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Review on the Epidemiology and its Public Health Importance of Camel Brucellosis

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Abstract: Brucellosis is a zoonotic disease that affects all domestic animals including camels. It is infectious to human beings also. Camels are infected by *Brucella abortus and Brucella melitensis* and *Brucella ovis.* The primary sources of brucellosis to humans are animals raised for food, including camels, pigs, sheep, goats and cattle. Infection is transmitted to humans from infected animals mainly by direct or indirect contact with animal's tissues, blood, urine, vaginal discharge, aborted fetuses and, particularly, placentas and also the consumption of unpasteurized milk, contaminated meat and milk products. The disease is more common in female camels than in males. The absence of erythritol sugar, which is present in the uterus, makes male animals less vulnerable to Brucella infection. The clinical manifestation of brucellosis can range from abortion to asymptomatic. The World Organization for Animal Health recommends the Complement Fixation Test (CFT) for the diagnosis of Brucella. This bacterium is controlled by pasteurizing milk and implementing hygienic measures in conjunction with efficient disease surveillance, combination of vaccination with S19 or Rev 1 vaccine strains and animal movement control. It is believed that treating the disease over an extended period of time with an antibiotic is good for caring for breeding male animals that are significant to the economy. The aim of this paper is to review the epidemiology and its public health importance of camel brucellosis and to highlight the major risk factors associated with the occurrence of camel Brucellosis and to recommend the disease for further research through one health approaches.

Key words: Brucella · Brucellosis · *Brucella abortus* · *Brucella melitensis* · Camel · Human

INTRODUCTION

In many regions of the world with dry and semi-dry climates, camels (*Camelus dromedarius*) are the members of the Camelidae family, play an important socioeconomic role [1]. Many anatomical and physiological traits of camels allow them to adapt remarkably well to incredibly hard environments, which is directly linked to their key responsibilities [2]. Several studies have shown that camels are extremely vulnerable to a number of bacterial diseases, one of which being brucellosis, which significantly reduces the camel's capacity for reproduction. The Brucella bacteria which cause brucellosis are known to exist in ten species, six of which are the classical species [3]. *Brucella abortus*, *Brucella melitensis* and *Brucella ovis* are the primary causes of brucellosis in camels [4, 5]. The most commonly isolated Brucella species from milk, aborted fetuses and vaginal swabs of sick camels are *Brucella abortus* and *Brucella melitensis*, according to numerous academic papers [5].

In 1931, Solonitsiun in Russia reported the first case of brucellosis in camels. Since then, reports of brucellosis serological evidence have come from the major nations that raise camels [6]. In the world's camel rearing regions, the Middle East, the Arabian Gulf, sections of Africa and Latin America camel brucellosis is a widely distributed [7-9]. In sub-Saharan Africa, brucellosis is a significant illness that affects both humans and livestock. Outside of sub-Saharan Africa, brucellosis surveillance and control measures are infrequently used [10]. In Africa, the first report of serological evidence of Brucella exposure in camels was made in Kenya in 1978 [11].

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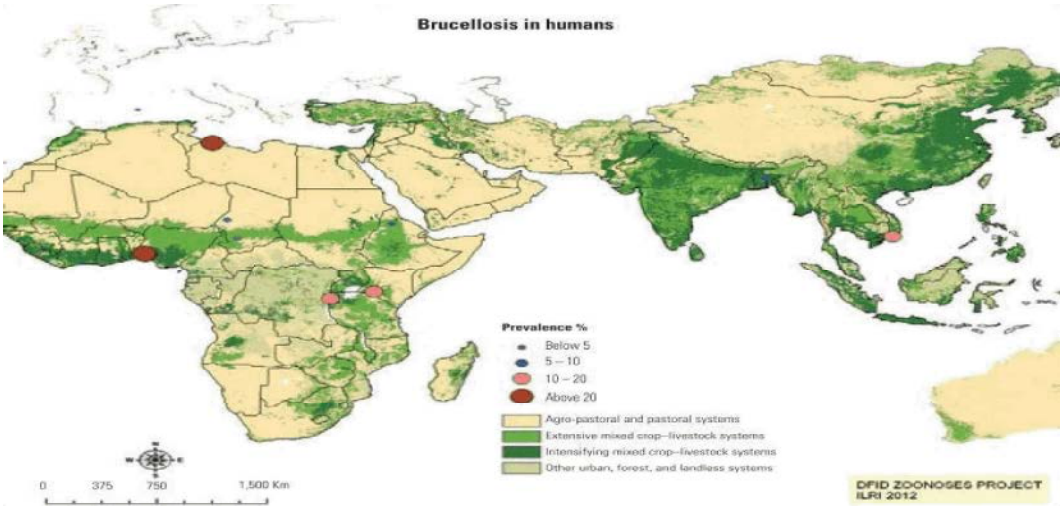

Fig. 1: Prevalence of human brucellosis in the world [20].

