



بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

Vitamins





Prepared by:

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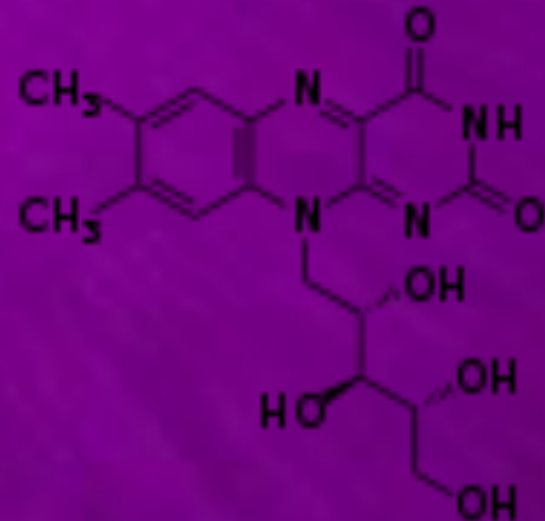
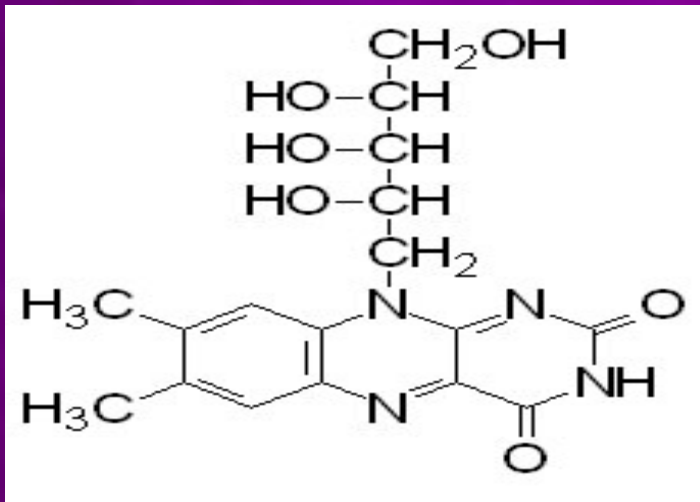
Vitamin B₂



Vitamin B2 (riboflavin)

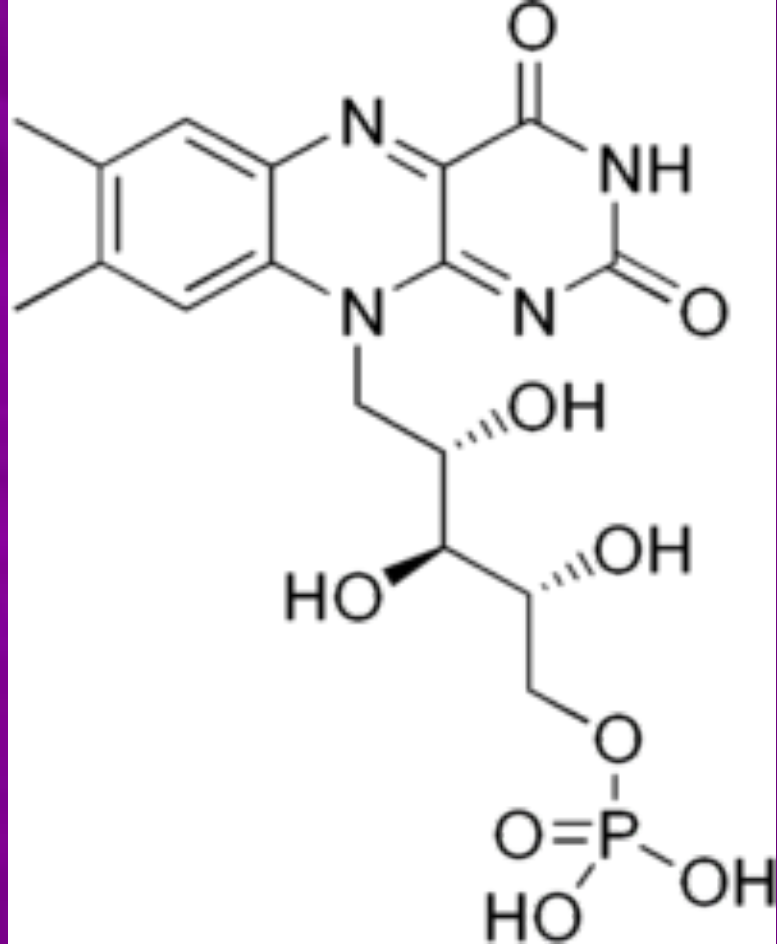
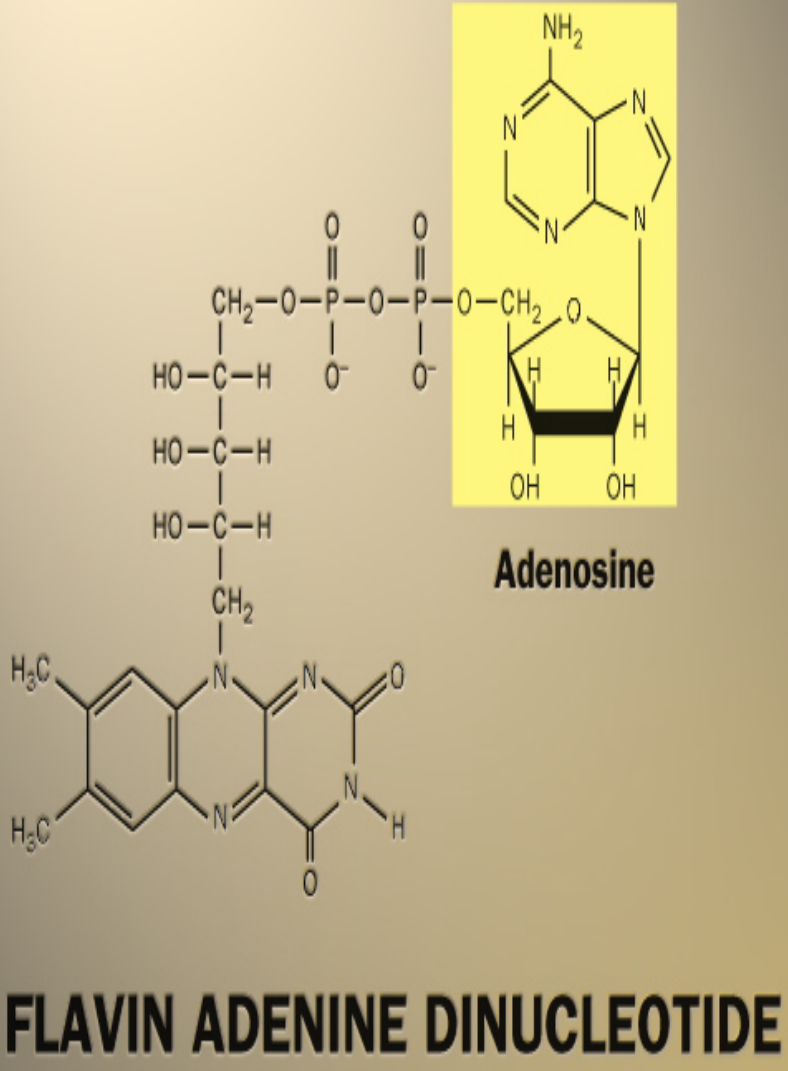
- Chemistry:

