ANIMAL HEALTH DISEASE CARDS

Brucellosis Ovine / Caprine

Names

Pathogen(s)

Preferred Name : Brucella melitensis

Disease/Parasitosis

Preferred Name : Brucellosis, ovine/caprine

Common Names (English):

Malta fever (man)
Contagious abortion

Overview

Before Brucella melitensis was recognized as the cause of Malta fever in man, a disease causing the same symptoms in countries bordering the Mediterranean was known as Fibris andulans. David Bruce, a British military medical officer stationed in Malta described the aetiology of the disease in man in 1884. The bacteriologist Zammit Themistocles, a member of the Mediterranean Fever Commission, isolated B. melitensis in 1897 from the milk of goats that had aborted. Zammit also discovered that drinking milk from these goats was the reason for outbreaks of Malta fever amongst British soldiers stationed in Malta. It soon became apparent that the disease is prevalent in Russia, the Balkans, Asia, Africa and other European countries, and that the organism also infects sheep.

Brucella melitensis primarily affects the reproductive tract of sheep and goats, and B. melitensis infection is characterized by abortion, retained placenta and, to a lesser extent, impaired fertility. Although B. melitensis infects mainly sheep and goats it is a zoonose that plays a significant role in the national economy and the public health of many developing countries.

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Animals Affected Table

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Animals Affected

Brucellae have definite host preferences. Secondary hosts play only a very small part if any in the maintenance or spread of a particular Brucella species. Brucella melitensis mainly infects sheep and goats, and in areas where B. melitensis is enzootic it is the major cause of abortion in those animals and very often also in cattle (Luchsinger and Anderson, 1967; Zowghi and Edadi, 1985; Zowghi and Edadi, 1988).

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Epidemiology

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- Medline

Brucellosis in sheep and goats is usually caused by B. melitensis. Infection with B. abortus is rare. The source of infection is an aborting animal. As in cattle, the surroundings where lambs are born to infected ewes or where abortion takes place become greatly contaminated. Animals may contract brucellosis by oral or cutaneous routes, or at birth. Infection by inhalation is also possible when healthy and aborting animals are kept in overcrowded pens with poor sanitary measures. Transmission of B. melitensis from flock to flock usually follows the movement of infected pregnant females. However it can also occur via an infected male. Wild animals and dogs may transmit parts of aborted foetuses to other areas (Alton, 1985; Mikolon et al., 1998a).

The incubation period after infection varies from 15 days to several months depending on the invasion site and the infecting dose. Therefore, it takes some time for signs of infection to occur. In naturally infected sheep the only symptom noted is abortion. In infected goats abortion and sometimes also mastitis can be observed. Infected goats that do not abort give less milk than uninfected goats. Abortion usually occurs at 3-4 months into pregnancy, and in a susceptible flock it may reach epidemic proportions. Goats that have aborted once are not likely to abort a second time. Sheep may abort a second time, as they can recover from the first infection. Both sheep and goats may shed Brucella with any subsequent parturition. Retention of the placenta may or may not occur. It is also possible that infected pregnant goats that have been born into an infected flock may give birth at the normal time (Stableforth and Galloway, 1959). Therefore, brucellosis in chronically infected flocks often becomes evident only through infected people who have been in contact with infected animals or consumed their milk or cheese.

Both sheep and goats may show signs of lameness, hygroma, and cough but the predilection sites of B. melitensis are the uterus, udder and the mammary lymph nodes in females and the testicles in males. Strangely enough, interference with fertility caused by orchitis seems to be limited. Infected sheep and goats may excrete Brucella in the milk for years but sheep may also cease excretion during one or more lactation periods (Alton, 1985; Stableforth and Galloway, 1959).

Resistance to infection

Resistance to infection resembles B. abortus infection in cattle. Age, sex and natural resistance to Brucella may influence the progression of infection. Sexually immature animals may show some resistant to infection whereas sexually mature animals are susceptible to infection, which in pregnant animals may result in abortion. Males are less susceptible to infection than females. There is very little difference between goat breeds in their susceptibility to the B.melitensis, whereas breeds of sheep differ in their susceptibility. Milking breeds of sheep seem to be more susceptible to B. melitensis infection than sheep kept for meat production (Alton, 1985).

