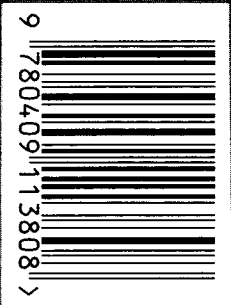


ZOONOSES

A zoonosis is a disease or infection that is naturally transmissible between vertebrates.

The purpose of this book is to inform those who are in regular contact with animals (at home or in the working environment) of the potential dangers involved in handling animals.

It is only through education and awareness that diseases such as rabies, ringworm, anthrax and brucellosis can be effectively controlled and prevented.



BUTTERWORTHS

Zoonoses Animal diseases and man

**Van den Heever
JH du Preez**



ZOONOSES ANIMAL DISEASES AND MAN

LW van den Heever • JH du Preez



BUTTERWORTHS

2

ECHINOCOCCOSIS OR HYDATID DISEASE

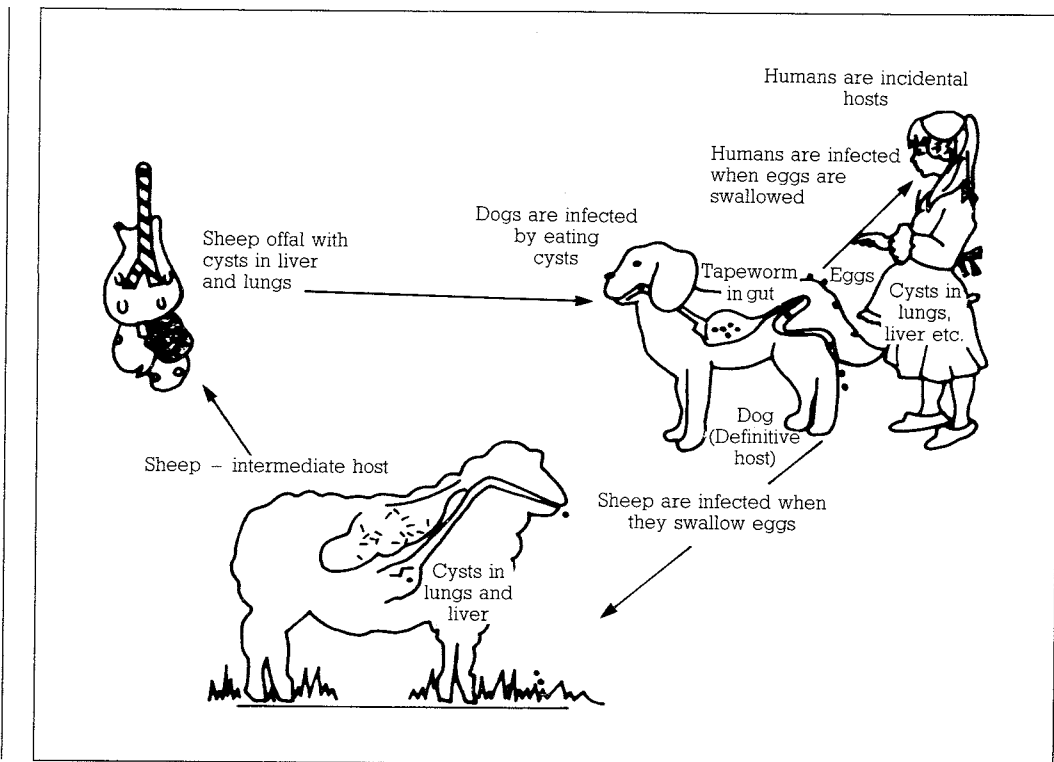
Echinococcosis and hydatidosis are forms of a parasitic disease. The former involves the dog as the definitive host and the latter, the sheep as the most common intermediate host. Man is an incidentally infested intermediate host.

Other names

Hydatid disease and hydatidosis are synonymous. The Afrikaans term for the disease in man, 'hondeplaaswurmsiekte', clearly indicates the involvement of the dog in the life cycle of the parasite.