In Ethiopia, the provinces of Sidamo, Harar and Tigray reported the first case of camel brucellosis, with a sero-prevalence of 4.4% [12]. In addition, investigation was conducted on camel brucellosis. With a 1.8% sero-prevalence in the Borena lowlands [13]. In pastoral areas where camels are raised, brucellosis is identified as one of the illnesses linked to reproductive loss. It was documented that there was a significant loss of productivity due to reduced herd fertility, a delayed first calving age, a longer calving gap and relatively low milk production in camels [14]. To ensure the livelihood of the pastoral communities, camel husbandry is mostly done in the eastern and southern regions of Ethiopia, specifically in Afar, Somali and Borena [15]. the disease is neglected zoonosis that has potential to spread to people and have catastrophic effects on both health and the economy. Despite these facts, the traditional habits of raw milk consumption, handle aborted materials, manipulate reproductive excretions with bare hands and herding of a huge number of animals with other species is common practice in pastoral community

This review aimed to review the epidemiology and its public health importance of camel brucellosis and to highlight the major risk factors associated with the occurrence of camel Brucellosis and to recommend the disease for further research through one health approaches.

Etiology: *Brucella abortus* and *Brucella melitensis* are the causative agents of the disease in dromedary camels [16, 17].

Table 1. Seroprevalence of camel brucellosis in Ethiopia

Study area	No of examined	Test employed	Prevalence %	References
Afar	245	CFT	4.1%	[22]
Akaki	201	CFT	4.5%	[14]
Borane zone	315	I ELISA	2.86%	[23]
Dire Dawa	350	CFT	2%	[24]
Southern Tigray	415	CFT	3.37%	[25]

Epidemiology

Geographical Distribution: Worldwide bacterial disease called brucellosis affects both humans and animals, posing a major risk to human health and causing financial damage. There is a continual fluctuation in the geographical distribution of brucellosis due to the emergence or reemergence of new foci [18]. In 1931, Solonitiun in Russia reported the first case of brucellosis in camels. Since then, the most significant nations that keep camels have reported serological evidence of brucellosis [6]. With the exception of Australia, camel brucellosis is a widespread illness in areas of the world that rear camels, including the Middle East, Arabian Gulf, Africa and Latin America [19].

The prevalence of brucellosis in Ethiopian camels from pastoral areas ranged widely, from 0.73-11.9% for RBPT to 0.53-9.6% for CFT. Because pastoral societies use different animal husbandry and management techniques, there is a diversity in the seroprevalence of camel brucellosis [21].

Human brucellosis is a serious public health risk that has an impact on the social and economic advancement of many nations, including Ethiopia. Humans can contract Brucella infection from infected animals or animal

Table 2: Seroprevalence of human brucellosis in Ethiopia

Study area	No of examined	Test employed	Prevalence %	References
Afar	5718	CFT	24.21%	[27]
Somali	190	CFT	1.5%	[28]
Oromia	166	CFT	1.2%	[29]
Amhara	499	CFT	33.5%	[30]
Southern Nation and Nationality people	243	SA	10.6%	[31]
Tigray	246	CFT	1.2%	[26]

products horizontally; this illness usually arises from foodborne or occupational sources. The most prevalent way for tourists and residents of endemic areas to become infected is by foodborne exposure, where people often consume raw or partially cooked animal parts such as muscle, liver and spleen, as well as raw milk and milk products [26].

Risk Factors: Due to an increase in vulnerability during sexual maturity and pregnancy, brucellosis has historically been thought of as an adult animal illness. The reason for this is that Brucella species exhibit tropism towards the reproductive system because their fetal tissues produce erythritol sugar [32]. Brucellosis is more common in female camels than in males. The possibility that female camels are more susceptible than males could be explained by the fact that they experience more physiological stress [33]. The absence of erythritol sugar, which is present in the uterus, makes male animals less vulnerable to Brucella infection [34]. Additionally, female camels are kept in herds for a longer period of time for breeding purposes than male camels, who are usually fattened and sold, with a small exception of those kept for services female camels, haulage and transport [33].

