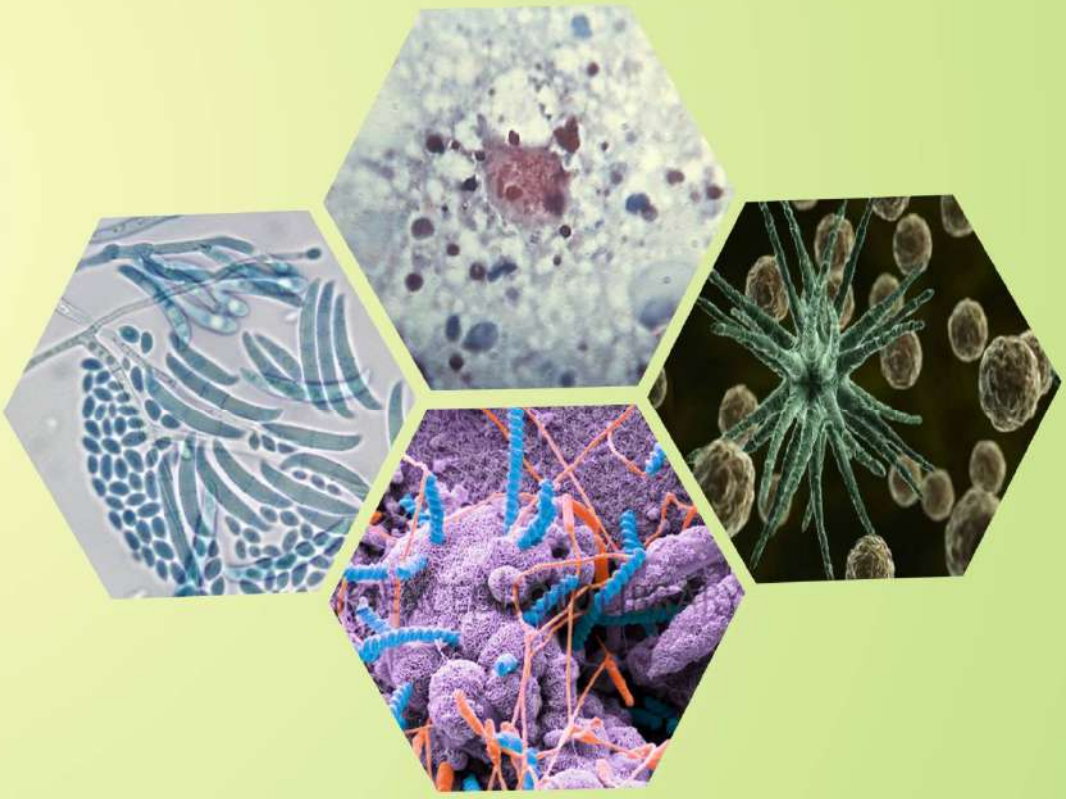
A STUDENT HANDBOOK ON SPIROCHAETES, RICKETTSIAE, CHLAMYDIA AND GENERAL AND PATHOGENIC MYCOLOGY

By

Dr. Subha Ganguly and Ms. Satarupa Roy



A STUDENT HANDBOOK ON SPIROCHAETES, RICKETTSIAE, CHLAMYDIA AND GENERAL AND PATHOGENIC MYCOLOGY

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A Student Handbook On Spirochaetes, Rickettsiae, Chlamydia And General And Pathogenic Mycology

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PREFACE

The book has been constructed to highlight on the various important issues related to spirochaetes, rickettsiae, chlamydial agents and general and pathogenic mycology. The book provides an overview on the relevant area of focus. The author also duly acknowledges the various researches as carried out by the investigators worldwide on the related issues as discussed in this text.

Dr. Subha Ganguly

Satarupa Roy

DEDICATION

This book is dedicated to the Students of Veterinary and Animal Sciences and has been composed exclusively for providing firsthand knowledge on the related issues for the development of science, education and technology. I also want to express my indebtnesss towards my Parents and family members for their constant encouragement in preparing this Book.