Type of zoonosis

Echinococcosis is a parasitic cyclozoonosis contracted by man by ingestion of the infective eggs voided by the dog in particular. Two different vertebrate hosts are required to complete the normal life cycle of the parasite. The dog and other carnivores are the final or definitive hosts which harbour the adult tapeworms while domesticated and wild herbivorous vertebrate animals such as sheep, goats, cattle, horses and pigs serve as intermediate hosts for the bladderworm stage. The sheep plays the most important role as intermediate host in the life cycle in the rural or farm situation. Man, like other herbivorous animals, is also susceptible to infestation with the bladderworm stage (anthropo-zoonosis).

Figure 1 Schematic diagram of the life cycle of *Echinococcus*

General information

The extremely small adult tape worm (*Echinococcus granulosus*) is only about 5 mm long, has only 3 to 7 segments (proglottides) and is found in the intestine of the dog and other carnivores. The last segment breaks off when it is mature, has the appearance of a flattened grain of rice and is voided in the dog's excrement. Such a mature segment contains several hundred eggs and several such segments may appear in the faeces at one time. Infested carnivores usually harbour numerous tapeworms.

Life cycle

The dog (final host) voids one ripe segment about every 14 days from each of the tapeworms it harbours. The eggs are immediately infective and must be ingested by an intermediate host (sheep, cow, pig, horse, antelope, etc) for the life cycle to proceed. Under favourable conditions the eggs remain alive in nature for extended periods. The sheep, pig etc ingests the eggs when taking in contaminated feed or water. The eggs hatch in the intestinal tract of the intermediate host and the resulting larvae penetrate the intestinal wall and are transported via the portal system to the liver which becomes the first filter organ. Consequently, most of the larvae are caught up in the liver where they begin to grow into a cyst or bladderworm. Other larvae will be caught up in the lungs, while a small percentage will pass through the lungs to reach other organs such as the brain, bone, muscles etc where they also develop into cysts. A fibrous membrane develops around these cysts which may reach a diameter of 10-40 mm within a few months. Most cysts develop in the liver and lungs, and a few in other organs. A characteristic feature of these cysts is the presence of a thick whitish loosely attached inner germinal membrane which is filled with a watery fluid in which the typical 'hydatid sand' (small free-floating tapeworm heads) is suspended. Should the final carnivorous host (the dog) eat raw or partially cooked liver, lungs etc containing these cysts, each of the tapeworm heads will develop into a tapeworm in the dog's intestine (see Plate 3).

How does man contract echinococcosis?

This occurs in the same way as in the sheep and other intermediate host animals. The tiny eggs, invisible to the naked eye, are taken in by mouth. Transfer of the parasite to man usually results from direct contact with an infested dog. The eggs cling to the hair coat at the base

of the tail and are transferred to the dog's lips and muzzle when it licks itself. Should the dog then lick a person, especially a child, on the face or hands, the eggs may be transferred to the person's mouth. The eggs also adhere to the paws of infested dogs and by holding the paws the eggs are transferred to the person's hands – and later to his own mouth. Man is therefore incidentally infested by direct contact with infested dogs or indirectly by ingestion of contaminated food or water. Coprophagic flies can mechanically transfer the eggs from dog faeces to water or food (see **Plate 4**).

Man is a terminal host and plays no role in the parasite's life cycle. By allowing dogs access to the raw offal of meat animals, man promotes completion of the life cycle. Man is not susceptible to infestation by ingestion of or exposure to the tapeworm heads in a hydatid cyst. Because such cysts are aesthetically objectionable, man will not knowingly use affected organs as food but he may discard such organs by throwing them to the dogs. Such dogs, of course, then become a danger to him.

Symptoms in man

Just as in the sheep, bovine or other intermediate host, ingestion of eggs by man leads to release of larvae which develop into bladderworms or hydatid cysts, especially in the liver, lungs, brain and other organs. Some cysts may contain several litres of fluid. Symptoms may only develop after years or not at all. Symptoms usually result from pressure or space-occupation by the cyst and will depend on the size of the cyst and the organ affected. Cysts in the liver may lead to abdominal enlargement, jaundice as a result of pressure on the bile ducts or liver dysfunction. In the lungs the cysts may lead to chest pain, coughing, fever, shortness of breath, etc. Cysts in bones may lead to spontaneous fractures and arthritis. Nervous symptoms and neurological deviations occur when the brain or nervous system is involved and may be fatal. Rupture of a cyst may lead to severe or even fatal shock. There is no known effective remedy for the treatment of echinococcosis (see **Plate 5**).