- It is an organic yellow compound formed from:
- Flavin pigment or dimethyl isoalloxazine.
- D-ribitol derived from D-ribose



Properties:

1. *Destroyed by light.*
2. *Alcoholic in nature due to ribitole.*
3. *It undergoes reversible reduction to a colourless substance called leucoriboflavin.*
4. *Heat stable in neutral or acid solution but not in alkaline solution.*
5. *On exposure to light, the ribityl residue is split off with the formation of a yellow pigment soluble in chloroform which is called :*
 - *Lumiflavine (in alkaline medium).*
 - *Lumichrome (in acid or neutral medium).*
6. *riboflavin is present in tissues in two biologically active forms:*
7. *Flavin mononucleotide (FMN).*
8. *Flavin adenine dinucleotide (FAD).*



- *Flavin mononucleotide*

- Sources:

- *Plants: yeast, dry beans and nuts. Green leafy vegetables and fruits and germinating seeds.*

- *Animals:*

- *Liver, kidney, eggs and milk.*

- Excretion:

- *In milk, in sweat, in stool and in urine.*

Function

1-It enter in the formation of 2 important coenzymes which are FMN and FAD.

- FMN and FAD are coenzymes for flavoprotein enzymes acting as hydrogen carriers in oxidation and reduction reactions.
- Their active centers include N1 and N10 of flavin ring.

2-It is a growth promoting factor in rats.



Vitamin B₂

Riboflavin (vitamin B2) works with other B vitamins to promote healthy growth and tissue repair, and helps release energy from carbohydrates

Healthy skin RDA: 1.7 mg
Water-soluble

Healthy red blood cell production

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Deficiency

1-Cheilosis is a dry fissured lips.

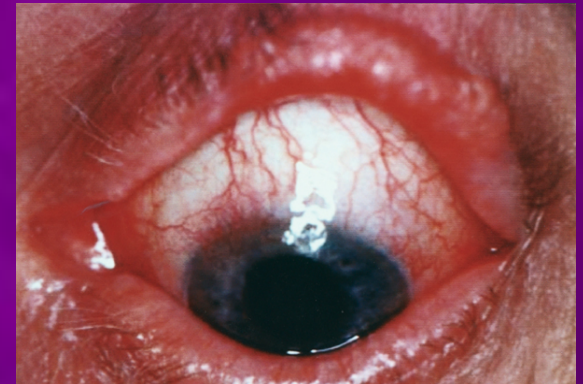
2-Angular stomatitis is fissuring at the angle of the mouth.

3-Inflammation of tongue.

4-In the skin: seborrheic dermatitis.

5-Vascularization of cornea, dryness and photophobia.

6-Synthesis of protein is impaired.



- Requirements:

- Adults 1.5-1.8mg/day.

- Pregnant and lactating female 1.7-2mg/day.

- Children 0.6mg/day.