Survival of Brucella in the environment

Temperature, humidity and pH of the environment influence the survival of B. melitensis as well as that of B. abortus. Brucellae are sensitive to direct sunlight, disinfectant and pasteurization. In dry conditions they survive only if embedded in protein. In optimal conditions Brucellae survive in tap water, damp soil, urine, aborted foetuses, uterine exudate and in frozen tissues (Davies and Casey, 1973: Wray 1975).

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Distribution Table

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Distribution

Most Mediterranean countries have large numbers of flocks of sheep and goats infected with B. melitensis (Yantzis, 1984). Brucella melitensis is also prevalent in developing countries of South-West Asia, parts of Latin America and Africa where it constitutes a serious human health hazard.

In countries with organized brucellosis control some areas may be free from B. melitensis while other areas are still infected. This is because the geographic context and the methods of farming influence the spread of the infection. In mountainous areas grouping of flocks in valleys is common, as in the villages. This allows maintenance of brucellosis that may become enzootic. However, mountainous areas may also isolate infected from non-infected flocks and sporadic outbreaks of brucellosis may not spread to other areas. The data given in the geographic

distribution table dates back 10-15 years and may reflect a situation resulting from geographical conditions. Most of the data is based on sero-epidemiological studies although it is generally accepted that only the isolation of Brucella confirms the presence of brucellosis. Therefore, the data must be looked upon as an indication for the presence of B. melitensis in an area or a country and not to what extend the area is infected.

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Economic Importance and Impact

There is no doubt that outbreaks of B. melitensis infection cause significant economic losses. Although the financial loss expressed in any currency may vary from one country to another, a few denominators are the same everywhere. The farmer suffers loss of income due to abortion, the consequent loss of milk production and a prolonged fattening time of lambs (meat production) due to birth of premature animals and low fertility rates. Human brucellosis causes physical and psychological suffering due to infection, hospitalization, the cost of drugs and the loss of work or income due to illness. The country incurs costs generated by prophylactic activities taken to control brucellosis, i.e. vaccination by the veterinarians and their assistants, vaccine costs and compensation paid to the farmers for sanitary slaughter of infected animals. Consequently, control and eradication of B. melitensis eventually pays off.

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Disease Systems

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Disease Course

The course of the disease is usually shorter in sheep than it is in cattle and goats. Sheep and goats are usually infected via the naso-pharynx route or subcutaneously. Invading Brucella usually localize the lymph nodes draining the invasion site, resulting in hyperplasia of the lymphoid and reticuloendothelial tissue and the infiltration of inflammatory cells. In susceptible animals Brucellae multiply in macrophages and eventually escape into the blood stream. Depending on the infection dose, abortion, mastitis, pyrexia, toxaemia or sudden death can occur in goats at the acute stage of the infection while sheep usually only abort (Enright 1990).

Pathologically B. melitensis infection in sheep and goats is very similar to B. abortus in cattle (FAO/WHO, 1986). Almost all organs can be infected including the brain, lungs, bones and muscles. In pregnant animals the bacteria will invade the uterus, multiplying in the placenta and the foetus. This usually leads to abortion or to the birth of infected lambs or kids and shedding of Brucellae into the environment. Excretion of Brucellae in uterine and vaginal discharges as well as in milk and urine is greatest in the first few days after abortion. Excretion in vaginal fluid and urine may last 4-6 months. Sheep may excrete Brucellae in milk for 1-3 weeks after abortion but in some cases it may also continue for up to 6 months. Goats may excrete Brucellae into the milk for a year or longer. In non-pregnant female animals chronic infection of the reticuloendothelial system results in latent carriers of B. melitensis, and causes orchitis in males (Stableforth and Galloway, 1959; Alton, 1985; Enright 1990).

