metabolism of Microbiology

Lectuer (3)
Dr.Baha, H.AL-Amiedi
Ph .D.Microbiology

The processes of breakdown and utilization of food material in bacteria are basically similar to higher organisms ,metabolism can be divided into

a. catabolism
b. anabolism

Catabolism: is break down of chemical compound into their constituent atoms molecules.

Anabolism : conversion or synthesis of catabolically generated atom into macromolecuoles that constitute physical & chemical make up of cells

catabolism :

All microorganisum seem to have certain fundamental metabolic pathway concerned in the interconversion necessary for the production abasic building blocks .

Energy metabolism

Energy used by bacteria primarily is produced by fermentative and /or respiratory metabolic pathway the expression of genes necessary for the utilization of substrates or for the synthesis of critical compounds it tightly regulated to satisfy the bacterium needs without consuming unncecessary energy. By breakdown of chemical compounds the main energy - providing chemical compounds are the nutrients carbohydrates lipid and protein

Respiration metabolism.

aerobes obtain energy by a series of coupled oxidation reductions in which the ultimate electron accepter is atmospheric O2 . In this aerobic respiration the carbon and energy source may be complete oxidized to carbon dioxide and water energy is obtain by a process called oxidative phosphorylation production of energy rich phosphate bounds &their transfer adenosine diphosphate to form adenosine triphosphate ,glucose C6H12O6 is main respiratory substrate which broken down in living organism to yield energy series enzyme - controlled chemical changes slowly release the potential energy from glucose ATP can be moved inside the cell and release kinetic energy for various cell activities at the same time forming ADP

$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O + 38\ ATP$

The most common type of respiration for human pathogen and commensal, pyurvate formed by the Embolden – meyerhof pathway also known as Glycolysis it occur in cytocol of all cells these system consist of some ten enzymes and can operate under both aerobic & anaerobic condition and aerobically so pyurvate is converted to carbon dioxide via acetylcoenzyme A (acetyl coA) which is the substrate to the Kreb cycle also

Known as the tricarboxylic acid (TCA) cycle.

It is located in mitocondria the significant of krebs cycle are for production of carbon skeleton for synthesis reactions particularly those leading to synthesis of amino acid and generation of ATP in aerobic condition.

other carbohydrate degradation is hexose monophate or pentose or pentose phosphate
pathway and Entner –Dudoroff pathway. intermediates formed and ATP are used in
synthesis of cellular substance

Anerobic respiration

Anaerobic(fermentation) growth occurs by a process in which organic compound (glucose) is not completely oxidized and yields the
end product alcohole lactic acid and others and only a few molecule of ATP for each molecule of glucose oxidized are produced .this process is called substrate level phosphorylation,
other fermentation product with diversity of products by the farther metabolism of pyurvate ,depending on the species of bacteria and environmental condition such as PH so the products formed are characteristic of particular species and aid to classification.

Anapolism

There are wide differences in ability of cells to carry out the individual biosynthesis of essential manomers, co-enzymes ..etc. from the building blocks produced by catabolism. Others almost completely lack such biosynthesis power within these two extremities there is a wide spectrum of different biosynthesis of essential low molecular weight compounds.

protein synthesis:

Three types of RNA are involve in protein synthesis

(1) Ribosome RNA {rRNA }

(2)Messenger RNA {mRNA

(3) Transfer RNA{tRNA} DNA transfers the genetic code for protein synthesis to the (mRNA) .m RNA Joint With several ribosomes called polyribosomes .tRNA possesses the information for placing each amino acid in the correct position on the mRNA - ribosome complex by specific enzynmes and energy As each tRNA combine with its complement-ery amino acid .The amino acid forms a peptid linkage with amino acid of preceding tRNA

This tRNA is then repeats the process .this poly-Peptide grows on the mRNA__ribosome.when the Entire mRNA has been translated into the amino acid sequence ,the complete polypeptide is released from the ribosome as a specific protein.the mRNA ribosome complex remains and continues the process.

