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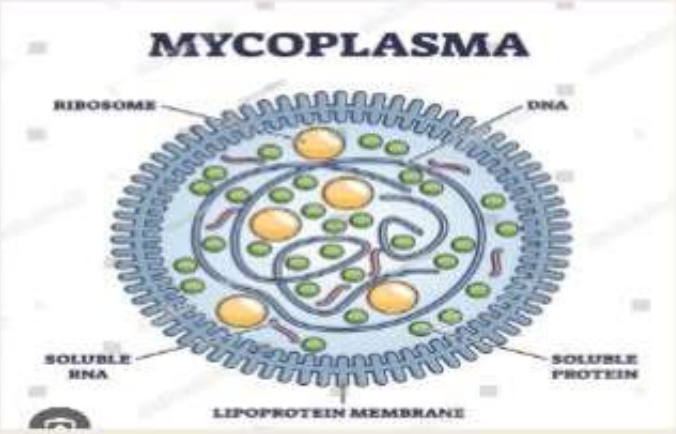
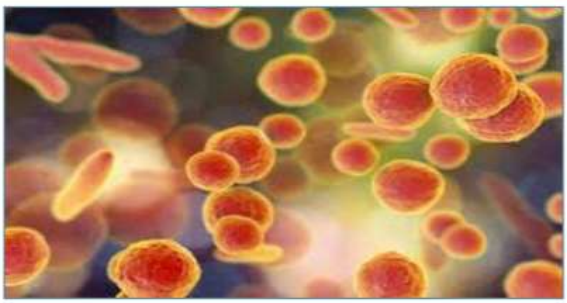
MYCOPLASMA

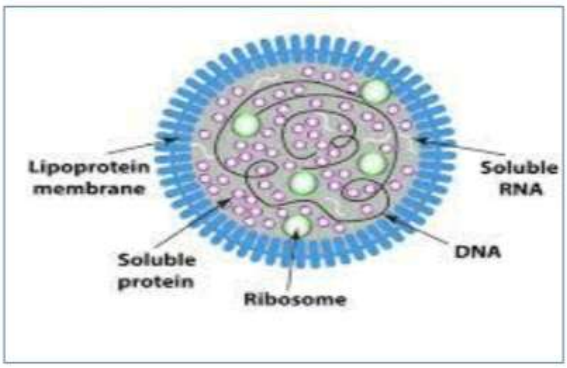
BOTANY (MAJOR) SEMESTER – I
UNIT -2 TOPIC

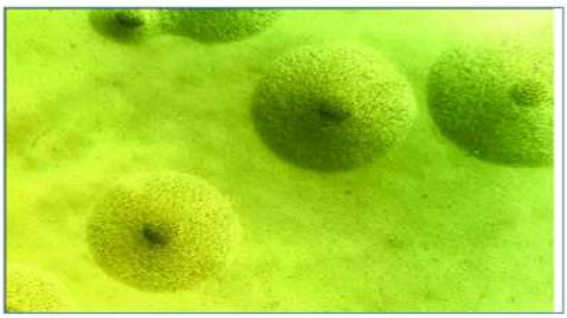


WHAT IS MYCOPLASMA ????

- *Mycoplasma* (plural mycoplasmas or mycoplasmata) is a genus of bacteria that lack a cell wall around their cell membranes.
- Mycoplasma are the smallest, wall-less free living prokaryotes belonging to class Mollicutes.
- This characteristic makes them naturally resistant to antibiotics that target cell wall synthesis (like the beta-lactam antibiotics).
- They can be parasitic or saprotrophic. Several species are pathogenic in humans, including *M. pneumoniae*, which is an important cause of "walking" pneumonia and other respiratory disorders, and *M. genitalium*, which is believed to be involved in pelvic inflammatory diseases.
- *Mycoplasma* species are the smallest bacterial cells yet discovered, can survive without oxygen, and come in various shapes.
- *M. genitalium* is flask-shaped (about 300 x 600 nm), while *M. pneumoniae* is more elongated (about 100 x 1000 nm).