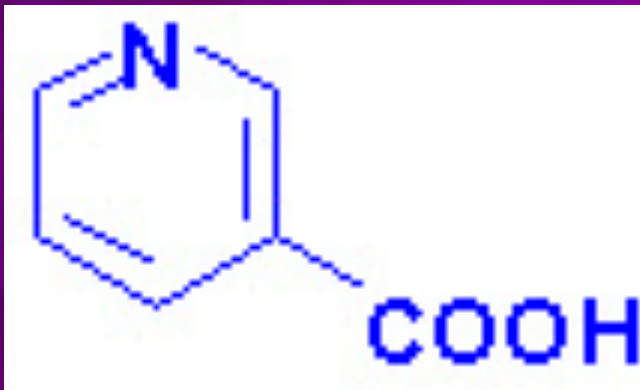
Vitamin B₃



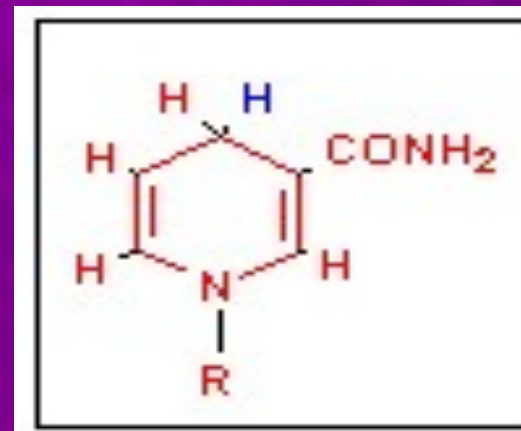
Vitamin B3 (niacin or niacinamide)

- Chemistry:

- It is also called Pellagra preventing factor (PP).
- It is a pyridine 3-carboxylic acid.



Nicotinic Acid



Nicotinamide

- Properties:

- *It is a white crystalline substance.*
- *It is stable in acid solution but not in alkalis.*
- *Not destroyed by light.*
- *It is the most stable member of vitamin B and thermostable.*
- *It is present in tissues in the form of nicotinamide.*
- *Nicotinic acid and nicotinamides are slightly soluble in water.*

- Sources:

- *Plants: yeast, Cereal grains, Some nuts and Legumes.*
- *Animals: Liver, kidney and meats.*

- Absorption:

- *Small intestine as such or as nicotinamide.*

- Excretion:

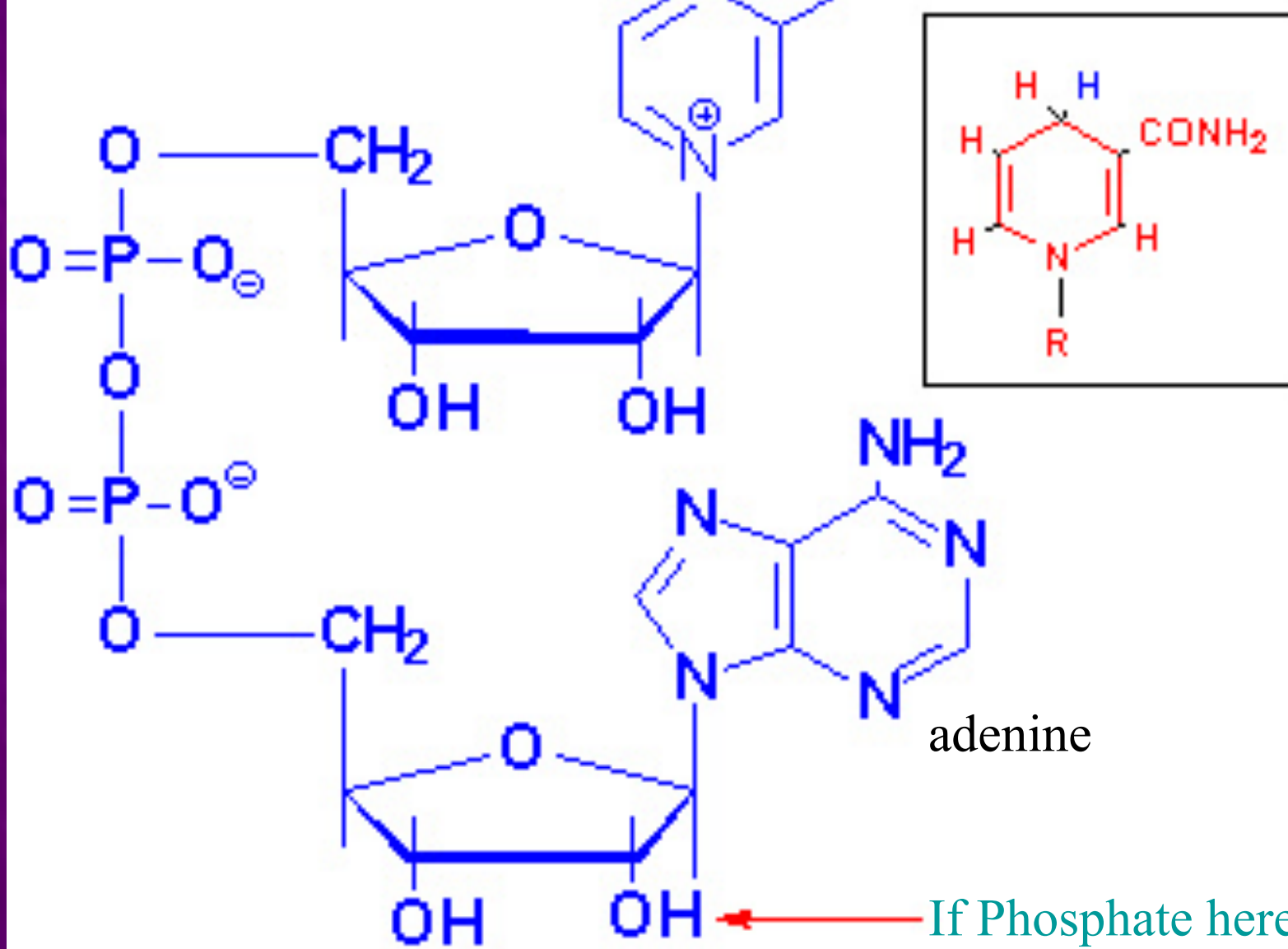
- *In urine: as nicotinic acid or nicotinamide or N1methyl nicotinamide.*
- *In sweat: as nicotinamide(traces).*
- *In milk; as nicotinamide (small amounts).*

