animals residing in the eastern sections of the country (Babege et al., 2021). This information comes from Babege et al. (2020). Many people in different parts of the globe rely on camel farming as their primary means of subsistence (Faraz et al., 2019).

Pastoralist groups in Ethiopia raise camels for a variety of goods, including meat and milk (Faraz et al., 2019). The pastoralists and merchants in Ethiopia who are part of the camel milk value

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chain rely on camel milk for food security and revenue. Even in the most arid and hostile of climates, camels manage to stay alive (Madalcho et al., 2019; Faraz et al., 2021). Traditional and comprehensive camel management practices depend on natural water supplies and pastures in Ethiopia (Woldearegay et al., 2015). Depending on the availability of water and pasture, pastoralists relocate their herds throughout the year (Nori, 2005). Camels often range in size from a few to hundreds per home, with females making up over 75% of the herd. It is common practice to sell male camels early for slaughter or to use them as pack animals. Camels have an impressive reproductive lifespan of up to 25 years, during which they may have anywhere from 8 to 10 calves. The majority of the drier lowland regions, which are typically located below 1,500 meters above sea level, are inhabited by camels (Bediye et al., 2018). Camels are an essential part of pastoral economics and a resource for most pastoralists. According to Bediye et al. (2018), camels were used as field plows and in agriculture. In East Africa, the Middle East, and South Asia, camels were integral to pastoral communities as a means of subsistence (Gader and Alhaider, 2016). Camels also served as modes of transportation, entertainment, celebration, and even competition. The camel has recently emerged as one of Ethiopia's most valuable export commodities (Kasaye et al., 2013; Saikat et al., 2020).

Many civilizations have turned to camel milk as a remedy for a wide range of illnesses. A research found that camel milk was utilized as a medication for gastritis, asthma, and stomach issues by individuals living in the Babilie and Kebribeyah districts of the Jijiga Zone of the Somali Regional State.

discomfort, hepatitis, TB, fever, hamot (kar), and HIV. Camels also have medicinal properties in their milk, which can help with a number of conditions including jaundice, malaria, constipation, stomach clearing, postpartum care for women, detoxifying snake venom, and diarrhea (Dibessa, 2020). Camels are rich in bioactive components, which led pastoralists to believe that camel milk could cure a wide range of illnesses. Researchers have discovered that these bioactive components possess antibacterial, antiviral, and anti-inflammatory characteristics. Milk also contains a lot of nutrients that are good for you. Calories, protein, and carbs in camel milk are all quite similar to those in whole cow's milk. The abundance of antioxidants in it also protects cells from harm and wards off serious diseases including cancer, diabetes, and heart disease (Dibessa, 2020). Because of its high nutritional content and possible health advantages, camel milk has gained immense popularity worldwide. The authors Abrhaley and Leta (2018) state that... Because of its superior flavor and nutritious content, camel milk is the preferred milk of children among dairy animals. Camel milk is readily digestible by those who are lactose intolerant since its lactose content is 4.8%, which is similar to human mother's milk.

People who are allergic to cow's milk will find this to be an excellent alternative (Gebremichael et al., 2019). Furthermore, camel meat has developed a preference for its availability, affordability, therapeutic properties, and culinary traditions in a number of African and Arabian nations. The protein content of camel meat is higher than that of chicken and it is leaner than beef. Bekhit and Farouk (2013) also noted that it is rich in minerals and vitamins, including iron, zinc, and vitamin B12. Many people in Ethiopia rely on camel husbandry for their livelihood. Profit was 70% from live animal trade and 30% from meat exports, according to statistics from Ethiopia's tax and revenue ministry. Exports of 16,877 metric tons of meat and 472,041 live animal heads brought in USD 211.1 million for Ethiopia during the fiscal year (July 2010–June 2011). A quarter of all traded live animals were camels, and they made up thirteen percent of all traded animals overall.

wealth created (Mamo, 2019).

