CHAPTER 6

CHAPTER

6

KINGDOM PROKARYOTAE (MONERA)

LONG QUESTIONS

DISCOVERY OF BACTERIA

Q.1: Define Prokaryotae. Discuss brief history of bacterial discovery.

→ Write a note on discovery and occurrence of bacteria.

Ans. Introduction

In Greek language; ***Pro*** means **before** and ***Karyon*** means **nucleus.**

Kingdom Prokaryotae consists of organisms with prokaryotic cells e.g. bacteria and blue green algae. (Cyanobacteria).

Microbiologists place bacteria in two major categories:

Eubacteria (taken from Greek meaning "true bacteria").

Archaeobacteria (taken from Greek meaning "ancient bacteria").

DISCOVERY OF BACTERIA

It was thought long before that very small creatures exist in our environment, which are too small to be seen with naked eye. But their discovery was linked to the invention of microscope. One of them is a bacterium. History of discovery of bacteria is described below:

(i) Work of Leeuwenhoek

A Dutch scientist Antonie Van Leeuwenhoek (1673) was the first to report the microbes such as bacteria and protozoa.

He used a simple microscope to describe bacteria and protozoa with accurate drawings and descriptions and called these small creatures as "**animalcules**".

He firstly observed small creatures in rain water, then confirmed them in saliva, vinegar, infusions and other substances.

(ii) Work of Louis Pasteur

The existence of microbes was further confirmed by Louis Pasteur's work. Pasteur went on making many discoveries in the field of microbiology and medicine. Some of his main achievements are following;

- He developed vaccines for disease of anthrax, fowl cholera and rabies.
- He made significant contribution in development of pasteurization process and development of fermentation industries.
- He proved that microorganisms could cause disease.

(iii) Work of Robert Koch

Some of the achievements of Robert Koch are;

- He postulated typical rod-shaped bacteria with squarish ends (bacilli) from the blood of sheep that died of anthrax.
- He discovered bacteria that cause tuberculosis and cholera.

- Koch and his colleagues invented many techniques concerning inoculation, isolation media preparation, maintenance of pure cultures and preparation of specimens for microscopic examinations.

Q. Describe four postulate of germ theory. (SGD-G1)-15, (RWP-G2)-17

- He formulated the **germ theory of disease.** There are four main postulates of **germ theory of disease,** which are pillars of this theory.

(i) A specific organism can always be found in association with a given disease.

(ii) The organism can be isolated and grown in pure culture in the laboratory.

(iii) The pure culture will produce the disease when inoculated into susceptible animal.

(iv) It is possible to recover the organism in pure culture from experimentally infected animals. These postulates are used to find out whether the organism found in disease lesion is the casual agent of the disease or not.

OCCURRENCE OF BACTERIA

Bacteria are widespread in their occurrence. They are found almost everywhere, in air, land, water, oil deposits, food, decaying organic matter, plants, man and animals. Their kind and number vary according to locality and environmental conditions.

- Some bacteria are always present and contribute towards the **natural flora.**
- Others are present in **specific environment** such as hot springs, alkaline/acidic soil, highly saline environment, in highly polluted soil and waters.

STRUCTURE OF BACTERIA

Q.2: Write a note on size and shapes of bacteria.

➔ Explain different shapes of bacteria.

Ans. SIZE OF BACTERIA

Bacteria vary in size. They usually range in size from about **0.1 to 600 µm** over a single dimension.

- The smallest (e.g. some members of *Mycoplasms*) are about 100 to 200 nm in diameter, which is approximately equal to size of largest virus (poxviruses).
- Staphylococci and streptococci are 0.75 to 1.25 µ in diameter. *Escherichia coli*, a bacillus of about average size, is 1.1 to 1.5 µm wide by 2.0 to 6.0 µm long.
- Some spirochetes occasionally reach 500 µm in length showing **larger length.**
- Recently a **huge** bacterium named as *Epulopiscium fishelsoni* has been discovered in the intestine of the brown surgeonfish (*Acanthurus nigrofuscus*), grows as large as 600 µm and 80µm wide, a little smaller than a printed hyphen.
- It is now clear that a few bacteria are much larger than the average eukaryotic cell.

SHAPE OF BACTERIA

Most of the bacterial species have normally constant characteristic cell shape. However, some cells are pleomorphic and they can exist in a variety of shapes. On the basis of general shape, bacteria are classified into three categories;

(i) Cocci (ii) Bacilli (iii) Spiral

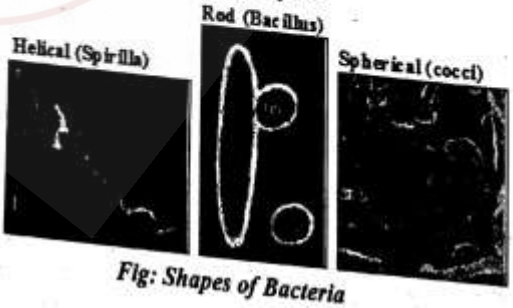

Fig: Shapes of Bacteria

Arrangements

Cocci have one of several distinct arrangements based on their planes of division

(i) **Diplococcus**

- They occur in form of pairs.
- Division in them is in single plane.