Occurrence and distribution

The disease may occur where dogs and other carnivores are in close contact with sheep, goats, cattle, wild herbivores or pigs, because both intermediate and final (definitive) hosts are available for completion

of the cycle. More particularly, sheep farming in the presence of dogs which are fed raw sheep offal or have access to sheep that have died or where dogs kill and eat sheep, promotes the occurrence and perpetuation of the disease. It should be remembered that although both sheep and humans are infested by dogs, man contracts the disease incidentally. It is estimated that about 100 human cases are diagnosed annually in South Africa.

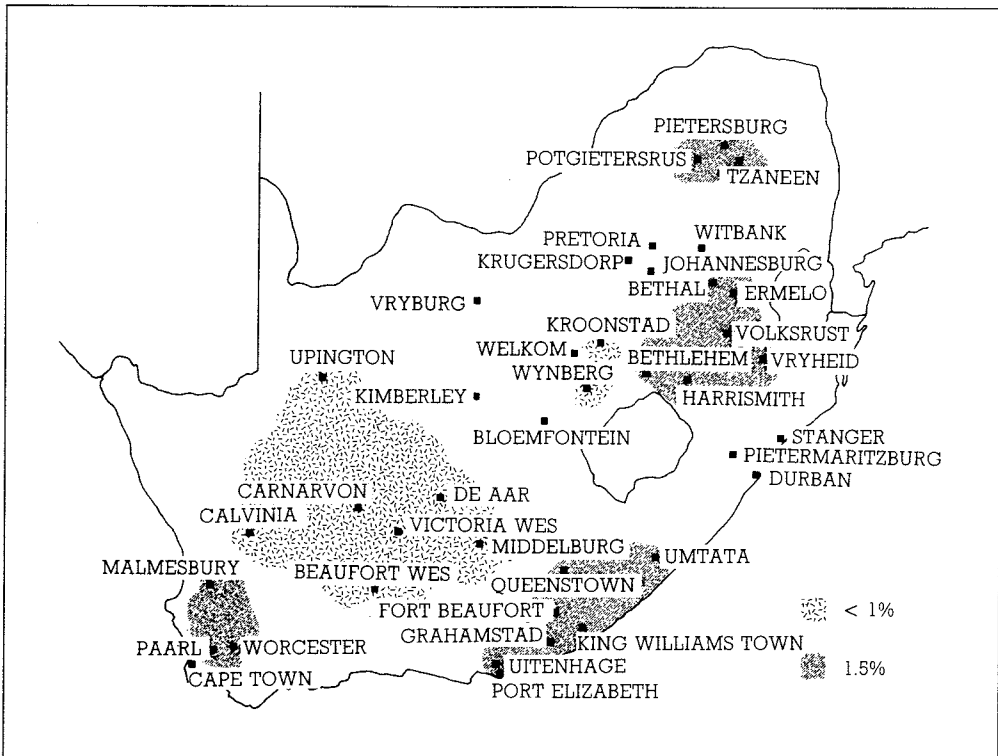
Symptoms in animals

- Dogs with *Echinococcus* tapeworms rarely exhibit obvious signs of infestation and are consequently not taken for veterinary attention and treatment as the owner remains ignorant of the fact that his dog(s) constitute a health hazard to him and his family.
- Sheep/cattle rarely show obvious signs of hydatid disease and the cysts in the organs are usually found during meat inspection after slaughter at the abattoir or on the farm. Just as in man, symptoms depend on the size, location and number of cysts and the organ affected. Cysts in the brain of sheep and goats may lead to various behavioural changes.

Prevention and control

- Dogs should be taken to a veterinarian at least every six months for correct and effective deworming. The first defecation after treatment may contain eggs and should be burnt or buried deeply.
- Never feed raw red offal of slaughter stock or game to dogs. Such offal may contain undetected cysts and transmit the tapeworm to the dogs. Only well cooked offal should be fed to dogs.
- Sheep/cattle etc should preferably be slaughtered under controlled conditions where thorough and complete meat inspection can be carried out. Where cysts are encountered, the entire affected organ should be condemned and rendered innocuous; cysts should never be incised or excised.
- The carcasses of dead sheep etc should be promptly burnt or buried.
- Ensure good personal hygiene. After working with dogs, the hands should be thoroughly washed to prevent possible ingestion of eggs.
- Information regarding the danger of hydatidosis should be made available to workers on stock farms as well as the general public.