Source of Infection: Pastoralists live in close proximity to their animals and frequently eat raw, unpasteurized dairy products, which makes them susceptible to the disease. The primary factor that predisposes people to the sickness in the area is the pastoralists' bare hands when handling aborted instances [35]. The primary carriers of brucellosis to humans are animals raised for food, including camels, pigs, sheep, goats and cattle [8].

Mode of Transmission: The primary means by which human brucellosis is contracted through the skin include by contact with animal tissues, blood, urine, vaginal discharge, aborted fetuses and, particularly, placentas; it is also contracted through the consumption of raw milk and other unheated dairy products. Animal enclosures, stables, labs and abattoirs are among the places where airborne illnesses happen. A few instances of unintentional self-inoculation with live vaccinations have also been reported [18, 36, 37]. Although occupational exposure typically results from direct contact with diseased animals, food-borne transmission and person-to-person transmission of brucellosis can occur among innocent camel herders through intimate personal or sexual interaction [38].

Clinical Sign: In camels, the clinical manifestation of brucellosis can range from abortion to asymptomatic [38]. The clinical symptoms of brucellosis in breeding camels are similar to those in bovines and small ruminants, according to multiple researchers [39]. But compared to small ruminants and cows, illnesses in breeding camels cause fewer abortions. In camels, brucellosis-related abortions often happen just once. Dams may develop hydro-bursitis, granulomatous endometritis and ovario-bursal adhesions. There have also been reports of delayed sexual maturation, infertility and placental retention [40]. Orchitis, inflammation of the accessory sex glands and arthritis with acute lameness are among the conditions that can affect males [41]. Premature birth is thought to be the main effect of infection, according to some authorities. In addition, mummification, decreased milk supply and fetal mortality are caused by brucellosis. Reportedly, another problem linked to brucellosis is delayed service age and infertility. Due to their dispersed placentas and different placental attachment mechanism, camels seldom have placental retention [42].

Diagnosis: Because the clinical picture of brucellosis can mimic other infectious and non-infectious illnesses, diagnosis can be difficult and commonly delayed or overlooked. Therefore, even though third-trimester abortions are suggestive of brucellosis, it is exceedingly challenging to diagnose based solely on clinical indications. This is because abortion storms can also be caused by other infectious diseases such leptospirosis, Rift valley fever and Listeriosis [43]. The Serum Agglutination Test (SAT), which measures agglutinating

antibodies of the IgM, IgG1, IgG2 and IgA types and detects acute infections, is one of the laboratory procedures used in the diagnosis of Brucella [44]. The Rose Bengal plate test is one of several tests in the class of buffered Brucella antigen tests that are based on the idea that IgM antibodies' capacity to attach to antigen and though very good as a screening tool, this test may be overly sensitive for diagnosing individual animals, especially those who have had vaccinations [45].

A great technique to screen large populations for Brucella antibodies and distinguish between the acute and chronic phases of the disease is the Enzyme Linked Immune Sorbent Assay (ELISA). The preferred test for complex, local, or long-term conditions, ELISA can detect individual and total immunoglobulins (IgG, IgA and IgM) with excellent sensitivity and specificity in 4-6 hours [46]. The World Organization for Animal Health recommends the Complement Fixation Test (CFT), which is the most commonly utilized confirmatory test. It is also very specific, time-consuming and dependent on the identification of particular IgM and IgG1 antibodies that fix complement; it calls for appropriate laboratory facilities and highly skilled staff [47].

Treatment: The high likelihood of treatment failure, expense and possible issues with keeping sick animals in the face of continued eradication attempts discourage the attempt to treat affected livestock [48]. Treating afflicted animals is not a standard procedure in developed nations. Still, in order to stop the infection from spreading to another herd, the contaminated animals are either quarantined, culled, or killed. Although brucellosis is a challenging disease to cure due to its complex nature, it is believed that treating the disease over an extended period of time with an antibiotic is good for caring for breeding male animals that are significant to the economy. Treatment should begin before the disease causes irreversible damage to the epididymis [49]. Due to the organisms' intracellular sequestration, primarily in the lymph nodes, treatment is unlikely to be economical or therapeutically successful. It's possible to prevent the culling of valued animals (such racing camels) by using antibiotics, although the effectiveness of antibiotic treatment at the herd level is questionable [9]. The World Health Organization advises treating human cases of acute brucellosis with oral doxycycline and rifampicin (600 mg for six weeks) [50]. For pregnant women, brucellosis is often treated with rifampicin monotherapy; for children, sulphamethoxazole and trimethoprim combination therapy is advised [51].

