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Chapter 1

History of microbiology

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Abstract: History of microbiology beginned with major discoveries by famous microbiologists like Leeuwenhoek, Louis pasteur and Robert Koch led the path to new discoveries on various disease-causing bacteria and also to the development of modern divisions like virology, Industrial microbiology and Food & Dairy microbiology. The chapter briefly discuss on key aspects of history of microbiology like Abiogenesis and Germ theory and the concepts and proofs that supported Biogenesis.

Keywords: Abiogenesis, Biogenesis, Germ Theory, Food & Dairy Microbiology, Virology

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1. Abiogenesis

Abiogenesis or spontaneous generation is different from Biogenesis in the context that living matter arises from non-living matter like maggots arise from rotten meat. Abiogenesis was completely disproved by scientists of 19th century and French chemist Louis pasteur.Biogenesis is the theory that states living matter arises from the living matter itself and does not arise spontaneously. Rudolf Virchow completely disproved the Abiogenesis by 1858 before virchow everyone believes strongly that living matter arise spontaneously from non-living matter.

1.1. Contributions of Redi

Franscesco Redi an Italin physicist and poet proved that maggots do arise spontaneously and they arise from the eggs laid by maggots on the rotten meat. Redi read a book about generation written by William Harvey a speculation that flies, insects or frogs wont arise spontaneously but they arise from the eggs or seeds which are small to be seen. In 1668,

Redi set up a experiment using glass jars containing meat. He covered half of the glass jars with a cover and he has kept half of them left open. He observed flies in the open jars. In the next set he covered the glass jars with wire gauze so that air could enter freely. He observed the similar result but surprisingly the debate of spontaneous generation continued due to intestinal worms and gall flies present in contaminated meat.

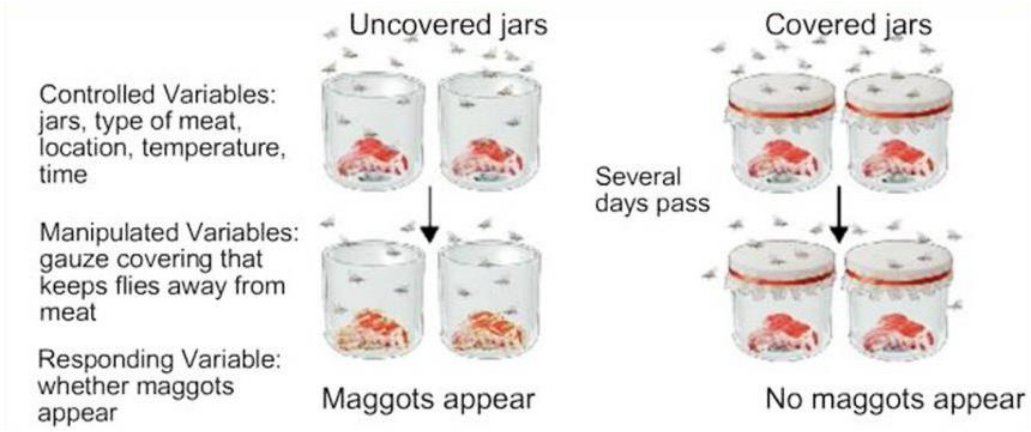

Figure:1 Experiments of Redi: He exposed meat to air by keeping the jars exposed to air with out any covering. Maggots appeared in the uncovered jars. He also covered some of the jars with guaze and no maggots appeared in the jars. [Taken fromE. Capanna. "Lazzaro Spallanzani: At the Roots of Modern Biology." Journal of Experimental Zoology 285 no. 3 (1999):178–196].

1.2. Contributions of Spallanzani

Spallanzani's experiment supported biogenesis by proposing that it is not due to matter and the inherent matter can be killed by boiling for half an hour. He also stated that the spoiling of foods or biogenesis is due to the microbes present in the air and can be killed by boiling of the matter. Spallanzani contributed to much on transplantation and regeneration through set of studies he carried out and his results are expansive.

In 1767 he wrote a book on Biogenesis disproving spontaneous generation bustressly and in 1768 he did research on Transplantation and regeneration studies which supports Biogenesis. In 1773 he studied on animal digestion and circulation. Later through the request of the friend he studied contribution of male in generation. Though some of his studies are failed he was the first person who did artificial insemination in lower animals like dogs.

