



# Microbiology

Lecture No: 29

Dr Name: Asem Shehabi

Done by: Mohannad Momani

Sheet  Slide

## Spirochete bacterium & Mycology

\*okay, this sheet is composed of 2 parts, the first one is talking about the last subject of bacteriology, and the second part is an introduction for mycology.

\*I added to this sheet some notes from our lecture in sec4, so don't get confused about them when referring to the original record. I also rearranged some repeated information here and there.

\*I'm being honest when I am saying that this is the simplest lecture in microbiology course so far, enjoy.

### **Part one;** spirochete bacterium.

From last lecture, we were left with one paragraph we need to cover,  
as we said in the last lecture, we have two groups of **spirochete bacterium**,

#### **Treponema & borrelia**

◆**Treponema:** a group of organism which has a special structure that is not easy to be cultured and isolated in a clinical specimen, **Treponema** is divided into;

•**obligated pathogen** represented mainly by "treponema pallidum" the causative agent of syphilis **السيلان**

•and the other type which is less important, located in our oral cavity as commensal bacteria

•and we have a third group that is associated with tropical chancres (tropical ulcer) responsible for skin infection, we shall not talk about it in this lecture.

◆**Borrelia;** a special group of spirochete mainly found in animals and it can be transmitted to humans by a special type of insects called "ticks **القراد**" these insects usually colonize on the skin of some large and small animals, this insect feeds on animals' blood. So if that animal was infected; this tick is considered a carrier that can transmit such infection to humans by a single bite to the skin, mainly in the neck and arms (upper part of the body) thus, it'll introduce this spiral form bacteria " **Borrelia** "

**Borrelia disease** was known in animals 100 years ago, associated with general infection in animals but it's not that important. In relation to human, first cases were recognized in the mid-70s in association with the presence of many cases of **borrelia infections** in forests of a city called "Lyme city" in the United States, due to the large numbers of cases there, they've called this disease "**Lyme disease**" which has been discovered by a German scientist. Now they've named the causative agent of Lyme disease "**borrelia burgdorferi**".

### •Lyme disease,

It is caused by the presence of these microorganisms in the skin by transmission through the insect as we mentioned earlier,



\*\*The picture shows this insect (tick القراد)\*\*

Lyme disease has two stages,

◆**first stage**: can be easily recognized by the presence of **inflammatory lesions** on the skin, an allergic reaction on the skin represented by redness of widespread lesions on the skin.

\*the doctor said it's more like an allergic reaction **NOT** an inflammatory one\*

There might be only one lesion or many lesions, and it may persist for few weeks and then disappear completely.

◆**Second stage:** it happens when all the lesions **disappear** and these nasty organisms reach the blood and internal organs causing some sort of septicemia by releasing its antigens which complicate the clinical picture, and gives the impression of having a viral infection (like hepatitis, associated with jaundice), as well as arthritis, which might be misdiagnosed as rheumatism fever. The case can further complicate by the presence of nephritis (the inflammation of the kidney).

This disease is not present in Jordan nor all Arab countries, **have no fear.** it's mostly present in USA, Canada and certain European countries where they have large number of white animals and different types of ticks that transmit the organism from infected animals to humans (especially ixodid ticks).

The organism might be found in rodents and certain type of birds.

### •**Treatment**

Using *antimicrobial drugs* in the *first stage* can give successful results; exactly like what we mentioned in syphilis disease. However, in the late stage, the body may develop some sort of autoimmune disease.

---

Another type of **borrelia** can be found in the nature, especially in the intestines and blood of many types of animals, those infected animals can contaminate water by their excretions. Also, there are special types of ticks and human lice القمل that could transfer these types of **leptospira** to human. Now this type of disease causes some sort of infection known as "**relapsing fever**", so once you get this organism you might develop fever (elevation on body temperature) for a long period of time, associated with jaundice, nephritis...etc and it might disappear and then retain back after few weeks, months or years with the same clinical feature. In certain countries it could

be an epidemic (there're always cases of relapsing fever) or it might be imported from other countries.

Again, these *Borrelia* species are not common in our country; only very rare cases have been reported.

---

Another type of **spirochaete bacteria** known as **leptospira** causes **leptospirosis** (the name is leptospirosis-from wiki) associated with enteric fever (similar to relapsing fever) and severe bleeding due to damage of blood vessels "vasculitis" in addition to jaundice and nephritis, similar to relapsing fever due to contaminated water (from infected animals' urine).

So here we can see that it is *transferred indirectly* by drinking contaminated water (unlike Lyme disease, which is transferred directly from animals via insects). This type of disease produce infection called **weil's disease**.

