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**DEPARTMENT OF MICROBIOLOGY**

**QUESTION BANK**

**Title of the paper: Microbial Metabolism**

**Subject Code:16SCCMB2**

**2MARKS**

**UNIT-I NUTRITION AND GROWTH OF MICROBES**

**GROWTH**

Growth can be defined as increase in cell number and increase in cell size.

**NUTRITION**

Nutrition can be defined as the agent supplies energy to cell for growth. The agent for nutrition is vitamins, carbohydrates and proteins

**AUTOTROPHS**

The microorganisms uses carbondioxide as the sole source of carbon is called autotrophs. Here carbon fixation is used. The microbes prepare their own food EG:*Klebsiella*

**CHEMOTROPHS**

The microorganisms that are not capable of using carbonndioxide as their source of energy is called chemotrophs. They depend upon others for food Eg:*Pseudomonas*

**CHEMOORGANOTROPHS**

The organism obtain their energy source from organic chemicals which may be acid, proteins and carbohydrates. Eg:*E.coli, Klebsiella*

**CHEMOLITHOTROPHS**

The microorganisms utilized organic sulphur as their energy source. Eg:*Sulfuromonas*, *Sulfolobus*

**PHOTOAUTOTROPHS**

The bacteria which obtain their energy from sunlight by itself. Eg:E.coli

**CHEMOAUTOTROPHS**

The bacteria utilize their energy from the oxidation from chemical compound Eg:Vibrio

**METHYLOTROPHS**

the bacteria which use methane-CH4 as their carbon source

Eg:Methanococcus, Methanosarcina, Methylomonas

**NUTRITIONAL REQUIREMENT**

The amount of nutrients required by the microorganisms is called as nutritional requirement. The amount of nutrients will be vary for each and every microorganisms. Some microbes will require lesser amount where some as require higher amount.

**MICRONUTRIENT**

The nutrient require in lesser amount is called micronutrient. It is otherwise called as trace elements. The element are important for the maintenance of protein synthesis. Eg:Zinc, Nickel, Copper, Cobalt, Manganese

**MACRONUTRIENTS**

The nutrient require in larger amount is called macronutrient. It is otherwise called as major elements. The element are important part of carbohydrates, protein, lipids and nucleic acids. Eg:Carbon, Oxygen, Nitrogen and hydrogen

**MINOR ELEMENTS:**

They are required very little amount of nutrition by most of cells. These elements are important for the growth of protein synthesis. Eg:Potassium, Magnesium, Calcium

**AUTOTROPHS**

The microorganisms obtain their carbon source from photosynthesis is called as autotrophs.

They prepare their own food from sunlight.

**HETEROTROPHS**

The microorganisms obtain their carbon source from other source such as glucose is called as heterotrophs.They depend upon other microorganisms for their own food .

**AEROBES**

The microorganisms which depend upon oxygen for their respiration process is called as aerobic respiration. They are otherwise called as aerobes

**ANAEROBES**

The microorganisms which do not depend upon oxygen for their respiration process is called as anaerobic respiration. They are otherwise called as anaerobes

**GROWTH FACTOR**

Organic components are very essential for cell, but these components cannot be synthesized. So they are supplied through nutrient medium such substance are called as growth factor. They are of three types such as aminoacids, purine & pyrimidine, Vitamins

**PSYCHROPHILES**

Microorganisms that require low temperature for their growth is called as psychrophiles. The temperature range is 0-20ᵒC. Eg:*Galionella*

**HYPERTHEMOPHILES**

Microorganisms that require high temperature of above 110 ᵒC for their growth is called as hyperthermophiles. The temperature range is 110ᵒC. Eg:*Sulfolobus*

**MESOPHILES**

Microorganisms that require moderate temperature for their growth is called as mesophiles. The temperature range is 20-45ᵒC. Eg:*Escherichia coli*

**THERMOPHILES**

Microorganisms that require high temperature for their growth is called as thermophiles. The temperature range is 45-80ᵒC. Eg:*Thermus aquaticus*

**CHAPERONS**

To maintain the acidic PH the microbes synthesis a protein called as chaperons. It gives acid tolerance to microbes by a protein called as acid shock proteins. Eg:*Salmonella typhimurium*

**GROWTH CURVE**

Growth curve can be defined as a graph obtained by plotting a number of cells against time factor

**PHASES OF GROWTH**

A typical bacterial growth curve has four phases such as Lag phase, Log phase, Stationary phase , Death or decline phase.