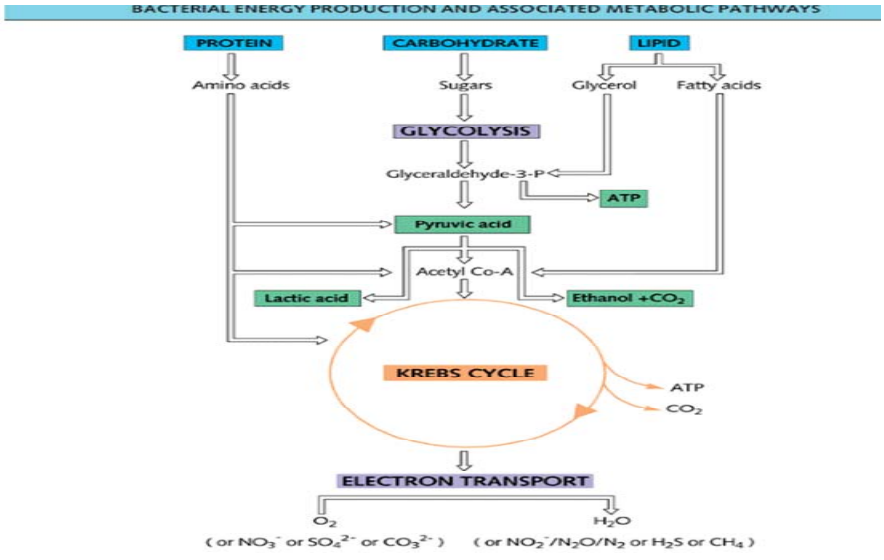
The main steps of protein synthesis are:

1-Amino acid are activated and form a complex with. Enzymes synthetase.

2-The activated amino acid are transferred to soluble RNA or tRNA These reactions are catalyzed by amino acetyl RNA synthetase.

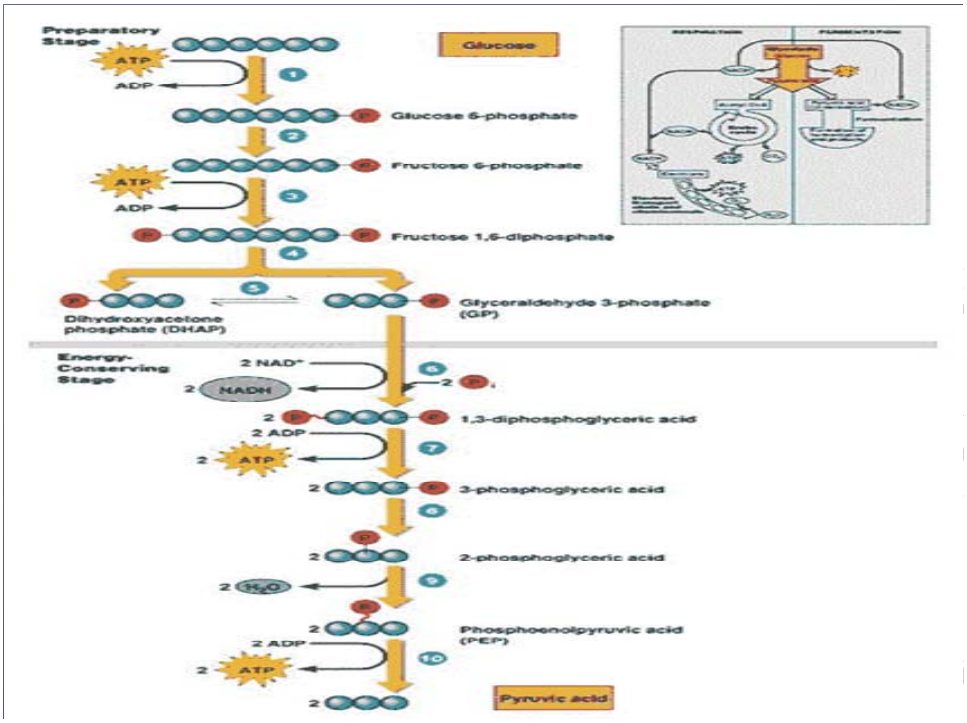
3-mRNA is synthestized on template of chromosomal DNA through the activity of RNA polymerase .