Figure 2 The incidence of echinococcosis in sheep in South Africa



(Source: Verster and Collins 1966)

3

TAPEWORMS AND CYSTICERCOSIS IN MAN AND PORK AND BEEF 'MEASLES'

Tapeworms constitute a health hazard to man. For the stock farmer they have important financial implications as they cause cattle and pigs to yield 'measly' meat which is unfit for human consumption.

Introduction

Man is the final host of the two species of tapeworm that cause 'measles' in cattle and pigs respectively. During their life cycle the parasites have to pass through a suitable vertebrate intermediate host, i.e. either a bovine or pig. Tapeworms usually occur in persons living in poorly developed economic societies where low standards of hygiene and social conditions go hand in hand. Nevertheless, any person who prefers raw or underdone meat runs the risk of harbouring a tapeworm.

Other names

Tapeworm infestation in man is also known as taeniasis when the parasite is the beef tapeworm (*Taenia saginata*) and/or the pork tapeworm (*Taenia solium*). The latter may also cause cysticercosis in man.

The disease

Beef and pork tapeworms develop and live in the small intestine of man and are non-fatal. The worms may, however, cause emaciation, loss of weight and digestive disturbances. The cysticercosis caused

by *T. saginata* and *T. solium*, also commonly known as 'measles', is, in fact, the condition which results from the development of the larvae or bladderworm stages of these worms within the muscles and other tissues of bovines and pigs respectively. 'Measles' is rarely recognised in the living animals and is almost exclusively diagnosed during or after slaughter. Under certain conditions the larvae or bladderworms of *T. solium* may also occur in human tissues and lead to serious disease, for example, when cysts develop in the eye or brain. The carrier of the adult *T. solium* is especially prone to such auto-infestation which follows the ingestion of the eggs or their movement from the intestine to the stomach of the host person.

Distribution

Tapeworms in man and 'measles' or cysticercosis in cattle and pigs have a worldwide distribution but occur more frequently in underdeveloped countries. The incidence (frequency) of infestation varies according to the geographic distribution of animals and man, level of socio-economic development, standard of meat hygiene control etc. Both beef and pork tapeworms occur in South Africa.

Type of zoonosis

Tapeworm infestation is a cyclozoonosis as two different vertebrates species (man and cattle/pigs) are required as hosts. Man is the final or definitive host and animals the intermediate hosts of the two tapeworms.

Details of the tapeworms

The adult beef tapeworm (*Taenia saginata*) produces six to nine mature or ripe and egg-laden segments per day (\pm 1.5 million eggs) and grows to a length of 4 to 8 metres. It may live in the human intestine for as long as 25 years. The adult pork tape worm (*T. solium*) produces about 5 segments and 250 000 eggs per day, varies in length from 3 to 5 metres and may also live in its human host for many years. Man may harbour more than one tapeworm at a time.

Life cycle

The tapeworm establishes itself in the small intestine of its human host and its ripe segments are voided in the faeces. The ripe segment of the beef tapeworm is motile and may spontaneously leave the human body; the segments of the pork tapeworm only leave the human body during defecation. The eggs or egg-laden segments are taken in by mouth by the bovine or pig. Larvae hatch from the eggs in the animal's intestine, enter the blood stream and locate in the muscles and other tissues of the intermediate host animal where they develop into cysts or bladderworms, also known as 'measles' or cysticerci. Should man consume the raw or underdone meat of infested cattle or pigs, the bladderworms, (each containing a single tapeworm head) develop into adult tapeworms in his/her intestine and so the life cycle is completed in the human host.

How does man contract the infestation?

