

Full Length Research Paper

The economic and public health significance of brucellosis

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Brucellosis is especially caused by brucella melitensis. It remains one of the most common zoonotic diseases that can seriously affect the wellbeing of animals and humans. The disease is caused by diverse *Brucella* species of which *Brucella abortus*, *B. melitensis* and *B. suis* are highly pathogenic for humans. The possible sources of infections include all infected tissues, aborted fetuses, fetal fluids, vaginal discharges, cultures and potentially contaminated materials. The nature aspects of the pathogenesis of the diseases lie on the presence of the bacteria in the cells and employing various methods to survive in the phagocytic cells. The diseases can be transmitted from infected host to susceptible animals in direct and indirect contacts. But the most common mode of transmission is sexual contact. Various methods are employed for the diagnosis of brucellosis including microscopic examination, culture methods, serological and molecular biology. Public health importance of brucellosis is much related to the infected animal species from which human transmission occurs. The economic importance of brucellosis depends up on the species of animal affected. It can cause considerable losses in cattle as a result of abortion and reduction in milk yield. Most literature address control of *B. abortus* infection by vaccinating young female animals. The most rational approach for preventing human brucellosis is the control and elimination of the diseases in animal reservoir and health education of the public working at high risk area.

Keywords: Brucellosis, Economic Importance, Public Health Significance

INTRODUCTION

Both domestic and wild animals are affected by diversity of diseases of different origin. They may also carry disease causing pathogenic agents that can seriously affect the wellbeing of other animals and man. Such infections of economic and public health significance may range from the intracellular viruses to multicellular bacterial and helminthes. Among the

bacterial diseases of economic and public health importance is brucellosis caused by various species of *brucella*¹. Brucellosis is one of infective disease from the group of zoonoses and has characteristics of systemic infection. *Brucella abortus*, *B. melitensis* and *B. suis* are highly pathogenic for humans, and all infected tissues, cultures and potentially contaminated

materials must be handled under appropriate containment conditions. It is the primary infective disease of domestic animals and is transmitted to humans directly or indirectly. The species of *Brucella* and their principal farm animal hosts are *B. abortus* (cattle), *B. melitensis* (goats), *B. suis* (pigs), *B. ovis* (sheep), *B. canis* (dog)². In addition to this, there are also other *Brucella* species known today. Among the above species *B. abortus*, *B. melitensis*, *B. suis*, *B. canis* and *B. ovis* are transmitted from animal to human causing undulant fever in humans³. Brucellosis in animal called Bang's disease, contagious abortion and infectious abortion. In case of human, it is known as Malta fever, Mediterranean fever and undulant fever⁴. Brucellosis occurs worldwide in domestic and game animals⁵. In Ethiopia, the available information on brucellosis clearly showed that the disease is endemic and wide spread with significant economic and public health importance⁶.

Clinically, Brucellosis is characterized by one or more of the following signs: in case of females it could be manifested by abortion, retained placenta, excretion of the organisms in uterine discharges and in milk where as in males it can be marked with orchitis, epididymitis and, rarely, arthritis as well as infertility in both sexes. The World Health Organization (WHO) laboratory biosafety manual classifies *Brucella* in risk group III. Brucellosis is readily transmissible to humans, causing acute febrile illness –undulant fever which may progress to a more chronic form and can also produce serious complications affecting the muscular-skeletal, cardiovascular, and central nervous systems of both animals and humans. Infection occurs mostly by the ingestion of materials which are contaminated with excretion of aborted animal. The infection also transmits through injured or intact skin, the mucosa of respiratory system and the conjunctiva. Susceptibility of animal to brucellosis depends up on natural resistance, level of immunity, age, sex, breed, pregnancy status and environmental stress⁷.

Diagnosis of the disease depends on isolation and identification of *Brucella* from aborted materials, udder secretions or from tissues removed at post-mortem or patient's serum by detection of specific antibodies using appropriate serological methods. Presumptive diagnosis can be made by assessing specific cell-mediated or serological responses to

Brucella antigens. All *Brucellae* are related to lifelong chronic animal infection, since they are found within the cells of their milk glands and reproductive system. This is the way they can cause abortion or sterility in these animals⁸. *Brucella* can also be isolated from bone marrow, liver, spleen, or abscess^{4, 9, 10}. When brucellosis diagnosed in domestic animal herd, segregation of the herd is mandatory. Sometimes the herd is slaughtered and incinerated. Brucellosis treatment is mostly not effective because of the intracellular nature of an agent and disease recurrences can occur 3 to 6 months after an early therapy discontinuation¹⁰. Therefore, the objective of this paper is to provide an outline on the economic and public health significance of brucellosis.