Function:

- *Nicotinic acid in the form of nicotinamide enters in the formation of coenzyme I, II and III.*
- *These coenzymes acts as electron and hydrogen carriers:*
 - *Coenzyme I (NAD): nicotinamide adenine dinucleotide.*
 - *Coenzyme II (NADP): nicotinamide adenine dinucleotide phosphate.*
 - *Coenzyme III: acts as a coenzyme for synthesis of taurine from cysteine.*
- *NAD and NADP are coenzymes for reductases, dehydrogenases and hydroxylases, acting as hydrogen carriers in oxidation-reduction reactions.*
- *The piridine ring is the active part of the 2 coenzymes, C4 accepts one hydrogen atom while N1 accepts one electron from another H atom converting to hydrogen ion.*
- *NAD acts as coenzyme for lactate dehydrogenas, malate dehydrogenase, glutamate dehydrogenase and isocitric dehydrogenase.*
- *NADP acts as coenzyme for glucose-6-phosphate dehydrogenase, enoyl-enzyme reductase, phenylalanine hydroxylase and tryptophane hydroxylase.*

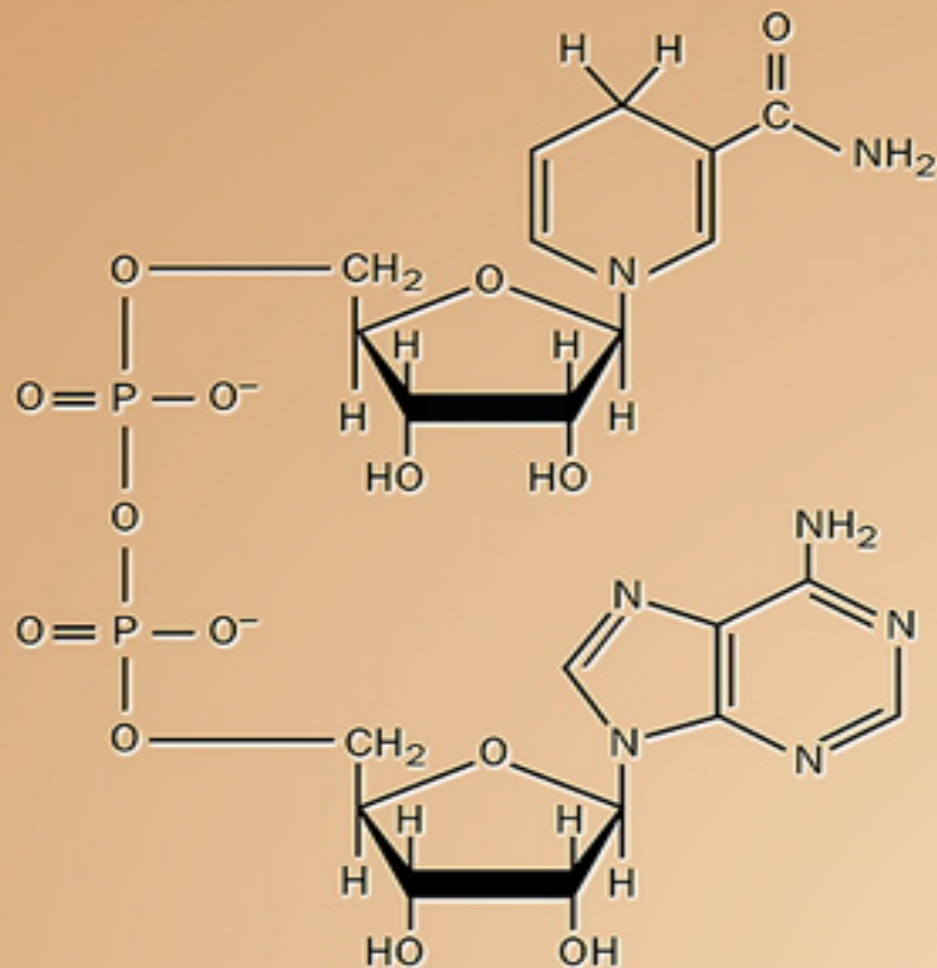
nicotinamide

CONH₂



Nicotinamide Adenine Dinucleotide

NADP



**Nicotinamide adenine dinucleotide
(NADH)**


- *Relation between nicotinic acid and tryptophane:*
- *Nicotinic acid synthesized in the body from tryptophan will result in deficiency of nicotinic acid e.g. zein of maize.*
- *Vitamin B6 is necessary for synthesis of nicotinic acid so deficiency of vitamin B6 results also in deficiency of niacin.*