1.3. Contributions of Needham:

In 1745, John Needham (1713–1781) Published a report on his own work by setup of experiment where the meat broth is added with plant and animal matter. He sealed the jars and subjected the jars to boiling inorder to kill the microbes. He leaved the jars for few days and he observed that a drop of broth contain millions of microbes and he argued that spontaneous generation is true but the fact is that he did not killed all the preexisting microbes.

1.4. Contributions of Louis Pasteur:

The debate of spontaneous generation continued till 19th century and scientists on both sides acting as proponents of the matter and finally Paris Academy of Sciences offered a Prize amount to settle the matter and Louis Pasteur a famous French chemist who is working on the microbial fermentation and spoilage of wine accepted the challenge. He passed the air through the gun cotton and observed the cotton under the microscope. He concluded that the spoilage and life is to occur due to the air borne microorganisms but not due to non-living matter.

Later, Pasteur disproved spontaneous theory by setting series of flasks with twised necks. If the vital force is responsible for life it is made available through the free exchange of air inside with the out side except with the air borne microorganisms.The flasks remain as such until the necks are broken contaminating the broth with air borne microbes. The microbes present in air actually trapped in the twists and bends of the necks and not allowed to contact with the broth inside the flask. Pasteur's set of experiments completely disproved the Abiogenesis and spontaneous generation because of which he secured a prestigious award called Alhumbert Prize from the Paris Academy of Sciences in 1862. In a lecture in 1864, Pasteur articulated "Omne vivum ex vivo" ("Life only comes from life") and he also speculated that Life is a germ and Germ is a Life.

1.5. Contributions of Tyndall

- He proved that dust contains microbes and if the dust is free of microorganisms the broth can remain sterile indefinitely with out life.
- He also designed a method called Tyndallisation where intermittent boiling of broth for 3 days can kill the whole microbes including the spores.