Dr. Subha Ganguly

Satarupa Roy

CONTENTS

Chapter 1: Spirochaetes

Characteristics of spirochaetes are:

(a) Helical shape
(b) Ability to twist their shape
(c) Special flagella which are known as periplasmic flagella (axial fibrils or endoflagella).

The two spirochaete families, namely *Spirochaetaceae* and *Leptospiraceae* differ from each other in the following properties:

(a) Unlike *Spirochaetaceae*, *Leptospiraceae* has hooked ends.
(b) *Leptospiraceae* have diaminopimelic acid as a component of peptidoglycan in the cell wall rather that L-ornithin found in *Spirochaetaceae*.
(c) Leptospires utlize long chain fatty acids as a source of carbon and energy which is not the case with *Spirochaetacae* organisms.
(d) Leptospires are obligate aerobes, whereas *Spirochaetaceae* organisms are anarobic, facultative anaerobes or microaerophilic.
(e) *Treponema* and *Borrelia* genera belong to the family *Spirochaetaceae* and Leptospira to the family *Leptospiraceae*.

Leptospira

Characteristics of Leptospira organisms:

(a) They are flexible, helical, motile and wound tightly.
(b) Their length is 4-20 µm, one or both ends are bent into a hook.
(c) Obligate aerobes, incubation temperature 25-30°C.
(d) Readily grow on a variety of artificial media having 10% rabbit serum. Pathogenic leptospires require long chain fatty acids in the media. Fletcher's semi-solid medium is satisfactory.
(e) Some leptospires are saprophytic and non-pathogenic. They are found in fresh and marine waters and sewage. Parasitic strains are pathogenic in wide variety of domestic and wild mammals.
(f) Leptospires stain with difficulty, but can be demonstrated with fluorescent antibody or silver deposition technique by phase contrast, dark field and electron microscope.
(g) Various enzymes like catalase, oxidase, lipase and hyaluronidase are produced.

Various *Leptospira spp*. are

(a) *L. interrogans*, comprised of 23 serogroups and more that 200 serotypes.
(b) *L. biflexa* found on surface water.
(c) *L. parva* isolated from tap water.

Weil's disease in man:

It is caused by *L. interrogans* serotype *icterohaemorrhagiae* and is characterized by severe febrile illness, jaundice, haemorrhages and involvement of kidneys. Many other immunological types of leptospirae cause a variety of illness which may mot be associated with jaundice. The most important reservoir of Weil's disease agent are wild rats.

The routes of transmission of leptospirae are

(a) Orally by contaminated food or water.
(b) By abraded skin.
(c) Through mucous membrane.

Antigens of pathogenic leptospira:

(a) Somatic antigen is genus specific and lipopolysaccharide in nature. It is common in all leptospires.
(b) Surface antigen is serotype specific and polysaccharide in nature. Serotypes are determined by agglutination reactions.
(c) The flagellar antigens of leptospires also reveal both genus and type specific antigens.

Clinical manifestations due to *L. icterohaemorrhagiae*, *L. canicola* and *L. pomona*:

(a) *L. icterohaemorrhagiae* produces typical jaundice in man and dogs. In man it produces Weil's disease. Most human infection occurs by contact with fresh brat urine or through consumption of contaminated water.
(b) *L. canicola* is pathogenic to dogs and causes uraemia and haemorrhages but mild jaundice. There is rise in temperature in beginning which declines later on, weakness of the posterior extremities, anorexia, depression, vomiting and marked thirst. Hamsters are the experimental animals of choice.
(c) *L. pomona* in cattle causes fever, loss of milk production, abortion, haemolytic anaemia, haemoglobinuria, loss of appetite and rarely jaundice. Abortion and

similar other symptoms are produced in horses and swines also. In human, the symptoms are fever, headache, backache and general muscle pain.

Diagnosis of leptospirosis:

(a) Direct microscopical examination of blood.
(b) Culturing the blood on media enriched with 10% serum. The inoculated media is incubated for 10-12 days.
(c) Blood or urine from rodents can be inoculated into guinea pigs by intraperitoneal route.
(d) After second week of illness the serum of patients can be tested by agglutination test with suspension of killed leptospires pooled together.