(ii) **Streptococcus**

- They occur in form of long chains.
- Division is in single planes.

(iii) **Tetrad**

- A tetrad is a square of four cocci.
- Division is in two plance.

(iv) **Sarcina**

- It is a cube of eight cocci.
- Division is in three planes.

(v) **Staphylococcus**

- In it, cocci are arranged in irregular, often grape-like clusters.
- In it, divisions occur in random planes.

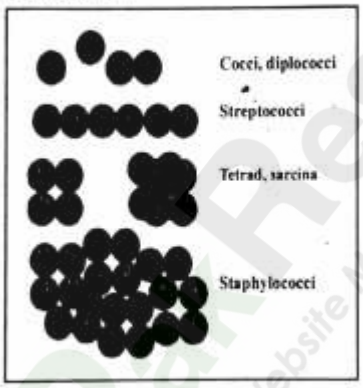

Fig. Cocci

Examples

Diplococcus pneumoniae and *Staphylococcus aureus* are some examples of cocci.

(2) **BACILLI**

Bacilli are **rod-shaped** bacteria.

Arrangements

All bacilli divide in one plane only. Their arrangements are given as;

(i) **Bacillus**

It is a single cell of rod-shaped bacteria.

(ii) **Streptobacillus**

It is log chain of bacilli.

(iii) **Diplobacillus**

It is arrangement in which rod chain bacteria occur in pairs.

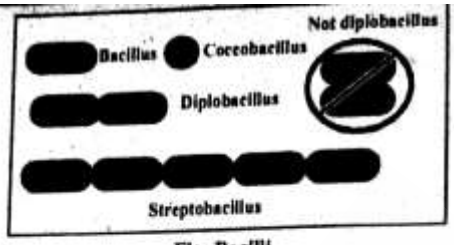

Fig. Bacilli

Examples

Examples of rod-shaped bacteria are *Escherichia coli, Bacillus subtilis, Pseudomonas.*

(3) SPIRAL

The **spiral shaped** bacteria are spirally coiled.

Arrangements

There are three important forms of spirals;

(i) Vibrio

It is curved or comma shaped rod.

(ii) Spirillium

It is a thick and rigid spiral.

(iii) Spirochete

It is thin and flexible spiral.

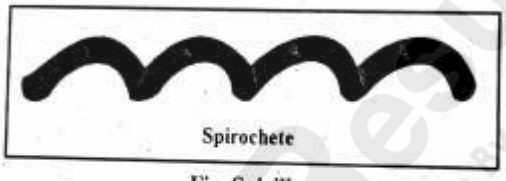

Fig. Spirilla

Examples

Examples of spiral shaped bacteria are *Vibrio, Hyphomicrobium.*

(4) EXAEPTIONS

Exceptions to the above shapes are trichome forming sheathed stalked, square, star-shaped, spindle shaped, lobed and filamentous bacteria.

Q.3: Write a note on bacterial cell structure.

➔ **Describe in details the structure of bacterial cell wall, emphasizing Gram positive and Gram negative properties.**

Ans. BACTERIAL CELL STRUCTURE

- ★ Essential all bacteria have cell membrane, cytoplasm, ribosome and chromatin bodies.
- ★ Majority have a cell wall, which gives shape to the bacterial cell.
- ★ Specific structures like capsule, simple flagella, pili, fimbriae and granules are not present in all bacteria.

(1) FLAGELLA

Introduction

These are extremely thin, hair like appendages. These are made of protein called **flagellin** Most of bacilli and spiral shaped bacteria have flagella. Cocci rarely have flagella.

Formation

They originate from basal body (structure present just beneath the cell membrane in cytoplasm) and come out through cell wall.

CLASSIFICATION OF BACTERIA ON BASE OF FLAGELLUM

Bacteria are classified in different taxonomic groups on base of;

- Presence of flagella
- Pattern of attachment of flagella
- Number of flagella

These types are as follows.

Q. Describe different classes of bacteria on the basis of flagella. (GUJ-2014GI, 15GII)

Q. Classify the bacteria with reference to presence of flagella. (GUJ-GI-2013)

Q. Classify the bacteria on the basis of arrangement of flagella. (SGD-GI-2014)

(i) **Atrichous**

These are bacteria without flagella.

(ii) **Monotrichous**

When single polar flagellum is present.

(iii) **Lophotrichous**

These are bacteria with tuft of flagella are present at one pole of bacteria.

(iv) **Amphitrichous**

It is condition in which tuft of flagella are present at each of two poles.

(v) **peritrichous**

In it, flagella surround the whole cell.

Function of Flagella

- Primary function of flagella is to help in **motility**.
- With the help of flagella, flagellate bacteria can also detect and move in response to chemical signals. This type of behavior is called *chemotaxis*.