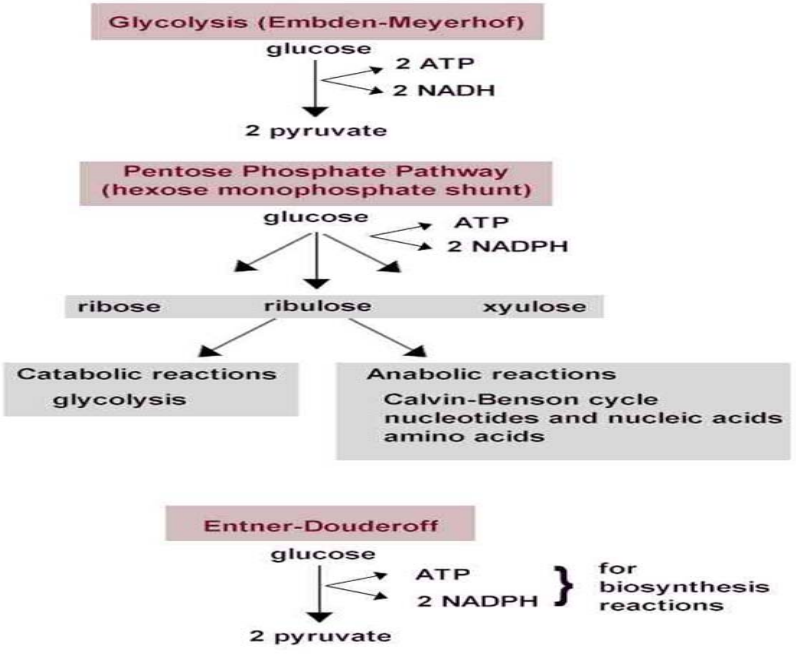
4-mRNA migreat to Ribosomes to form polysome and serve as template for assembly of amino acids into polypeptide chain. The genetic code is incorporated in the mRNA