Borrelia

Borrelia organisms have following characteristics:

(a) They are parasites of wild rodents, small mammals and arthropods associated with these animals.
(b) Their spirals are more loosely wound than treponemes with open coils.
(c) Contains 12-15 axial fibrils inserted at each end.
(d) Can be propagated in young mice, rats and chicken embryos or in complex medium, under microaerophilic conditions.
(e) Various strains of *Borrelia* do not undergo antigenic variations.
(f) They are transmitted to vertebrates by blood sucking arthropods.
(g) Cause louse borne or tick borne epidemic relapsing fever in humans and tick borne spirochaetosis in birds.
(h) The G+C content of DNA is 27-32 mol. %.

Different *Borrelia spp*. and diseases caused by them:

(a) *B. burgdorferi*: It causes lyme disease in human. Lyme disease has 3 stages, in stage I there is erythema chronica migrans (ECM), in stage II which is 4-5 weeks after stage I there is cardiac or neurological complications. Stage 3 is observed months later in which there is recurrent arthritis. The disease occurs in North America, Europe and Australia.
(b) *B. recurrentis*: It uis the causative agent of relapsing fever in man.
(c) *B. coriaceae*: It causes epizootic bovine abortion and is transmitted by soft tick, *Ornithodorus*.
(d) *B. anserina*: It causes septicaemic disease called spirochaetosis in fowls. The disease is characterized by acute septicaemia causing death in 3-4 days. There is high temperature, greenish diarrhoea, paralysis, emaciation, anaemia and

enlarged spleen. The morganiosms can be isolated from blood at height iof temperature. The disease spreads through ticks.

Endemic relapsing fever is caused by *B. hermsii*, *B. turicatae*, *B.parkeri* and *B. hispanica*.

Diagnosis of fowl spirochaetosis:

(a) By clinical symptoms.
(b) Stained blood smears at high temperature
(c) Experimental inoculation of blood at height of temperature in chicks or in embryonated eggs.
(d) Testing the serum for agglutinating antibodies after about 1 week of onset of disease.

Treponema

T. pallidum was first discovered by Schaudinn and Hoffmann in 1905.

Characteristics of *Treponema pallidum*:

(a) They are unicellular, spiral shaped and extremely slender.
(b) They are host specific and many are pathogenic.
(c) Anaerobic or microaerophilic.
(d) Extremely difficult to cultivate.
(e) Motile with periplasmic flagella.
(f) The wall of *T. pallidum* is peptidoglycan in nature.
(g) *T. pallidum* is sensitive to penicillin.
(h) Treponemes multiply by binary fission.
(i) They have 4-14 spirals and are 5-20 µm in length and 0.4 µm thick.
(j) The generation time of *T. pallidum* is 8-10 hours.
(k) Suspesions of *T. pallidum* in glycerine, preserved below -70^{o}C can be kept viable for years.
(l) They are difficult to stain. Staining can be done either with prolonged Giemsa staining or silver staining methods.
(m) Cytochrome b and c are presnet and glucose is utilized via Embden-Meyerhof and hexose monophosphate pathways.
(n) They are resposible for syphilis in man which spreads by sexual contact.
(o) The morphology of treponemes can be studies by dark field and phase contrast microscopy.
(p) Noguchi medium with a layer of liquid paraffin has been used to ghrow some strains.
(q) Treponemes can be maintained in laboratory by incoculating in the testes of rabbits. Generation time is about 10 hours.

(r) After about 2 hours of primary stage, syphilis in man can be diagnosed by Kahn's CF test and *T. pallidum* immobilization tests. Kahn test is slide flocculation test.

Human syphilis occurs in primary, secondary and late or tertiary stages. Wasserman test to diagnose syphilis is a complement fixation test. Wasserman reaction was described by Wasserman, Neisser and Bruck in 1906. Cardiolipin used for Wassermann test is an alcoholic extract of naormal cardiac muscle. Average inclubation period of syphilis is about 3 weeks. The Wassermann test is based on the measurement of Reagin.