In relation that there is a variety of clinical signs and symptoms which can't be easily diagnosed at first stage due to this type of infection, it will require lots of investigation to confirm a case of leptospira disease, because it's hard to isolate the organism from the infected person, and it's hard to culture in most medical labs. Despite the fact that **Borrelia** and **leptospira** can be cultured in fluid media, this is done by a special laboratory which deals with these organisms.

In routine medicine they rely mainly on serological test to detect some specific antibodies for this type of leptospira or **Borrelia**, especially in Lyme disease. The treatment is by antimicrobial drugs.

Again these diseases are rarely detected in our countries -the middle east- and are hard to be isolated. However, in countries like USA they have many cases so they're more experienced in such cases.

NOW, we've finished the introductory course of bacteriology, woohoo!

## Second part. Mycology, (the study of fungi)

■ way to begin this subject, it must be known that this branch of microbiology is not well-studied...

**Mycology** means: the study of fungi, so **Mycosis** is a fungal infection.

Fungi is divided according to the *morphological structure* into two types,

◆ unicellular cells: which are called **yeast**.

◆ multi-cellular organisms: which are called molds العفن or filamentous fungi.

Fungi include a huge variety of organisms, some of them are used as food, and others can be useful in production of certain chemical compounds which are used as drugs;

-Pencillium produces *antibiotics*

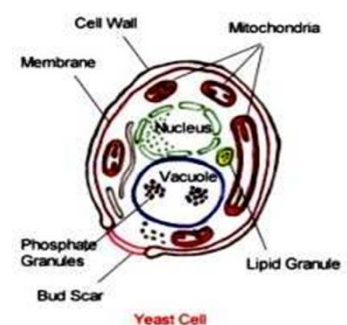
-Other types produce *Cephalosporins*

- Cyclosporine fungi produce an *immunosuppressant drug called cyclosporine*

### Basic structure of fungi,

◆ First, for **unicellular fungi** (presented by a single cell called **yeast** which is a simple type of eukaryotic organism).

As shown in this picture, it has a special cell wall composed mainly of complex polysaccharide, especially **chitin**, this chitin might be associated with few amounts of specific types of sugar; called glucan and mannan, this is implied also to multi-cellular fungi. So it's a very simple structure, similar to the plants cell wall, of course in plants cell wall mainly it's composed of cellulose rather than chitin.



◆Second, inside the cytoplasm we have a *true nucleus* with true nuclear membrane, a mitochondria and an endoplasmic membrane, thus fungi is considered as **eukaryotic cells**. Also, there are certain substances like phosphate, lipids and glycogens packed in granules [known as lipid granules]. The composition of the cytoplasm, to some extent, is **simpler** than bacterial cells -in general-

### ◆cell membrane

Cell membrane of the fungi (whether unicellular “yeast” or multicellular), is composed mainly of lipophosphate associated with certain amount of complex fatty acids known as **Ergosterol**, while our human cells has sterol. Ergosterol in fungi is the target component for any fungi treatment, ALL antifungal drugs interact with Ergosterol to produce a complex compound, destroying the cell membrane and thus KILLING the organism.

*ALL Antifungal drugs have the same target of action (cell-membrane “Ergosterol”) → all have the same mechanism, unlike antibacterial drugs which have different targets (cell-wall, protein/DNA synthesis..etc)*

However, the difference between different kinds of antifungal drugs is related to their pharmacokinetics; absorption, distribution, toxicity and side effects -typical- . Still the same mechanism in all.

Notice! Side-effects of antifungal drugs are **more** than that those of antimicrobial drugs.

Yeast as well as filamentous fungi MIGHT develop some **resistant** to antifungal drugs, but NOT rapidly like bacteria, it requires long time to make some changes in Ergosterol, it has been recognized in a certain type of fungal infection caused by a certain type of yeast called **Candida**.