The majority of the people in the Somali region made their living by selling camel milk. As in the adjacent country of Soma, there are a number of camel milk selection centers selling milk in the Somali province of Ethiopia and its surrounding towns and cities (Yohannes Mehari and Gebru, 2006). Furthermore, pastoralists in the Ethiopian lowlands of Meiso (Oromia) have been selling camel milk at a rate of 78% (Tegegne et al., 2013). Dromedaries, Bactrian camels, and other Old World Camelids (OWC) are susceptible to tuberculosis (Miller et al., 2015). The prevalence of camel tuberculosis is high; one study found 13% in camels in Kazakhstan (Kinne et al.,

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2006a), and another found 10% in Ethiopian slaughterhouses (Kinne et al., 2006b). These prevalence estimates are based on the diagnosis of macroscopic lesions in otherwise healthy dromedaries (Mamo et al., 2011). Tuberculosis is a long-lasting bacterial illness that may infect both humans and other animals. One telltale sign is the gradual appearance of specific granulomatous tubercle lesions in the affected tissues. This bacterial illness kills more people than any other in the world right now, and it affects hosts of all ages who are vulnerable to it (Shitaye et al., 2006; Gole and Hamido, 2020).

There seems to be a higher incidence of animal tuberculosis infections in this African nation compared to human tuberculosis infections in cattle. Because of the great reliance on livestock for subsistence and the daily use of raw animal products like meat and milk by Ethiopia's massive pastoral population, effective control measures are critically required. People are more susceptible to get zoonotic illnesses like TB in such a setting. Finding out how common camel TB is in pastoral areas and other animals is the first step in estimating the danger and impact of this disease's spread. No comprehensive data on the national prevalence, public health significance, or control methods for TB in Ethiopia is available, despite the disease's long history of reporting in various pastoral regions (Ayana and Dibessa, 2020).

The aims of this paper are -

1) To discus the zoonotic impotrance of camel tuberculosis
2) To highlight some possible approaches for the Camel tuberculosis control and prevention

Camel Tberoculosis

Long, non-sporing acid-fast rods of different lengths make up the genus Mycobacterium, which is in the family Myco-bacteraceae (Teshome, 2021). The waxy coating that mycobacteria have renders them resistant to the host's immune system, leading to a gradual and persistent illness (Thacker et al., 2011). (Djelouadji et al., 2011) The Mycobacterium tuberculosis Complex (MTC) includes the following species: Mycobacterium canettii, Mycobacterium africanum, Mycobacterium bovis, Mycobacterium pinnipedii, Mycobacterium caprae, and Mycobacterium microti.

Damène et al. (2020) found that camelids are a reservoir for many Mycobacterium species, including TB, bovis, pinnipedii, caprae, and microti. The disease is named "tuberculosis" because of the lumps, or "tubercles," that develop in the lymph nodes of animals that are infected (Pasick et al., 2015). The granulomatous zoonosis known as Tuberculosis (TB) is caused by the Mycobacterium tuberculosis complex and affects a wide variety of animal species, camels included (Dibessa, 2020).
The seven different bacterial species that make up MTBC include Mycobacterium tuberculosis, Mycobacterium canettii, Mycobacterium africanum, Mycobacterium pinnipedii, Mycobacterium microti, Mycobacterium caprae, and Mycobacterium bovis (Riojas et al., 2018). However, they vary significantly in terms of host range, pathogenicity, and physiological features. The most common types of Mycobacterium that cause illness in people are M. TB, M. africanum, and M. canettii. The bacteria that cause tuberculosis in animals, such as Mycobacterium bovis and Mycobacterium microti, may also infect people (Mostowy et al., 2005).

Etiology of Tuberculosis in Camel

Cattle and other domestic animals may get TB from two species of Mycobacterium: Mycobacterium bovis and Mycobacterium tuberculosis (Erler et al., 2004). Atypical Mycobacteria, such as Mycobacterium kansasii, Mycobacterium aquae, Mycobacterium aqua var. ureolyticum, Mycobacterium microti, Mycobacterium fortuitum, and Mycobacterium smegmatis, are uncommon causes of tuberculosis in camels. Mycobacterium atypical spices infect immunocompromised camels (Mamo et al., 2011). New World Camelids have yielded four major Mycobacteria: Mycobacterium bovis, Mycobacterium tuberculosis, Mycobacterium avium, and Mycobacterium avium sups Para tuberculosis. Three atypical Mycobacteria, M. kansasii and M. microti, were found to cause tuberculosis in a small herd of llama on the Welsh/English border (Kinne et al., 2006b).

