

Popular Article

Overview of Mycobacterium species

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General Characters

- ✓ The mycobacteria are thin rods of varying lengths (0.2-0.6 x 1.0-1 0.0 µm) and sometimes branching filamentous forms occur but these easily fragment into rods.
- ✓ They are non-motile, non-sporing, aerobic and oxidative.
- ✓ Although cytochemically Gram-positive, the mycobacteria do not take up the dyes of the Gram-stain because the cell walls are rich in lipids, mycolic acid forming the bulk of these. They are characteristically acid-fast, as once a dye has been taken up by the cells, they are not easily decolourised, even by acid-alcohol. The rods tend to stain irregularly and often have a beaded appearance.
- ✓ A comparatively slow growth rate is a characteristic of the mycobacteria, with generation times ranging from 2- 20 hours.
- ✓ The genus includes animal and human pathogens as well as saprophytic members often referred to as '*atypical*', '*anonymous*' or '*nontuberculous*' mycobacteria. Some of these can occasionally cause disease in animals.

Natural Habitat

The source of the pathogenic mycobacteria is usually infected animals. *Mycobacterium bovis* is excreted in respiratory discharges, faeces, milk, urine and semen. *M. avium* and *M. paratuberculosis* are shed in faeces and *M. tuberculosis* mainly in respiratory discharges. Tuberculosis is typically a disease of captivity or domestication

The plasmid PXO1 encodes the three components which form two exotoxins; the genes that Mycobacteria which are pathogenic for animals and man

| Sr. No | <i>Mycobacterium species</i> | Main hosts | Species occasionally infected | Disease |
|--------|---|---------------------------------------|--|---|
| 1 | <i>M. tuberculosis</i> | Man , captive primates | Dogs, cattle, psittacine birds, canaries | Tuberculosis (worldwide) |
| 2 | <i>M. bovis</i> | Cattle | Deer, badgers, possums, man, cats, other mammalian species | Tuberculosis |
| 3. | <i>M. africanum</i> | Man | - | Tuberculosis (regions in Africa) |
| 4. | <i>M. avium complex</i> | Most avian species except psittacines | Pigs, cattle | Tuberculosis |
| 5. | <i>M. microti</i> | Voles | Occasionally other mammalian species | Tuberculosis |
| 6. | <i>M. marinum</i> | Fish | Man, aquatic mammals, amphibians | Tuberculosis |
| 7. | <i>M. leprae</i> | Man | Armadillos, chimpanzees | Leprosy |
| 8. | <i>M. lepraemurium</i> | Rats, mice | Cats | Rat leprosy, feline leprosy |
| 9. | <i>M. avium subsp. Paratuberculosis</i> | Cattle, sheep, goats, deer | Other ruminants | Paratuberculosis (Johne's disease) |

Tuberculosis in cattle

Bovine tuberculosis, caused by *M. bovis*, occurs worldwide. ***Because of the zoonotic implications of the disease and production losses due to its chronic progressive nature, eradication programmes have been introduced in many countries.***

Pathogenesis

Virulence appears to reside in the lipids of the cell wall.

- I. **Mycosides, phospholipids and sulpholipids** are thought to protect the tubercle bacilli against phagocytosis.
- II. **Glycolipids** cause a granulomatous response and enhance the survival of phagocytosed mycobacteria.
- III. **Wax D and various tuberculoproteins** induce a delayed hypersensitivity reaction detected in the tuberculin test.

Infection is usually via the respiratory and intestinal tracts. In previously unexposed animals, local multiplication of the mycobacteria occurs and the resistance to phagocytic killing allows continued intracellular and extracellular replication. Infected host cells and mycobacteria

can reach local lymph nodes and from there may pass to the thoracic duct with general dissemination.

Clinical signs

Clinical signs are evident only in advanced disease and cattle with extensive lesions can appear to be in good health. Loss of condition may become evident as the disease progresses. In advanced pulmonary tuberculosis, animals may eventually develop a cough and intermittent pyrexia. Involvement of mammary tissue may result in marked induration of affected quarters, often accompanied by supra-mammary lymph node enlargement. **Tuberculous mastitis facilitates spread of infection to calves and cats, and is of major public health importance.**



Field and laboratory immunological tests for tuberculosis

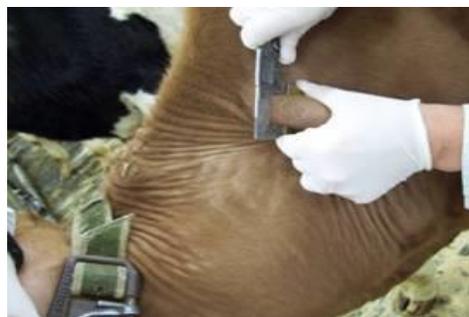
The tuberculin test,

Based on a *delayed-type hypersensitivity (type IV hypersensitivity)* to mycobacterial tuberculo-protein, is the standard ante-mortem test in cattle. The test can be adapted for use in pigs and farmed deer. Reactivity in cattle is usually detectable 30-50 days after infection.

Tuberculin, also called a *purified protein derivative (PPD)* prepared from *M. bovis* or *M. avium*, is a complex mixture of proteins, lipids, carbohydrates and nucleic acids.

Two main methods of tuberculin testing are employed:

1. In the *single intradermal (caudal fold) test*, 0.1 ml of bovine PPD is injected intradermally into the caudal fold of the tail. The injection site is examined 72 hours later and a positive reaction is characterized by a hard or oedematous swelling.



2. In the **comparative intradermal test**, 0.1 ml of avian PPD and 0.1 ml of bovine PPD are injected intradermally into separate clipped sites on the side of the neck about 12 cm apart. Skin thickness at the injection sites is measured with calipers before injection of tuberculin and after 72 hours. **An increase in skin thickness at the injection site of bovine PPD which exceeds that at the avian PPD injection site by 4 mm or more is interpreted as evidence of infection and the animal is termed a reactor.**

The reaction is characterized by thickening of the skin due to a mononuclear cell infiltration and sometimes oedema.

- **False positive reactions** which occur in the tuberculin test may be attributed to sensitization to mycobacteria other than *M. bovis*.
- **False negative test** results may be recorded: -
 - I. Cattle tested before delayed-type hypersensitivity to tuberculoproteins develops (at about 30 days post- infection) do not react.
 - II. In some cattle an unresponsive state, referred to as anergy, may accompany advanced tuberculosis.
 - III. A transient desensitization may follow injection of tuberculin. Reactivity usually returns within 60 days.
 - IV. Cows may be unresponsive to the tuberculin test during the early postpartum period

A number of laboratory-based tests have been developed in recent years for the diagnosis of tuberculosis. These include the lymphocyte transformation test, serological tests for circulating antibodies (such as the ELISA) and gamma interferon assays using whole blood. These *in vitro* tests are usually used in conjunction with the tuberculin test

Control

- Treatment and vaccination are inappropriate in control programmes for cattle.
- In many countries, tuberculin testing followed by isolation and slaughter of reactors has been implemented as the basis of national eradication schemes.
- Routine meat inspection forms part of the surveillance programme for bovine tuberculosis in many countries.
- Wildlife reservoirs such as badgers and possums are major obstacles to disease eradication in some countries. Effective measures for dealing with infected wildlife species have not been described.

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