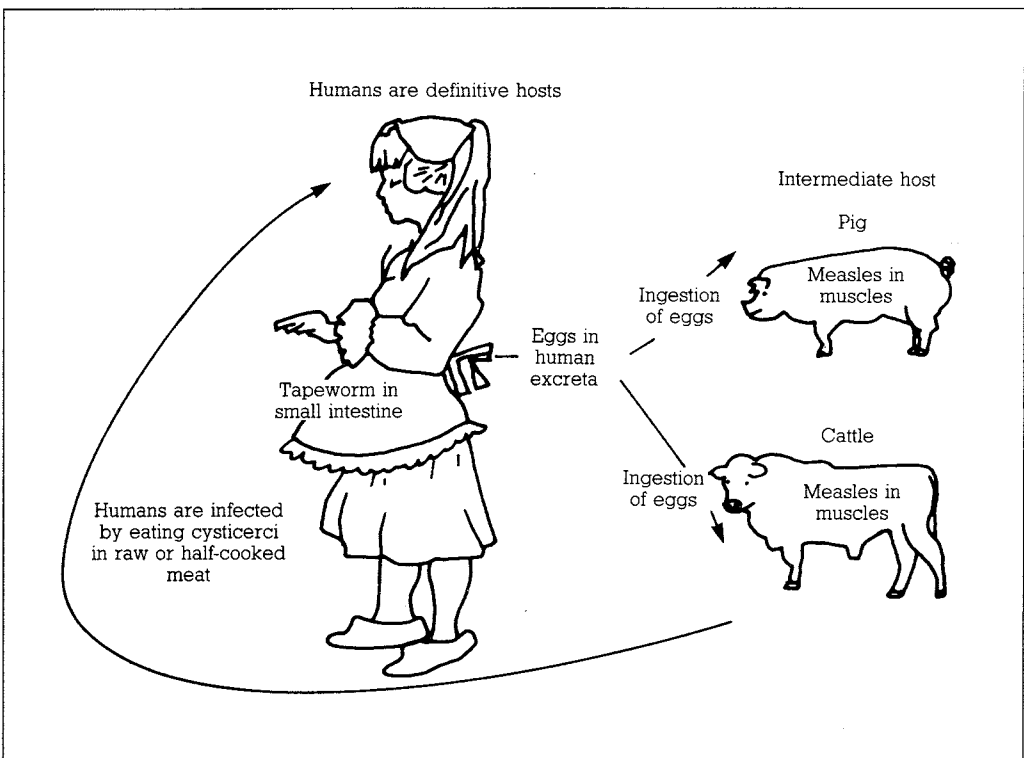
- Tapeworms develop in man as a result of eating raw or underdone meaty beef or pork (see **Plate 6**).
- Man can develop bladderworms (cysticercosis) if he harbours a pork tapeworm and becomes auto-infested or if he ingests the eggs voided by another tapeworm carrier (see **Plate 7**).

The effect of tapeworm infestation

- Tapeworm infestation is not a fatal condition. The parasite, however, competes with its human host for nutriment (food), which may lead to loss of weight, vitamin deficiencies and other forms of malnutrition.
- Persons who contract bladderworms or cysticercosis develop symptoms which depend on where the cyst(s) are located. When in the brain, they may cause epilepsy, meningitis, paralysis etc. In the eye even a single cyst is likely to cause serious impairment of sight (see **Plate 8**). Muscular cysticercosis is usually asymptomatic.

Prevention and control

- Regular deworming of persons will prevent the excretion of eggs and so prevent infestation of cattle and pigs. This is particularly important in the case of farm workers where cattle and pigs are raised, especially in feedlots and other intensive systems.



- Measly beef or pork should not be consumed.
- Even the best inspection at slaughter cannot ensure that slightly infested meat may not, on occasion, reach the consumer.
- Meat which is lightly infested with measles may be rendered entirely safe by cooking at 100°C for 2.5 hours, freezing at -10°C for 10 days or pickling for 21 days at 10°C.
- Good personal hygiene is essential to prevent ingestion of pork tapeworm eggs.
- Consult your veterinarian for more detailed information regarding the prevention of tapeworm infestation and your medical practitioner regarding the deworming of persons suspected of harbouring tapeworms.

7

BRUCELLOSIS

(UNDULANT OR MALTA FEVER)

Brucellosis is a highly infectious bacterial disease of cattle, goats, sheep, pigs and dogs which also occurs in man. Livestockmen, veterinarians, abattoir personnel and all who handle livestock run the risk of contracting brucellosis. In addition the public at large also face the hazard of brucellosis inasmuch as the consumption of raw infected milk and milk products may result in the disease.