**GENERATION TIME**

The time required by the cell to divide of time or the time required for the population to divide is called as generation time. The generation time for E.coli is 12minutes. The generation time can be calculated by using the formula N=2n

**UNIT-II BACTERIAL ENZYMES**

**OXIDOREDUCTION**

The enzyme involved in the reaction of addition of oxygen and the removal of hydrogen is called as oxidoreduction. The enzyme is called as oxidoreductase.

**TRASFERASE**

The reaction involved in the transfer of groups between the group is called called as transferase enzyme

**HYDROLASE**

The removal of water in the reaction is called as hydrolysis and the enzyme involved is called as hydrolase.

**LYASE**

The removal of groups like ammonia and carbondioxide or addition of group to form double bond or removeing double bond is called as lyase enzyme.

**ISOMERASE**

The reaction involved in the isomerisation of the compound that has same structural formula but different molecular formula

**LIGASE**

The joining of two molecules using ATP energy and NAD is called as ligation and the enzyme involved in the process is called ligase

**ENDOENZYME**

The enzyme synthesized and function within the cell is called as endoenzymes. It is otherwise called as intracellular enzymes. Eg:Cytochrome oxidase

**EXOENZYME**

The enzyme synthesizes in the outer layer of the cell is called as exoenzymes. It is otherwise called as extracellular enzyme.It acts as protective agent. Eg:Lipase

**ISOZYMES**

The enzyme involved in the isomerisation of the compound that has same structural formula but different molecular formula. This enzyme regulate the multibranched pathway.

**ANTIENZYME**

The enzyme neutralize the effect of other enzyme is called as antienzyme. This is one of the defense mechanism of intestinal parasite. Eg:Ascaris lumbricoides

**MULTIENZYME**

The enzyme which has more than one function and play the role a multiple role in the enzyme action is called as multienzyme. Eg:Fattyacid dehydrogenase

**PRODUCT**

The substance found at the end of the reaction is called as product.

**SUBSTRATE**

The intermediate product which increase the speed of the reaction is called as substrate

**APOENZYME & COFACTOR**

The protein part of the enzyme is called as apoenzyme and the non-protein part of the enzyme is called cofactor.

**HOLOENZYME**

This is a conjugated protein contain both the protein and non-protein part of the enzyme such as apoenzyme and cofactor. It is otherwise called as complete enzyme.

**SUBSTANCE**

The reactive molecule in the reaction is called as substance.

**COENZYMES**

Many reaction of substrate are catalysed by enzymes only in the presence of the specific non-protein organic molecule called as co-enzymes. It combines with the apoenzymes to form the holoenzyme.

**ISOENZYME:**

The multiple forms of the enzyme catalyzing the same reaction is called as isozymes or isoenzymes. It is used for the synthesis of different genes.

**LACTATE DEHYDROGENASE**

LDH has five different isozymes such as LDH1, LDH2, LDH3,LDH4, LDH5.

**CREATINE PHOSPHOKINASE**

CPK involve in the conversion of phosphocreatine into creatine. CPK is of three types such CPK1, CPK2, CPK3 which are present in brain, heart and skeletal muscle.

**BACTERIAL ENZYMES:**

The enzymes secreted by the bacteria is called as bacterial emnzymes. It is otherwise called as biocatalyst which is protein in nature. It was coined as catalyst by Berzelius in 1836 and called as enzyme by Kuhne.

**UNIT-III METABOLISM OF CARBOHYDRATES**

**CATABOLISM**

In catabolism, larger molecules are converted into smaller molecules . The word Cata means breakdown and the word bolism means through the

**ANABOLISM:**

In anabolism, smaller molecules are builded into larger molecules. The word ana means build up and the word bolism means through the.

**METABOLISM:**

Carbohydrate are the major source for the living cell. This was synthesized by green plants during photosynthesis from carbondioxide and water. The monosaccharide glucose is the central molecule of carbon dioxide metabolism.

**GLYCOLYSIS:**

Glycolysis is the word derived from the greek word. The word glucose means sweet or sugar and the word lysis means dissolution. The glycolysis has been simply defined as the oxidation of glucose to pyruvate and lactate.

**GLYCOLYSIS:**

Glycolysis can be defined as the sequence of reactions converting glucose to pyruvate or lactate with the production of energy. It was elucidated in 1940 and discovered by Embden, Meyerhoff and Parnas and so it is called as glycolysis pathway.

**FEATURE OF GLYCOLYSIS:**

Glycolysis takes place in all cell of the body. It occurs in the presence or absence of carbondioxide. It is the major pathway for the ATP synthesis. Lactate is the end product of glycolysis. Glycolysis is very important for the brain which is depend on glucose for energy.