ETYMOLOGY

- The term mycoplasma is derived from the Greek word *mykes* (fungus) and *plasma* (formed).
- They were the first discovered by Pasteur in 1843 when he was studying the causal organisms of pleuropneumonia in cattles. He named it as Pleuropneumonia like organisms (PPLO) but failed to isolated them in pure cultures.
- In 1889, Albert Bernhard Frank described these organisms as an altered state of plant cell cytoplasm resulting from infiltration by fungus-like microorganisms.
- These ere first isolated by the two French bacteriologist E. Nocard and E.R. Roux in 1898 from pleuro fluids of cattles affected with pleuropneumonia.
- These organisms were named as mycoplasma in 1929 by Nowak. He proposed the genus name *Mycoplasma* for certain filamentous microorganisms imagined to have both cellular and acellular stages in their lifecycles which could explain how they were visible with a microscope, but passed through filters impermeable to other bacteria.
- Now the name of phytopathological mycoplasma was changed to phytoplasma for plant. Phtoplasma basically survive in phloem tissue of plants and produced symptoms like yellowing, phyllody and witch's brooms.
- With the discovery of several groups of mycoplasma like organisms, it has been categorized as mycoplasmas (infect animals), phytoplasmas (infect plants), spiroplasmas (infect plant and insects), Archeoplasmas (infect animals, plants and insects) and entomoplasmas (infect insects and plants).

IMPORTANT CHARACTERISTICS OF MYCOPLASMAL

- These are the smallest prokaryotic organisms. Cell wall is absent and plasma membrane forms the outer boundary of the cell.
- Due to the absence of cell wall these organisms can change their shape and are pleomorphic.
- Lack of nucleus and other membrane-bound organelles. Genetic material is a single DNA duplex and is naked. ribosomes are 70S type. Some of the major characteristics of the best-studied mycoplasmas are summarized in table

Genus	No. of Recognized Species	Genome Size (Mb)	Sterol Requirement	Habitat	Other Distinctive Features
Acholeplasma	13	1.50–1.65	No	Vertebrates, some plants and insects	Optimum growth 30–37°C
Anaeroplasma	4	1.50–1.60	Yes	Bovine or ovine rumen	Oxygen-sensitive anaerobes
Asteroleplasma	1	1.50	No	Bovine or ovine rumen	Oxygen-sensitive anaerobes
Entomoplasma	5	0.79–1.14	Yes	Insects, plants	Optimum growth 30°C
Mesoplasma	12	0.87–1.10	No	Insects, plants	Optimum growth 30°C; sustained growth in serum-free medium only with 0.04% detergent (Tween 80)
Mycoplasma	104	0.60–1.35	Yes	Humans, animals	Optimum growth usually 37°C
Spiroplasma	22	0.94–2.20	Yes	Insects, plants	Helical filaments; optimum growth at 30–37°C
Ureaplasma	6	0.75–1.20	Yes	Humans, animals	Urea hydrolysis

- ❖ Mycoplasma are characterized by their small genomes, and simplified metabolic pathways. Their small genomes appear to be the result of genome reduction such that they now lack a variety of metabolic capabilities, including the ability to synthesize peptidoglycan precursors.

- ❖ Mollicute genomes are among the smallest found among bacteria, ranging from 0.7 to 1.7 Mb. The genomes of the human pathogens *Mycoplasma genitalium, M. pneumoniae,* and *Ureaplasma urealyticum* have fewer than 1,000 genes, suggesting a minimal genome size.

- ❖ Their limited number of genes reflects their inability to synthesize a number of macromolecules. For instance, because *M. genitalium* relies so heavily on its host's biosynthetic capacity, it has lost genes that encode enzymes needed to synthesize amino acids, purines, pyrimidines, and fatty acids.

- ❖ They possess a replicating disc at one end which assist replication process and also the separation of the genetic materials.

- ❖ Sterols are an essential component of the mycoplasma plasma membrane, where they may facilitate osmotic stability in the absence of a cell wall.