General Account of the Disease

Etiology

Brucellosis is an important zoonotic disease caused by infection with bacteria of the Genus *Brucella*. It was first isolated by Bruce in 1887 from the spleens of soldiers dying of Mediterranean fever on the island of Malta. Bruce called it *Micrococcus melitensis*. The origin of the disease remained a mystery for nearly 20 years until it was discovered that goats were the source of infection for human populations⁵. Nine *Brucella* species are currently recognized. Seven of them that affect the terrestrial are, *B. abortus*, *B. melitensis*, *B. suis*, *B. ovis*, *B. canis*, *B. neotomae*, and *B. microti*³, and two that affect marine animals are, *B. ceti* and *B. pinnipedialis*¹¹. The first three species are called classical *Brucella* and within these species, seven biovars are recognized for *B. abortus*, three for *B. melitensis* and five for *B. suis*. The remaining species have not been differentiated into biovars¹².

Morphology and staining

The organism responsible for brucellosis is small gram negative, coccobacillus, non spore forming and non motile facultative intracellular organism. It has an external envelope demonstrated by electron microscope. The morphology of *Brucella* is fairly constant except in old cultures, where pleomorphic

Table1: Characteristics of Brucella species

Species	Co ₂ requirement for growth	Time to positive H ₂ S production	Urease
<i>B. abortus</i>	+/-	2 hr (rare 24 hr)	+
<i>B. melitensis</i>	-	2 hr	+
<i>B. suis</i>	-	15 min	+/-
<i>B. ovis</i>	+	≥ 7 days	-
<i>B. ineotomae</i>	-	15 min	+
<i>B. canis</i>	-	15 min	-

Source (Quinn *et al.*, 1994).

forms may be evident. Brucella is partially acid fast in that it is not decolorized by 0.5% acetic acid in modified Zeihl Neelson stain and thus appears pink in blue background^{13, 14}.

Collection and culture of samples: For the diagnosis of brucellosis by cultural examination, the choice of samples usually depends on the clinical signs observed. The most valuable samples include aborted fetuses (stomach contents, spleen and lung), fetal membranes, vaginal secretions (swabs), milk, semen and arthritis or hygrometry fluids. From animal carcasses, the preferred tissues for culture are those of the reticulo-endothelial system (i.e. head, mammary and genital lymph nodes and spleen), the late pregnant or early post-parturient uterus, and the udder. Growth normally appears after 3–4 days, but cultures should not be discarded as negative until 8–10 days have elapsed¹⁵.

Culture and growth characteristics: Brucella members are aerobic, but some strains require an atmosphere containing 5-10% carbon dioxide (Co₂) added for growth, especially on primary isolation. The optimum pH for growth varies from 6.6 to 7.4 and culture media should be adequately buffered near PH of 6.8 for optimum growth. The optimum growth temperature is 36-38°C, but most strains can grow between 20°C and 40°C. When viewed from above, colonies appear convex and pearly white. Later, colonies become larger and slightly darker¹⁶.

Biochemistry: The metabolism of *Brucella* is oxidative and *Brucella* cultures show no ability to acidify carbohydrate media in conventional tests. The *Brucella* species are catalase positive and usually oxidase positive, and they reduce nitrate to nitrite (except *B. ovis* and some *B. canis strains*). The production of H₂S from sulphur containing amino-acids also varies. *B. melitensis* does not produce H₂S.

Urease activity varies from fast to very slow. Indole is not produced from tryptophane and acetylmethylcarbinol is not produced from glucose (table 1 above)¹⁶.

Resistance

Organisms are fairly resistant to some environmental conditions, example *B. abortus* will survive for four and half hour when exposed to direct sun light; four days in urine; five days at room temperature and 75 days in aborted fetus during cool weather at low concentration in liquid media. Brucella is fairly heat sensitive. Thus diluted suspensions are readily inactivated by pasteurization. Brucella does not survive longer in ripened fermented cheese. In contrast to dairy product, the survival time of Brucella in meat is extremely short, except in frozen carcasses where the organism can survive for many years. The organism rarely survives in sour milk and sour cream and butter or fermented cheese (age over 3 months)¹⁷.