Source of the contamination and means of the Transmission

Granulomas, which are clumps of immune cells that isolate hazardous substances in the body and are most commonly found in the lungs and

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accom- panying lymph nodes, where the mycobacteria spread and infected additional susceptible people, are what characterize the disease (Dibessa, 2020). In close-contact groups of animals, respiratory sprea- ding is the most important mode of disease trans- mission. When an infected host coughs or sneezes, releasing *M. bovis* into the air, an uninfected host inhales it directly, resulting in infection or conta- mination (Francis, 1971). Inhaled air, milk, urine, nasal discharge, vaginal discharge, and discharges from exposed peripheral lymph nodes are all sources of microorganisms. Evident infection disseminators are gross lesions that link with the airways, skin, or intestinal lumen. Animals may have active myco- bacterium in their nasal and bronchial mucus prior to the onset of any sickness symptoms. Excretion of the organism starts in experimentally infected animals around ninety days after infection (Teshome, 2021). When an infected animal is put into a herd of camelids that is not already diseased, tuberculosis can spread between the herds (Alvarez *et al.*, 2012). Animals with pulmonary lesions exhale bacteria that non-infected animals may breathe in and become infected as a result (Dubie *et al.*, 2015). Due to their frequent interaction with their domesticated animals, pastoralists are particularly susceptible to zoonotic illnesses, which are diseases that can spread from animals to humans (Desta, 2016). In Ethiopia, the main ways that camels can infect people are by drinking raw milk and eating under oocked meat from sick animals, and by breathing in the air near them. For several underdeveloped nations where pasteurization is uncommon and where people live close to their livestock, these potential risk risks are especially concerning (Gumi *et al.*, 2012).

Epidemiology

Animals and humans alike are susceptible to Mycobacterium tuberculosis, a highly infectious and long-lasting illness. There is evidence that camelids, like dromedaries, may spread tuberculosis (TB) to other animals (Pesciaroli et al., 2014). Animal welfare and public health are both jeopardized by tuberculosis, which is widespread in Ethiopia. Unfortunately, there is a lack of data on the epidemiology of tuberculosis (TB) that is pertinent to camelids in Ethiopia. The current research indicates that diagnostic procedures and geographic location have a significant impact on the prevalence of tuberculosis in camelids. Camel TB is caused by bacteria that are part of the tuberculosis complex. You may get a disease from contaminated animals or objects, either directly or indirectly. Alvarez et al. (2012) noted that camelid tuberculosis diagnosis is complicated due to the absence of reliable and well-established tests. Wennerry and Kinne (2012) state that further research is necessary to improve camelid tuberculosis diagnosis and control efforts as well as to understand the impact of this disease on animal and human health in Ethiopia. Tuberculosis may infect any living thing, including humans, untamed animals, and those in captivity. The association between drome-daries and tuberculosis (TB) dates back to 1888. The geographical distribution varies considerably among regions and countries (Kasaye et al., 2013). Less than 1% of camels in the US, Canada, Japan, and New Zealand have TB, which is quite low compared to most European nations. Australia, Denmark, Sweden, Norway, and Finland are among the nations that have said they are clear of this illness. Nonetheless, almost every African country has bovine TB (Dubie et al., 2015). Research on dromedary camel tuberculosis (TB) at an Ethiopian slaughterhouse identified the causative agent as M. Bovis. The results showed that 33 out of 398 corpses, or 8.3%, tested positive for camel Tb (Beyi et al., 2014). In an effort to characterize its prevalence and identify M. bovis as the causative agent from afflicted camels, it was found in eastern Ethiopia. Researchers found a 5% incidence of TB in 14 of 276 pastoral camels killed at a slaughterhouse east of Addis Abeba. The camels had lesions that were consistent with the disease. Only four out of fourteen camels with lesions tested positive for AFB in a tissue impression smear; moreover, only one of those fourteen samples was shown to carry MTBC using PCR (Rhodes et al., 2015). The research found a 10% incidence of tuberculosis in 906 camels from two pastoral districts in Southern and Eastern Ethiopia, with 91 camels showing suspicious lesions. Thirty-one camels (34 percent) with acid fast Bacilli (AFB) positive mycobacterial isolates from cultured meat were found among those with liver illness symptoms. Of the camels tested, 21 were positive for Mycobacterium using a

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polymerase chain reaction.

31 were tested, however only 2 tested positive for MTBC, confirming that they were M. bovis (Dibessa, 2020).