**HMP SHUNT:**

HMP shunt is otherwise called as hexose monophosphate pathway or phosphoglucanate pathway or pentose phosphate pathway. This pathway start withglucose-6-phosphate and no ATP is used directly in this HMP shunt pathway.

**LOCATION OF HMP:**

The enzyme of HMP is located in the cytoplasm. The tissues such as liver, adipose tissue, adrenal gland, erythrocytes are highly active in the HMP pathway. The sequence of reactions are divided into two phase such as oxidative and non-oxidative phase.

**KREB’S CYCLE:**

The citric acid cycle is the common pathway for the oxidation of carbohydrates, fatty acids and aminoacids. The main function is to provide energy from food. The cycle is called as Kreb’s cycle and it was discovered by HA.Krebs. It is also called TCA cycle or tricarboxylic acid cycle.

**ELECTRON TRANSPORT SYSTEM:**

During cellular oxidation, the metabolite is situated at one end and the molecular oxygen at the other end. The hydrogen and electron acceptor are seriously arranged inbetween the metabolite and oxygen.

**ATP:**

ATP means Adenine Tri Phosphate. It is a energy rich compound and it is the universal currency of energy. It was discovered by Longmann and Fiske in 1929. It consist of three subunits namely Adenine, Triphosphate and ribose sugar. It function as immediate donor of energy. Atp is found in all the cells such as plant, animal and bacterial cell.

**PHOTOSYNTHESIS:**

Photosynthesis is the conversion of light energy from the sun into chemical energy. The chemical energy is then used to convert Co2 from atmosphere to reduce carbon compounds as primarily as sugar. The word photo means light and synthesis means assembly of organic compounds.

**LIGHT ENERGY:**

The light energy is converted into chemical energy that convert carbondioxide from atmosphere into carbon compounds which can be used as sugars.

**CARBON FIXATION**:

The synthesis of sugar by using carbon from carbondioxide gas is called carbon fixation. Cyanobacteria, algae and green plants are play a role of photosynthesis for the production of energy.

**STAGES OF PHOTOSYNTHESIS:**

Photosynthesis cam be takes place in two stages called as dark reaction and also light reaction. Both reaction involved in the production of energy.

**LIGHT REACTION:**

The light energy is used in the process of converting ADP and inorganic phosphorus to ATP. Here NADP is reduced to NADPH. It is otherwise called as oxygenic photosynthesis.

**DARK REACTION:**

The electron are used along with the energy from ATP is used to reduce carbondioxide that again reduced into sugar. It is otherwise called as anoxygenic photosynthesis.

**OXYGENIC PHOTOSYNTHESIS:**

Oxygenic photosynthesis provides energy to organism and allows for carbon fixation all the while oxygen will be the end product. The plant, algae and blue green algae release oxygen during this type of photosynthesis.

**ANOXYGENIC PHOTOSYNTHESIS:**

Anoxygenic photosynthesis produces cellular energy ATP without oxygen as the by product. It is the phototrophic process where light energy is captured and converted into ATP. It has photosynthetic pigments called bacteriochlorophyll. Green sulfur bacteria, Purplebacteria, Acidobacteria and Helicobacteria were involved in this anoxygenic photosynthesis.

**UNIT-IV METABOLISM OF PROTEINS**

**AMINOACIDS**

Aminoacids are alpha-amino substituted carboxylic acids. They are the building block of protein. Aminoacids are of both essential and non-essential aminoacids.

**PEPTIDES:**

The two or more aminoacids covalently joined together by means of linkages called as peptide bonds. The peptide bonds are otherwise called as protein linkages.

**PROTEINS:**

A macromolecule composed of one or more polypeptide chain. Each sequence of aminoacids are linked by peptide bonds. The aminoacids are joined together to form protein like compound.

**CATABOLISM:**

The catabolism occur by means of oxidative deamination, transamination, decarboxylation and transmethylation. The breakdown of aminoacids from protein is called as catabolism or degradation of aminoacids.

**OXIDATIVE DEAMINATION:**

Deamination means removal of amino group into imino acid. The iminoacid is again converted into ketoacid. This process is called oxidative deamination.

**TRANSAMINATION:**

Transamination is the process of transfer of amino group from aminoacid to ketoacid which react in the formation of new aminoacid and new ketoacid. This process of transamination is carried out by enzyme Transaminase.

**DECARBOXYLATION:**

Decarboxylation is the process of removal of carbondioxide from an aminoacid to form amines. This process of decarboxylation was carried out by means of decarboxylase.

**TRANSMETHYLATION:**

The transfer of methyl group from one compound to another is called as transmethylation. The process of transmethylation was carried out by enzyme transmethylase.