Introduction

Brucellosis is a direct zoonosis contracted after direct contact with the infected animal, its secretions and excretions, animal products etc. Bovine brucellosis is widely prevalent in South Africa. Veterinarians, livestock handlers and abattoir personnel are particularly exposed to the infective agent and consequently fall into the high risk category of persons who may contract the disease. Because of the economic importance of bovine brucellosis and the danger it presents to the health of the public the Animal Health Directorate of the Department of Agriculture introduced the Bovine Brucellosis Scheme in 1979. Veterinarians in private practice also contribute materially to the control of brucellosis.

Other names

Human brucellosis is also known as Mediterranean or Malta fever (when caused by a mediterranean species of *Brucella*), brucella fever,

abortus fever and undulant fever (when caused by *B. abortus*). The disease in cattle is also known as contagious abortion or simply CA.

Causes of human brucellosis

Various species of *Brucella* bacteria cause brucellosis in man i.e. *B. abortus* which is derived from cattle, *B. melitensis* which occurs mainly in goats and sheep, *B. suis* which occurs in pigs and *B. canis* in dogs. *B. abortus* and to a lesser degree, *B. melitensis* are of particular significance to human health in southern Africa.

Geographic distribution

Although the disease has been eliminated in a few countries, it has a worldwide distribution. In South Africa more than 20% of all cattle herds are known to be infected with *B. abortus*. The prevalence is highest in Transvaal herds (\pm 50%), followed by 16% in Natal. Brucellosis in goats and sheep is usually caused by *B. melitensis* and occurs on a limited scale in isolated areas in Namibia, the eastern Cape and the northern Transvaal. *B. canis* and *B. suis* are not known to occur in southern Africa.

How does man contract the disease?

Persons who are in close contact with cattle, goats and sheep run the greatest risk of contracting brucellosis.

The most important source of infection by *B. abortus* is the infected cow. Cows with brucellosis may abort or give birth to premature or normal calves. This also applies to the nanny goat and sheep ewe. The infected cow frequently fails to shed her placenta or afterbirth. With birth of a calf the environment is heavily contaminated because the placenta and the birth fluids contain millions of bacteria. Persons who assist cows during difficult calving run a great risk of infection via minor sores, cuts or abrasions of the skin, particularly of the hands and arms, as well as splashes in the eyes, nose and mouth. Handling the newborn calf is also an infection hazard. The cow is mainly responsible for spreading the infection during and for a month or so after aborting or calving; the same applies to the nanny goat and the ewe. Because man contracts the disease by direct contact with the animal or its tissues or fluids, brucellosis is classified as a direct anthroponozoonosis. Other

animals (cattle) are also infected by sniffing, licking or nibbling at the placenta and eating or drinking contaminated feed or water. When the cow comes into heat again, the vaginal mucus is also infective.

The environment may thus become contaminated with *Brucella* bacteria present in the aborted foetus, placenta, vaginal discharges and oestrus mucus and the faeces of a calf that has consumed contaminated colostrum. In infected cows the bacteria colonise the udders and these cows thus excrete the bacteria in their milk for weeks or months; consumption of such raw milk may lead to humans contracting brucellosis. This also applies to cream and dairy products which have not been heat processed.

The *Brucella* bacteria not only colonise and establish themselves in the udder but also in the genital organs, lymph nodes, synovial sheaths and joints of infected animals (see **Plate 13**). Contact with such tissues or fluids may also result in transmission of the bacteria to man. This explains why persons in the abattoir including veterinarians and farmers who carry out post-mortem examinations on dead or slaughtered animals may also contract brucellosis.

Members of the public may contract brucellosis from contaminated milk or dairy products. Milk (see Annexure B) produced by *Brucella*-infected cows, nanny goats or ewes which is not exposed to efficient heat-processing (pasteurisation, UHT, etc) is an important source of *Brucella* infection for people, who may contract undulant fever. Where babies that are allergic or intolerant to cow's milk are given raw contaminated goat's milk, they may contract Malta fever.

There is a distinct possibility that man may become infected via droplet infection when the bacteria may be present in an aerosol form and thus inhaled. Man may also become infected by handling contaminated instruments. Laboratory workers who deal with *Brucella* cultures are also at risk.

The most important ways in which man contracts the infection are through direct contact with contaminated material (placenta, foetus, etc) or the consumption of contaminated milk. Brucellosis in cows results in a subclinical (non-obvious) form of udder inflammation (mastitis) and the milk is consequently not visibly abnormal although it is infectious, as is the udder tissue. Consumers often wrongly assume that only abnormal milk constitutes a health hazard.