Epidemiology

The epidemiology of brucellosis is complex. The important factors that could contribute to the occurrence and spread in livestock include, farming system and practice, farm sanitation, live stock movement, sharing of grazing lands and moderate changes towards identification¹⁸.

Global Perspective: Brucellosis occurs worldwide in domestic and game animals⁵. Bovine brucellosis has been eradicated from most industrialized countries such as in Finland, Norway, Sweden, Denmark, Germany, Australia, and Netherland¹⁷. In other part of

Table 2: Summary on prevalence of brucellosis in Ethiopia by using RBPT and CFT

Locations	Breed	n*	Prevalence (%)	Sources
Tigray	Cross	816	3.19	³⁵ Gebretsadik (2005)
Bahir Dar	cross	1135	0.26	³⁰ Mussie (2005)
Sidama zone	Cross	811	2.5	³¹ Kassahun (2004)
	Local	1627	1.7	³² Tadele (2004)
Jimma zone	Cross	805	0.8	
	NWE	Local	1305	0.2
Cross		4243	22	

n*=Total number of animal tested

the world the rates of brucellosis caused by *B. abortus* vary greatly from one country to another and between regions within a country. The highest prevalence is noticed in dairy cattle. Even in highly developed countries like USA and France have so far not been able to eradicate brucellosis completely. Brucellosis caused by *B. melitensis* occurs in sheep and goat raising regions of the world with exception of North America, Australia and New Zealand. *B. suis* infection also occurs worldwide^{12, 14}. Brucellosis is an important livestock disease in many African countries¹⁴. The incidence of infection up to 80% can be found in intensive dairy production systems of the tropics. The extensive animal production systems of the Sahel, an average diseases incidence of 25 -30% has been calculated. In eastern Sudan an infection rate in cattle of almost 22% and in sheep about 13.6% was found⁵.

Status of Brucellosis in Ethiopia

Studies on the prevalence of brucellosis have been carried out in many parts of Ethiopia by different persons. These studies were conducted in local and cross breed animals. In these studies prevalence of brucellosis in cattle ranging from 0.2-22% were recorded (Table 2).

Source of Infection and Transmission in Animals

Susceptibility to infection depends on age, breed and pregnancy status. Younger animals are relatively resistant. Sexually mature animals are much more susceptible to infection, regardless of gender¹⁹. The main sources of infection for cattle are fetuses, fetal fluids, and vaginal discharges. Transmission through gastro intestinal tract is also common following ingestion of contaminated pasture, feed, fodder or water. Moreover, cows customarily lick fetuses, and new born calves; all of which may contain a large number of organisms and constitute a very important source of infection. Bull is also important source of infection and transmits the infection during artificial insemination, if the bull already infected with the organism. The source of infection for swine is the same as to cattle. The most common mode of transmission is sexual contact. Sheep and goat are infected with *B. melitensis* in a manner similar to cattle. Kids become infected during the suckling period. Such infection may persist in some animals. Infection with *B. ovis* is not common in ewes because, it does not persist very long in ewes¹⁷ (figure 1).