Diagnosis of syphilis:

(a) VDRL test: VDRL test is Venereal Disease Research Laboratory test in which microscopic agglutinationscreening is done for the detection of Wasserman antibodies in the serum of syphilitic patients.The antigen used in the test is cardiolipin, a non-treponemal antigen. The cardiolipin is an extract of beef heart muscle. Anticardiolipin antibodies found in syphilitic patients are detected by this test. The test is non-specific in nature. VDRL test is microscopic slide flocculation test.

(b) Fluorescent antibody test: In this test patient's serum is tested with specific treponemal antigen which can be obtained from cultivation of non-virulent strains or obtained from non-syphilitic lesions.

(c) *T. pallidum* immobilization test (TPI): In this test patient's serum is used to immobilize treponemes on the slide. Treponemes are obtained from syphilitic lesions in rabbits. The slide is incubated with guinea pig complement for about 18 hours to kill or immobilize the organisms. The test is read under phase contrast or dark field microscope. It is the most specific test for diagnosis of syphilis.

***Treponema spp*. and diseases caused by them are as follows:**

(a) *T. pallidum* subsp. *pallidum* causes syphilis in man. The disease is spread by sexual contacts and also congenital.

(b) *T. pallidum* subsp. *pertenue*: It causes yaws, a skin disease in humans. It spreads by direct contact.

(c) *T. carateum*: It causes Pinta, a skin disease in human beings. It also spreads by direct contact.

In primary syphilis,

(a) There is localized single ulcer.

(b) The initial lesion appears 10-30 days after contact.

(c) Treponema may be demonstrated in the chancre (hard swollen initial lesion of syphilis) by dark field microscopy.

Secondary syphilis is characterized by inabilty to find treponemes from lesions.

Chapter 2: Rickettsiaceae

Rickettsiaceae

Tribes and genera within the family *Rickettsiaceae*:

Tribe: 1. *Rickettsiae*

Genera (a) *Rickettsia*

(b) *Rochalimaea*

(c) *Coxiella*

2. *Ehrlichiae*

Genera (a) *Ehrlichia*

(b) *Cytoecetes*

(c) *Cowdria*

(d) *Neorickettsia*

3. *Wolbachieae* They are non-pathogenic for vertebrates but infect artropods only.

Characteristics of the microorganisms under the tribe *Rickettsieae*:

(a) Except the organisms of genus *Rochalimaea*, other organisms are obligate intracellular parasites.

(b) Except the organisms of genus Coxiella, others can grow in non-phagocytic cells.

(c) The organisms are rod-shaped or coccobacillary forms but much smaller than pathogenic bacteria. Their size is about 0.3 µm.

(d) They have longer generation time than most other bacteria, rickettsias multiply by binary fission.

(e) Their transmission between hosts usulally depends on arthropod vectors. Arthropods are their natural hosts in which they do not produce any disease.

(f) They are Gram negative except *Coxiella burnetii* which are Gram positive. They stain poorly. Giemsa stain gives satisfactory staining.

(g) The chemical composition of cell wall is similar to Gram negative bacteria.

(h) The G+ C content of DNA is 28-33 mol %.

(i) *Rochalimaea* species grow in media without cells and in vivo on the surface of the cells.
(j) They have single chromosome, also have ribosomes, cytoplasmic membrane and a cell wall like bacteria.
(k) They possess many enzymatic activities.
(l) *Rickettsiae* are susceptible to tetracyclines, sulfonamides and erythromycin.
(m) *Rickettsiae* multiply in the nucleus or the cytoplasm of host cells.
(n) *Rickettisiae* multiply in most animals, tissue cell cultures, embryonated chicken eggs and artificial media.
(o) The *Rickettsiae* multiply in the gut of arthropod vectors and infect the hosts through bites by infected saliva.

