Mycoplasmas

Introduction to Mycoplasma:

Mycloplasmas are the smallest, wall-less free living prokayotes belonging to class-Mollicutes. There were first discovered by Pasteur in 1843 when he was studying the causal organisms of pleuropneumonia in cattle.

He named it as Pleuropneumonia like organisms (PPLO) but failed to isolate them in pure cultures. These were first isolated by two French bacteriologists E. Nocard and E.R. Roux in 1898 from pleural fluids of catties affected with pleuropneumonia and these organisms were named as Mycoplasma in 1929 by Nowar.

It may be mentioned that Pleuropneumonia is a highly contagious disease of cattle and it first appeared in Germany and Switzerland in 1713 and it spread throughout Europe in the 18th Century. Mycoplasma mycoides was found to be the causal organism of Bovine and Cattle pleuropneumonia.

Mycoplasmas are highly pleomorphic, reproduce by budding and/or by fission and by producing small bodies. They lack sterols, a class of lipid invariably present as component of cell membrane of Eucaryotes, but are capable of incorporating exogenous sterols obtained from growth medium.

Therefore, most mycoplasma require a rich nutrient medium containing sterols and serum protein for growth. On solid (Agar) medium mycoplasmas form minute, transparent colonies that typically have a characteristic **"fried egg"** appearance.
Since their discovery it was found that members of mycoplasma are obligate parasites and pathogens of many mammalian and Avian hosts.

Plant Pathologists had not considered or even suspected mycoplasmas as causal agents of plant diseases before the discovery of Japanese workers Doi etal., (1967) and Ishii et.al., (1967).

They found that wall-less microorganisms resembling mycoplasmas were seen with electron microscope in the phloem of plants infected with yellow type and Witche's broom of alfa-alfa diseases. Such diseases were earlier thought to be caused by viruses.

Currently more than 15 distinct plant diseases are known to occur due to mycoplasma like organisms. Now the name of phytopathological mycoplasmas was changed to Phytoplasrna.

Phytoplasmas are wall-less prokaryote which are phytopathogenic and belong to class Mollicutes. Phytoplasmas basically survive in Phloem tissues of plants and produce symptoms like yellowing, phyllody and witche's brooms.

With the discovery of several groups of mycoplasma like organism, it has been categorised as Mycoplasmas (infect animals). Phytoplasmas (infect plants), Spiroplasmas (infect plants and insects). Archeoplasmas (infect animals, plants and insects) and Entomoplasmas (infect insects and plants).

Morphology of Mycoplasma:

Since mycoplasmas pass through many filters and grow on media without living tissues, these are considered to be intermediate between bacteria and viruses.

1. Mycoplasma are very small unicellular, usually non-motile, procaryotic organisms.

2. They can grow in cell free media forming, typical “fried egg” shaped colony.

3. They are highly pleomorphic (variable in shape) showing small coccoid bodies, ring forms and five filamentous forms which may be branched.

4. Mycoplasma cells are bounded by triple layered unit membrane without a rigid cell wall. They lack ability to synthesize cell wall material.

5. They are filterable through bacterial filter.

6. They are highly resistant to pencillium but inhibited by tetracyclines.

7. They are inhibited by specific antibody.

8. They require sterols for growth.

9. Mycoplasma have no history of reversion to or derivation from a bacterial parent.

10. Mycoplasma cells contain both DNA & RNA.

11. Reproduction is controversial – perhaps develop within filaments tiny coccoid structures called elementary bodies, released by fragmentation of filaments or by binary fission or by budding.

Cell-Shape of Mycoplasma:

Mycoplasmas vary in shape (Fig 19.10). These may be entire, spherical, polymorphic or irregular filamentous in form. The filaments may be branched or unbranched.

