(4)

Nutrition in Bacteria

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From nutritional point of view, bacteria are the most versatile organisms. They may be autotrophic, heterotrophic and Symbiotic.

I - AUTOTROPHIC BACTERIA:

These bacteria oxidise simple inorganic or organic substances and synthesize their own food

They are of two types
1. Photoautotrophic (Photosynthetic), and
2. Chemoautotrophic (Chemosynthetic)

1. Photoautotrophic bacteria : (i) These bacteria can convert radiant energy into the chemical energy, and CO_2 is reduced to carbohydrate. The only difference from the Photosynthesis of higher plants is that they require hydrogen donor other than water. Hence Oxygen is never produced.

(ii) On the basis on hydrogen donor, photosynthetic bacteria are further divided into two types -

(a) Photolithotrophs → The H-donor is an inorganic substance

- Green Sulphur Bacteria → H-donor is Hydrogen Sulphide (H_2S) and the pigment is Chlorobium chlorophyll (bacteriaviridin) eg. Chlorobium

$$6CO_2 + 12H_2S \xrightarrow[\text{chl.}]{\text{light}} C_6H_{12}O_6 + 6H_2O + 12S$$

- Purple Sulphur bacteria + Use Sulphur compounds. pigment - Bacteriochlorophyll eg. Chromatium

$$6CO_2 + 15H_2O + 3Na_2S_2O_3 \xrightarrow[\text{Bacterio-Chlorophyll}]{\text{Light}} C_6H_{12}O_6 + 6H_2O + 6NaHSO_4$$
(Sodium thiosulfate) (Sodium bisulfate or Sodium hydrogen sulfate)

(b) Photo-organolithotrophs. → The H- donor is non-Sulphur organic compounds like organic acids, alcohol, eti. eg., purple non-Sulphur bacteria (Rhodospirillum)

$$6CO_2 + 12\,CH_3CHOHCH_3 \xrightarrow[\text{pigment (Bacteriochlorophyll)}]{\text{Light}} C_6H_{12}O_6 + 12\,CH_3COCH_3 + 6H_2O$$
(isopropyl alcohol) (Acetone)

2. Chemoautotrophic bacteria: These bacteria do not require light and pigment for their nutrition. The energy comes from the oxidation of inorganic and organic substances. In nature most of the bacteria are chemoautotrophs. Two types - on basis of source of energy -

(a) Chemolithotrophs utilise energy released in the oxidation of inorganic substances. It may be of following types

(i) Nitrifying bacteria - oxidise ammonia into nitrite and then nitrite into nitrate.

$$2NH_3 + 3O_2 \longrightarrow \underset{\text{Nitrite}}{2NO_2} + 2H + 2H_2O + \text{Energy}$$

e.g., Nitrosomonas

$$2NO_2 + O_2 \longrightarrow \underset{\text{Nitrate}}{2NO_3} + \text{Energy}$$

eg. Nitrobacter

(ii) Iron bacteria - Ferrous compounds are converted into ferric compounds and energy is released.

Iron(II) refers to ferrous ion i.e. Fe^{+2}.

Iron (III) refers to elemental iron in its +3 oxidation state. Ferric ion is denoted as Fe^{3+} or referred as ferric.

$$2Fe(HCO_3)_2 + O + H_2O \longrightarrow \underset{\text{Ferric hydroxide}}{2Fe(OH)_3} + 4CO_2 + \text{Energy}$$

Iron(II) hydrogen carbonate

or Iron(III) oxide-hydroxide

eg., Ferrobacillus, Leptothrix

(iii) Sulphur bacteria - H_2S is changed into free sulphur and then into sulphuric acid.

$$2H_2S + O_2 \longrightarrow 2S + 2H_2O + \text{Energy}$$

$$2S + 8H_2O + 3CO_2 \longrightarrow 2H_2SO_4 + 3(CH_2O) + 3H_2O + \text{Energy}$$

eg., Beggiatoa, Thiobacillus

(iv) Hydrogen bacteria - convert molecular hydrogen into water.

$$2H_2 + O_2 \longrightarrow 2H_2O + \text{Energy}$$

eg., Hydrogenomonas

(b) Chemo-organotrophs: These bacteria oxidise organic substance for energy.

e.g., Methane bacteria such as Methanococcus oxidises methane into CO_2 and H_2O.

$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O + \text{Energy}$$

Acetobacter and Lactobacillus are other common chemo-organotrophs.

II - HETEROTROPHIC BACTERIA:

These bacteria don't synthesize their own food and are dependent on other organisms for the nourishmen They may be Parasites or Saprophytes.

1. Parasitic bacteria: These bacteria derive their nutrition from the plants and animals on which they grow. As a result of their growth, certain enzymes are produced which decompose or kill the protoplasm of the hostcell. Such effects of the prasites are visible on the host in the form of disease developmen These are also known as Pathogenic bacteria.

e.g., Streptococcus, clostridium.

2. Saprophytic bacteria: The bacteria grow on dead plants and animals, dung, rotten wood, stagnant water and many other decaying substances rich in organic matter. Certain enzymes secreted by the bacteria decompose the complex organic substances of the substrate, converting them into simpler ammonium compounds. Putrefying bacteria like Bacillus mycoides, B. ramosus etc. belong to this category.

Most of the saprophytic bacteria are harmless to humans, but some can be harmful through the toxin they secrete. The souring of milk, manufacture of cheese, preparation of butter from milk and vinegar from sugarcane juice, are various processes completed by the action of specific saprophytic bacteria

III - SYMBIOTIC BACTERIA:

Some bacteria are found in close association with other organisms and both of them are mutually benefitted. A few species of Rhizobium (eg. R. leguminosarum) are found in the root nodules of leguminous plants and helps in fixing the atmospheric nitrogen for the plants. The later provide protection and nutrition in the form of carbohydrate to the bacterium. Such bacteria add to the fertility of soil.