Symptoms Table

See Table

Diagnosis

Bacteriological examination of aborted material is time consuming, laborious, costly, and cannot routinely be used as a diagnostic procedure in developed or developing countries. Nevertheless, B. melitensis can be isolated from the lungs, liver, kidney, stomach contents abomasum and brain of aborted animals (Ribeiro et al., 1990). The Counterimmuno-electrophoresis method, which detects Brucella antigens in suspect aborted material (Mahajan and Kulshreshtha, 1986) cannot be used everywhere, as it requires specialized laboratory equipment.

As abortion is the only symptom that indicates B. melitensis infection, serological tests are used to confirm brucellosis in suspect animals. Some countries have eradicated brucellosis from small ruminants with the aid of serological tests and the slaughter

of positively reacting animals. However, many other countries are still trying to control brucellosis.

Control or eradication of brucellosis would not be a problem if an easy, rapid, sensitive and highly specific serological test existed. However, because each serological test has its advantages and disadvantages, no single test, or even a combination of tests, conclusively detects all infected animals in a flock. The commonly used tests are the Rose Bengal plate test (RBPT), serum agglutination test (SAT), complement fixation test (CFT), Coombs test, enzyme-linked immunosorbent assay (ELISA), Rivanol test, skin delayed-type hypersensitivity (SDTH) test and the Milk ring test (MRT).

The use of the RBPT which is easy to perform and is considered a valuable screening test (Farina, 1985) is less effective than the CFT at detecting brucellosis in individual sheep and goats (FAO/WHO, 1986). Furthermore, its efficacy is influenced by the cell concentration and the standardization procedure of the antigen (Hosie et al., 1985; Blasco et al., 1994a). The less frequently used Rivanol test has a specificity and sensitivity that equals that of the SAT and RBPT (Coker et al., 1990).

The SAT is relatively easy to perform and adequately detects acute infection. However, it may fail to agglutinate with Brucella antibodies present in sheep or goats sera and may give reactions with marked prozone-phenomenon (Renoux, et al., 1956; Goguer, 1965; Le Pennec, 1967). The Coombs test is highly sensitive and detects both IgG1 and IgG2 antibodies. Therefore, it is suggested to use the Coombs test when suspected animals test negative with the SAT or, when SAT and CFT give ambivalent serological test results (Farina, 1985; Acharya and Panda, 1985).

The CFT is considered to be the most effective test for diagnozing brucellosis in small ruminants (FAO/WHO, 1986) but has no particular advantage over the SAT performed in a hypertonic environment of 5-20% NaCl (Levchenco and Drozhzhin, 1958). Furthermore, sera from small ruminants may show anti-complementary activity in the CFT. Although the anti-complementary activity can be eliminated when the sera are inactivated for 55 minutes at 60¯ C (Bercovich, unpublished data) the test remains tedious to perform. Moreover, acutely or chronically infected animals as well as latent carriers may elude detection with the CFT (Karmann and Schloz, 1956; Farina, 1985; Blasco et al., 1994b). However, numerous studies demonstrate its specificity and its value for the detection of brucellosis, especially when used in combination with the SDTH test (Ebadi and Zowghi, 1983; Ebadi, 1984; Loquerie and Durand, 1984).

Since neither a single serological test nor a combined use of several serological tests detects all infected animals in a flock, detection of brucellosis remains a major problem in areas of low prevalence of brucellosis. Therefore, studies were conducted to choose a reliable diagnostic procedure by comparing serological tests with various ELISA procedures with or without the SDTH test. Most studies agree that the ELISA is as specific as the CFT but it is more sensitive. Yet, for a reliable diagnosis of infected animals studies suggest using the ELISA in combination with other tests (Bercovich et al., 1998; Jacques et al., 1998; Mikolon et al., 1998b). Other studies consider the ELISA suitable for screening flocks of sheep and goats for brucellosis (Biancifiori et al., 1996; Sting and Ortmann, 2000). Nevertheless, small ruminants should be tested with the ELISA, CFT and SDTH tests to prevent the spread of brucellosis after an outbreak of the disease in an area with low prevalence of brucellosis or in an area free from brucellosis (Bercovich et al., 1998).