- ❖ They are among the smallest bacteria capable of self-reproduction. Most species are facultative anaerobes, but a few are obligate anaerobes. When grown on agar, most form colonies with a "fried egg" appearance because they grow into the agar surface at the center while spreading outward on the surface at the colony edges.

- ❖ Heterotrophic in nutrition. Some live as saprophytes but the majority are parasites of plants and animals. In addition, most species require sterols for growth, which they obtain from the host.

HABIT AND HABITAT OF MYCOPLASMAL

- These are distributed variously according to their habitat.
- More than 200 mycoplasma like bodies are found to be associated with sewage, plants, animals, insects, humus, hot water springs and other high temperature environment.
- They have been found in phloem tissues of diseased plants.
- At least eleven serologically and biologically distinct mycoplasmas have been found in man.
- *M. orale* and *M. salivarium* are found almost in every healthy adult. *M. hominis* is present in a large proportion in sexually active adults.
- Diseases like primary atypical pneumonia (PAP) in the mouth, pharynx and genito-urinary tract and tonsillitis in humans are caused by mycoplasma.
- *Mycoplasma* species have been isolated from women with bacterial vaginosis. *M. genitalium* is found in women with pelvic inflammatory disease.
- Mycoplasmas are associated with infant respiratory distress syndrome, bronchopulmonary dysplasia, and intraventricular hemorrhage in preterm infants.
- Species of *Mycoplasma*, have been recovered from humans, but are assumed to have been contracted from a non-human host. The following species use humans as the primary host: *M. amphoriforme, M. buccale, M. faucium, M. fermentans, M. genitalium, M. hominis, M. incognitus, M. lipophilum, M. orale, M. penetrans, M. pirum, M. pneumoniae, M. primatum, M. salivarium, M. spermatophilum* etc.

CLASSIFICATION OF MYCOPLASMAL

❖ These are distributed variously according to their habitat.

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

❑ 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.

❑ 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.

❑ 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.

MORPHOLOGY OF MYCOPLASMA

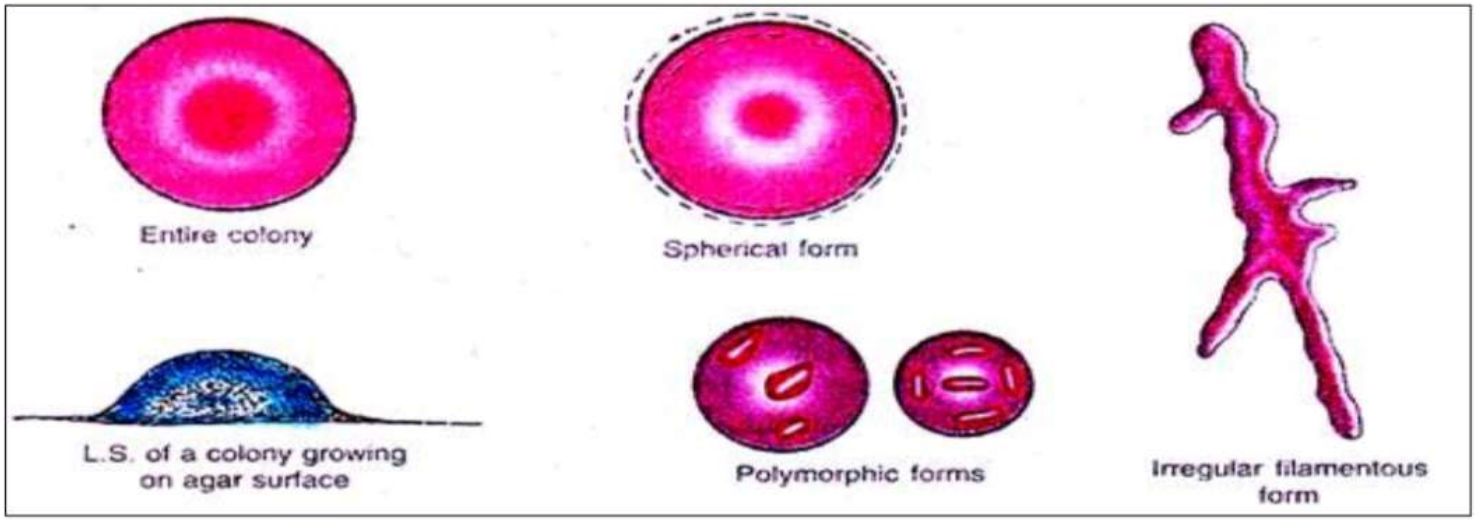
- Since mycoplasmas pass through many filters and grow on media without living tissue, these are considered to the intermediate between viruses and bacteria.
- Mycoplasma are very small, unicellular, usually non motile prokaryotic organisms.
- They are filterable through bacteria filters.
- They are highly resistant to penicillium but inhibited by tetracyclines.
- They can grow in cell free media forming typical "fried egg shaped" colony.
- They are highly plueromorphic (variable in shape) showing small coccoid bodies, rings forms and five filamentous forms which may be branched.