It is shown in these two Ethiopian investigations that the spectrum of mycobacteria that cause mycobacterial diseases in camels is extensive, and the low recovery rate of a positive causative agent (i.e., M. bovis) from most lesioned camels may be due to inadequate culture for non-MTBC mycobacteria. According to current 16S rDNA sequencing, the non-MTBC mycobacteria that are responsible for this have been identified as Mycobacterium avium, Mycobacterium brasiliensis, Mycobacterium chelonae, and Mycobacterium terrae complex (Mamo et al., 2011). Other tests carried out in slaughterhouses have also indicated the likely relationship between non-MTBC and MTBC in camel mycobacterioses in Ethiopia. Postmortem examinations of 293 OWCs in eastern Ethiopia revealed a 12.3% (36/293 total) likelihood of tuberculosis lesions in female dromedaries. One study on camels with visible lesions indicated that 61% of the lesions had mycobacteria. The majority (15/22) of the isolates were not Mycobacterium tuberculosis, with just three of them being positively identified as M. tuberculosis using molecular characterization (Gumi et al., 2012; Zerom et al., 2013). The camel tuberculosis (TB) rate in Akaki abattiors was 9.82% in camels from Metehara and Borana. The predominance of camels from Metehara is 9.6 percent and that from Borana is 10.9 percent. A total of 38 camels (9.82% of the total) tested positive for tuberculin response out of 387 that underwent the single intra-dermal comparative cervical tuberculin (SICCT) test (Jibril et al., 2019). Similar to what was found in one study, another found that camel tuberculosis was 10.4% in Akaki, 5.1% in Dire Dawa, and 3.1% in Southern Ethiopia, all based on data collected from abattoirs (Jibril et al., 2016; Gumi et al., 2012a; Gumi et al., 2012). Also, according to Beyi et al. (2014) and Kasaye et al. (2013), camel TB is present in Akaki at a prevalence of 5.1% and in Eastern Ethiopia at 6.1%. Zerom et al. (2013) reported that dromedary camels in Ethiopia had tissue lesions from which Mycobacterium bovis and Mycobacterium TB have been identified. In addition, the MTBC has been confirmed to include M. pinnipedi, M. caprae, and M. microti in camelids (García-Bocanegra et al., 2010; Manual, 2008). Zerom et al. (2013) and Kinne et al. (2006) state that non-

In addition to Mycobacterium smegmatis, Mycobacterium kansasii, Mycobacterium aquae, and Mycobacterium fortuitum are the causative agents of camel tuberculosis. Ruminants in southern Ethiopia, camels in eastern Ethiopia, goats in Afar, and pigs in Ethiopia have all tested positive for Mycobacterium tuberculosis (Gumi et al., 2012; Zerom et al., 2013; Arega et al., 2013).

Risk Factors

In accordance with Mamo *et al.* (2011) the tuber-culosis-causing agent is susceptible to all types of animals, including humans, physical conditions, sex, and age groups. In conventional domesticated animal raising systems, The way livestock are kept and managed, such as mixing different animal species and sharing water sources, can increase the risk of

M. bovis spreading among animals, from animals to humans, from humans to animals, and from humans to humans (Gumi *et al.,* 2012). Camels with TB were more common in the youngest and oldest age groups. Similar findings have been reported in cattle, especially in older animals with TB (Munyeme *et al*., 2009). This might be because older animals have weaker immune systems. Younger camels might have more lesions because their immunity is not fully developed (Menzies and Neill, 2000). Also a pathogen risk factor: the causative organism is heat, desiccation, and many disinfectants resistant; *M. bovis* pathogenicity is related to its capacity to survive and reproduce in the host macrophages. Housing, sharing a shelter with humans, and animal stocking intensity are all environmental risk factors (Quinn *et al.,* 2003). The consumption of raw milk (as opposed to pasteurized milk) is a common practice in the Ethiopia that increases the risk of zoonotic TB transmission from infected animals to humans. *M. bovis* is the main agent of zoonotic TB and it can be found in unpasteurized milk and other dairy products. Moreover, the inhala-tion of aerosols from cattle to humans (or vice versa) can also be a potential source of infection (Romha and Ameni, 2018). Another factor that

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contributes to the spread of zoonotic TB is the low level of aware-ness among pastoralists. They often value the nutria-tional and medicinal benefits of raw milk and do not boil it before the consumption. They also have limited knowledge about milk-borne diseases (Wako, 2015).

Pathogenesis

Camel tuberculosis (TB) is a persisting infectious disease caused by *Mycobacterium bovis* or *Myco-*

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bacterium tuberculosis, which can affect the respiratory system, lymph nodes, and other organs of camels (Mohamed, 2019). The pathogenesis of camel TB is not well understood, but it is believed to involve inhalation or ingestion of the bacteria, followed by multiplication and dissemination within macrophages (Gumi *et al*., 2011). The bacteria can evade the host immune response by inhibiting phagosome-lysosome fusion, modulating cytokine production, and inducing granuloma formation (Abebe, 2019). The clinical signs of camel TB may include weight loss, coughing, dyspnea, lympha- denopathy, and abscesses (Khan *et al.,* 2013).