The milk ring test that is widely used to detect brucellosis in dairy cattle is not sensitive enough to detect brucellosis in sheep (Shimi and Tabatabai, 1981). However, because the test is simple and easy to perform it might be useful to detect Brucella antibodies in milk from dairy sheep and goats kept for cheese production. The MRT using 8-ml milk (Bercovich and Lagendijk, 1978) or the MRT performed on three parts sheep milk supplemented with one part pooled cowäs milk, which tests negative for Brucella with the MRT, strongly increases the sensitivity of the test (Bercovich, unpublished data).

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Disease Treatment Table

No data

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Disease Prevention and Control

Effective control of brucellosis largely depends on the co-operation of the flock owner. Treatment of infected sheep and goats with antibiotics is not done because the antibiotics may appear in the human food chain and this would be disastrous for the cheese production industry. Instead, efforts are directed towards controlling and eradicating brucellosis from small ruminants. Serological testing and slaughter of the animals that react positively with Brucella antigens successfully eradicated brucellosis in several countries. This procedure, however, is not easy to apply in developing countries where usually animals are not tagged. In areas with endemic brucellosis only vaccination against B. melitensis may reduce the number of infected flocks and eventually permit brucellosis control. Currently two vaccines are in use: the H38 and Rev 1. The H38 vaccine is composed of killed, smooth, virulent cells of B. melitensis in adjuvant. The vaccine gives good protection and can be administered to pregnant or lactating animals. However, because it stimulates a long lasting immune response (that interferes with the serological diagnosis of brucellosis) and it induces a marked skin reaction on the injection site of the vaccine it is not used very often (Alton, 1985; Plommet, 1991). The Rev 1 vaccine is composed of living attenuated cells of B. melitensis and is used in most countries that vaccinate small ruminants against B. melitensis. Although vaccination with 1-2 x 109 CFU (classical dose) at 4-6 months old, or of non-pregnant adults protects the animals for several years the vaccine also has some disadvantages. Since the vaccine consists of living B. melitensis cells it may cause abortion in pregnant sheep and goats and it is excreted in the milk. While a year after vaccination most CFT results are negative, the antibody response to the vaccination may last longer than 24 months. To limit the risk of abortion and excretion of brucellae following the vaccination the conjunctival vaccination with 5 x 104 CFU was introduced. Conjunctival vaccination, with a reduced dose, is not only safer but it is also easier to apply (Alton, 1985; Plommet, 1991). Rev 1 vaccine it is an attenuated Brucella strain that is dangerous for man.

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Vaccines

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Zoonoses and Food Safety

Brucella melitensis is a zoonotic disease causing a debilitating illness in human. Symptoms of acute brucellosis caused by Brucella melitensis are Æflu-likeä and highly non-specific. Chronic brucellosis is an insidious disease with vague symptoms that might be confused with other diseases affecting various organ systems (Serter et al., 1991). Humans usually acquire brucellosis by consumption of raw milk or milk products (Thapar and Young, 1986). Brucellosis is also recognized as an occupational hazard for farmers, veterinarians, and workers in the meat industry in areas with enzootic B. melitensis. Humans working in the meat industry may contract brucellosis percutaneously, conjunctivally or by nasal mucous membrane infection. Veterinarians may become infected with brucellosis when handling aborted foetuses or apparently healthy calves born to infected cows, performing gynaecological and obstetric manipulations, or when handling Rev 1 vaccine (Glosser, 1972; Schnurrenberger et al., 1975; Dekeijzer, 1981; Peelman and Dekeyser, 1987).

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Taxonomic Tree

Kingdom Proteobacteria [01PROT]

Class Rhodospirilli [21RHOD]

Order Rhizobiales [31RHIZ]

Family Brucellaceae [41BRUC]

Genus Brucella [51BRUC]

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Hosts Table

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Pathogen Characteristics

The organism responsible for brucellosis is a small Gram-negative coccobacillus, which is non-motile, non-encapsulated and non-spore-forming. In infected tissue it normally occurs singly or in small groups. Several commercial firms produce media suitable for isolation and propagation of Brucella. The colonies are circular and 2-4 mm in diameter. It does not require supplementary carbon dioxide to grow and it takes 3-5 days incubation at 37¯ C for visible colonies to appear. B. melitensis does not produce H2S, grows in the presence of basic fuchsin and thionin at standard concentrations and is catalase and oxidase positive. It is lyzed only by brucella-phage Berkeley. Currently there are three recognized B. melitensis biovars (Corbel et al., 1978).