Prevention and Control: Most developed countries have successfully managed brucellosis; but, in some underdeveloped or tropical nations, the illness has been neglected as a zoonosis because disease prevention and control efforts have not been sustained [52]. Programs for controlling or eliminating brucellosis, how those programs are implemented and the control measures used in various nations vary widely based on their unique national circumstances, according to the Zhang *et al*. [53] research. While human brucellosis is controlled by pasteurizing milk and implementing hygienic measures in conjunction with efficient disease surveillance and animal movement control, animal brucellosis is controlled in the developed world through a combination of vaccination, test and slaughter programs [54].

Camel brucellosis control should be customized to the unique circumstances of the nations where camels are raised. The majority of these nations are impoverished and tribes that live on the move produce camels. It was recommended that the best way to control camel brucellosis in nations with high camel keeping rates would be to vaccinate the entire herd with S19 or Rev 1 vaccine strains, followed by blood testing in the field using the Serum Agglutination Test or card test [55]. Tests should be repeated on animals that test positive for antibodies and they should be identified by branding or a unique earmark. Selling of seropositive animals will be prohibited as a result of this marking. It is recommended that camel calves receive a full adult dose of vaccination between the ages of 4 and 8 months [56, 57].

Vaccination: Due to the severe medical and financial ramifications of brucellosis, great attempts have been made to employ vaccinations to avoid the illness. Both inactivated and attenuated Brucella vaccinations have been effectively administered to ancient world camels. *B. melitensis* Rev 1 [58] and *B. abortus* strain S19 [55] vaccinations were administered to dromedaries. The vaccination was given in full to young (3 months) and lowered to adult (10 years) dromedaries. Extensive research is necessary to determine whether dromedaries are naturally infected with *B. abortus* or *B. melitensis* before beginning vaccination; this can only be done by culture or PCR. Since *Brucella melitensis* Rev 1 is an attenuated vaccine, it must be administered extremely carefully to prevent infections in those who have received it as well as those who have not. Live *B. melitensis* vaccine bacteria may be excreted in milk and vaginal discharge and vaccination of pregnant goats and sheep may cause abortion. It is unknown how things are in dromedaries [59].

Public Health and Economic Importance: Ethiopia's pastoral tribes primarily rely on the milk and milk products of camels and other domestic animals to meet their nutritional needs; yet, it is well recognized that raw camel milk can spread brucellosis to people [60]. Conversely, customary techniques of animal killing for food obviously degrade the safety, wholesomeness and hygiene of food originating from animals. Eating such tainted food, which can contain Brucella germs, might have a negative impact on one's health [61]. Brucellosis causes severe feverish disease with sporadic fever in people. Anorexia, malaise and prostration frequently follow, along with liver, lymph node and spleen enlargement. It is the second most significant zoonotic disease, affecting 500,000 humans annually [16] and it presents as an acute illness in the majority of patients [62].

According to the site of infection, brucellosis in humans can cause a wide range of symptoms, including encephalitis, meningitis, spondylitis, arthritis, endocarditis, orchitis and prostatitis. It is also known to cause complications and affect internal organs. Pregnant women with Brucella infection had spontaneous abortions, typically during the first and second trimesters of pregnancy [63]. The most significant economic impact of brucellosis in camels is the financial loss resulting from abortion and perinatal mortality, temporary infertility, the cost of a replacement bull, veterinary expenses and losses in milk and meat [25].

CONCLUSION AND RECOMMENDATIONS

Brucellosis is a disease of high economic and public health importance that has a worldwide distribution. It is also widely spread in the camel producing horns of African countries. Most of the study revealed that Pastoralists are in close contact with their animals and the consumption of raw milk and handling of aborted materials is common making them more exposed to risk of infection.

Therefore, the following recommendations are forwarded;

- In camel rearing pastoralist settings, public knowledge of the condition should be raised. As part of a coordinated health approach, continuous epidemiological surveillance and molecular detection of Brucella infection in camels and people in camel raising regions should be begun.
- In an emergency, cooperation between the animal and human health sectors is essential for identifying the risk of animal-to-human Brucella transmission.
- More research and analysis of the disease should be done, taking into consideration all elements of Brucella sickness, including identifying risk factors that can be used to manage the disease.

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