Rickettsial species, disease caused by them and arthropod vectors and vertebrate hosts

S.No.	Species	Diseases in man	Arthropod vector	Vertebrate hosts
1.	*R. prowazekii*	Endemic typhus and Brill Zinsser disease	Body louse and flea	Men
2.	*R. typhi*	Murine typhus (endemic typhus)	Rat flea	Rats
3.	*R. richettsii*	Rocky mountain spotted fever	Tick	Wild mammals, birds, dogs
4.	*R. conorii*	Boutonneuse fever	Tick	Small wild animals, dogs
5.	*R. australis*	Queensland tick typhus	Tick	Small wild rodents
6.	*R. sibirica*	Siberian tick typhus	Tick	Wild and domestic animals
7.	*R. akari*	Rickettsial pox	Mite	House mice
8.	*R. tsugtsugamushi*	Scrub typhus	Mite	Small wild rodents, birds
9.	*Ro. quintana*	Trench fever	Body louse	Men
10.	*C. burnetii*	Q fever		Small wild mammals, cattle, sheep,

				goats (without arthropod vectors)

Epidemic typhus:

The disease is caused by *R. prowazekii*. The disease occurs in two forms:

(a) Primary or epidemic form: Incubation period is 9-12 days, fever, headache and rash at the end of first week, death or recovery in 2-3 weeks.

(b) Recrudescent typhus: Months or years after primary infection, latent infection breaks out in some individuals which is known as recrudescent or Brill-Zinsser disease. The disease is milder than primary disease.

All rickettsiae are Gram negative except *C. burnetii*.

Except *Rochalimaea* no other rickettsiae grow on artificial media.

The generation time of Rickettsiae is about 8-12 hours.

The arthropod vector of scrub typhus is mite.

Q fever is a zoonotic disease. Q fever infection in man is by ingestion of contaminated material with tick faeces, by inhalation of dust containing *C. burnetii* and by consuming contaminated unpasteurized milk.

Diagnosis of rickettsial diseases:

(a) By isolation of organisms by inoculation in susceptible laboratory animals or tissue cultures.

(b) Microscopic demonstration of organisms in target cells, in stained blood smears or in sections of stained blood smears or in sections of skin biopsy and in tissues labeled with fluorescent labeled antibodies.

(c) Specific antibody response detected by serological tests, i.e. indirect fluorescent antibody test, CFT with soluble antigens, haemagglutination reaction using erythrocyte sensitizing subject and ELISA.

(d) Weil-Felix test depends on serological cros reactions between some members of Rickettsia and OX 2 and OX 19 of *Proteus* strains. Except trench fever and Q fever almost all species of Rickettsia give posiive Weil-Felix reaction with OX 2 and/or OX 19 strains of *Proteus*.

Ehrlichia

(a) Intracytoplasmic rickettsiae are pathogenic for some mammals, but not for human beings.
(b) Associated with monocytes and lymphocytes.
(c) *E. canis* causes canine rickettsiosis which is an acute febrile disease.
(d) Bovine and ovine infections are milder.
(e) *E. canis* remain as clusters in cytoplasm of monocytes when stained with Giemsa stain.
(f) It is sensitive to tetracycline.
(g) Infection is not transmissible to lab animals and chicken embryos.

Cytoecetes

(a) Causes tick borne fever in cattle and sheep.
(b) *C. phagocytophilia* and *C. bovis* are transmitted through Ixodes ticks.
(c) The organisms resemble *Ehrlichia*, but found in neutrophils, eosinophils, basophils and monocytes.
(d) In bovine it causes petechial fever (Ondiri disease). The organisms multiply in the vascular epithelium of blood vessels causing thrombosis and haemorrhages.
(e) The organisms are resistant to penicillin and streptomycin.
(f) Various developmental forms of organisms are found in the leucocytes in clusters.

Cowdria

(a) There is single species, *C. ruminantium* which causes the disease heart water in cattle, sheep and goats.
(b) The disease is transmitted by the tick, *Amblyomma*.
(c) The disease heart water is characterized by fever and increased vascular permeability.
(d) The organism is 0.2-0.8 µm in size, pleomorphic and found mainly in the vascular endothelial cells.
(e) The organisms are Gram negative and stained with Giemsa stain.
(f) It is sensitive to tetracyclines.

Neorickettsia

N. helminthoeca causes an acute and genel fatal disease known as salmon poisoning in dogs that have ingested the metacercariae of the fluke, *Nanophyetus* found in salmon fishes on west coast of America. The disease is of interest as the disease is transmitted by trematode rather than an arthropod. The organism is

predominantly found in the fixed reticulo-endothelial cells of dogs. In stained preparations with Giemsa, the organisms appear as single bodies, pleomorphic and 0.3-0.5 µm in size.