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References

Abela B, 1999. Epidemiology and control of brucellosis in ruminants from 1986 to 1996 in Malta. Revue Scientifique et Technique - Office International des ‘pizooties, 18(3):648-659; 20 ref.

Acharya BN, Panda SN, 1985. Role of blocking antibody and Coombs antiglobulin tests in the detection of brucellosis in sheep. Indian Journal of Animal Health, 24(2):123-126; 14 ref.

Ahl AS, Bartlett PC, Frerichs WM, 1993. Serological evidence for the presence of Brucella antibodies in sheep and goats on Saint Croix, U.S. Virgin Islands. Revue d''levage et de M‘decine V‘t‘rinaire des Pays Tropicaux, 46(1/2):61-63; [Actes de la 2e R‘union Biennale de la Society for Tropical Veterinary Medicine, 2-6 f‘vrier 1993, Saint FranÎois, Guadeloupe.]; 14 ref.

Alton GG, 1985. Rev. 1 and H38 Brucella melitensis vaccines. Brucella melitensis. CEC seminar, Brussels, November 1984, 215-227; [Current Topics in Veterinary Medicine and Animal Science volume 32]; 39 ref.

Amin JD, Silsmore AJ, 1993. A serological survey of some abortifacient diseases of sheep and goats in the Maiduguri area of Nigeria. Bulletin of Animal Health and Production in Africa, 41 (2):123-128; 26 ref.

Bandey SD, Parvez S, Bandey S, 1989. Sero-epidemiological studies on brucellosis in exotic sheep in Kashmir valley. Indian Journal of Animal Sciences, 59(2):213-215; 16 ref.

Bekele T, Kasali OB, 1990. Brucellosis in sheep and goats in Central Ethiopia. Bulletin of Animal Health and Production in Africa, 38(1):23-25; 14 ref.

Bercovich Z, G®ler L, Baysal T, Schreuder BEC, Zijderveld FGvan, 1998. Evaluation of the currently used diagnostic procedures for the detection of Brucella melitensis in sheep. Small Ruminant Research, 31(1):1-6; 27 ref.

Bercovich Z, Lagendijk W, 1978. A modified milk ring test for detecting Brucella agglutinins in bulk tank coolers. Tijdschrift voor Diergeneeskunde, 103:407-416.

Biancifiori F, Nannini D, Matteo Adi, Belfiore P, 1996. Assessment of an indirect ELISA in milk for the diagnosis of ovine brucellosis. Comparative Immunology, Microbiology and Infectious Diseases, 19(1):17-24; 13 ref.

Blasco JM, Garin-Bastuji B, Marin CM, Gerbier G, Fanlo J, Jim‘nez de Bagu‘s MP, Cau C, 1994a. Efficacy of different Rose Bengal and complement fixation antigens for the diagnosis of Brucella melitensis infection in sheep and goats. Veterinary Record, 134 (16):415-420; 26 ref.

Blasco JM, Mar‰n C, Jim‘nez de Bagu‘s M, Barberàn M, Hernàndez A, Molina L, Velasco J, D‰az R, Moriy»n I, 1994. Evaluation of allergic and serological tests for diagnosing Brucella melitensis infection in sheep. Journal of Clinical Microbiology, 32 (8):1835-1840; 31 ref.

Boargob A, Muhammed SI, 1989. The prevalence of brucellosis in some sheep and goat flocks in the Western Mountains of Libya. Bulletin of Animal Health and Production in Africa, 37(1):9-12; 8 ref.

Capuano F, Bartoli M, Fenizia D, Landolfi MC, Pinto O, Zullo T, Ciabrelli M, Esposito A, Gallo A, Maddaluno F, Guzzo A, 1996. Health status of sheep and goat flocks in the Campania region: seroepidemiological survey. Veterinaria Italiana, 32(20):13-16; 11 ref.