Deficiency

- *Deficiency manifestations in man:*
- *Niacin deficiency causes Pellagra (Pella= skin, agra= rough) which occurs among the poor population consuming maize as the chief constituent of diet (as maize is deficient in tryptophan).*
- *Pellagra symptoms are 3D's:*
 - *1-Dermatitis: dry, rough, scaly with rough brown discoloration to exposed skin, glossitis and stomatitis.*
 - *2-Diarrhoea.*
 - *3-Dementia: mental power is lost.*
- *Deficiency manifestations in dog:*
- *A condition called canine black tongue is produced it is characterized by dark red areas with necrotic lesions in the mucosa of the mouth.*
- *Pellagra manifestation may result from nicotinic acid, tryptophan or vitamin B6 deficiency.*



Vitamin B₃



An inability to absorb niacin (vitamin B₃) or the amino acid tryptophan may cause pellagra, a disease characterized by scaly sores, mucosal changes and mental symptoms

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- Requirements:

- Children: 16mg/day.

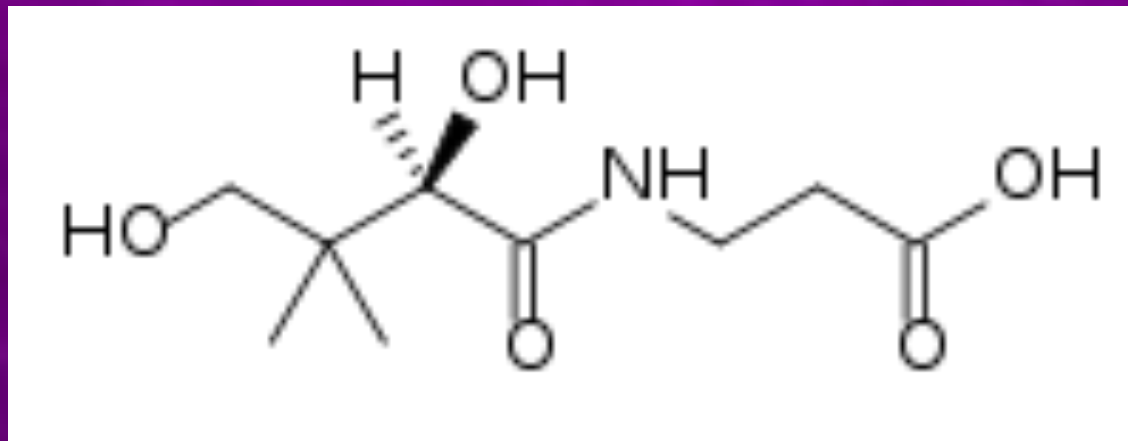
- Adult: 15mg/day.

- Pregnant and lactating female: 20mg/day.

Vitamin B5 (Pantothenic acid)

Chemistry:

- *It is also called chick antidermatitis factor.*
- *It consists of pantoic acid and β -alanine.*



- Properties:

- It is soluble in water.
- It is destroyed by alkali, acid and heat (thermolabile) unstable.
- In tissues the vitamine is present almost in the form of CoA.
- It is usually written as CoA-SH because the activity of CoA is due to the free –SH group at its end.

- Sources:

- Plants: yeast, wheat and rice.
- Animals: it is present in all living tissues e.g. liver, eggs, kidney but the richest known source of pantothenic acid is the royal jelly of bees.

- Excretion:

- Mainly by urine.
- Small amounts are excreted by milk and sweat.

- Requirements:

- Adults: 10 mg/day.

Function:

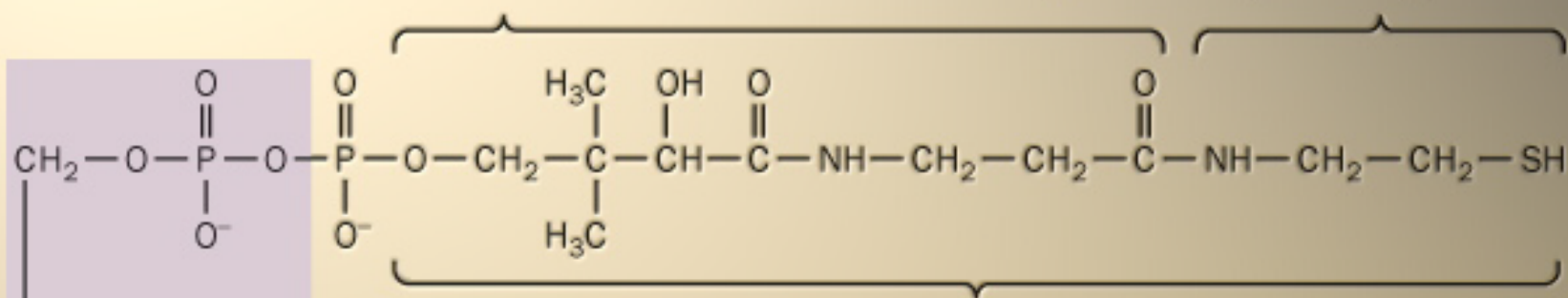
1-It enter in the formation of coenzyme A (CoA-SH) which has the following metabolic function:

- It combine with acetic acid to for active acetate which may be oxidized to give energy or enter in the synthesis of cholesterol, steroid hormones and acetylinecholine.
- It combines with succinic acid to give active succinate enters in the synthesis of heme.
- CoA is imortant in fatty acid oxidation.