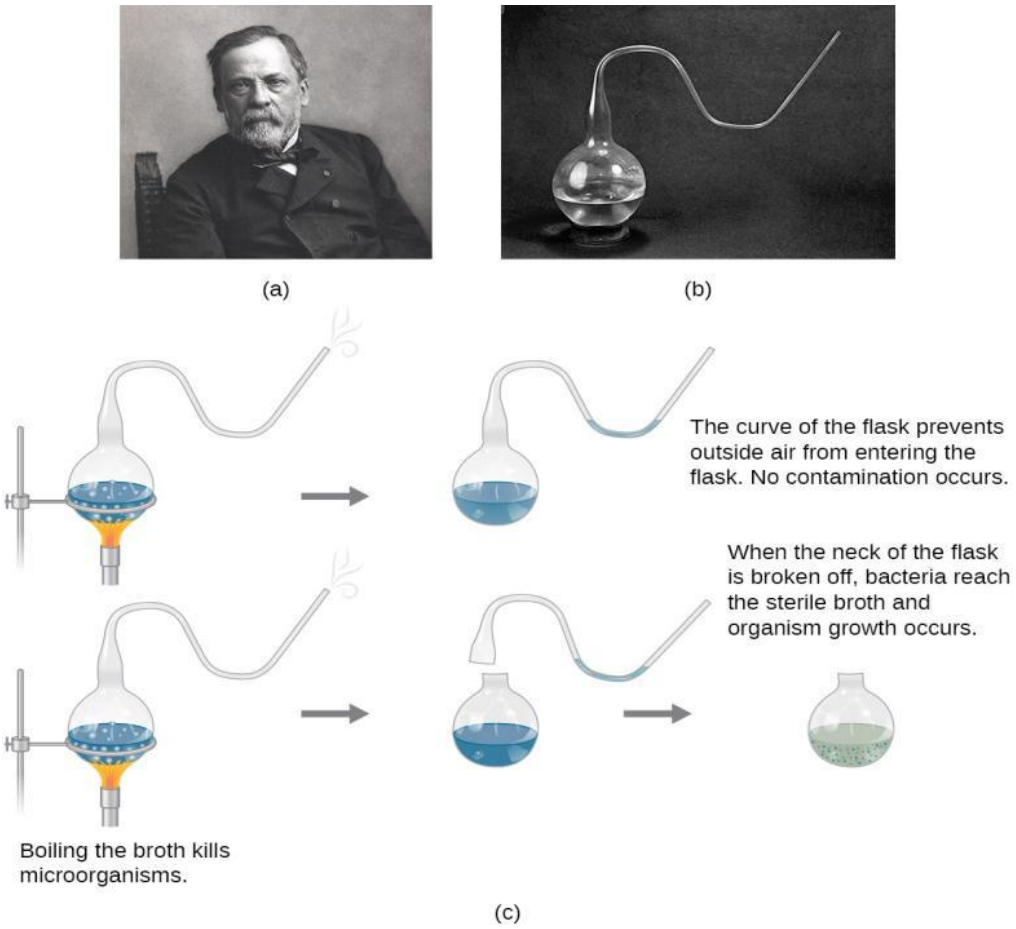

Figure:2 Swan neck flask experiment by Louis pasteur: Louis pasteur placed the broth infusion in the round bottom flask and curved the necks of the flask and subjected them to boiling. Broth infusion remains clear until the curve of the neck remain intact and not broken. [Taken from Vallery-Radot. The Life of Pasteur, trans. R.L. Devonshire. New York: McClure, Phillips and Co, 1902, 1:142].

1.6. Contributions of Alexander fleming

- **Alexander Fleming (1928)** identified the fungal strain Pencillium notatum and isolated the antibiotic pencillin.
- He studied the Staphylococcus aureus and inhibition of the growth of the bacterium by pencillin.
- Florey and chain finally studied the structure of pencillin and crytallised the antibiotic penicillin.

1.7. Contributions of Edward Jenner

- Edward Jenner was a famous scientist of 18 th century and his major contribution in the scientific era is modern vaccination.
- He developed a procedure for vaccination by introducing the liquid isolated from cow pox pustules to the patients infected with small pox which led to procedure called vaccination (Vacca-a-cow).
- He is indirectly responsible for the development of concept "Preventive medicine" and he saved more lives than many.
- Jenner's most important contribution to the field of microbiology was the development of vaccine to cow pox which is a most contagious disease in the older days.
- In 18 th century he designed a famous experiment through a boy. He collected material from the cow maids who has infected with mild cow pox and inoculated it to the small boy and he observed that the boy does not fell sick.
- This is the first observation which led to development of first vaccine against Small pox and later on to the diseases like Rabies, measles, Polio etc.,

1.8. Contributions of Robert koch:

German physicist Robert Koch (1843-1910) was the scientist awarded with the Nobel prize for his inventions in Physiology and medicine for developing the scientific proofs for Tuberculosis and he contributed to the studies of the causative agents of Cholera, Rabies and Tuberculosis. He developed the staining techniques to view the bacteria easily under the microscope and his assistant Petri designed a Petri dish for the isolation and cultivation of microorganisms.

He continued his further interventions on traumatic diseases and he first time developed the concept of "Specificity of the infection". He proposed some of the criteria based on his findings which are now famously referred as Koch Postulates.

1. The organism should be present in every case of the disease.
2. The organism must be isolated from the disease containing animal and should be cultured in pure form.
3. Samples of the pure culture should cause the same disease in the healthy susceptible laboratory organism.

4. The organism must be isolated from the inoculated organism and the organism from the susceptible one should be same as the organism isolated from the disease caused one.

2. Germ Theory:

The **germ theory of disease** is one of the current widely accepted scientific theories. It states that diseases are caused by the germs which cannot be seen with out magnification. Germs are referred as any living matter that can multiply and replicate inside the host and can able to cause the disease. Germs are the organisms including not only bacteria but also Fungi and also protists. Diseases are also caused by non living organisms like viruses, viriods or prions also referred as germs.

Diseases are caused by the Pathogens. Even the disease is caused by the microbe but the severity of the disease depends on the surrounding environmental factors and hereditary factors exposed, by the person infected with the disease. Pathogens are the disease causing microorganisms that can pass from one organism to other organism and infections can be caused by the pathogens like (viruses, bacteria, and fungi) as well as parasites.

Basic forms of germ theory were proposed by Girolamo Fracastoro in 1546, and expanded upon by Marcus von Plenciz in 1762. However, such views were held in disdain in Europe, where Galen's miasma theory remained dominant among scientists and doctors.By the end of the early 19 th century many of the scientists in Europe does not know how to extend the principle behind the disease for most of the diseases. By the end of the century Louis pasteur started working on this and Robert Koch further extended the work. By the end of the decade, the miasma theory was struggling to compete over Germ theory and discovery of viruses are found to be initially happen in 1890s which led to Golden era of bacteriology during which causative agents for various diseases are identified.

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