Coker A, Mete K, Kaya O, 1990. Comparison of the results of the rivanol plate test with those of other serological tests on serum samples for Brucella melitensis infected sheep. Pendik Hayvan Hastaliklari Merkez Arastirma Enstit®s® Dergisi, 21(2):17-22; 17 ref.

Cooper CW, 1992. Risk factors in transmission of brucellosis from animals to humans in Saudi Arabia. Transactions of the Royal Society of Tropical Medicine and Hygiene, 86(2):206-209; 16 ref.

Corbel MJ, Gill KPW, Thomas EL, 1978. Methods for the identification of Brucella. Tolcarne Drive, Pinner, Middlesex HA5 2DT, UK: Ministry of Agriculture, Fisheries and Food (Publications).

Dafni I, Hoyda G, 1989. Eradication of ovine/caprine brucellosis in Israel, 1970-1987. Israel Journal of Veterinary Medicine, 45 (4):233-240; 9 ref.

Davies G, Casey A, 1973. The survival of Brucella abortus in milk and milk products. British Veterinary Journal, 129:345-353.

Dekeijzer P, 1981. Brucella biotypen in BelgiÐ. Landbouwtijdschrift, 34:1513-1520.

Ebadi A, 1984. Evaluation of the allergic test in diagnosis of brucellosis in sheep. Developments in Biological Standardization, 56:387-391; 6 ref.

Ebadi A, Zowghi E, 1983. The use of allergic test in the diagnosis of Brucella melitensis infection in sheep. British Veterinary Journal, 139(5):456-461; 11 ref.

El-Gohary AH, Hattab SA, 1992. Zoonotic importance of brucellosis at Behera Governorate in Egypt. Indian Journal of Animal Sciences, 62(11):1015-1017; 12 ref.

Enright FM, 1990. The pathogenesis and pathobiology of Brucella infection in domestic animals. Animal brucellosis., 301-320; 55 ref.

FAO/WHO, 1986. Sixth report of the expert committee on brucellosis. Technical report series 740, Geneva, Switzerland: FAO/WHO.

Farina R, 1985. Current serological methods in Br. melitensis diagnosis. Brucella melitensis. CEC seminar, Brussels, November 1984, 139-146; [Current Topics in Veterinary Medicine and Animal Science volume 32]; 41 ref.

Garin-Bastuji B, Gerbier G, Douzal Y, Vaucel D, Hummel N, Thiebaud M, Grayon M, Verger JM, 1994. Animal brucellosis in France in 1993. 'pid'miologie et Sant' Animale, No. 26:103-130; 4 ref.

Glosser JW, 1972. Comments on abattoir-associated brucellosis. Journal of the American Veterinary Medical Association, 160:643-644.

Goguer M, 1965. Comparison of the plate and tube agglutination tests for brucellosis in sheep. Veterinary Bulletin, 35: abstract 3710.

Gouvÿa G, Roxo E, Lima MABS, Homerich D, 1989. Occurrence of brucellosis in goats from Sao Paulo State. Arquivos do Instituto Biol»gico (Sao Paulo), 56(Supl.):60.

Hadad JJ, Al-Azawy ZSA, 1991. Incidence of brucellosis in sheep and goats in Ninevah province. Iraqi Journal of Veterinary Sciences, 4(1):27-33; 13 ref.

Hellmann E, Matuschik M, Rippinger P, 1992. Data on the occurrence of ovine/caprine brucellosis in some parts of the German Federal Republic between 1980 and 1989. Tierïrztliche Umschau, 47(12):891-894, 897-899; 10 ref.

Hosie BD, Al-Bakri OM, Futter RJ, 1985. Survey of brucellosis in goats and sheep in the Yemen Arab Republic: comparison of tests for Brucella melitensis infection in sheep. Tropical Animal Health and Production, 17(2):93-99; 13 ref.

Jacques I, Olivier-Bernardin V, Dubray G, 1998. Efficacy of ELISA compared to conventional tests (RBPT and CFT) for the diagnosis of Brucella melitensis infection in sheep. Veterinary Microbiology, 64(1):61-73; 29 ref.

Jha VC, Thakur RP, Yadav JN, 1993. Sero-prevalence of brucellosis in cattle and buffaloes in the Koshi Hills of Nepal.