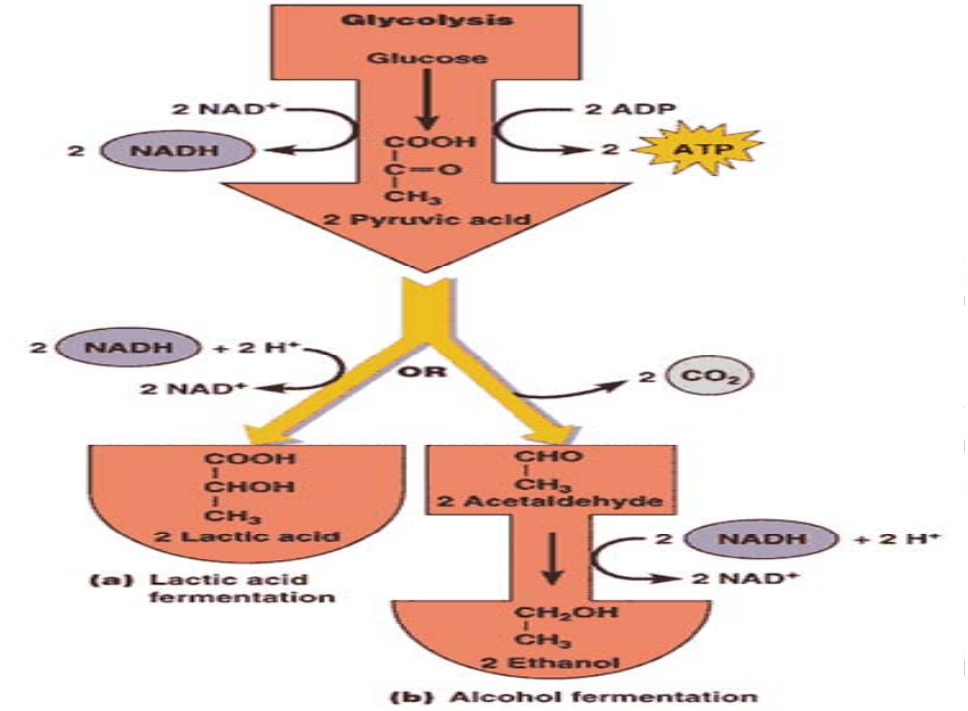


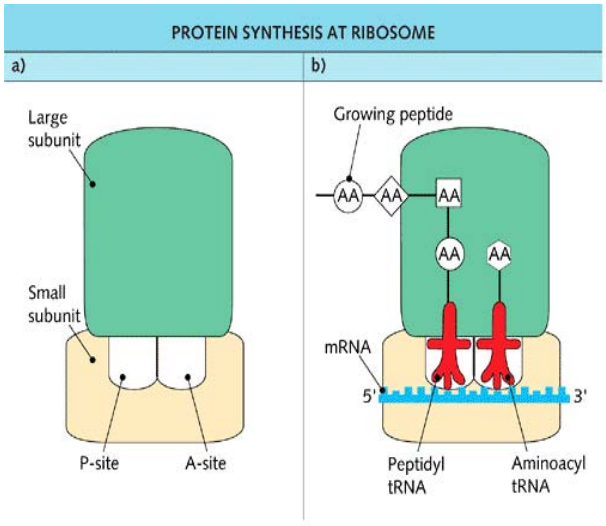
= Key reactants in fermentation

Atmospheric growth conditions	Energy production by	Final electron acceptor	Type of phosphorylation	Moles ATP produ per glucose equiv
Aerobic	Aerobic respiration	Molecular oxygen	Substrate level and oxidative	38
Anaerobic	Anaerobic respiration	Inorganic molecule e.g. NO_3^- or SO_4^{2-} or CO_3^{2-}	Substrate level and oxidative	>2 <38
Aerobic or anaerobic	Fermentation	Organic molecule	Oxidative	2


Preparatory Stage
ATP
ADP
Glucose
Glucose 6-phosphate
Fructose 6-phosphate
ATP
ADP
Fructose 1,6-diphosphate
Dihydroxyacetone phosphate (DHAP)
Glyceraldehyde 3-phosphate (GP)
Energy-Conserving Stage
2 NAD+
2 NADH
1,3-diphosphoglyceric acid
2 ADP
2 ATP
3-phosphoglyceric acid
2-phosphoglyceric acid
2 H2O
Phosphoenolpyruvic acid (PEP)
2 ADP
2 ATP
Pyruvic acid


Glycolysis (Embden-Meyerhof)
glucose
2 ATP
2 NADH
2 pyruvate
Pentose Phosphate Pathway
(hexose monophosphate shunt)
glucose
ATP
2 NADPH
ribose
ribulose
xyulose
Catabolic reactions
glycolysis
Anabolic reactions
Calvin-Benson cycle
nucleotides and nucleic acids
amino acids
Entner-Douderoff
glucose
ATP
2 NADPH
for biosynthesis reactions
2 pyruvate


Glycolysis
Glucose
2 NAD+
2 NADH
2 ADP
2 ATP
COOH
C=O
CH3
2 Pyruvic acid
2 NADH + 2 H+
2 NAD+
OR
2 CO2
COOH
CHOH
CH3
2 Lactic acid
(a) Lactic acid fermentation
CHO
CH3
2 Acetaldehyde
2 NADH + 2 H+
2 NAD+
CH2OH
CH3
2 Ethanol
(b) Alcohol fermentation


PROTEIN SYNTHESIS AT RIBOSOME
a)
b)
Large subunit
Small subunit
P-site
A-site
Growing peptide
AA
mRNA
5'
3'
Peptidyl tRNA
Aminoacyl tRNA