(2) **PILI**

Q. What are Pili? Give its functions. (LHR-G2), (FBD-G1)-16

Features

- These are hollow, nonhelical, filamentous appendages.
- These are smaller than flagella and not involved in motility.
- These are present **only on gram-negative bacteria**.
- They are made up of special protein called **pilin**

Function

- They are primarily involved in a mating process between cells called **conjugation process**.
- Some pili function as a **means of attachment** of bacteria to various surfaces.

(3) **THE CELL ENVELOPE: THE OUTER WRAPPING OF BACTERIA.**

"Bacterial surface and walls are very diverse. Collectively complexes of layers external to the cell protoplasm are called as cell envelope and include capsule, slime and cell wall."

(A) **CAPSULE**

Features

(i) It is produced by bacteria and is made up of repeating polysaccharide units or proteins or of both.

(ii) It is tightly bound to cell.

(iii) It has a thicker, gummy nature that gives sticky characters to colonies of encapsulated bacteria.

Function

It is mainly involved in **protection**.

(B) **SLIME**

Slime capsule (slime) is loose and soluble shield of macromolecules present in some bacteria.

Function

It provides greater **Pathogenicity** to bacteria and protects them against phagocytosis.

(C) CELL WALL

Features

(i) It is present beneath extracellular substances, external to cytoplasmic membrane.

(ii) It is rigid structure determine the shape of bacterium.

(iii) It is present in all bacteria except **mycoplasmas**.

Composition

- Cell walls of most bacteria have a unique macromolecule called peptidoglycan. It is composed of framework of long glycan chains cross-linked with peptide fragments.

  Amount of peptidoglycan varies in different types of bacteria.

  The intact cell wall also contains chemical substances such as sugar molecules, teichoic acid, lipoproteins and lipopolysaccharides, which are linked to peptidoglycan.

Q. Discuss about bacterial cell wall. (FBD-GI-2015)

Q. Compare Gram positive and Gram negative bacteria on the basics of cell wall. (LHR-GII, SGD-GI-2016)

Q. What is peptidoglycan? (DGK-G1)-15

- Cell walls of archaeobacteria are different from eubacteria. Their cell wall does not contains peptidogycan instead composed of proteins, glycoprotein's and polysaccharides.

Fig. Rod shaped bacterium with flagella (lophotriphious)

Function

- Cell wall determines the **shape** of bacterium.
- It **protects** the cell from osmotic lysis.

Classification of Bacteria Due to Gram Staining (Cell Wall Differences)

Bacteria are divided in to two groups based on their response to gram staining procedure developed by **Christian Gram**.

(i) **Gram-positive bacteria**, which are stained purple (retain the primary dye due to formation of CV-I compels).

(ii) **Gram-negative bacteria**, which are stained pink (retain secondary dye).

Comparison of Gram positive and Gram negative Cell Walls

There are many structural differences between two groups especially in their cell walls, which differ in staining behavior.

CHARACTERISTIC	GRAM POSITIVE	GRAM NEGATIVE
Number of major layers	1	2
Chemical make up	Peptidoglycan (50% of dry weight in some bacterial cells), Teichoic acid and Lipoteichoic acid, Lipids (1-4%)	Lipopolysaccharides, Lipoproteins, Peptidoglycan (10% dry weight of some bacterial cells), Lipids (11-12%)
Overall thickness	20-80 *nm*	8-11 *nm*
Outer membrane	No	Yes
Periplasmic space	Present in some	Present in all
Permeability	More Permeable	Less permeable

Several bacterial groups lacks the cell wall structure characteristics of Gram positive or Gram negative bacteria, and some bacteria have no cell wall at all.

(4) CELL MEMBRANE

Features

(i) Cell membrane of plasma membrane lies just beneath the cell wall.

(ii) It is very thin, flexible and completely surrounds the cytoplasm.

(iii) It is very delicate in nature and any damage to it results in death of organism.

(iv) Bacterial membranes differ from eukaryotic membranes in lacking sterols such as cholesterol.

Functions

★ Cell membrane **regulates** the transport of proteins, nutrients, sugar and electrons or other metabolites.

★ Plasma membrane of bacteria also contains **enzymes for respiratory metabolism**.

(5) CYTOPLASMIC MATRIX

Introductions:

"The cytoplasmic matrix is the substance present between the plasma membrane and the nucleotide".

Features:

(i) It is a major part of protoplast.

(ii) It has gel like consistency.

(iii) Small molecules can move through it rapidly.

(iv) The plasma membrane and everything present within it known as protoplast.

(v) Thus the cytoplasmic matrix is a major part of protoplast.

(vi) Different large, discrete structures of bacteria such as chromatin/nuclear body, ribosomes, mesosomes, granules and nucleoid are present in this matrix.

(vii) In cytoplasm of prokaryotic cell membrane bounded organelles and cytoskeleton (microtubules) are absent.