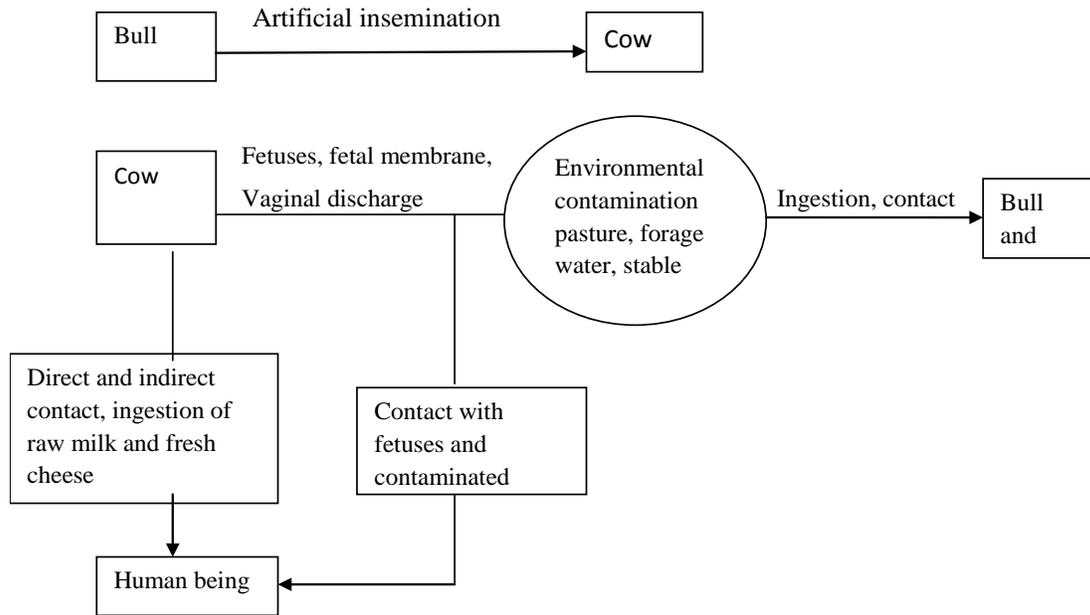


Figure 1: Mode of transmission of bovine brucellosis (*B. abortus*)

Source: Acha and Szyfres (2001).

Risk Factors

Animal risk factors: Susceptibility of cattle to *B. abortus* infection is influenced by the age, sex and reproductive status of the individual animal. Sexually mature pregnant cattle are more susceptible to infection with the organism than sexually immature cattle of either sex. Susceptibility increases as stage of gestation increase².

Pathogen risk factor: *B. abortus* is a facultative intracellular organism capable of multiplication and survival within the host phagosome. The organisms are phagocytised by polymorphonuclear leucocytes in which some survive and multiply. The organism is able to survive within macrophages because; it has the ability to survive phagolysosome. The bacterium possesses an unconventional non-endotoxin lipopolysaccharide, which confers resistance to antimicrobial attacks and modulates the host immune response. These properties make lipopolysaccharide an important virulence factor for *Brucella* survival and replication in the host².

Occupational risk factors: Laboratory workers handling *Brucella* cultures are at high risk of acquiring brucellosis through accidents, aerosolization and/or inadequate laboratory procedures. In addition to this, abattoir workers, farmers and veterinarians are at high risk of acquiring the infection^{20,2}.

Managemental risk factors: The spread of the disease from one herd to the other and from one area to another is almost always due to the movement of an infected animal from infected herd in to a non infected susceptible herd. A case-control study of brucellosis in Canada indicates that, herds located close to other infected herds and those herds whose owners made frequent purchase of cattle had an increase risk of acquiring brucellosis. Once infected, the time required to become free of brucellosis was increased by large herd size, active abortion and by loss housing².

Pathogenesis

B. abortus has predilection in the pregnant uterus, udder, testicle and accessory male sex glands, lymph

nodes, joint capsule and bursa. After initial invasion of the body, localization occurs initially in the lymph nodes. *B. abortus* is phagocytized by macrophages and neutrophils in an effort by the host to eliminate the organism. However, once inside phagocyte, *B. abortus* is able to survive and replicate. The phagocyte migrates via the lymphatic system to the draining lymph node where Brucella infection causes cell lysis and eventual lymph node hemorrhage 2-3 weeks following exposure. Because of vascular injury some of the bacteria enter the blood streams and subsequent bacteremia occurs, which disseminates the pathogen throughout the body. If the infected animals are pregnant, *B. abortus* will colonize and replicate in high number in the chorionic trophoblasts of the developing fetus. The resulting tissue necrosis of the fetal membrane follows transmission of bacteria to the fetus. The net effect of chorionic and fetal colonization is abortion during the last trimester of pregnancy². Sexually immature and other non pregnant cattle can become infected but lose their hormonal antibody to the organism much more quickly than cattle infected while pregnant. In the adult non pregnant cow, localization occurs in udder and uterus, if it becomes gravid, is infected bacteremic phases originated in the udder. Infected udders are clinically normal but they are important as a source of infection for calves and humans drinking the milk. Erythritol that produced by the fetus stimulates the growth of *B. abortus* and stimulates localization of infection in the placenta and fetal fluids. Invasion of the gravid uterus results severe ulcerative endometritis. In acute infection of pregnant cows, up to 85% of the bacteria are in cotyledons, placental membranes and allantoic fluid. In fetus, naturally and experimentally infected with *B. abortus*, the tissue changes include lymphoid hyperplasia in multiple lymph nodes, lymphoid depletion in thymic cortex, adrenal cortical hyperplasia and disseminated inflammatory foci composed mainly of large mononuclear leukocytes. In cattle abortion occurs principally in the last three months of pregnancy, while in dogs occur around 50 days of gestation. Abortion in swine can occur at any time in gestation².