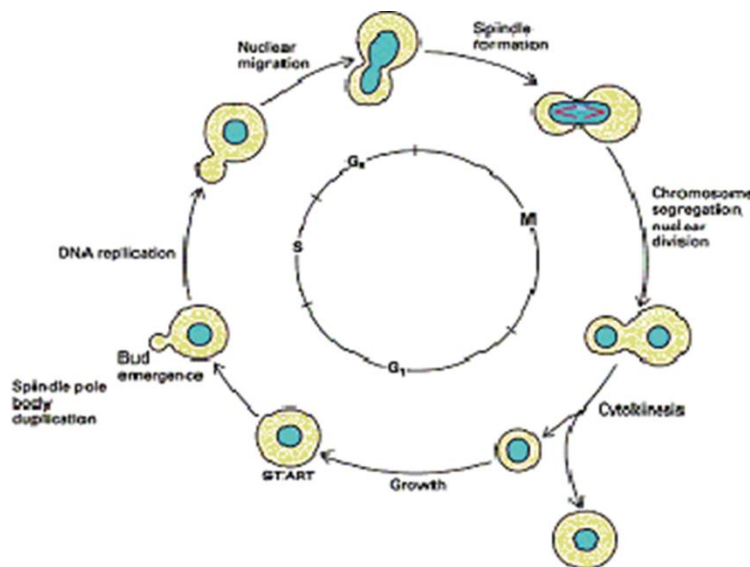


## ◆fungi reproduction ( Budding & Sporulation )

-In mono-cellular (spherical) types of fungi "yeast":

The reproduction happens by reproduction of the daughter cells (not by binary fission). It starts by *bulging of cell membrane*, associated with the flow of cytoplasm to the bulging area, it will enlarge as a result and contain part of the nuclear material.

The nucleus will elongate and divide by mitosis into two parts, one copy will go to the bulging area (which is called daughter cell or bud), separation from mother cell will happen after complete enlargement. As a result 2 cells will occur. Notice it was not binary division as bacteria. This is called **budding** تبرعم. Just imagine a mother cell budding its daughters. The result is a mother and a number of daughter cells. Not as in bacteria!

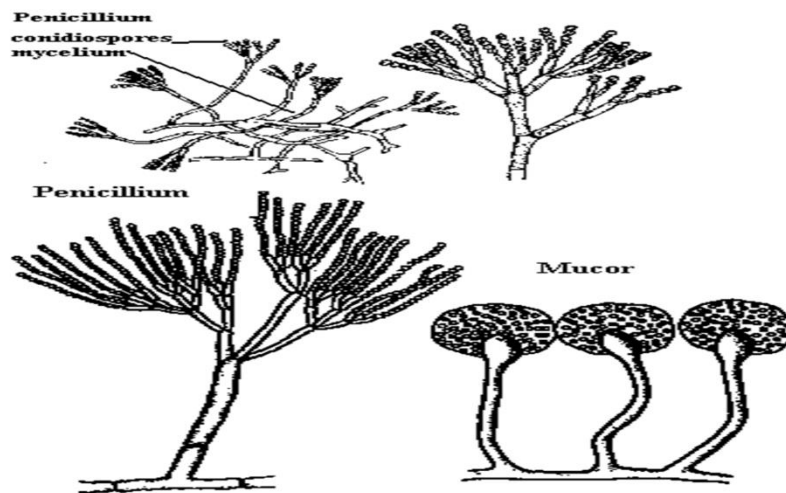


-In the second type as we can see, there are **filaments**:

single filament is produced from a single spore, this spore produces a tube like structure, called **horizontal filaments** or **hyphae**, later, from the middle of this tube, there will be an eruption associated with production of horizontal cells, each one of these cells produces from its extended tip a second cell and so on...at the end, the number of these cells will be increased, later on, these filaments will start branching "like a tree", now, each tip of



those branched filaments will produce spores "sporulation" upon exposure to a large amount of oxygen.



•a way to sum it up; filament "hyphae" are the first product in this type of reproduction; the last product is the spores.

Too many filaments form a **mycelium**, mycelium has two types;

◆ Vegetative mycelium: horizontal filaments (tube-like structure) which عادةً means the presence of filaments inside the medium -which could be soil, plants or whatever..-. They're responsible for absorption of nutrients and support the growth of the second type of mycelium (over-the-medium-areal mycelium). More like the roots of a tree, that's why in the past filamentous fungi were classified as plants.

Filaments might not be divided by presence of septa (singular; septum) it might be elongated without any presence of crosswords. In some types of fungi it might be divided and you might recognize the presence of crossword between one cell and the other.

◆ Areal mycelium: the filaments and the spores which grow over the medium (over the surface of soil or culture media) so it will be exposed to the air, more like the branches of a tree. It's often recognized by eyes.

Area mycelium projects over the surface of its media (whether soil, culture media..)- you'll recognize it with your eyes, you may observe different colors, due to the color of spores (red, black...). In addition, the arrangement of spores differs from one type of filamentous fungi to another.

Filamentous fungi also differ in; type of filaments, type of fragmentation of these filaments, presence of different branching, number of branching, the number of spores and the size of the spores..etc, scientists use these features to differentiate between types of fungi.