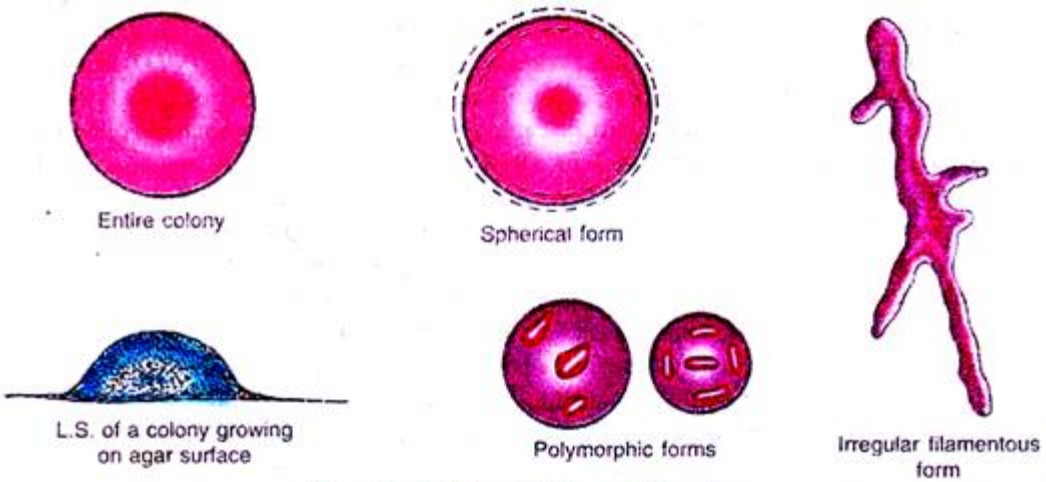

Fig. 19.10. *Different Cell Shapes of Mycoplasma*

Cell Structure of Mycoplasma:

The cells are small, and the diameter of the cells range between 0.3 and 0.9 μm. These are prokaryotic and do not contain a true nucleus.

Each cell is covered with a unit lipoprotein cytoplasmic membrane which is 7.5 – 10 μm thick. The cytoplasm contains genetic material (nucleoplasm like material) and ribosomes (Fig. 19.11). Both DNA and RNA act as genetic materials.

It is usually half that usually occurs in other prokayotes. The DNA amounts to 4 per cent and RNA about 8 per cent. Though gram negative, mycoplasmas stain slowly on long exposure to dyes.

Mycoplasmas are non-motile but show gliding slow movements. Mycoplasmas are sensitive to streptomycin, erythomycin and chloram phenicol but are insensitive to pencillin.

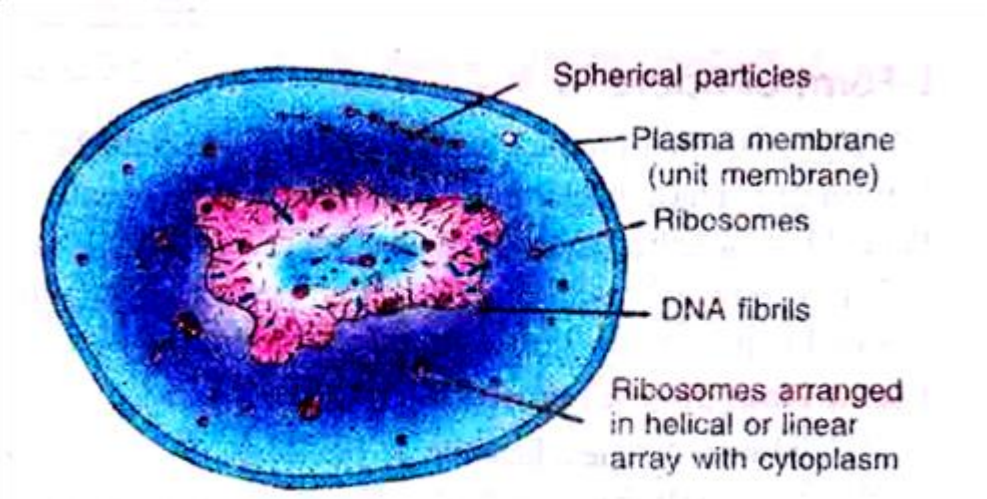

Fig. 19.11. *Cell Structure.*

Reproduction in Mycoplasma:

Mycoplasmas reproduce by budding and/or binary fission (Fig. 19.12). Cells of mycoplasma divide unevenly into very minute bodies called the elementary bodies or minimal reproductive units.

