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A Review on Epidemiology of Bovine Brucellosis and its Public Health Significance in Ethiopia

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Abstract

Brucellosis is economically important zoonotic bacterial disease caused by the genus *Brucella*. Brucellosis occurs worldwide, except for few countries that have been successfully eradicated. The Aborted fetus, fetal membrane and uterine discharges are considered as the major source of infection. The bacteria are preferentially localized mainly in the reproductive tract of pregnant animals and consequently cause late abortion, retained fetal membrane and infertility, whereas *orchitis* and *epididimitis* are seen in males. The overall studies of bovine *brucellosis* in Ethiopia range from 1.1% to 22.6% and 0.05% to 15.2% in intensive and extensive management systems respectively. Brucellosis is mainly transmitted to humans through the consumption of unpasteurized dairy products, occupational case direct contact with infected animal and their discharges. The prevalence of *Bovine brucellosis* depends on the standards of environmental hygiene, animal husbandry practices and species of the causative agent. Brucellosis has been widely reported from cattle in Ethiopia. This requires formulating effective control strategies are needed that includes surveillance to identify infected animals, prevention of transmission to non-infected animals and removal of the reservoir to eliminate the source of infection.

Keywords: Bovine, brucellosis, epidemiology, public health significance

Introduction

Ethiopia has the largest livestock population in Africa with an estimate of 65 million cattle, 40 million sheep, and 51 million goats 8 million Camels 49 million Chickens (CSA, 2020) and 11.1 million equines (CSA, 2017). However, the country has not used this resource effectively owing to various limitations. Animal disease, management problems, poor genetics, and nutritional deficiency are among the foremost impediments to cattle production in the country (Ibrahim *et al.*, 2010). Among the infectious diseases, *Brucella* infection is widely prevalent and causes extensive economic losses, and brucellosis is one of the most serious zoonotic diseases in Ethiopia (Asgedom *et al.*, 2016).

Brucellosis is one of the economically important diseases of livestock caused by members of the genus *Brucella* (OIE, 2020). The disease is characterized by reproductive disorders such as abortion, stillbirth and birth of weak offspring in females and orchitis and epididymitis in male animals causing transient or permanent infertility (Constable *et al.*, 2017).

The genus *Brucella* currently comprises six classical species primarily affecting domestic animals and rodents including *B. melitensis* of small ruminants, *B. abortus* of cattle, *B. suis* of pigs and hares, *B. ovis* of small ruminants, *B. canis* of dogs and *B. neotomae* of desert wood rats; and six novel species identified from marine mammals (*B. penipedialis* and *B. ceti*), red foxes (*B. vulpes*), baboons (*B. papionis*), a human breast implant (*B. inopinata*) and rodents (*B. microti*) (Scholz *et al.*, 2018).

Human *brucellosis* is popularly known as undulant fever, Crimean fever, Mediterranean fever, remitting fever, Maltese fever, goat fever, Gibraltar fever and bovine *brucellosis* is called as contagious abortion or Bang's disease (Hayou *et al.*, 2020). *Brucella* species are among those pathogenic bacteria which have propensity to those pathogenic bacteria which have

propensity to adapt to new host and they can either be naturally transmitted to their primary hosts by direct or indirect contact or sometimes inadvertently to other susceptible hosts (Moreno, 2014). Mixed farming of cows, buffaloes, sheep and goats has increased the risk of brucellosis where small ruminants act as primary hosts for *B. melitensis* and cattle as spillover host (El-Sayed *et al.* 2018).

The direct economic impact of the disease is associated with loss of replacement stock, reduction in milk production and culling of valuable reproductive age animals further constraining herd expansion. In countries like Ethiopia, where the export of live animals is one of the sources of foreign exchange earnings, brucellosis hinders access to lucrative international markets. Where market accesses are permitted, the requirements by importing countries of testing every individual animal at export quarantines and rejection of those testing positive, further adds up to the economic loss (Franc *et al.*, 2018).

Brucellosis is also one of the significant zoonotic diseases affecting 0.83 million individuals worldwide, annually (WHO, 2019). Serological studies conducted so far demonstrated that the disease is endemic across greater areas of the country (Sintayehu *et al.*, 2015). However, no official figures are available both for livestock and human brucellosis. Only the presence, absence or suspected statuses of the disease during the various years between 1996 and 2019 in livestock and humans had been reported to the World Organization for Animal Health (OIE) (OIE, 2020).

No control strategy including vaccination is so far been implemented against brucellosis in any of the livestock species in Ethiopia. Studies conducted to estimate the prevalence of brucellosis in the country were conducted by individual researchers, in research organizations or higher education institutions. But they were fragmented and are limited in space, time and scope; as a result, there is a need for summarizing

such data to make them useful in understanding the disease burden and its distribution at a national level to devise appropriate intervention strategies. Then the objective of this review is to illustrate the potential predictors and the disease's spatial distribution pattern along the bovine and describe the public health impact.