Mycoplasma pneumoniae shows pleomorphic nature

Mycoplasma colonies appear as fried egg

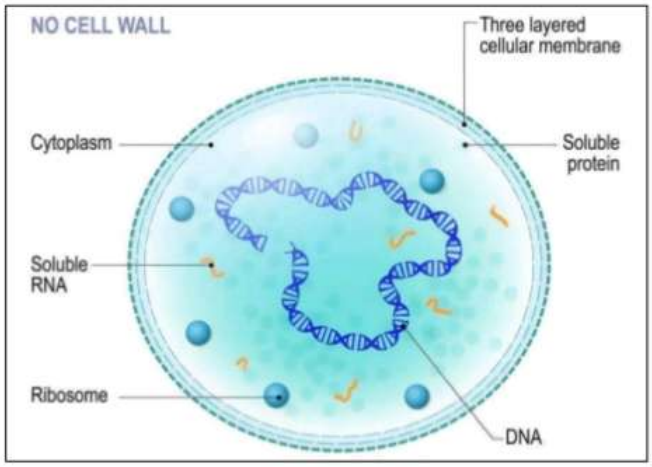
MORPHOLOGY OF MYCOPLASMA

- Mycoplasma cells are bounded by triple layer unit membrane without a rigid cell wall. They lack ability to synthesize cell wall material. They required sterols for growth.
- Mycoplasma have no history of reversion to or derivation from a bacterial parent. Mycoplasma cell contain both DNA and RNA
- Reproduction is controversial perhaps developed within filaments tiny coccoid structures called elementary bodies, released by fragmentation or binary fission or by budding.
- Mycoplasma vary in shapes. These may be entire, spherical, ploymorphic or irregular filamentous in form. The filament may be branched or unbranched.



CELL STRUCTURE OF MYCOPLASMA

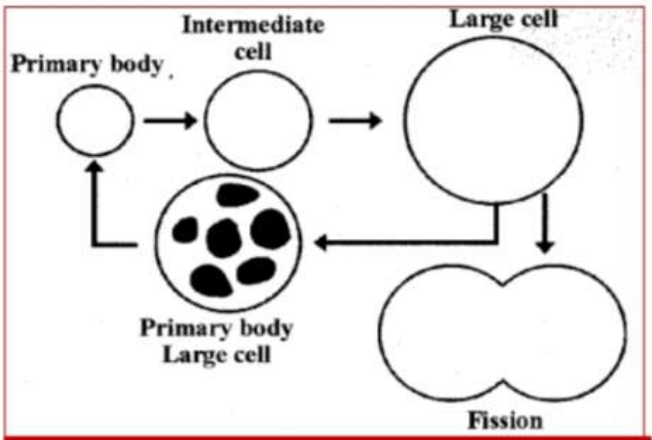
- In mycoplasma, the cells are small varying from 300 nm to 800 nm in diameter.
- Rigid cell wall is absent. Cells are surrounded by a triple layered lipo-proteinaceous unit membrane. It is about 10 nm thick. Unit membrane encloses the cytoplasm.
- Within the cytoplasm RNA (ribosomes) and DNA are present. The ribosomes are 14 nm in diameter and 70 S type.