Camel TB poses a significant threat to the health and productivity of camels in Ethiopia, as well as a potential zoonotic risk to humans who consume camel milk or meat (Gutema *et al.,* 2019). According to the distribution of TB lesions in the bodily organs of camels, lungs and related lymph nodes accounted for 57.14% of lesions, retropharyngeal lymph nodes for 28.57%, and mesenteric lymph nodes for 14.29% (Kasaye *et al*., 2013). By using this process, mycobacteria are able to live, grow, and finally destroy phagocytes. In order to move from cell to cell, M. marinum, a close relative of *M. TB* and *M. bovis*, may break through the phagosomes and enter the cytoplasm (Stamm *et al*., 2003). Then, more phagocytes come in to ingest the growing amount of tubercle bacilli. A granuloma, a tiny collection of cells, forms. Large numbers of phago- cytes build up as a result of the disease's cellular reactions, and eventually macroscopic lesions called tubercles appear. After 10-14 days, the host's macro- phages acquire cell-mediated immunity (CMI) responses and become more capable of eliminating the intracellular bacteria. T lymphocytes, which are involved in cell-mediated immunity (CMI), secrete lymphokines that are messenger proteins produced by lymphocytes. These lymphokines attract, immo- bilize, and activate more mononuclear cells from the blood at the locations where harmful mycobacteria or their products are present (Thoen *et al*., 2006).

The presence and enlargement of macrophages in the difficult-to-access channels between the reticular cells of the lymph node assist the growth and deve- lopment of the granulomatous lesion in the node. In certain cases, the lung and the thoracic nodes are both impacted because some of the mycobacteria that have been engulfed are still in the lung. Primary lesions may grow big and solid and frequently localize in a node or nodes (Thoen *et al*., 2006).

Clinical Findings

Camel Tuberculosis is a serious and contagious disease that affects camelids, such as llamas and alpacas. It is caused by bacteria from the Mycoba- cterium tuberculosis species, which can infect the respiratory tracks and other organs. Camelids with TB may `not show any signs of illness or may only have mild symptoms, such as changes in behavior, reduced appetite, weight loss, coughing or difficulty breathing. Some camelids may die suddenly without any warning. TB can be transmitted to camelids by contact with infected cattle or wildlife, or through contaminated materials (Crawshaw *et al*., 2013). Therefore, it is important to test camelids for TB regularly and to examine any dead animals for signs of TB lesions. The most common organs affected by TB in camelids are the lungs and the lymph nodes near the lungs. The lesions caused by TB can be very severe and extensive, and may not be detected until the animal is dead. The lesions are white or creamy and caseous.the clinical signs in camelids include wasting, anorexia, and respiratory distress, enlarge- ment of superficial lymph nodes, recumbence and eventually death (Twomey *et al*., 2010). The most common organs affected by tuberculosis are the lungs and their related lymph nodes. The infection can cause multiple or single lesions in the bile ducts or lungs that can merge into large areas of dead tissue, sometimes involving the entire lung lobes. Healthy camelids have small and hard-to-detect lymph nodes. However, tuberculous affected lymph nodes are often very large and have many white, cream or yellowish foci of dead tissue. In severe cases, the whole

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node may be replaced by one big lesion (Jibril *et al*., 2018). The lung damage may be so extensive that it is surprising that the animal did not die sooner (Crawshaw *et al.,* 2013). In humans, the common symptoms of active lung TB include, cough with sputum and sometimes with blood, chest pains, weakness, weight loss, fever, and night sweats (Bazzano and Yan, 2020).