These are formed inside the large bodies or mature cells. Their size varies from 330 nm to 450 nm. These bodies are the smallest independent living entities so far known.

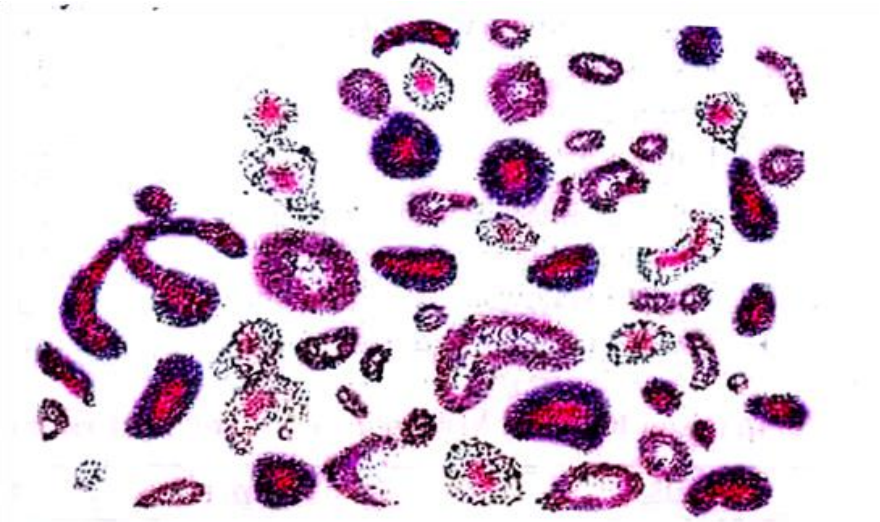

Fig. 19.12. *Several polymorphic mycoplasmas showing binary fission or budding.*

Transmission of Mycoplasma:

Mycoplasma like organisms (MLO) or phytoplasmas are usually present in phloem of the host plants and are transmitted from host to another host by leaf hoppers but some are transmitted by psyllids, treehoppers, plant hoppers and some possibly by aphids and miles.

Some of the pathogens are known to infect various organs of their leaf hopper or psyllid vectors and to multiply in their cells. The vectors cannot transmit the phytoplasma immediately after feeding on the infected plant but it begins to transmit if after an incubation period of 10 to 45 days depending upon the temperature.

Mycoplasmas are commonly found in soil, hot spring, sewage water and also in plants and animals including man. Borrel (1910) named these organisms Asterococcus mycoides. Later, in 1929, Nowak placed them under the genus Mycoplasma.

Mycoplasmas are tiny, virus-like non-motile prokaryotic organisms. They are the simplest and smallest known organisms capable of growing on cell free laboratory culture media containing sterols. Mycoplasmas lack definite cell wall and are characteristically delimited by a distinct, soft, flexible trilaminar unit membrane of lipoprotein.

Because of the soft and plastic membrane they can assume a variety of shapes and sizes (Pleomorphic). The electron micrographs have revealed that mycoplasmas are small spherical bodies or branched worm-like structures which are smaller than bacteria but are within the size range of large viruses.

They can pass easily through bacterial filter and can be squeezed through filter pores smaller than their actual diameter. They are highly resistant to many antibiotics.

The unit membrane of mycoplasma surrounds the cytoplasm which is packed with ribosomes, fibrilar DNA, one or more electron dense areas, and some empty vacuoles (Fig. 1.10).