**UREA CYCLE:**

The conversion of amine to urea is called as urea cycle. It is also called as kreb’s cycle because it was discovered by Hans.Kreb and Kurf Henseleit in the year 1932. This cycle start with the aminoacid ornithine and so it is called as ornithine cycle.

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**GLYCINE:**

The biosynthesis of glycine is a complex reaction catalysed by serine hydroxymethyl transferase and tetra hydrofolate. Since this reaction is reversible and it also provides a pathway for the biosynthesis of serine.

**TYROSINE:**

Tyrosine is formed from the essential aminoacid phenyalanine by phenyl hydroxylase. Here phenylalanine is converted into tyrosine with the production of water compound.

**GLUTAMINE:**

Glutamine is synthesized from glutamic acid and ammonia. The reaction is catalysed by glutamic acid synthetase in the presence of ATP. The glutamic acid combined with ammonia and converted to glutamine compound.

**SERINE:**

Non-essential aminoacid namely glycine and cysteine derived from another essential aminoacid serine. Here 3-phosphoglyceric acid is converted into a final product called as serine.

**CYSTEINE:**

Biosunthesis of scysteine occur from two aminoacid such as methionine and serine which are considered as essential and non-essential aminoacid. Here methionine is converted into cysteine.

**PROTEIN SYNTHESIS:**

The assembling of aminoacids into proteins is called protein synthesis. Protein synthesis occur in the cytoplasm. Ribosome is the site of protein synthesis.Protein synthesis involves three steps namely transcription, translation and processing of polypeptide chain.

**CENTRAL DOGMA:**

The information of the sequence of aminoacid in the protein is present in the DNA. This mRNA from DNA is called as transcription. The translation is the process of conversion of mRNA into protein.

**UNIT-V RESPIRATION**

**ANAEROBIC RESPIRATION**

The anaerobic energy yielding process in which the electron transport chain acceptor is an oxidized organic molecule other than oxygen is called anaerobic respiration. The major electron acceptors are nitrate, sulphate and carbondioxide.

**AEROBE**

The microorganisms grow well in the presence of normal atmospheric oxygen. They are otherwise called as aerobes or aerobic microorganisms.

**ANAEROBES:**

The microorganism that can grow well in the absence of carbondioxides and do not require oxygen for their metabolism. They are divided into facultative anaerobe and obligate anaerobe.

**NITRATE RESPIRATION:**

Some bacteria can use nitrate as the electron acceptor and produce ATP. Nitrate may be reduced to nitrite by nitrite reductase. The conversion of nitrate to nitrite is called denitrification. It is formed by Pseudomonas species

**METHANE RESPIRATION:**

The organisms use carbondioxide as electron acceptor and reduced carbon dioxide into methane gas. This is called as methanogens. Eg:Methanococcus

**SULPHATE RESPIRATION:**

Sulphate act as final acceptor and are reduced the sulphate to sulphide. This process is called as sulphate respiration Eg:Sulfuromonas

**FERMENTATION:**

Fermentation can be defined as the conversion of complex compound into simpler compound with the help of microorganisms. It may be carried out in the presence or absence of air.

**TYPES OF FERMENTATION:**

There are five types of fermentation such as alcoholic fermentation, lactic acid fermentation, mixed acid fermentation, homolactic acid fermentation and heterolactic fermentation.

**ALCOHOLIC FERMENTATION:**

Alcoholic fermentation was carried out by number of bacteria, fungi and yeast. Fermentation is the break down of sugar into ethanol and carbondioxide.This catalysed by the enzyme alcohol dehydrogenase. It is produced by the organism Saccharomyces cerevisiae.

**LACTIC ACID FERMENTATION:**

It is one of the oldest form of fermentation. Bacillus, Lactobacillus and Chlorella are used for this fermentation. The energy generators used in the form of ATP. Here 2 molecules of pyruvic acid are reduced to two molecules of lactic acid. Here lactic acid are used as final end product.

**HOMOLACTIC FERMENTATION:**

Homolactic fermentation are used the glycolactic pathway and reduced all the pyruvate to lactate by the enzyme lactate dehydrogenase. Here the microbes involved in the fermentation is called as homofermentative microorganisms.

**HETEROLACTIC FERMENTATION:**

Heterolactic fermentators forms an efficient amount of product like lactose, ethanol and carbondioxide. Microrganisms involved in this fermentation is called as heterlafermentative organism. Here glucose is converted into ethanol and lactic acid and lead to food spoilage.

**MIXED ACID FERMENTATION:**

The microorganism like E.coli, Salmonells, Klebsiella, ferment the glucose to ethanol and complex mixture of acid along with ethanol. The mixed acid are acetic acid, lactic acid, succinic acid and formic acid.