Veterinary Review (Kathmandu), 8(1):17-19; 7 ref.

Kadohira M, McDermott JJ, Shoukri MM, Kyule MN, 1997. Variations in the prevalence of antibody to brucella infection in cattle by farm, area and district in Kenya. Epidemiology and Infection, 118(1):35-41; 33 ref.

Karmann P, Schloz HD, 1956. Beitrag zur Bekïmpfung des Maltafiebers der schafe in Lande Nordrhein-Westfalen. Mhonatsheft f®r Tierheilkunde, 8:127-134.

Kiran MM, Baysal T, Gùz®n H, G®ler L, G®nd®z K, Kuyucuoglu ù, K®c®kayan U, 1997. Pathological, bacteriological and serological studies on ovine abortion in Konya province. Etlik Veteriner Mikrobiyoloji Dergisi, 9(2):109-128; 27 ref.

Le Pennec J, 1967. Serology of ovine brucellosis. Vaccination and infection antibodies negative to Wright's agglutination test but positive to the complement fixation test. Veterinary Bulletin, 37: abstract 3571.

Levchenco ID, Drozhzhin VN, 1958. Use in outbreaks of abortion in sheep of the agglutination test with 10% NaCl. Veterinary Bulletin, 28: abstract 1006.

Loquerie R, Durand MP, 1984. Clinical application of a skin test for delayed hypersensitivity, using a commercial allergen, for detecting brucellosis in sheep and goats. Developments in Biological Standardization, 56:407-410; 5 ref.

Luchsinger DW, Anderson RA, 1967. Epizootiology of Brucellosis in a flock of sheep. Journal of the American Veterinary Medical Association, 150:1017-1021.

Mahajan NK, Kulshreshtha RC, 1986. Counterimmunoelectrophoresis detection of brucella antigens in fetal stomachs of aborted sheep. Veterinary Record, 119(18):455-456; 12 ref.

Mikolon AB, Gardner IA, Anda JHde, Hietala SK, 1998a. Risk factors for brucellosis seropositivity of goat herds in the Mexicali Valley of Baja California, Mexico. Preventive Veterinary Medicine, 37(1/4):185-195; 13 ref.

Mikolon AB, Gardner IA, Hietala SK, Anda JHde, Pestana EC, Hennager SG, Edmondson AJ, 1998b. Evaluation of North American antibody detection tests for diagnosis of brucellosis in goats. Journal of Clinical Microbiology, 36(6):1716-1722; 23 ref.

Mirza MA, Jalvi MA, Abdul Razzak, 1998. Screening of goat flocks for brucellosis using Rose Bengal plate test. Pakistan Veterinary Journal, 18(3):146-149; 12 ref.

Mrunalini N, Ramasastry P, 1999. Serological survey on the occurrence of brucellosis in domestic animals and man in Andhra Pradesh. Indian Veterinary Journal, 76(6):483-484; 3 ref.

Nagal KB, Katoch RC, Sambyal DS, Sharma M, 1991. Sero-prevalence of brucellosis in livestock of Kangra Valley in Himachal Pradesh. Asian Journal of Dairy Research, 10(1):15-18; 12 ref.

Oloffs A, Baumann MPO, Afema J, Nakavuma J, 1998. Experiences with a strategy to investigate ovine/caprine brucellosis in a rural area in southwest Uganda. Revue d''levage et de M'decine V't'rinaire des Pays Tropicaux, 51(2):101-105; 8 ref.

Ostanello F, Farina L, Turilli C, Serra P, Cagnolati V, Abdullahi M, Scagliarini A, Prosperi S, 1999. Reliability of results of the Rose Bengal test performed for export control in northern Somalia. Revue Scientifique et Technique - Office International des 'pizooties, 18(3):660-666; 13 ref.

Peelman J, Dekeyser P, 1987. De verspreiding van de Brucella infectie bij vlaamse werknemers professioneel in contact met runderen. Vlaams Diergeneeskundig Tijschrift, 56:314-23.