Literature Review

Etiology

Bovine brucellosis is usually caused by *Brucella abortus*, less frequently by *B. melitensis*, and rarely by *B. suis*. However; humans, sheep, goats, and other domestic animals can also be infected by *Brucella abortus*. Cattle are infected with *B. suis* and *B. melitensis* when they graze together with infected pigs, goats, or sheep (Khurana *et al.*, 2021). *Brucella* organism persist in targeted organ of the reservoir host and Persistent (lifelong) infection is a characteristic of its facultative intracellular organism, with shedding in reproductive and mammary secretions (Abera, 2024).

Source of infection

The concentration of the bacteria is highest in pregnant uterus. The aborted fetus, placental membranes or fluids, and other uterine discharges were considered as major source of infection (Oliviera *et al.*, 2020). Infected animals also shed organisms in milk which serve as source of infection for the new born. Contaminated feed can spread the infection from infected pasture over long distance. Survival of the first line of defense by the bacteria results in local infection and the escape from the lymph nodes in to the blood. During bacteremic phase, bones, joints, eyes and brain can be infected, but the bacteria are most frequently isolated from supra-mammary lymph nodes, milk, iliac lymph nodes, spleen and uterus. In bulls, the predilection sites for infection are also the reproductive organs and the associated lymph nodes (Acha and Szyfers, 2001).

Transmission

Brucellosis is typically transmitted to other cattle by direct or indirect interaction with diseased cattle discharges. The spread of brucellosis in cattle occurs through the ingestion of contaminated feed and drinking water contaminated by the bacteria that are present in massive amounts in birth products and discharge (Acha and Szyfres, 2001). Moreover, cattle typically lick their fetuses and newborn calves, which can have very high levels of bacteria and are the major source of infection. (FAO, 2010).

Humans acquire *Brucella* infection via the ingestion of unpasteurized milk or milk products. Interaction of the mucosal abrasions with the fluid or tissues of aborted fetuses of diseased cattle can also be a source of disease in humans (Zenu and Bekele, 2024). Work-related contact with cattle or their products is the major risk, for human brucellosis. Abattoir, farm, and laboratory workers as well as veterinarians, known risk groups for *Brucella* infection (Tulu, 2022).

In the herd animals, the infection can be due to introduction of an infected animal that subsequently gives birth or aborts a fetus, whereupon pasture or water becomes contaminated by these excretions. Transient disease such as abortion can also develop following administration of a live *Brucella* vaccine, particularly the *B abortus* vaccine strain 19. The organisms have been recovered from fetal and manure samples that remained in a cool environment for longer than 2 months. However, exposure to sunlight kills the bacterium within a few hours, and the organism is susceptible to many common disinfectants (Ragan, 2021).

Epidemiology of Brucellosis

Geographical Distribution of Brucellosis

Brucellosis is endemic in many developing countries and is caused by *Brucella* species that affect man, domestic, some wild animals and

marine mammals (Berhanu and Pal, 2020). The majority of human and animal brucellosis is found in sub-Saharan Africa with large pastoral communities has been recorded at herd level, within-herd level and individual animal level. The persistent disease was observed in most countries in the Sahel, with Ethiopia, Chad, Tanzania, Nigeria, Uganda, Kenya, Zimbabwe and Somalia reporting brucellosis in humans attributed to domestic cattle, camels, goats and sheep calculated an estimated seroprevalence of 16.2% with in cattle in sub-Saharan African (Sibhat *et al.*, 2022) . It is more prevalent in developing countries and considered to be a serious health problem due to lack of effective public health measures, domestic animal health programs, and appropriate diagnostic facilities. Furthermore, the situation is also worsened by the resemblance of the disease with other diseases leading to misdiagnosis and under reporting (Aworh *et al.*, 2013). The management systems as well as ecological conditions greatly influence the spread of brucella infection (Soltani *et al.*, 2026).

Risk Factors for Bovine Brucellosis

Bovine brucellosis is a highly contagious bacterial disease primarily affecting adult, female, and pregnant cattle, as the *Brucella* organism thrives on erythritol sugar in fetal tissues. While males show clear symptoms leading to culling, non-pregnant females frequently become symptomless carriers, and large herd sizes or external purchasing further accelerate transmission (Coelho *et al.*, 2015). Environmental factors and farming systems significantly impact the spread of the disease, with dairy and intensive systems facing high risks due to confined spaces and stress. Conversely, extensive systems and arid agro-ecologies drive prevalence through shared contaminated grazing lands and the inhalation of aerosolized dust from infected calving discharges (Medeiros *et al.*, 2021).