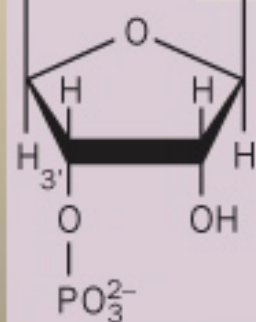
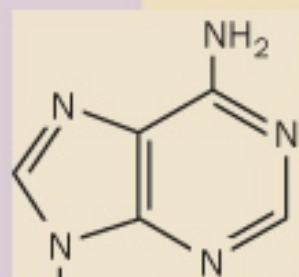
2- pantothenic acid enters in acyl carrier protein structure (ACP). It is a coenzyme necessary for synthesis of fatty acid.

Pantothenic acid

β -Mercaptoethylamine



4-Phosphopantetheine



3',5'-ADP

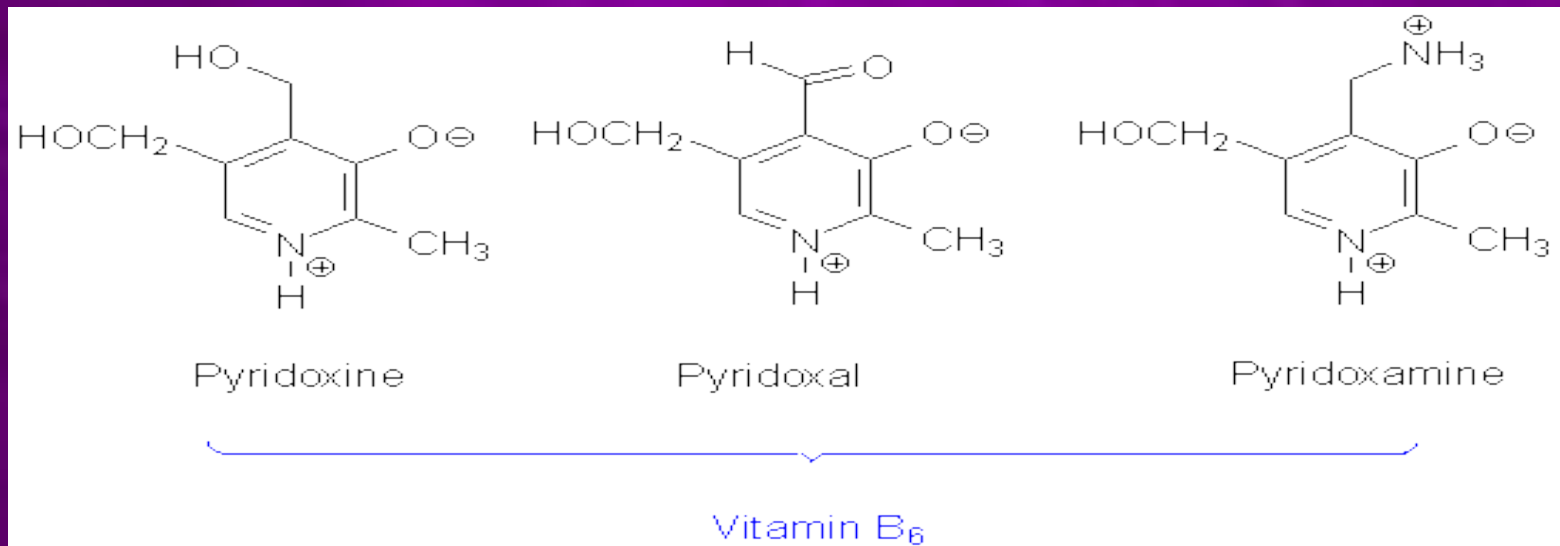
COENZYME A (CoA)

Deficiency:

- *Deficiency of pantothenic acid is shown in the following symptoms:*
 - 1-*Inadequate growth.*
 - 2-*Lesions of the skin and its appendages.*
 - 3-*haemorrhage below the skin, kidneys and adrenal cortex.*
 - 4-*Normocytic anemia.*
 - 5-*Impairment of adrenal function.*
 - 6-*GIT disturbances.*
 - 7-*Fatty liver.*
 - 8-*haemorrhage below the skin, kidneys and adrenal cortex.*
 - 9-*nervous manifestations e.g. myelin degeneration of peripheral nerves.*
- *In rats: it causes special dermatitis especially around the eye “spectacle eye” and depigmentation of hair “antigrey hair vitamins”.*

Vitamin B6 (pyridoxine, pyridoxal, or pyridoxamine, or pyridoxine hydrochloride)