Pathology

There were few research on camel TB, hence the use of histology to identify the illness was unique in Ethiopia. A tuberculosis lesion epidemiology assessment was carried out by a group of researchers in several pastoral areas of Ethiopia utilizing abattoirs (Dibessa, 2020). Following the aforementioned procedure, a postmortem examination was carried out (Mamo et al., 2011). Lung and lymph node tissues, as well as the sub-mandibular, retro-pharyngeal, trachea-bronchial, cranial, and caudal mediastinal lymph nodes, were examined in detail under a powerful light source. The outer lobes of the two lungs were palpated and inspected. To help find lesions, sterilized surgical blades are used to slice each lobe into sections about 2 cm thick. In a similar vein, lymph nodes were sliced into tiny slices (about 2 mm thick) and evaluated for the presence of visible abnormalities. In order to detect abscesses and tubercle lesions, the cut surface was examined under a powerful light source (Asseged et al., 2004; Mamo et al., 2011). While research on camel tuberculosis in Ethiopia is limited, what little there is suggests that it poses a significant concern in pastoral areas where camels are raised for their meat, milk, and transportation. Of 906 camels killed at two slaughterhouses, a cross-sectional analysis indicated that 10.04 percent had visible tuberculosis lesions, most often in the abdominal organs (Mamo et al., 2011). Nineteen non-tuberculous mycobacteria strains and two novel Mycobacterium caprae strains were found in a different investigation that tested 31 myco-bacterial isolates from camels with tuberculosis lesions (Dibessa, 2020). Based on these results, it seems that many mycobacteria are responsible for camel tuberculosis in Ethiopia, each with its own unique pathogenicity, infection source, and mode of transmission. Lacking established and approved diagnostics for camels makes camel tuberculosis diagnosis difficult. Despite their use as screening methods, the sensitivity and specificity of the P22 ELISA and intradermal tuberculin test remain uncertain (Infantes et al., 2020). There is a severe lack of accessibility to the high-tech laboratory methods needed for agent isolation and identification.

The existence of visible lesions, which were more prevalent in certain lymph nodes and lung lobes, gave rise to a pathological prevalence of camel tuberculosis of 10.04 percent. A third of the camels who had tuberculosis lesions also had mycobacterial growth. Using multiplex PCR, RD4-based PCR, and spoligotyping, the mycobacteria were confirmed to be members of the Mycobacterium TB complex (Jibril et

(2018, p.). Postmortem positivity was recognized in camels with macroscopic lesions ranging from hard white, grey, or yellow nodules to thin-walled suppurative abscesses, all of which had a dry and solid necrotic core (Kinne et al., 2006). The lymph nodes of every camel were examined for tuberculous infections and removed if found positive. These nodes were located in various areas such as the parotid, mandibular, retropharyngeal, tracheobronchial, mediastinal, pres- capular, prefemoral, mesenteric, superficial inguinal, and supramammary regions. The kidneys, liver, lungs, and mammary gland were among the other organs that were also evaluated (Beyi et al., 2014).

Medical diagnosis

There are two parts to determining if an animal has tuberculosis: pre- and post-mortem inspections. The tuberculin skin test and the interferon-gamma (IFNγ) test are two examples of ante-mortem testing. The former employs pure protein derivatives (PPD) from Mycobacterium bovis and Mycobacterium avium to identify skin responses, while the latter evaluates the immunological response to mycobacteria. But, particularly for camelids, these tests aren't very sensitive or specific. Although more confirmation is necessary,

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serological assays have shown promising results in detecting antibodies against mycobacteria. These tests may detect infected animals before they exhibit nonspecific clinical indications such weight loss, respiratory discomfort, enlarged lymph nodes, and even death. Histopathology, bacterial culture, and the presence of characteristic lesions in the organs form the basis of post-mortem diagnosis. This is the one certain method for diagnosing TB in camelids. The location of the infection determines the symptoms and organs affected by camel TB, a chronic and contagious illness. Because it is similar to many other illnesses, accurate diagnostic procedures are required to rule it out. The tuberculin skin test and bacterial identification in affected animal samples are the gold standards for camel TB diagnostics (Kasaye et al., 2013). Microscopic analysis of stained samples, bacterial culture, genetic techniques, spoilgotyping, histopathology, serological testing, and other similar approaches may also be used to detect camel tuberculosis. While these strategies have shown promise in some circumstances, they still need validation in others (Beyi et al., 2014).

Consequently, improved diagnostic methods for camel TB need further study.

Medical Care

Streptomycin, isonized (INH), ethambutol, and rifampin are the first-line medicines for tuberculosis treatment. Medications such as pyrazinamide, paraminosalicylic acid, kanamycin, cyclosserine, caperomycin, and ethionamide are available as second-line medicines. The development of resistance under a single medication regimen is a typical reason why a combination of drugs is regularly prescribed. Teshome (2021) states that anti-tuberculous chemotherapy in animals is discouraged due to the public health risks associated with keeping TB animals. A number of nations have passed legislation mandating the reporting of animal TB cases and the culling of sick animals as a means of disease prevention. Although anti-TB medications are not often given to ill animals, they have been administered to some wild animals kept in captivity. Two Bactrian camels housed in a zoo tested positive for tuberculosis; therefore, seventeen camels were treated prophylactically with isoniazid mixed with pelleted feed at a dosage of 2.4 mg/kg, given as needed (Oevermann et al., 2004).