Chapter 3: Chlamydia

Chlamydial microorganisms have the following characteristics:

(a) Spherical or ovoid Gram negative microorganisms.
(b) Undergo replication cycle in the cutoplasm of the host cells. They do not grow on artificial media.
(c) The infective form is the ;'elemnetary body'measuring 200-300 nm in diameter.
(d) Elementary body is transformed in host cell cytoplasm to vegetative form which are 600-1000 nm in diameter.
(e) The vegetative form undergoes a series of fissions to produce new elementary bodies contained within a cytoplasmic inclusion body.
(f) Pathogenic to man, animal and human hosts.

Chlamydial reproduction:

(a) Infectious particle or elementary body is taken into host cell by phagocytosis.
(b) The lelmtary body ghets nclosed in a membrane bound vacoule in the cytoplasm of host cell.
(c) Within vacuole the elementary body is reorganized into a reticulate body (having less dense nucleoid material).
(d) The nuclear material undergoes binary fission to form a number of reticulate bodies. The reticulate bodies then undergo reorganization into elemnatry bodies. This aggregate of reticulate and lementary bodies within the vacuole of hiost cell forms host cell inclusion which can be seen by light microscopy.
(e) The progeny elemenary bodies are liberated from host cell and infect other cells.

Chlamydiae resemble rickettsiae in the following characteristics:

(a) They both are Gram negative and stain with Giemsa stain.
(b) They are sensitive to antibiotics effective against other bacteria.
(c) Cell wall of both are same as Gram negative bacteria.
(d) Both are obligate intracellular parasites.
(e) Both contain RNA and DNA.
(f) The size of elementary bodies of chlamydiae and rickettsiae is more or less equal (about 0.3 µm).

Infection caused by *Chlamydia trachomatis*:

Some serotypes cause trachoma, a chronic keratoconjunctivitis. Infection occurs directly from infected persons, fomites or thorugh flies. Other serotypes may cause sexuallyu transmitted urethritis and sexually transmitted lymphogranuloma venereum disease.

Infection caused by *C. psittaci*:

It causes psittacosis in psittacine birds. The infected birds may be symptomless or may bcom eseriously ill causing mortlality. The birds may have diarrhoea, respiratory tract infection and conjunctivitis. Human beings ra einfected from dust laden chlamydiae by respirattory tract from shedder birds or infcted persons. In human beings, there may be mild respiratory infection or pneumonia and may involve CNS causing coma, convulsions and death. In othe domestic animals, it may cause abortion.

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Chapter 4: General and Pathogenic Mycology

General characteristics of fungi:

(a) Fungi are eukaryotic organisms.
(b) They are comprised of molds and yeasts.
(c) Molds are filamentous and multicellular, but yeasts are usually unicellular.
(d) The basic structures of fungi are the hyphae which may be septate of aseptate.
(e) A large mat of hyphae is called mycelium which may be vegetative type or aeril or reproductive type.
(f) A septate hyphae may contain one or more nuclei in each cell, wereas aseptate hyphae form one large cell containing many nuclei.
(g) Yeasts are devoid of hyphae and reproduce by budding.
(h) Fungi reproduce by sexual or asexual methods.

Major characteristics of four classes of pathogenic fungi:

(a) ***Phycomycetes*****:** Non-septate, reproduce sexually and asexually by sporangia which contain sporangiospores. Sexual spores are thick walled resting spores called zygospores or oospores. Only a few human and animl pathogens occur in this class. Examples are Mucor and Rhizopus.

(b) ***Ascomycetes*****:** Contain large number of fungi including molds and yeasts, hyphae septate, sexual and asexual reproduction. Asexual reproduction takes place by budding. Sexual reproduction is by sexual spores called ascospores. Examples are true yeasts (*Saccharomyces cerevisiae*), *Neurospora*, *Penicillim* and *Aspergillus*.

(c) ***Basidiomycetes*****:** Mycelium septate, reproduce asexually or sexually by basidiospores contained in the basidium. Examples are mushrooms, rusts, smuts causing diseases in plants.