(6) NUCLEOID

Introduction

"It is the irregular shaped, dense area in which nuclear material of bacteria is present." This chromatin body is actually an extremely long molecule of DNA that is tightly folded so as to fit inside the cell component.

It is also called as nuclear body, chromatin body and nuclear region. It is visible in light microscope after staining with **Feulgen stain**.

Features

(i) It lacks discreet chromosomes and nuclear membrane.
(ii) Its position is near to the center of cell.
(iii) There is a single, circular and double stranded DNA molecule.
(iv) Since bacteria have a single chromosome, they are haploid.
(v) *Escherichia coli* closed circle chromosome measures approximately 1,4000 µm.

Q. [illegible]

(7) PLASMID

Many bacteria contain plasmids in addition to chromosomes.

Q. What is plasmid? (SWL-G1), (BWL-G1)-16

Features

(i) These are circular, double stranded DNA molecules.
(ii) They are self replicating and are not essential for bacterial growth and metabolism.
(iii) They often contain drug resistant, heavy metals, disease and insect resistant genes on them.

Importance

Plasmids are important **vectors**, in modern **genetic engineering techniques**'.

(8) RIBOSOMES

Features

(i) Ribosomes are composed of RNA and proteins.
(ii) There are thousands in number in healthy growing cell and some may be loosely attached to plasma membrane.
(iii) They are smaller than eukaryotic ribosomes i.e. 70 S.

Function

They are involved in protein synthesis so are called as protein factories.

(9) MESOSOMES

The cell membrane invaginates into the cytoplasm forming structure called **mesosome**.

Q. What are mesosomes. (GUJ-G1)-15, (SGD-G1)-16, (RWP-G1)-17

Q. Write function of mesosmes. (GUJ-G1)-14

Features

(i) These are in form of vesicles, tubules or lamellae.
(ii) Respiratory enzymes are present on them.

Function

- These are involved in **DNA replication and cell division**.
- Some mesosomes are also involved in **export of exocellular enzymes**.

(10) GRANULES AND STORAGE BODIES

Since bacteria exist in a very competitive environment where nutrients are usually in short supply, they tend to store extra nutrients when possible. These may be

- Glycogen
- Sulphur
- Fat
- Phosphate

In addition, cells contain waste materials that are subsequently excreted. For example

- Alcohol
- Lactic acid
- Acetic acid

(11) SPORES

Certain species of bacteria produces spores. They may be

- External to the vegetative cells (exospores)
- Within the vegetative cells (endospores)

Features

(i) They are metabolically dormant bodies and are produced at a late stage of cell growth.
(ii) They are resistant to adverse physical environmental condition such as light high temperature, desiccation, pH and chemical agents. Under favorable condition, they germinate and form vegetative cells.

(12) CYSTS

Cysts are dormant, thick-walled, desiccation resistant forms and develop during differentiation of vegetative cells, which germinate under suitable conditions. They are not heat resistant.

Q.4: Write a note on Nutrition of bacteria.

→ Discuss nutritional modes in bacteria.

Ans. NUTRITION OF BACTERIA

Like other organisms, bacteria need energy for their growth, maintenance and reproduction.

Classification on Base of Mode of Nutrition

On base of difference in mode of nutrition, bacteria are classified into two major, groups.

(1) Heterotrophs (2) Autotrophs

(1) HETEROTROPHS BACTERIA

"Such types of heterotrophic bacteria, which cannot synthesize their organic compounds from simple inorganic substances, are called heterotrophic bacteria."

Heterotrophic bacteria are further classified as;

(i) Saprophytic

(ii) Parasitic

(i) Saprophytic Bacteria

Type of heterotrophic bacteria which get their food from dead organic matter causing its decay is called saprophytic bacteria."

Soil is full of organic compounds in the form of humus. **Humus** is the material resulting from the partial decay of plants and animals.

Many soil-inhabiting bacteria have very extensive enzyme system that breaks down the complex substances of humus to simpler compounds. The bacteria then absorb and utilize these simpler substances as a source of energy.

Q. Give nutrition in Bacteria. (SWL-GI-2015: GUJ-GI-16)

Q. Discuss the process of Nutrition in Bacteria. (GUJ-GI-2004: FBD-GI-16)

Q. Describe nutrition in Bacteria. (BWP, AJK-GI-2015: LHR-GI-16)

Q. Describe in detail nutrition of Bacteria. (GUJ-GI-2012, 15: LHR-GII-13, 15: SWL-GI-16)

Q. Write a note on Nutrition of Bacteria. (BWP-2013, 15: SWL-GII-2014: MTN-14GII, 11GI, GIIS: FBD-13)

Q. How bacteria get their nutrition? Explain. (LHR-GII-2012)

Huge Bacterium

Epulopistcium fishelsoni is a huge bacterium in the intestine of brown. Surgeon fish. It can grow as large fish. It can grow as large as 600 μm smaller then a printed hyphen.