- It is called rat antidermatitis factor.
- It is methyle-3-hydroxy4,5-dihydroxy methyl pyridine derivative.
- There are 3 active forms of pyridoxine in nature which are:



- *Properties:*

- *All forms of vit. B6 are soluble in water and alcohol.*
- *All are destroyed by light.*
- *It is colorless crystalline substance.*
- *Alcoholic in nature.*
- *Pyridoxal can be phosphorylated to give pyridoxal phosphate which acts as a coenzyme.*

- *Sources:*

- *Animals:*

- *Egg yolk.*
- *Royal jelly of bees (very rich in vitamin B6).*

- *Plants:*

- *Yeast.*
- *Rice polishings.*
- *Germinal portion of various seeds.*

- Absorption:

- *Small intestine.*

- Excretion:

- *In urine:*

- *As pyridoxal and pyridoxamine (small amounts).*
- *The major urinary excretion is 4-pyridoxic acid.*

- *In sweat.*

- *In milk,*

• Function

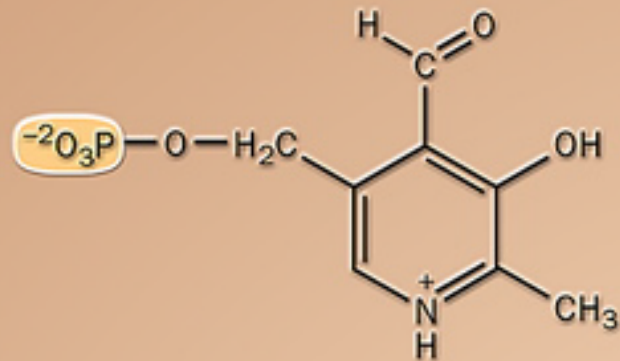
1-Vitamin B6 is converted in the body into pyridoxal phosphate (PLP) which is an important coenzyme in amino acid metabolism, as it catalyzes the following reaction:

a) *Transaminases: “transfere of aminogroup”.*

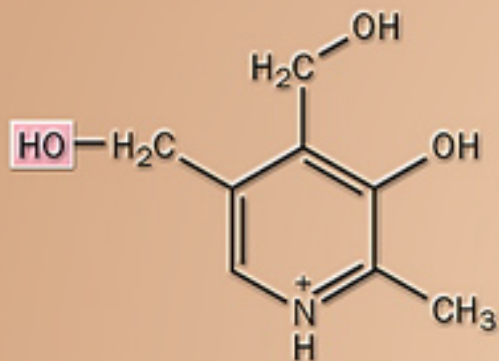
- *It is one of the most important functions of pyridoxal phosphate.*
- *It trnsfer amino group froman aminoacid to α -keto acid to form a new aminoacid and new α -keto acid “cotransaminase”.*
- *Examples of transaminases which use PLP as a coenzyme are glutamic oxaloacetate transaminase GOT and glutamic pyruvic transaminase GPT.*

b) *Decarboxylation: codecarboxylation.*

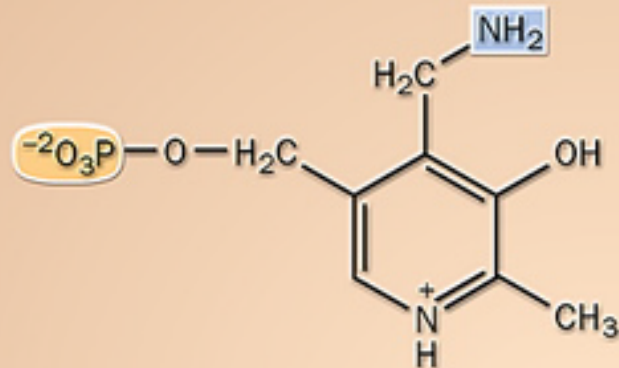
- *Removal of CO₂ of certain amino acids “codecarboxylase” e.g. decarboxylation of histidine, tyrosine and 5hydroxytryptophane.*
- *Dopamine produced is used for synthesis of adrenaline hormone.*
- *Deficiency of PLP leads to convulsions due to defeciciency in the amount of γ -amino butyric acid (GABA) which acts as an inhibitory neurochemical transmitter in the brain.*



Pyridoxal phosphate



**Pyridoxine
(Vitamin B₆)**



**Pyridoxamine
phosphate**

- c) *It is important in the metabolism of tryptophan converting it into nicotinic acid by activating kynureninase enzyme.*
- d) *Trans-sulfuration (transfer of sulfur):*
 - *In metabolism of cysteine, PLP is concerned with the transfer of sulfur from methionine to serine to form cysteine.*
- e) *It acts as a coenzyme in dehydration of serine and threonine amino acids.*
- f) *It is essential coenzyme in haemoglobin synthesis.*
 - *It helps absorption of amino acids from intestine.*
 - *Pyridoxine is involved in amino acids transport into the cells.*

2-Vitamin B6 in CNS is intimately concerned with the metabolism of γ -amino butyric acid and glutamic decarboxylase are found the gray matter. It acts as a regulator of neural activity.