Signs of disease in animals

Symptoms of brucellosis in dairy cows are abortion, retention of placenta, swollen joints and bursae etc. Abortion is often the only symptom observed. Not all infected cows abort although they may nevertheless spread the infective agent. Nanny goats may occasionally develop clinical mastitis.

Symptoms of brucellosis in man

These may be slight or severe and the disease may be acute or chronic (of protracted duration). The incubation period (from infection to first symptoms) extends over 2 to 3 weeks. A very wide range of symptoms, many of which are common to other diseases, are displayed by persons with brucellosis. Some of the more typical signs of the disease are an undulating fever, severe sweating at night, back and bone pain, sore throat, joint and muscle pain, continuous coughing, headache, loss of weight, depression and malaise. The disease may affect a person over a number of years. Medical consultation and early treatment is recommended.

Prevention and control

- Brucellosis in animals is officially controlled by the Directorate of Animal Health of the Department of Agriculture in terms of the Animal Diseases Act 35 of 1984. Diagnostic tests are carried out and cattle reacting positively are branded with a 'C' on the right side of the neck and thereafter preferably slaughtered. Positive reactors may only be moved from the farm under cover of an official permit from a State Veterinarian.
- All female calves between 4 and 8 months of age must be inoculated once with strain 19 vaccine against brucellosis. Vaccination prevents abortion, which is the main means of spreading the infective agent, but does not prevent the animal from contracting the disease and excreting the bacteria in her milk. Consult your veterinarian for full details.
- Prevent direct contact with aborted foetuses and all placentae. These should be burnt without delay (see **Plate 14**).
- Drink only heat-processed milk i.e. pasteurised, UHT-processed, sterilised or boiled milk and dairy products unless obtained from known and certified brucellosis-free herds.

- Abattoir personnel dealing with brucellosis-positive (C-branded) cattle should be protected by wearing overalls, gloves and even masks.
- The public and more especially those whose occupation exposes them to *Brucella* infection should be fully informed about brucellosis and the hazards of working in a laboratory dealing with *Brucella* cultures.
- Livestock owners should consult their veterinarians regarding the prevention and control of the disease e.g. vaccination programmes for cattle, sheep and goats.
- Persons vaccinating calves should take care not to inject themselves with the live vaccine. The wearing of gloves is recommended to prevent the vaccine from entering cracks and abrasions of the skin.
- Although vaccination of calves against contagious abortion is effective, it alone cannot eliminate the disease. Vaccinated animals can still contract the disease and spread infection. There is no efficient treatment for brucellosis in animals.

8

ANTHRAX

Animals with anthrax constitute a serious danger to humans. Because of this the disease is controlled by the state and accordingly strict rules exist concerning the immunisation of livestock, post-mortem examinations, the destruction of infected cadavers etc.

Introduction

Anthrax, a direct zoonosis, is a contagious bacterial disease caused by the spore-forming *Bacillus anthracis*. The disease is of particular significance to the food animal industry because it may lead to considerable economic losses. It is an occupational disease of persons working with livestock as well as those working with wool, hides and skins and those engaged in the processing of animal blood, bones and carcasses. It occurs more frequently under lesser-developed socio-economic circumstances. In man, timely therapy is successful.

Man is more resistant to the anthrax bacillus than ruminants (e.g. cattle) but more susceptible than pigs and dogs.

Other names

Anthrax in animals is also known as splenic fever (Afr. 'miltstiekte') and 'milzbrand' (Ger).

In man the skin form is known as a malignant pustule or malignant carbuncle and the pulmonary form as woolsorter's disease.

History

The name 'anthrax' is derived from the Greek word for charcoal. It has been suggested that anthrax was the fifth plague (plague among

the cattle) which was brought upon the Egyptian Pharaoh before he let the Israelites go.

The disease in sheep was first recorded in 1850. Both Pasteur and Koch did research on anthrax in an effort to find answers to questions about the disease.

It is estimated that about 60 000 persons died from anthrax in 1913. In 1958 about 20 000 persons contracted the disease. The incidence in man is now very much lower.

How does man contract the disease?