Q. What is huge bacterium. (AJK-G1)-15

(ii) Parasitic Bacteria

"Such types of heterotrophic bacteria, which are fully dependent on live organisms (host) for their food, are called parasitic bacteria."

They are usually **pathogen** and cause disease in their host.

Example

Vibrio coma, Bacillus anthracis.

(2) AUTOTROPHIC BACTERIA

"Such bacteria which can synthesize organic compounds from inorganic substances are called autotrophic bacteria."

Autotrophic bacteria may be

(i) Photosynthetic

(ii) Chemosynthetic

Q. What are photosynthetic bacteria. (AJK-G1)-16

(i) Photosynthetic Bacteria

"Such type of photosynthetic bacteria, which have chlorophyll and manufacture food by process of photosynthesis are called photosynthetic bacteria."

There are some **differences in photosynthetic bacteria and plants** related to process of photosynthesis. These are;

- Their chlorophyll is different from that of green plants structurally.
- Green plants have chlorophyll in chloroplast, while bacteria chlorophyll is dispersed in cytoplasm.
- During photosynthesis these bacteria use hygrogen sulphide (H_2S) instead of water as hydrogen source.
- They liberate sulphur while plants liberate oxygen.

Overall reaction of photosynthesis in photosynthetic bacteria can be written as:

$$CO_2 + 2H_2S \xrightarrow[Chlorophyll]{Light} (CH_2O) + H_2O + 2S$$

Example

Green sulphur bacteria, purple sulphur bacteria and purple non-sulphur bacteria.

Q. Name the bacteria which ... photosynthetic. (MTN-Gi)

(ii) Chemosynthetic Bacteria

"Such type of autotrophic bacteria, which oxidize inorganic compounds like ammonia, nitrate, nitrite, sulphur or ferrous iron and trap energy to use in ... reactions are called chemosynthetic bacteria".

Example

Nitrifying bacteria

Q.5: Write a note on respiration in bacteria.
→ Give classification of bacteria on basis of respiration.

Ans. RESPIRATION IN BACTERIA

Bacteria need energy for their different life processes. This energy is released in process of respiration.

Classification on Base of Respiration

Q. Explain the respiration in Bacteria (MTN-Gi-20...

Bacteria are classified into different groups on base of differences in respiration.

(i) Aerobic Bacteria

Bacteria which are able to grow in presence of oxygen are called aerobic bacteria.

Example

Pseudomonas is an example.

(ii) Anaerobic Bacteria

Bacteria, which can grow in absence of oxygen, are called anaerobic bacteria.

Example

Spirochete is an example.

(iii) Facultative Bacteria

Such bacteria, which are neither aerobic nor anaerobic, are called facultative bacteria they can grow ... the presence or absence of oxygen.

Example

E. coli is an example.

(iv) Microaerophilic

Such bacteria which require a low concentration of oxygen for growth are called as microaerophilic.

Example

Campylobacter is an example.

Q.6: Write a note on growth and reproduction in bacteria.
→ Explainlist various phases in bacterial growth curve.

Ans. GROWTH AND REPRODUCTION OF BACTERIA

Bacterial refers commonly to increase in number of bacterial cells.

REPRODUCTION

Bacteria mostly reproduce asexually and sometimes sexually.

(i) Asexual Reproduction

Bactria usually reproduces asexually by **binary fission**. In binary fission, following steps occur in sequence;

Parent cell enlarges →Chromosome duplicates →plasma membrane pinches inward at the center of cell →Nuclear material evenly distributed→ cell wall grows inward to separate cell into two.

This sequence is repeated at intervals by each new daughter cell which in turn increases the population of cells.

The interval of time until the completion of next division is knows as **generation time**.

(ii) Sexual Reproduction:

Bacteria lack traditional sexual reproduction and mitosis. However, some bacteria transfer genetic material from a donor bacterium to a recipient during a process called **conjugation**.

Some conjugating bacteria use specialized **sex pili** to transfer genetic material. Conjugation produces new genetic combinations that may allow the resulting bacteria to survive under great variety of conditions.

Q. Explain growth and reproduction in Bacteria. (SWL-GI-2013)
Q. Discuss growth and reproduction in bacteria. (LHR-GI-2015: AJK-GI-16)

GROWTH

Once the division is complete, bacteria grow and develop their unique features. Four distinct phases are recognized in bacterial growth curve.

(i) Lag phase

It is phase of no growth. Bacteria prepare themselves for division.

(ii) Log phase

It is phase of rapid growth. Bacteria divide at exponential rate.

(iii) Stationary phase

Bacteria death rate is equal to bacterial rate of reproduction and multiplication.

(iv) Death /Decline phase

Bacteria start dying. Here the death rate is more than reproduction rate.