• Septa may present in the filaments "fragmentation", it can be easily noticed

septae :wall or membrane that separates two parts or structures in an organism. Septae subdivide the hyphae of some fungi-wiki

---

### From the book;

-Moulds (multicellular filamentous fungi), which are composed of branching filaments, termed hyphae, that grow by apical extension to form an intertwined mass, termed a mycelium. In most fungi the hyphae have regular cross-walls (septae) but in lower fungi these are usually absent. Moulds reproduce by means of spores produced, often in large numbers, by an asexual process (involving mitosis only) or as a result of sexual reproduction (involving meiosis, preceded by fusion of the nuclei of two haploid cells). Many fungi can produce more than one type of spore, depending on the growth conditions. The precise

method of spore production and the type(s) of spore produced are unique to each individual fungal species. In some higher fungi the sexual spores are produced in macroscopic structures such as mushrooms and toadstools. In laboratory cultures, moulds produce mainly asexual spores.

---

### ◆Pathology.

- We call large spores "macroconidium", while small spores "microconidium".

**Microconidium** it is located on the tip of the filaments, it spreads in the air and grows outside our body, once a spore from a type of fungus like **aspergers** attaches to our lungs or our oral cavity mucosa, tube like structures (hyphae) will first be produced.

However, in vivo (in our tissues) spores are not going to be produced from these filaments because they need a huge amount of oxygen which is not available in our tissue.

So as a conclusion, in an infected tissue, we only recognize the presence of filaments NOT spores. These filaments increase in number causing damage to the infected tissue of our lungs and blood vessels, it could increase in number producing masses of filaments in our lung, and those can be detected by X-ray.

- we have in our body certain type of **commensal yeast** found in few numbers without any significant clinical cases, they are part of our oral flora, they also present of the surface of our mucosa as unicellular cells, if it starts to produce an infection "*pathological reaction*" those yeast must be producing **pseudohyphae** (filament-like structure), because unicellular cella cannot attach fairly to our mucosal epithelial cells, so it must be converted

to a filament spore, and by the tip of these filaments it can attach the mucosal surface and then starts to invade making an inflammatory reaction. If it reaches blood stream, we only recognize the presence of unicellular cells NOT the filaments, however in tissues we recognize filaments instead of unicellular cells.

There are about 50,000 to 250,000 species of fungi, from all these numbers only 100 types are involved in human infections (not a large number), we have in relation to yeast not more than 10 types which might produce infection, especially superinfection or systemic infection in our body.

Some types of *filamentous fungi* are adapted to our skin and called **Dermatophyte** which means that it only produces superficial infection in our skin, nails and hair. and some are considered **systemic** which might produce localized infection in the mucosa of our respiratory tract, but later, they might invade عاده our subcutaneous tissue causing a damaging effect.

Generally replication of all types of fungi are followed by **asexual** means, most pathological fungi reproduce asexually (budding for yeast or production of filaments for filamentous fungi). However, there are certain types which reproduce by sexual means "exchanging of genetic materials"

### ◆Fungi in nature,

- ALL types of fungi are present in nature, but notice that the filamentous fungi are more widely distributed; it's usually associated with plants and soil, especially in soil which contains loads of decaying organic material like animals feces, dead plants... That's why we have a huge number of spores that contaminate the soil.
- we are easily exposed to fungal spores, since they are present in air and soil, fungal infections usually begin in our lungs and skin, but our immune system can destroy these spores once inhaled by the lysozyme effect on the

mucosal surface not allowing these spores to produce filaments and thus causing infection. In immunocompromised people, they are more susceptible to fungal infection (easily catch these spores), also damaged respiratory mucosal surface can make us susceptible as well.

- there are certain type of fungi which can be used as **food** "*mushroom*" but you must have some experience in order to distinguish between them and other toxic types.
- especially in winter, you can see large numbers of fungi spreading all over the streets, walls and plants, some types are very healthy with a great nutrient value (certain amount of minerals). On the other hand, there are a very toxic types, small amount of it can cause liver cirrhosis. In Jordan each year, we have at least 10 persons die following intoxication with fungi.
- ALL types of fungi are considered **chemoheterotrophs**, which means; they must be supplied with a source of nutrition to supply them with all the minerals and organic compounds needed for survival, they can't produce their own complexes like plants and certain types of autotrophic bacteria. They also need **moister** environment (more water) than bacteris.
- at **home**, fungi sometime appears on lifted food or clothes or furniture due to the presence of favorable conditions "*humidity and heat*" once they find a suitable environment; temperature between **35- 40 °C** and **moist**, damaging acts starts to show on food, especially milk powder, corn and peanut, they can be easily contaminated.
- mycotoxins are produced by special type of fungi like "**aspegillus flavus**" one micro-gram of its toxin can cause liver cirrhosis and DEATH.

-studying without desire spoils the memory, and it retains nothing that it takes in

done by: Mohanned Momani, best of luck.