(d) ***Deuteromycetes* (*Fungi imperfecti*):** The fungi in which sexual reproduction is not detected are included in this group. They are septate and reproduce asexually. Most of the human and animal pathogenic fungi belong to this class.

Superficial mycoses: These diseases are called dermatomycoses and occur n nails, hair, skin and mucous membranes. Many of these fungi cause ringworm or tinea and are called dermatophytes.

Diseases caused by dermatophytes

Group	Species	Disease
(a) Epidermophyton	*E. floccosum*	Infection of fingers and nails of fingers and toes.
(b) Microsporum	*M. audouinii*	Ringworm of scalp in children.
	M. canis	Infection of skin and hair in dogs, cats and other animals, causes tinea capitis in children.
(c) Trichophyton	*T. mentagrophytes*	Primarily a parasite of hair
	T. rubrum	Causes ringworm and infects hair
	T. verrucosum	Causes ringworm in cattle
	T. gallinae	Infection in chicken

Systemic or deep mycoses:

Group	Species	Disease
(a) Cryptococcus	*C. neoformans*	Cryptococcosis is subacute or chronic infection involving brain and mninges in humans, occasionally in dogs and horses, many other affect other parts of the body. Isolated from pigeon droppings
(b) Blastomycosis	*B. dermatitidis*	Resembles lung TB charactyerized by chronic granlomatous suppurative lesions of any body tissue.
(c) Paracoccidioidomycosis (South American blastomycosis)	*B. brasiliensis or Paracoccidioides brasiliensis*	Lesions in mouth and GI tract and lymph nodes.
(d) Coccidioidomycosis	*C. immitis*	It is highly infectious

		found in soils of some areas of USA.
(e) Histoplasmosis	*H. capsulatum*	Acute or chronic, localized or disseminated infection of reticuloendothelial system.
(f) Moniliasis (Candidiasis)	*C. albicans*	Found on mucous membranes of intestines. Infection in mouth is called Thrush. May also cause endocarditis, pulmonary infection and vaginitis.
(g) Rhinosporidiosis	*R. seeberi*	Chronic granulomatous disease characterized by formation of polyps in m.m. of nose, eyes, ears and rarely other parts of the body.

Cryptococcus neoformans:

Morphology: The fungus is spherical, resemble true yeasts and large variation in cell diameter. All strains produce very thick capsule. It reproduces by budding. No hyphae or spores are formed.

Cultural characteristics: It grows on ordinary media and on Sabouraud's agar producing smooth, mucoid, cream-colored colonies. They belong to the class *Basidiomycetes* and are termed as *Filobasidiella neoformans* and *F. basilispora*.

Pathogenicity: It is a soil saprophyte and is found abundantly in oigeon droppings. Infection may occur through inhalation or through skin or mucosa. Pulmonary cryptococcosis may lead to pneumonia. The disease can have cutaneous, visceral and meningeal forms. Bones and joints may be involved.

It has been reported to cause mastitis. It grows at 37°C and kills mice when administered intraperitoneally.

Histoplasmsa species

Mycology: It has two types: *H. capsulatum* and *H. farciminosum*. Small oval cells found intracellularly in tissues. Colonies grow on blood agar. On Sabouraud's agar, delicate branching, septate hyphae develops with chlamydospores develop in old cultures. It is dimorphic in nature. The conidia have regularly spaced spiny projections. Tnhe sexual stage is called *Ajellomyces capsulata* and is now classified under *Ascomycetes*.

Pathogenicity: This may occur in acute or chronic forms, as local or disseminated infection of RES. The symptoms are progressive. Histoplasmosis is characterized by emaciation, leucopenia, anemia and ulceration of nasal region, lymph nodes, spleen and liver.

H. farciminosum causes epizootic lymphangitis in equines. The infection spreads by lymphatic vessels through wounds. Legs and chest are mostly affected and characterized by suppurative inflammation of superficial lymph glands. Nodules along the lymphatics rupture discharging thick creamy pus. The disease is reported in lungs and m.m of nasal passages. There is also conjunctivitis.

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