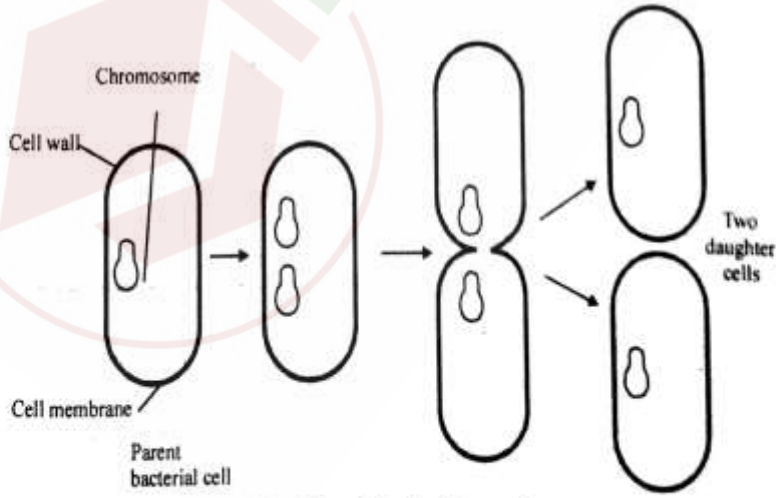

Fig: Binary Fission in bacteria

Q.7: Give economic importance of bacteria.

➔ What are beneficial and harmful aspects of bacteria.

Ans. BENEFICIAL ASPESCTS

Ecological importance

Bacteria are ecologically very important.

- They are highly adaptable **as a group** and are found nearly everywhere.
- They are able to decompose organic matter and play a significant role in the completion of cycles of nitrogen, phosphorous, sulphur and carbon.

Economic importance

They are used in number of **industries** including food, drugs, (production of antibiotics and vaccines) and in biotechnology.

HARMFUL ASPECTS

- They are responsible for **spoilage of food** and vegetables.
- Many **plant pathogens** adversely affect the agricultural industry.
- They are very common **pathogens of humans**. Approximately 200 species are known to cause diseases in human. Many bacteria normally inhabit the bodies of humans and other animals.

Q.8: Write and account different methods used for controlling microbes.

➔ Discuss the role of antibiotics and immunization in controlling bacteria diseases. What problem can arise due the misuse of antibiotics?

Ans. CONTROL OF MICROORGANISMS / BACTERIA

Control of microorganisms is essential in home, industry as well as in medical fields. By controlling microorganisms, one can

- Prevent and treat diseases
- Prevent food and industrial products from spoilage

Microorganisms can be controlled by various methods. Effects of these methods can be microbicidal or microbistatic.

- **Microbicidal effect** is one that kills the microbes immediately.
- **Microbistatic effect** inhibits the reproductive capacities of the cells and maintains the microbial population at constant size.

(1) PHYICAL METHODS

In physical control, different measures are used e.g.

- Steam
- Dry heat
- Gas
- Filtration
- Radiation

Q. Describe different physical and chemical methods to control bacteria.
(LHR, MTN, RWP -2014: DGK, BWP-GI-16)

Q. Describe various methods of Control of Bacteria. **(DGK-GI-2016)**

Some methods are described below;

(i) Sterilization

Sterilization is destruction of all life forms and the process in which we use physical agents to control bacteria / microorganisms is known as sterilization process.

(ii) High Temperature

High temperature is usually used in microbiological labs for microbes. Both dry heat and moist heat are effective.

- **Moist heat** causes coagulation of proteins and kills the microbes.
- **Dry heat** causes oxidation of chemical constituents of microbes and kills them.

(iii) **Radiation**

Certain electromagnetic radiations **below 300 nm** are effective in killing of microorganisms. Gamma rays are in general use for sterilization process.

(iv) **Filtration**

Heat sensitive compounds like antibiotics, seras, hormones etc can be sterilized by means of membrane filters.

(2) **CHEMICAL METHODS**

Antiseptics, disinfectants, antibiotics and chemotherapeutic agents can be used for microbial control.

(i) **Antiseptics**

Chemical substances used on living tissues that inhibit the growth of microorganism are called antiseptics.

Q. What are antiseptics. (DGK-G1)-16

(ii) **Disinfectants**

"Killing of some but not all microorganisms is called disinfection.

The important chemical agents used for disinfection are oxidizing and reducing agents. For example halogens and phenols, hydrogen peroxide, potassium permanganate, alcohol and formaldehyde etc. inhibit the growth of vegetative cells and are used on nonliving materials.

(iii) **Chemotherapeutic Agents and Antibiotics**

Chemotherapeutic agents and antibiotics work with natural defense and stop the growth of bacteria and other microbes. These are sulphonamides, tetracyclin, penicillin etc. They destroy or inhibit the growth of microorganisms in living tissues.

Modes of action of different chemical and physical agents of control vary. Damage can result malfunctions in cell wall, cell membrane, cytoplasmic enzymes, or nucleic acid.