Diagnosis: Diagnosis of brucellosis is the corner stone of any control and eradication programmes of the disease. Especially in humans due to its heterogeneous and poorly specific clinical symptoms, the diagnosis of brucellosis always requires laboratory

conformation. It is made possible by direct demonstration of the causal organism using staining, immunofluorescent antibody, culture, and directly demonstration of antibodies using serological techniques^{14,13}.

Clinical sign in animals: In highly susceptible non vaccinated pregnant cow, abortion occurs after the 5th months of pregnancy; in bull, orchitis and epididymitis are cardinal signs. In case of horse, it is usually associated *B. abortus* with chronic bursal enlargement of the neck and withers, and abortion in mares. Brucellosis in swine has acute symptoms like abortion, infertility and birth of weak piglets, orchitis, epididymitis and arthritis. Sheep and goats have similar to that observed in other species of animals. Abortion in goats occurs most frequently in the third or fourth months of pregnancy. In case of dog and cats, infertility either in male or female, abortion and still birth or weak puppies are common manifestations².

Microscopic examination and culture methods: Specimen of fetal stomach, lung, liver, placenta, cotyledon and vaginal discharges are stained with Gram stain and modified Ziehl Neelsen stains. Brucella appears as small red-colored, coccobacilli in clumps. Blood or bone marrow samples can be taken cultured in 5-10% blood agar is used. To check up bacterial and fungal contamination; Brucella selective media are often used. The selective media are nutritive media, blood agar based with 5% seronegative equine or bovine serum. On primary isolation it usually requires the addition of 5-10% carbon dioxide and takes 3-5 days incubation at 37°C for visible colonies to appear¹³.

Animal inoculation: Guinea pigs are the most sensitive laboratory animals. Two guinea pigs are intramuscularly inoculated 0.5-1ml of suspected tissue homogenate and sacrificed at three and six weeks post inoculation and serum is taken along with spleen and other abnormal tissue for serology and bacteriological examination, respectively¹³.

Serological diagnosis: Body fluid such as serum, uterine discharge, vaginal mucus, and milk or semen plasma from suspected cattle may contain different quantities of antibodies of the IgM, IgG1, IgG2 and IgA types directed against Brucella²¹.

Milk ring test: It is cheap, easy, simple and quick to perform. It detects lacteal anti-Brucella IgM and fat

60. Glob. Res. J. Publ. Health. Epidemiol.

Globules from milk and form red ring in positive case. However, it tests false positive when milk that contains colostrums, milk at the end of the lactation period, milk from cows suffering from abnormal disorder or mastitis. Milk that contain low concentration of lacteal IgM, IgA or lack the fat clustering factors, tests false negative. Because lacteal antibodies rapidly decline after abortion or parturition, the reliability of MRT using 1ml milk to detect Brucella antibodies in individual cattle or intact milk is strongly reduced²². Although the MRT performed with 8ml milk, it improved the detection of brucellosis in tank milk. It may test false positive when races of colostrums are present in tank milk²¹.

Rose Bengal Plate Test (RBPT): It is a spot agglutination technique. It does need special laboratory facilities and is simple and easy to perform. It used to screen sera for Brucella antibodies. The test detects specific antibodies of the IgM and IgG type. Although the low PH (3.6) of the antigen enhances the specificity of the test and temperature of the antigen and the ambient temperature at which the reaction takes place may influence the sensitivity and specificity of the RBPT test^{1, 23}. Complement fixation test (CFT): This test detects specific antibodies of the IgM and IgG1 type that fixe complement. The CFT is highly specific but it requires highly trained personnel as well as suitable laboratory facilities. It measures more antibodies of the IgG1 type than antibodies of the IgM type²¹.