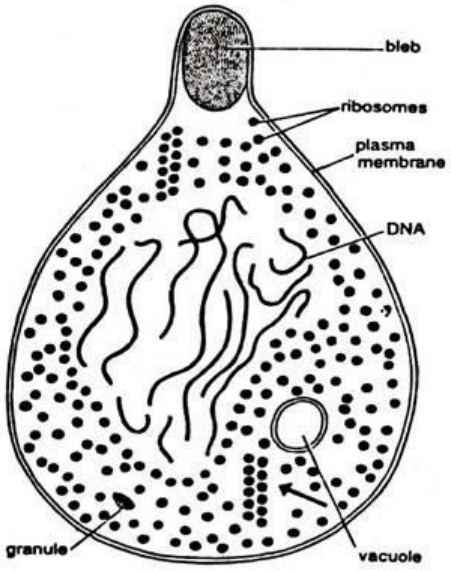

Fig. 1.10 Pleuropneumonia like organism (PPLO).

They are capable of performing all life activities. The genetic material of mycoplasma consists of a naked circular chromosome of fibrilar DNA which is about 3 nm in thickness and 1000 x 10^6 daltons in weight (1 dalton = 1/16 the atomic weight of oxygen = 1.650 x lo^{-24} g). This replicates in the same way as does the bacterial chromosome. The ribosomes are generally 72 S and are about 14 nm in diameter.

Reproduction in mycoplasma has not yet been conclusively proved. They can reproduce by binary fission, by formation of spores (elementary bodies), by filamentous growth and by budding.

Classification of Mycoplasmas:

Based on nutritional requirement, mycoplasmas are divided into the following three genera:

1. Mycoplasma:

They require cholesterol for their growth. They parasitise on animals including man by causing damage to the mucous membranes and different joints of the body.

2. Acholeplasma:

They do not require cholesterol for their growth. They are available in sewage water and soil as saprophytes and in vertebrates and also in plants as parasites.

3. Thermoplasma:

They also do not require cholesterol for their growth. They are aerobic microorganisms showing good growth in acidic pH between 0.96-3.0, with an optimum temperature of 59°C.

Structure of Mycoplasmas:

The cell is devoid of cell wall which makes them readily deformable showing irregular and variable shapes. They may be ring-like, granular, coccoid, pear-shaped, filamentous, etc. (Fig. 2.50). The filaments are of two types: unbranched or branched. The cells are very small and measure 0.3-0.9 μm in diameter.

The cells are covered by cytoplasmic (lipoprotein) membrane (Fig. 2.51). Cell membrane covers the cytoplasm which contains nucleoplasm like structure and ribosomes. The genetic material is composed of DNA and RNA. It is about less than 50%, the amount present in other prokaryotic organisms. The amount of RNA (8%) is more than DNA (4%).

They are usually non-motile, but some forms show gliding movements. They reproduce by vegetative means i.e., by binary fission and budding.

They are sensitive to antibiotics like chloramphenicol, streptomycin, erythromycin etc., but are insensitive to penicillin, ampicillin etc., due to the absence of cell wall.

Diseases Caused by Mycoplasma:

Mycoplasmas cause different serious diseases in plants and animals including man.

Some of these are:

(a) Plant Diseases:

(i) Little leaf disease of brinjal,

(ii) Bunchy top of papaya,

(iii) Big bud of tomato,

(iv) Witches broom of legumes,

(v) Yellow dwarf of tobacco,

(vi) Strip disease of sugarcane,

(vii) Clover dwarf,

(viii) Cotton vires- cence.

(b) Human Diseases:

(i) Primary atypical pneumonia (PAP) by Mycoplasma pneumoniae,

(ii) Mycoplasma hominis causes pleuropneumonia, prostatitis, inflammations of genitals etc.

(iii) Mycoplasma fermentants causes infertility in man.

(c) Animal Diseases:

(i) Mycoplasma agalactia causes agalactia of goat and sheep,

(ii) Mycoplasma mycoides causes pleuropneumonia of cattle,

(iii) M. bovigenitalium causes inflammation of genitals of different animals.