(3) **IMMUNIZATION AND VACCINATION**

Methods of prevention and treatment that have been introduced to control microbial diseases include:

- **Immunization** (e.g. vaccination)
- **Antisepsis** (procedures to eliminate or reduce the possibility of infection)
- **Chemotherapy and public health care measures** (e.g. water purification, sewage disposal and food preservation)

Discovery of Vaccination

Pasteur made many discoveries concerning the cause and prevention of infectious diseases. In 1880's he isolated the bacterium responsible for **chicken cholera** and found its mechanism of immunization. He grew it in pure culture. To prove he really had isolated the bacterium responsible for this disease Pasteur made use of the fundamental techniques devised by Koch. He arranged experiments for a public demonstration in which he repeated an experiment that had been successful in many previous trails.

He inoculated healthy chicken with his pure cultures and waited for them to develop chicken cholera and die. But to his dismay, the chickens failed to get sick and die. Reviewing each step of the experiment, Pasteur found that he had accidently use the cultures several weeks old instead of fresh one grown especially for the demonstration. He soon discovered that somehow bacteria could lose their virulence or virulent, bacteria could still stimulate the host (in this case the chicken) to produce antibodies, substances that protect the host (in this case the chicken) against infection due to subsequent exposure to the virulent organism.

Pasteur applied this principle of inoculation with attenuated cultures for prevention of anthrax and succeeded. He called the attenuated culture of bacterial **vaccine** (a term derived from Latin **Vacca,** meaning **cow**) and immunization with attenuated cultures of bacteria as vaccination.

Pasteur honored ***Edward Jenner*** (1749-1823) who successfully vaccinated a boy (James Phipps) against small pox in 1796.Jener had learned that milkmaid who contracted cowpox from the cows,they milked ,never subsequently contracted the much more virulent small pox.Accordingly he tested this hypothesis by inoculating young James Phipps with cowpox causing material and later with small pox causing material. The boy did not get small pox.

Q. What is role of Edward Jennes. (DGK-G2)-15

Q. What meant by vaccination. (GUJ-G2)-15

Pasteur also made a vaccine for hydrophobia (rabies), disease transmitted to people by bits from rabid dogs, cats and other animals.

USE AND MISUSE OF ANTIBIOTICS

Antibiotics is a **Greek work (Anti meaning against and Bios meaning Life)**

"Antibiotics are the chemotherapeutic chemical substances which are used in treatment of infectious diseases."

Q. Write a note on use and misuse of antibiotic. **(LHR-2007: BWP-GI-14: SGD-GI-16)**

Q. Explain about use and misuse of antibiotic. **(MTN-G1)-15, 16 (SWL-G2)-14, (GUJ-G1)-15**

Synthesis

Antibiotics are synthesized and secreted by certain bacteria **actinomycetes** and fungi. Today, some antibiotics are synthesized in the laboratory. However their origins are living cells. To determine drug of choice, one must know its mode of action, possible adverse effects in human beings.

Adverse Effects of Antibiotics

Massive quantities of antibiotics are being prepared and used, which are followed by the widespread problems. Some are given below;

(i) They produce drug resistance in microorganisms, thus causing increased resistance against disease treatment.

(ii) Misused antibiotics can interact with the human metabolism and in severe cases can cause death of **human beings.**

(iii) Misuse of antibiotic such as **penicillin** can cause **allergic reactions.**

(iv) **Streptomycin** can affect auditory nerve thus causing **deafness.**

(v) **Tetracycline** and its related compounds cause **permanents discoloration of teeth** in young children.

Use antibiotics as prescribed by the physicians. Take dose at regular intervals and complete the treatment as advised by the doctor.

CHARACTERISTICS OF CYANOBACTERIA

Q.9: Describe general characteristics of Cyanobacteria with special reference to *Nostoc*.

Ans. Introduction of Cyanobacteria

The cyanobacteria are the largest and most diverse group of photosynthetic bacteria which was previously known as **blue green algae.** They are true prokaryote.

Characteristics

(i) Size and shape

- They range in diameter from 1-10um.
- They vary greatly in shape and appearance.

(ii) Mode of Life

They may be unicellular, exists as colonies of many shapes or from filaments consisting of trichomes (chain of cells) surrounded by mucilaginous sheath.

(iii) Structure

- They have normal Gram-negative type cell wall (lipopolysaccharides peptidoglycan (10%) and lipids (11-12%).
- They **lack flagella** and often use gas vesicles to move in the water and many filamentous species have gliding motility.
- Different cells present in cyanobacteria are **hormogonia, akinetes, heterocysts and vegetative cells.**

- They have **phycobilin** as accessory pigments, which are involved in photosynthesis. These pigments along with electron transport chain components are located in thylakoid membranes linked with particles called as **phycobilisomes**. **Phyococyanin** pigment (blue) is their predominat phycobilin and CO_2 in them is assimilated through the Calvin cycle.
- Their photosynthetic system closely resembles that of eukaryotes because they have **chlorophyll a and photosystem II**. They carry out oxygenic photosynthesis i.e. they use H_2O as an electron donor and generate oxygen during photosynthesis.
- Reserve food material in cyanobacteria is **glycogen**.