Status of Brucellosis in Ethiopia

Bovine brucellosis has been a major livestock disease in Ethiopia since its first detection in the 1970s, heavily impacting a nation where over

85% of the population relies on agriculture (Ibrahim *et al.*, 2010). The disease is widespread but varies greatly by production system, with individual seroprevalence ranging from **1.1% to 22.6%** in intensive management systems, compared to a lower range of **0.05% to 15.2%** in traditional, extensive systems (Megersa *et al.*, 2011). Herd-level seroprevalence is generally high, spanning from **2.9% to 45.9%**, with urban and peri-urban dairy farms in highland agro-ecologies being primary hotspots (Benti and Zewdie, 2014).

Prevalence rates fluctuate drastically across different geographic regions and cattle populations within the country. The highest seroprevalence in the text reached **50%** at Didituyura Ranch using ELISA testing, while central smallholder farms and the East Showa Zone average around **11% to 11.2%** (Kebede *et al.*, 2008), aligning with broader East African trends. Conversely, much lower rates are documented in pastoral and remote regions, such as a **2.91%** seroprevalence in southern Borena cows, **1.4%** in south-eastern pastoral herds, and a minimal **1.0%** confirmed seroprevalence in north-west Benishangul-Gumuz (Sintayehu *et al.*, 2015).

Disease spectrum in humans

Human brucellosis is primarily caused by *B. melitensis* globally. *B. abortus*, *B. suis* and *B. canis* also cause human brucellosis worldwide (Khurana *et al.*, 2021). Sheep, goats and their products are major sources of *B. melitensis* infection in human beings (Das *et al.*, 2021). Main source of transmission of *B. abortus* to human is through consumption of unpasteurized or raw milk or milk products including butter, whey, cheese, yogurt, ice-cream, etc. (Islam *et al.*, 2023).

Public Health and Economic Significance

Brucellosis, particularly *B. melitensis* is thought to be one of the most prevalent re-emerging zoonotic diseases globally with an estimated

incidence of more than 50,000 human cases per year (Khurana *et al.* 2021). The zoonotic

importance of brucellosis as zoonosis is increasing owing to tremendous increase in global trade in animal products, rapid deforestation, unplanned and unsustainable development, urbanization, intensive farming, having migratory/nomadic animal husbandry and increased international tours and travel (Das *et al.*, 2022).

Even the exhaustive and advanced surveillance and control measures have not been able to reduce the prevalence of brucellosis in most of the developing countries due to poor hygiene, lack of sanitation, poverty, lack of proper administration and political will (Pappas *et al.*, 2006). Brucellosis badly affects livestock welfare and economy. The collective economic losses are the cumulative effect of reduction in the production of milk, abortions, losses of newborn calves resulting from abortions and stillbirths, culling of brucellosis affected animals, hindrance in export and trade of animals, loss of human effort in terms of man-days wasted, veterinary and medical expenses, administrative and governmental expenses on research and control programs (Gharekhani *et al.*, 2005).

Conclusions and Recommendations

Bovine Brucellosis is a bacterial zoonotic disease, which has both public health and economic importance. This disease can be transmitted from infected animal to healthy one through fetal discharges, contaminated feed and water, licking of vaginal discharges or secretions or newly born infected calves in animals. In human, brucellosis can be transmitted via consumption of unpasteurized milk and cheese, direct contact with infected animal and handling of specimen that contaminated with *Brucella* species. Brucellosis is a worldwide disease both in developed and developing country even though; this disease is eradicated in developed countries with

vaccination program and screening method of livestock, this disease poses serious problem in developing countries mainly African countries

including Ethiopia. This disease causes abortion, delayed heat, loss of calve, infertility, reduce milk production and meat production and still birth in cattle due to absence of regular screening method and vaccination programs in most developing country mostly in sub Saharan Africa. Since brucellosis is a leading zoonotic bacterial disease that affects human health and economy due to trade ban attention must be given to control or prevent this disease in developing country through routinely screening method, regular vaccination and tackling the mode of transmission of this disease may reduce risk posed. In addition, at regional, national and international level strict regulation should be devised to control or prevent as well as to eradicate this disease. Therefore, I recommend:-

- ❖ Effective control and prevention strategies should be formulated and applied.
- ❖ Public education on the source of infection and transmission of the disease as well as awareness creation should be applied.
- ❖ Implementation of control and prevention measures of brucellosis in animals, to stop human infections.
- ❖ Good hygiene and protective clothing/equipment are very important in preventing occupational exposure.
- ❖ Avoid eating or drinking unpasteurized milk, and milk product

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