ELISA tests: The ELISA tests offer excellent sensitivity and specificity whilst being robust, fairly simple to perform with a minimum of equipment and readily available from a number of commercial sources in kit form. They are more suitable than the CFT for use in smaller laboratories and ELISA technology is now used for diagnosis of a wide range of animal and human diseases. Although in principle ELISAs can be used for the tests of serum from all species of animal and man, results may vary between laboratories depending on the exact methodology used. Not all standardization issues have yet been fully addressed. For screening, the test is generally carried out at a single dilution. It should be noted, however, that although the ELISAs are more sensitive than the RBPT, sometimes they do not detect infected animals which are RBPT positive. It is also important to note that ELISAs are only marginally more specific than RBPT or CFT (WHO, 1997). There are also other

serological diagnostic tests that use for diagnosis of brucellosis such as SAT, PCR, and so on²¹.

Public Health Significance of Brucellosis

Five out of nine known Brucella species can infect humans. The most pathogenic and invasivespecies for human are, *B. melitensis*, *B. abortus*, and *B. canis*. The zoonotic nature of marineBrucella (*B. ceti*) has been documented. Human brucellosis caused by *B. melitensis* is the most sever one followed by *B. suis*, *B. abortus* and *B. canis* in decreasing order. They are listed as potential bio-weapons by the contents for disease control and prevention program in USA. This is due to the highly infectious nature of three species, as they can be aerosolized. Moreover an outbreak of brucellosis would be difficult to detect because the initial symptoms are easily confused with those of influenza²⁴.

Occurrence in Humans: Each year half a million case of brucellosis occurs in humans around the world. The prevalence of infection in animal reservoir provides a key of its occurrence in humans (Scholz *et al.*, 2008). *B. abortus* and *B. suis* infection usually affect occupational groups. *B. melitensis* infection occurs more frequently than others types in the general population. In the Latin American countries, the greatest number of record are Argentina, Mexico, and Peru. The same pattern holds true to the Mediterranean countries, Iran, the former Soviet Union and Mongolia⁸. (Table 3 below)

Locations	Total tasted	Number of positives	References
Baher Dar	238	9	³⁰ Mussie (2005)
Sidama	38	2	³¹ Kassahun (2004)
Jimma	126	3	³² Tadele (2004)
North western Ethiopia	49	12	³³ Gebreyesus(2001)
Abernosa	8	1	³⁴ Taye (1999)

Source of Infection and Transmission in Humans

Humans are infected by eating or drinking something that is contaminated with Brucella, breathing organisms (in halation or wind infection). The relative

importance of etiological agent, mode of transmission and path way of penetration varies with the epidemiological area, animal reservoirs and occupational groups at risk. Conception of sheep and goat milk contain *B. melitensis* is an important source of human brucellosis worldwide and has caused several out breaks. For example, in some countries including Italy 99% of human brucellosis is caused by *B. melitensis*. In countries where milk and dairy products are always pasteurized, brucellosis principally affects persons who are close contact with animals and animal products²⁵. Direct person to person spread of brucellosis is extremely rare. Mothers who are breast feeding may transmit the infection to their infants and sexual transmission has been recorded¹⁷.

Symptoms of Human Brucellosis: The most common symptoms of brucellosis include undulant fever in which the temperature can vary from 37.8⁰c in the morning to 40⁰c in the afternoon; night sweats with peculiar odder and weakness. Common symptoms also include insomnia, anorexia, headache, constipation, sexual impotence, nervousness, encephalitis, spondilitis, arthritis, endocarditis, orchitis and depression. Spontaneous abortion mostly in the first and second trimesters of pregnancy, are seen in pregnant women infected with Brucella. Lack of appropriate therapy during the acute phases may result in localization of Brucella in various tissues and organs and lead to sub acute or chronic disease which is very hard to treat²⁶.

Economic Significance of Brucellosis

Brucellosis occurring worldwide in domestic and game animals as well as humans creates a serious economic problem for the intensive and extensive livestock production systems²⁷. Losses in animal production due to this disease can be of major importance primarily because of 20% decreased milk production in aborting cows. The common sequel of infertility increases the period between lactations. The average inter calving period of an infected herd prolonged by several months. In addition, it results in loss of calves and interference with the breeding program. This is of the greatest importance in beef herds, where the calves represent the sole source of income. A high incidence of permanent infertility

results in heavy culling of valuable cows and some deaths occur as a result of acute metritis following retention of the placenta².