Prevention and Control

Dromedary camels are an important source of income for pastoralists in Ethiopia since they can withstand the extreme weather conditions seen throughout the nation. Dromedary camels are susceptible to tuberculosis (TB), which may lead to illness and death in these animals (Jibril et al., 2018). Intradermal tuberculin testing is the main focus of national control efforts, however it is not very sensitive in camelids, therefore a combination of ante mortem tests might increase the sensitivity of herd testing. While culling the herd of affected animals and stopping the disease's spread is an effective first step, eradicating the virus will need addressing the reservoirs of the disease—the wildlife hosts—(Thoen et al., 2006). In order to implement effective disease management measures, it is crucial to get a comprehensive understanding of the transmission of the virus within the environment, taking into account both domestic and wild animals (Renwick et al., 2007). Pasteurizing milk, removing diseased animals and organs after meat inspections, and using effective disease management procedures are all ways to avoid diseases (Dibessa, 2020). Maintaining clean and sanitary conditions around feeding troughs, water sources, and other contaminated areas is also helpful. Cabs that have not been properly aged are more likely to get TB than well tended livestock (Kiros, 1998). Thoroughly clean and disinfect food and water troughs with hot 5% phenol or an equivalent cresol as phenols (2-5%), hypochlorite (1-5%), alcohol (typically 70% ethanol), formaldehydes and iodophores (3-5%), and glutara-ldehyde (Zahra). This is recommended.

The significance of camel tuberculosis to public health Tuberculosis (TB) is among the world's most serious infectious illnesses that affect people.

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Globally, tuberculosis was responsible for an estimated 8.8 million new cases in 2010, an incidence rate of 128 per 100,000 people, and 1.5 million deaths (WHO, 2012). In developing nations like Ethiopia, where the prevalence of M. bovis infections is on the rise, the disease's public health significance has been reemphasized (Radostitis et al., 2007). Animals and people are both susceptible to the zoonotic illness known as camel tuberculosis (TB), which is caused by the bacteria Mycobacterium bovis and Mycobacterium tuberculosis. Because camels are so ubiquitous in Ethiopia—used for everything from milk production to transportation to meat consumption—camel tuberculosis is a serious issue in terms of public health. There is a grave danger that camel tuberculosis may spread throughout the country, endangering the lives of camel caretakers, customers, and the economy and food supply.

With an anticipated incidence of 164 infections per 100,000 population in 2019, Ethiopia is ranked among the 30 nations with the highest TB burden in the world by the World Health Organization (WHO, 2012). Prevalence estimates for camel tuberculosis in Ethiopia are sketchy at best, with estimates from bacteriological and molecular investigations placing the number anywhere from 1.4% to 15.6%. Humans may get camel TB via coming into close touch with sick animals or eating meat or milk from affected animals. It is unclear, however, how widespread camel tuberculosis infection is among Ethiopian humans (Teshome, 2021). Wild species like gazelles, antelopes, and hyenas share water supplies and habitats with camels, making camel tuberculosis a possible danger to wildlife conservation efforts. The population dynamics and biodiversity of these animals might be impacted by outbreaks caused by camel tuberculosis. Furthermore, since camels may both transmit and store tuberculosis (TB), camel TB might undermine attempts to eliminate bovine TB in domestic animals like cattle (Mamo et al., 2009). Dromedary camels are valuable cattle because they provide a variety of dairy products for human consumption. The majority of their 30 million-strong population lives in Africa and the Middle East. Camels endure a number of dangers to their health despite their adaptation to arid, harsh climates. Zhu et al. (2019) noted that these animals may carry and spread illnesses to people and other animals, including Middle East respiratory syndrome (MERS), Brucella, camelpox, and Rift Valley fever. Intimate contact between animals and people is a common pathway for the spread of contagious zoonotic diseases. "Those diseases and infections that are naturally communi-cated between vertebrate animals and man," notes the World Health Organization (WHO). The Mycobacterium bovis bacteria may cause zoonotic tuberculosis, which is more common in people who live in close quarters with animals, particularly in underdeveloped nations. Although this bacteria may infect a wide variety of animals, humans often get it via infected cattle. The germs that cause zoonotic tuberculosis may be inhaled via contaminated animal droppings or corpses, or consumed through raw milk or meat from infected animals. The diagnosis and treatment of zoonotic tuberculosis are complicated due to the lack of readily accessible specialized testing and medications. Zoonotic tuberculosis may spread to other parts of the body, including the lungs. For those whose livelihoods are dependent on cattle, it poses a significant threat to public health (WHO, 2017). Tuberculosis in camels,