Plommet M, 1991. New animal vaccines. In: Emel T®mbay, S®leyha Hilmi, °zdem Ang, eds. Brucella and brucellosis in man and animals. Proceedings of a symposium held in Izmir, Turkey, on September 24-26, 77-85.

Prahlad Kumar, Singh DK, Barbuddhe SB, 1997. Serological evidence of brucellosis in sheep and goats. Indian Journal of Animal Sciences, 67(3):180-182; 15 ref.

Quezada FV, Andrade LH, Aparicio ED, 1997. Evaluation of the modified milk ring test for goat milk for diagnosis of Brucella

melitensis and the effect of mastitis on the test results. T'cnica Pecuaria en M'xico, 35(1):52-55; 16 ref.

Renoux G, Alton G, Mahaffey LW, 1956. Etude sur la brucellose ovine et caprine:V. R'actions s'rologiques dans le sang de br'bis r'cemment par Brucella melitensis. Archives Institue Pasteur, Tunis, 33:33-41.

Reviriego FJ, Moreno Ma, Domingues L, 2000. Risk factors for brucellosis sero-prevalence of sheep and goat flocks in Spain. Preventive Veterinary Medicine, 44:167-173.

Ribeiro LMM, Herr S, Chaparro F, Vyver FHvan der, 1990. The isolation and serology of Brucella melitensis in a flock of goats in central RSA. Onderstepoort Journal of Veterinary Research, 57 (2):143-145; 14 ref.

Russo AM, Monz»n CM, 1998. Serological study of ovine/caprine and caprine brucellosis in the province of Formosa, Argentina. Veterinaria Argentina, 15(150):701-709; 11 ref.

Scharp DW, Al-Khalaf SA, Al-Muhanna MW, Cheema RA, Godana W, 1999. Use of mass vaccination with a reduced dose of REV 1 vaccine for Brucella melitensis control in a population of small ruminants. Tropical Animal Health and Production, 31(3):135-141; 13 ref.

Schnurrenberger PR, Walker JF, Martin RL, 1975. Brucella infections in Illinois Veterinarians. Journal of the American Veterinary Medical Association, 167:1084-1089.

Scrimgeour E, Mehta F, Suleiman A, 1999. Infectious and Tropical disease in Oman: a review. American Journal of Tropical Medicine and Hygiene, 61:920-925.

Serter D, Karakartal G et al., 1991. Clinical picture in adult brucellosis - Typical and unusual. In: Emel T®mbay, S®leyha Hilmi, °zdem Ang, eds. Brucella and brucellosis in man and animals. Proceedings of a symposium held in Izmir, Turkey, on September 24-26, 101-107.

Shimi A, Tabatabayi AH, 1981. Pathological, bacteriological and serological responses of ewes experimentally infected with Brucella melitensis. Bulletin Office International des Epizooties, 93:1411-1422.

Stableforth AW, Galloway IA, 1959. Infectious diseases of animals: diseases due to bacteria. London, UK: Butterworths Scientific Publications, 1:109-119.

Sting R, Ortmann G, 2000. Experience with a simple ELISA for immunodiagnosis of Brucella in cattle, sheep and goats. Berliner und M®nchener Tierïrztliche Wochenschrift, 113(1):22-28; 32 ref.

Thapar MK, Young EJ, 1986. Urban outbreak of goat cheese brucellosis. Paediatric Infectious Diseases, Nov.Dec., 5:640.643.

Wray C, 1975. Survival and spread of pathogenic bacteria of veterinary importance within the environment. Veterinary Bulletin, 45:Abstract 546.

Yantzis D, 1985. Brucella melitensis in Greece: current situation report. Brucella melitensis. CEC seminar, Brussels, November 1984, 43-46; [Current Topics in Veterinary Medicine and Animal Science volume 32]; 12 ref.

Zowghi E, Ebadi A, 1985. Naturally occurring Brucella melitensis infection in cattle in Iran. Revue Scientifique et Technique, Office International des 'pizooties, 4(4):811-814; 8 ref.

Zowghi E, Ebadi A, 1988. Abortion due to Brucella abortus in sheep in Iran. Revue Scientifique et Technique, Office International des 'pizooties, 7(2):379-382; 11 ref.

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