**LIPIDS:**

Lipids are found to be major content for the structure and function of the body. It make use of energy compounds and so here fatty acid was found to be converted into acyl CoA and Acetyl CoA. Finally the product will be carry out to kreb’s cycle.

**CHOLESTROL:**

Cholesterol is found in animals and hence it is called as animal cholesterol. The cholesterol content was found to be 28gm/Kg body weight. One gram of cholesterol was synthesized per day in adults. All the tissues of the body participate in the biosynthesis of cholesterol.

**ANSWER THE FOLLOWING (5 MARKS)**

**UNIT-I NUTRITION AND GROWTH OF MICROBES**

1. Short notes on nutrition based on carbon source
2. Short notes on nutrition based on energy source
3. Explain the nutrition of microbes
4. Explain the nutritional requirement of microbes
5. Short notes on growth factor
6. Write about the PH need for the growth of microbes
7. Mention the moisture content needed for the growth of microbes
8. Write about the bacterial growth
9. Write about the growth curve
10. Notes on phases of growth

**UNIT-II BACTERIAL ENZYMES**

1. Write about the bacterial enzymes
2. Mention the characters of enzymes
3. Write about the classification of enzyme based upon reaction
4. Write about the classification of enzyme based upon location
5. Write about the classification of enzyme based upon chemistry
6. Describe the michaleis-menton equation
7. Short notes non Co-enzymes
8. Comment on Isozymes

**UNIT-III METABOLISM OF CARBOHYDRATES**

1. Explain the oxygenic photosynthesis
2. Short notes on anoxygenic photosynthesis
3. Write about the stages of photosynthesis
4. Comment on light and dark reaction
5. Mention about carbon fixation
6. Comment on photosynthesis
7. Write about ATP production
8. Detail account on Electron transport system
9. Write about HMP shunt
10. Describe the glycolysis pathway
11. Explain the major pathway of carbohydrate metabolism

**UNIT-IV METABOLISM OF PROTEINS**

1. Explain the central dogma of protein synthesis
2. Explain the biosynthesis of glutamine.
3. Mention the biosynthesis of tyrosine.
4. Comment on the biosynthesis of cysteine
5. Write about the biosynthesis of serine.
6. Explain the biosynthesis of glycine.
7. Write about the ornithine cycle
8. Write about the degradation of aminoacids
9. Write about the metabolism of protein

**UNIT-V RESPIRATION**

1. Explain the anaerobic respiration and its types
2. Write about nitrate respiration
3. Comment on sulphate respiration
4. Short notes on methane respiration
5. Write about fermentation
6. Describe the alcoholic fermentation
7. Explain the lactic acid fermentation
8. Short notes on mixed acid fermentation
9. Write about the types of lactic acid fermentation
10. Short notes on cholesterol.
11. Difference between aerobic and anaerobic respiration
12. Difference between respiration and fermentation

**EXPLAIN BRIEFLY (TEN MARKS)**

**UNIT-I NUTRITION AND GROWTH OF MICROBES**

1. Describe the culture techniques adopted for the growth of microbes in detail
2. Explain the measurement of microbial mass in detail.
3. Describe the bacterial growth and bacterial growth curve in detail.
4. Explain the factor influencing the growth of microorganisms in a detailed manner.
5. Explain the nutritional requirement of microorganism in a brief manner
6. Explain the nutritional pattern of microorganism in a brief manner

**UNIT-II BACTERIAL ENZYMES**

1. Describe the enzymes of bacterial and its characters in detail
2. Explain the classification of enzymes in detail.
3. Describe the factors affecting the enzyme activity in detail.
4. Explain the role of coenzymes and isoenzymes in a detailed manner.

**UNIT-III METABOLISM OF CARBOHYDRATES**

1. Describe the EMB pathway in detain
2. Explain the Kreb’s cycle in detail
3. Explain the process of photosynthesis in detail.
4. Describe the pentose phosphate pathway in detail
5. Detailed account on citric acid cycle.

**UNIT-IV METABOLISM OF PROTEINS**

1. Explain the biosynthesis of aminoacids in a detailed manner.
2. Explain the urea cycle in detail.
3. Describe the central dogma process of protein synthesis in a detailed manner.

**UNIT-V RESPIRATION**

1. Explain the respiration done in anaerobic form in detal
2. Explain the fermentation and its type in detail.
3. Explain the biosynthesis of cholesterol in detail.
4. Explain the metabolism of lipids in detail.
5. Explain the biosynthesis of lipids in detail.