The zoonotic effect of diseases like bovine TB is significant, especially for nomadic people who ingest raw camel milk and other animal products. According to mamo et al. (2009), the prevalence in slain camels was found to be 5-10%. Present Infectious Disease Situation in Ethiopia Mycobacterium tuberculosis complex germs cause bovine tuberculosis (BTB) in Ethiopian animals. Shitaye et al. (2007) state that the main methods for identifying BTB in Ethiopia are meat inspection at slaughterhouses, tuberculin skin testing, and sometimes bacterial culture. The incidence of camel tuberculosis was found to be 10.04 percent in a cross-sectional analysis of 906 camels killed at the Akaki and Metehara abattoirs,

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and 2.2 percent in a research that used molecular characterisation to determine the etiological agents (Ashenafi et al., 2013). Using postmortem examination and culture isolation of M. bovis, another investigation on 276 camels killed at the Dire Dawa slaughterhouse found a prevalence of 5.07% and 1.45%, respectively. Table 1 summarizes the findings of Zerom et al. (2013), which state that camel tuberculosis (TB) has public health consequences, particularly in pastoral regions of Ethiopia where humans often come into close contact with camels and ingest raw camel milk and its derivatives.

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Table 1: Summary of current Status of the infection in Ethiopia.

No	Site of the study	Reported Prevalence	Study
1	At the Dire Dawa abattoir in Ethiopia, a cross-sectional study of camel tuberculosis was conducted.	5.07% based on postmortem examination	(Ethiopie, 2009)
2	Infection with *Mycobacterium tuberculosis* complex in animal and humans in the Afar region's Amibara District	34% (31/91) of camels with grossly suspicious TB lesion	(Ashenafi *et al.,* 2013)
3	Pathology of camel tuberculosis and molecular characterization of its causative agents in pastoral regions of Ethiopia at Akaki and Metehara abattoir	10.04% (91/906) on the basis of pathology	(Mamo *et al*., 2011)
	Tuberculosis in dromedaries in Eastern Ethiopia: Abattoir-based prevalence and molecular typing of its causative agents	12.3% based on post mortem	(Zerom *et al.*, 2013)
5	Prevalence of camel tuberculosis at Akaki abattoir in Addis Ababa, Ethiopia.	4.52 % based on tuberculosis lesion detection	(Kasaye *et al.*, 2013)
6	Prevalence of bovine tuberculosis in dromedary camels and pastoralists' understanding of the disease's zoonotic significance in Eastern Ethiopia's Dire Dawa City Administrative Council (DDAC) and Somali pastoral region.	8.3% based on the post mortem examination and 6.0% based on the tuberculin test.	(Beyi *et al.*, 2014)

CONCLUSION AND RECOMMENDATIONS:

Humans who ingest camel milk and meat put themselves at danger of contracting camel TB, a zoonotic illness caused by Mycobacterium bovis and M. tuberculosis. The disease impacts the well-being and productivity of camels. Due to a lack of accurate data and diagnostic methods, little is known about the public health significance and epidemiology of camel TB in Ethiopia. On the other hand, research has shown that camel tuberculosis is rather common in some parts of Ethiopia, particularly in pastoral areas where camels are kept in close quarters with people and other animals. Camels may spread TB by direct contact with diseased animals or their products, or through inhalation or ingestion. Poor camel husbandry, insufficient biosecurity measures, co-infection with other illnesses, and camel genetic vulnerability are risk factors for camel TB. Weight loss, coughing, lymphadenitis, mastitis, and abscesses are all possible symptoms of camel TB, which is a generic disease. Limited capabilities of currently available testing make camel TB detection more difficult. These tests include the tuberculin skin test, the interferon-gamma assay, bacteriological culture, and molecular approaches. Camels, their owners, veterinarians, public health authorities, researchers, and lawmakers must all work together in a concerted effort to manage and prevent camel TB.

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