There are three main forms of human anthrax according to the route by which the infection enters the body:

- In the cutaneous form the infection enters the skin via cuts, wounds, abrasions or other breaks; infection cannot take place if the skin is unbroken and intact. An acute lesion develops at the site of entry. Called a malignant pustule, this will, in time, develop into the typical blackish skin lesion consisting of dead skin and called an 'eschar'. The infection may spread from the primary skin lesion and involve the whole system. Those who carry out post-mortem examinations of animals with anthrax are particularly likely to contract the skin form of the disease. Biting flies also transfer the infection from animals with anthrax to man. More than 90% of persons who contract anthrax suffer from the cutaneous form (see **Plate 16**).

- Anthrax (woolsorter's disease) may also be contracted by persons who inhale the dormant or spore form of the infectious agent. This leads to the respiratory and other internal systems being affected. Persons working with wool, hides, skins, cadavers and unsterilised bone meal derived from animals with anthrax are particularly at risk of contracting this form of anthrax from spore-bearing dust.

The spores of the anthrax bacillus are able to survive in nature for many years. They can also withstand temperatures of 100°C for 5 minutes without loss of viability but are killed by prolonged boiling in water. When bacteria are exposed to oxygen, they sporulate and remain infectious for many years. It is for this reason that the cadavers of animals who have died of anthrax should never be opened or incised.

- Man may also contract anthrax by eating the meat of animals who have died of anthrax (see **Plate 15**) or more rarely by drinking the

milk of a cow with anthrax. The digestive system is affected in such cases and this may lead to systemic symptoms.

Animals affected by anthrax

It appears that all mammals are more or less susceptible to infection, although ruminants (cattle, sheep, antelope, etc) are the most susceptible. Pigs and horses most often develop anthrax of the throat. Both domesticated and wild birds are rather resistant to the disease. Vultures may spread the spores mechanically or via their excreta after feeding on the cadavers of animals with anthrax. Reptiles are extremely resistant to the disease.

Distribution

Anthrax occurs virtually all over the world. It still occurs sporadically in animals in South Africa and more recently animals in game parks have become affected, particularly buffalo, kudu and even elephant. The disease in animals is usually systemic and fatal, animals dying shortly after the first signs of disease are observed.

Prevention and control of anthrax as a zoonosis

- Persons who by virtue of their occupations are exposed to infection e.g. laboratory workers, can be vaccinated against the disease. Precautions should be taken to preclude the aspiration or ingestion of the bacteria or their spores.
- Because animals affected with anthrax are an important source of infection for man, all contact with diseased animals should be avoided. Investigation into the sudden deaths of animals should preferably be done only by veterinarians. Animals which may have died of anthrax should not have a post-mortem examination before a blood smear has been taken and microscopically examined by a veterinarian.
- Anthrax in animals is a state-controlled disease. All cattle should be immunised annually against anthrax. Diseased animals should be isolated and quarantine regulations applied. The cadavers of animals who have died of anthrax must be efficiently destroyed. Consult your state or private veterinarian for further information concerning anthrax in animals.

- The importation of hides, skins, bonemeal and bloodmeal is subject to state control.
- If there is any reason to believe or suspect that a person may have been exposed in any way to anthrax bacteria or spores, a medical practitioner should be consulted immediately.

9

PLAGUE AND BUBONIC PLAGUE

Plague is primarily a disease of rodents such as mice and rats. It is a cyclozoonosis and is transmitted by fleas to other animals and man. It may be fatal in man. Control of rodents and fleas constitute important measures in combating plague.

Introduction

Plague is a serious contagious bacterial disease caused by bacteria *Yersinia pestis* (*Y. pseudotuberculosis* spp. *pestis*). Man usually contracts the disease by being bitten by an infected flea but may also contract the disease by inhaling the bacteria in the air or by eating or handling uncooked infected meat.

Other names

The disease in man is also known as the black death, pest and either bubonic or pneumonic plague.

History

There is good reason to believe that the boils and swelling ('emerods') and the death which struck down the Philistines, and which they associated with the presence of mice (1 Samuel 5 & 6), were in fact bubonic and pneumonic forms of plague.

In later years there were three major outbreaks (pandemics) of plague. The first occurred during the reign of the Roman emperor Justinian in about 540 AD and claimed the lives of about 100 million people. The second, known as the Black Death, spread westwards from