The economic losses due to bovine brucellosis include: losses of calves due to abortion, reduced milk yield, culling and condemnation of valuable cows because of breeding failure, endangering animal export trading of a nation, loss of man power, medical costs and government cost for research and eradication programs²⁸. Available information indicates that brucellosis is one of the most serious diseases of cattle in Latin America and other developing areas. Official estimates put annual losses from bovine brucellosis in Latin America at approximately US\$ 600 million⁸. Brucellosis in sheep caused by *B. ovis* has been reported in Australia, Newzealand the United state, South Africa and Europe. The incidence has been very high in some areas, and there was much economic loss at one time. In California, 30-40% of rams were thought to be affected and annual loss of US \$ 2million was estimated. *B. suis* is a chronic disease of swine manifested by sterility and abortion in sows, heavy piglet mortality and orchitis in boars. The disease owes its economic importance to the fertility and reduction in numbers of pigs weaned per litter that occur in infected herds².

Prevention and Control

In animals: Prevention and control of brucellosis can be adopted realistically through understanding of local and regional variations in animal husbandry practices, social customs, infrastructures and epidemiological patterns of the disease. The common approaches used to control brucellosis include, quarantine of imported stock, hygienic disposal of aborted fetuses, fetal membrane and discharges with subsequent disinfection of contaminated area. Animals which are in advanced pregnancy should be kept in isolation until parturition²⁷. Moreover replacement stock should be purchased from herd free of brucellosis, and decide for or against immunization of negative animals. Eradication by test and slaughter of positive reactors is also possible¹⁴.

Immunization: vaccines like *B. abortus* strain 19 (S19), which is a live vaccine and is normally given to female calves aged between three and six months as

62. Glob. Res. J. Publ. Health. Epidemiol.

a single subcutaneous dose of $5-8 \times 10^{10}$ viable organisms. A reduced dose from 3×10^8 to 3×10^9 organisms can be administered subcutaneously to adult cattle. Alternatively, it can be administered to cattle of any age as two doses of $5-10^9$ viable organisms, given by the conjunctival route. This reduces the risk of abortion and excretion in milk²⁹. The protection on a herd basis is much greater due to reduction of clinical symptoms and increased herd resistance⁵. There are also Brucella strain 45/20 (Dyphavac) and strain RB51 vaccines²⁹.

Chemotherapy: it is mostly not successful because of intracellular sequestration of the organisms in the lymph nodes, mammary glands and reproductive organs. If it is necessary the treatments often given are, sulphadiazine, streptomycin, chlortetracycline and chloramphenicol^{19,2}.

In human: The most rational approach for preventing human brucellosis is control and eradication of the infection in animal reservoirs. In addition there is a need to educate the farmers to take care in handling and disposing of aborted fetus, fetal membrane and discharges as well as not to drink unpasteurized milk and abattoir workers in transmission of infection especially via skin abrasion¹⁷. The drug recommended is rifampicin at dosage of 600 -900 mg daily combined with doxycycline at 200 mg daily. Both drugs are given in the morning as a single dose and relapse is unusual after a course of treatment continued for at least 5 weeks¹.

CONCLUSION AND RECOMMENDATIONS

Brucellosis is worldwide and has high prevalence in many African countries. Brucellosis affected both animals and humans, has a very high economic and public health impact. Its impact on Public health is very well related to the infected animal species from which human transmission occurs. The disease transmits from infected animals to human beings through several routes. It is special hazard to occupational groups. It causes considerable losses in cattle as a result of abortion and reduction in milk yield. Even though the disease is prevalent in Ethiopia, few reports in human are available. This may be due to absence of appropriate diagnostic facilities.

Based on the above concluding remarks, the following recommendations are forwarded:

1. To reduce the economic losses and public health impact of the disease, control and eradication of brucellosis in animals should be designed at the national level.
 2. To convince the decision makers, prevalence, distribution, economic and public health impact of the disease should be well studied and documented.
 3. Reference laboratories have to be established at national level.
 4. Public education on the transmission and source of infection of the disease need to be undertaken.
 5. The necessary precautions should be taken to reduce occupational risks.
- Pasteurization of milk should be widely practiced to prevent human infections.

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