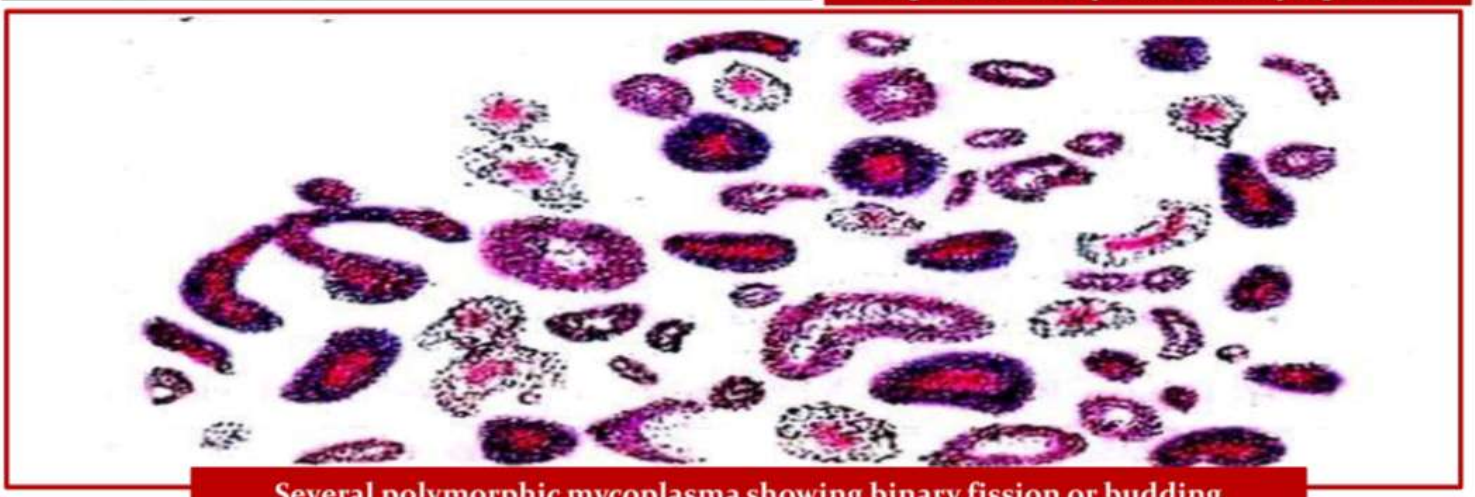
- DNA is double stranded helix. It can be distinguished from bacterial DNA by its low guanine and cytosine content.
- The DNA is up to four percent and RNA is about eight percent and it is less than half that usually occurs in other protoplasm's.
- The guanine and cytosine (G and C) contents in DNA range from 23-46 percent.
- In some species e.g., *M. gallisepticum* some polar bodies protrude out from one or the other end of the cell.
- These are called bleb and are considered to be the site of enzymatic activities and attachment during infection.

REPRODUCTION IN MYCOPLASMA

- Mycoplasmas reproduce by budding and/or binary fission.
- 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.