Q. Explain characteristics of cyanobacteria. (SGD-GI-2014)

Q. Write down characteristics of cyanobacteria. (LHR-GII-15, 14: SGD-GII-15: DGK-GI-15)

Q. Give the general characteristics of cyanobacteria. (FBD-GI-2014: RWP, GUJ-GI-16)

Q. Write a note on cyanobacteria. (DGK-GI-2015)

Q. Describe the general characteristics of Cyanobacteria. (LHR-2007, 11GI: MTN-10GI: FBD-14)

Q. Write down economic importance of Cyanobacteria. (MTN-2013-A)

(iv) Reproduction

Cyanobacteria reproduce by **binary fission** and **fragmentation**

ECONOMIC IMPORANCE OF CYANOBACTERIA

BENEFICIAL ASPECTS

Some of the beneficial aspects of cyanobacteria are:

(i) Increase in soil Fertility

They help in reclamation of alkaline soil. They have **heterocysts** which are helpful in the fixation of atmospheric nitrogen.

(ii) Oxygen source

They release O_2 in the environment due to their photosynthetic activity.

(iii) Pollution indicator

*Oscillatoria*and few other cyanobacteria can be used as pollution indicator.

(iv) Symbiotic Relationship

They have symbiotic relationship with protozoa fungi and nitrogen fixing species which form associations with angiosperms. They are photosynthetic partner in most of **lichen** association.

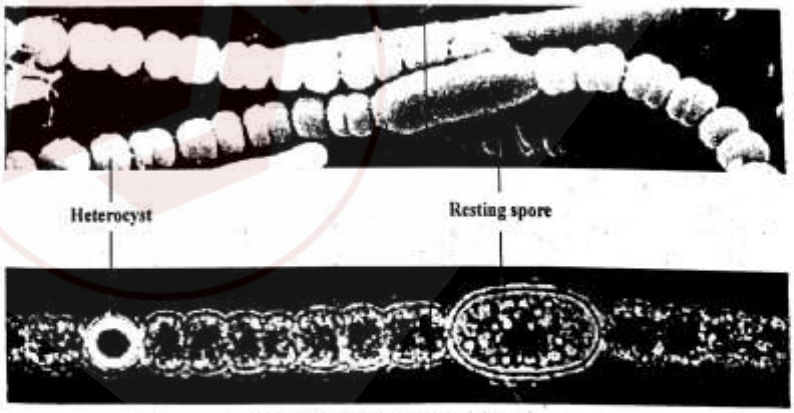

Fig. *Cyanobacterium Anabaena*

HARMFUL ASPECTS

Some of their harmful aspects are;

(i) Production of Unpleasant smell

Many species of cyanobacteria form water blooms where they often impart unpleasant smell and due to large amount of suspended organic matter, water becomes unfit for consumption.

Q. What are super blue green algae? (GUJ-G1)-15

(ii) Production of Toxins

Some species produce toxin that kill livestock and other animals that drink the water.

Information:

Super Blue green algae are basically expensive pond scum, in which cynaobacterium is a singled cell organisms that produces its own food through photosynthesis. It serves as a complete whole food which contains 60% protein with all essential amino acids in perfect balance.

NOSTOC

Introduction

Nostoc is an example of cyanobacteria.

Habitat and occurrence

Nostoc is common as **terrestrial** and **subaerial** cyanobacterium. It is widely distributed in alkaline soils and one moist rocks and cliffs. It forms a jelly like mass in which numerous filaments are embedded.

Structure

- Individual cells are mostly spherical but sometime barrel shaped or cylindrical.
- Trichomes are unbranched and appear beaded.
- All cells in trichome are mostly similar in structure but at interval are found slightly large round light yellowish thick walled cells called as **heterocysts**.
- Trichomes mostly break near heterocysts and form **hormogonia** and thus help in fragmentation.

Q. Give general characteristics of cyanobacteria with special reference to Nostoc. (RWP-G1)-15

Q. Describe general characteristics of cyanobacteria with special reference to Nostoc. (SGD-G1)-15

Q. Write structure and reproduction of NOSTOC. (MTN-G2)-12, (GUJ-G1)-16 (DGK-G2)-15

Fig: Nostoc sp. (A) external morphology of Nostoc colony (B) an enlarged dissected portion of colony (C) an enlarged filament (mucilaginous sheath is also shown)

REPRODUCTION

There is no sexual reproduction but it reproduces asexually in different ways

(i) By Hormogonia

Hormogonia are formed when filament break at different point into smaller pieces. This is due to death and decay of an ordinary cell or the heterocyst may serve as a breaking point.

(ii) By Akinete

Akinete are thick walled enlarged vegetative cells which accumulate food and become resting cells. On arrival of favorable conditions they form normal vegetative cells.