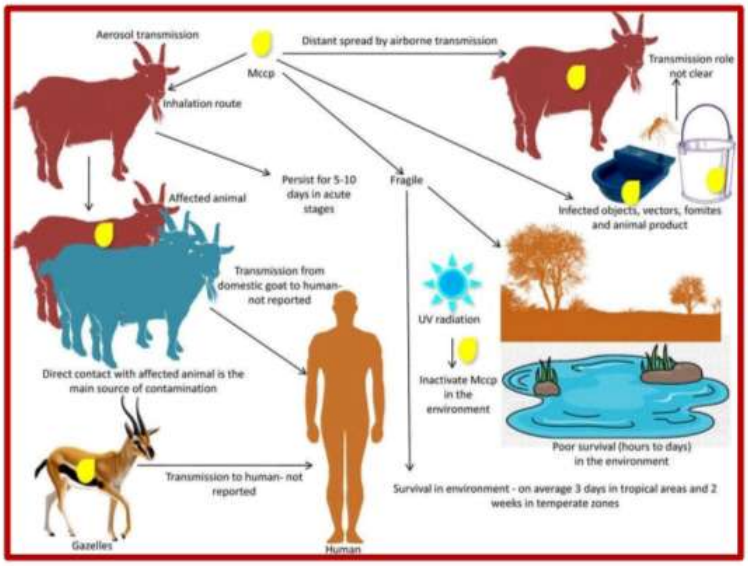
Reproduction by fission in mycoplasma

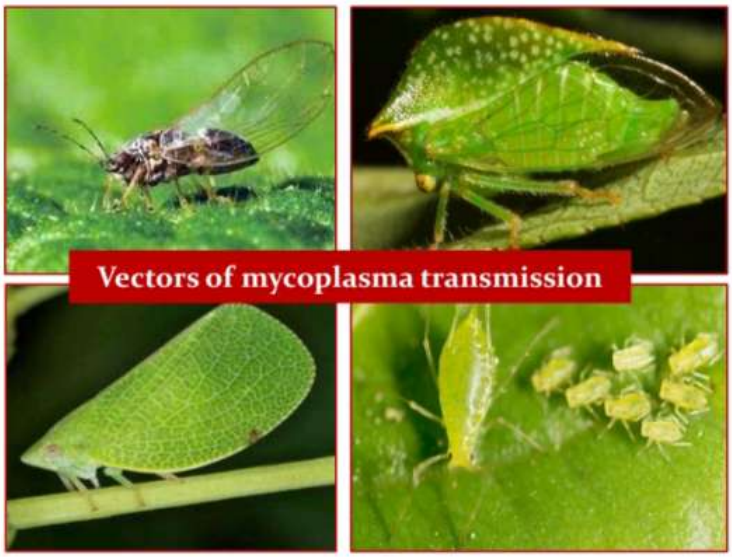


Several polymorphic mycoplasma showing binary fission or budding

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.





DISEASES CAUSED BY MYCOPLASMA

❖ Mycoplasmas cause different serious diseases, these are:

❑ **Plant Diseases:**

- Little leaf disease of brinjal
- Bunchy top of papaya
- Big bud of tomato
- Witches broom of legumes
- Yellow dwarf of tobacco
- Clover dwarf
- Cotton vires- cence

❑ **Human Diseases**

- Primary atypical pneumonia (PAP) by *Mycoplasma pneumoniae*
- *Mycoplasma hominis* causes pleuropneumonia, prostatitis, inflammations of genitals etc.
- *Mycoplasma fermentants* causes infertility in man.

❑ **Animal Diseases:**

- *Mycoplasma agalactia* causes agalactia of goat and sheep
- *Mycoplasma mycoides* causes pleuropneumonia of cattle
- *M. bovigenitalium* causes inflammation of genitals of different animals.

Little leaf of brinjal

Primary atypical pneumonia

Agalactia of goat and sheep

KEY POINTS OF THE LECTURE

- *Mycoplasma* (plural mycoplasmas or mycoplasmata) is a genus of bacteria that lack a cell wall around their cell membranes.
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- Some of the pathogens are known to infect various organs of their leaf hopper or psyllid vectors and to multiply in their cells.
- Mycoplasmas cause different serious diseases, these are: in plants (Little leaf disease of brinjal, Bunchy top of papaya, Big bud of tomato, Witches broom of legumes, Yellow dwarf of tobacco, Clover dwarf etc),
- In animals (*Mycoplasma agalactia* causes agalactia of goat and sheep, *Mycoplasma mycoides* causes pleuropneumonia of cattle, *M. bovigenitalium* causes inflammation of genitals of different animals etc).
- In humans (Primary atypical pneumonia (PAP) by mycoplasma pneumoniae, *Mycoplasma hominis* causes pleuropneumonia, prostatitis, inflammations of genitals, *Mycoplasma fermentants* causes infertility in man etc).
- The genome of mycoplsma are considered as the smallest genome.
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