Deficiency:

1. Impaired growth due to disturbed amino acid metabolism.
2. Microcytic hypochromic anemia (hemoglobin synthesis).
3. Interference with tryptophan metabolism thus may cause pellagra.
4. Skin lesions.
5. Epileptiform convulsions and neuritis.
6. Demyelination of peripheral nerves and axons.
7. In rats: dermatitis is the most characteristic.

Causes of deficiency:

1. Low vitamin intake.
2. Pregnancy due to increased demand of vitamin for embryo.
3. Tuberculous patients taking high doses of isonicotinic acid hydrazide (INH) as it combines with pyridoxine forming hydrazone which inactivates the vitamin.

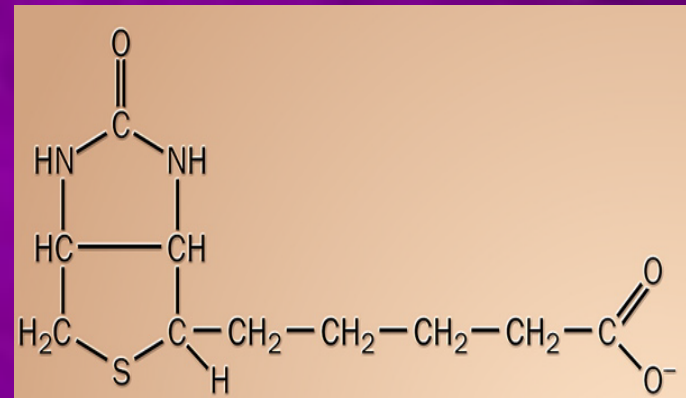
- Daily requirements:

- *Adults: 2mg/day which must be increased in high protein diet.*
- *Pregnant and lactating female: 2.5mg/day.*

Vitamin B7 (Biotin, vitamin H or coenzyme R)

- Chemistry:

- It is formed of:
- Imidazole ring.
- Thiophene ring.
- Valeric acid.



Properties:

- *It is a white crystalline compound.*
- *It is soluble in hot water and dilute alkali.*
- *Biotin is present in nature in combination with lysine forming biocytin which is active and acts as a coenzyme.*
- *Avidin, a basic protein present in raw egg white, form a very stable biologically inactive complex with biotin.*

• Sources:

- *Egg yolk, liver, kidney, milk and yeast.*
- *Large amounts are present in royal jelly of bees.*
- *In man much of the biotin requirement is supplied by its synthesis from intestinal bacteria.*

• Excretion:

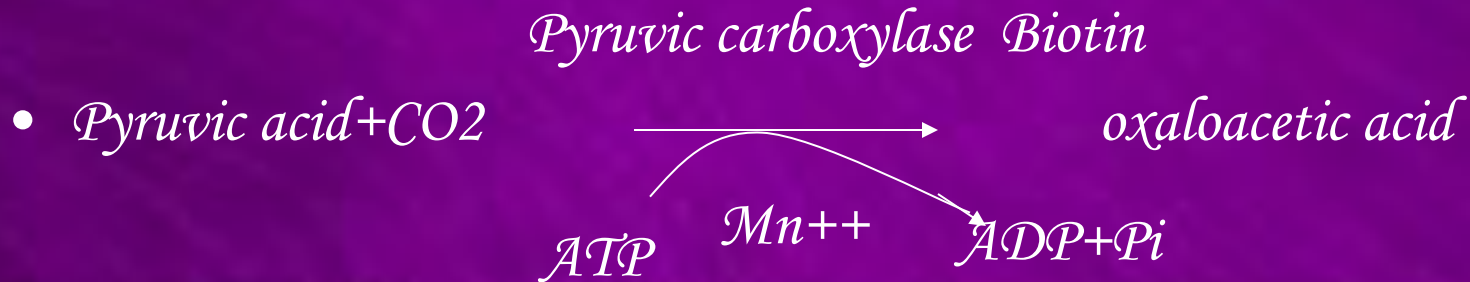
- *In urine and stools.*

• Requirements:

- *Adults: 150-300ug/day.*

Function

- *Biotin is a coenzyme helping CO₂ fixation. So it is a coenzyme helping different (carboxylases). It is found in the form of biocytin or “CoR”*
- *Example of CO₂ fixation:*
- *1-fixation of CO₂ into pyruvic acid to form oxaloacetic acid.*



2-Fixation of CO₂ to form C₆ of purines.

3-Fixation of CO₂ into acetyl CoA to form malonyl CoA which is used for synthesis of fatty acids.



4-Fixation of CO₂ into propionyl CoA converting it into methyl malonyl CoA this reaction needs propionyl CoA carboxylase.

5-carbamoyl phosphate synthetase:

- Catalysing the formation of carbamoyl phosphate from CO₂ and ammonia. This carbamoyl phosphate is important for formation of urea and pyrimidines.

Deficiency

- *Biotin deficiency in man is rare as it is synthesized by intestinal flora, but if deficient, it causes:*
 1. *dermatitis of extremities.*
 2. *Pallor of the skin and loss of hair.*
 3. *Anorexia (loss of appetite), anemia, fatigue in muscles and vomiting.*

Causes of deficiency:

- *Intake of antibiotics and sulfa drugs which inhibit the bacteria of the intestine.*
- *Intake of raw egg white which contains avidin.*
- *A basic protein in raw eggs known as avidin was found to cause deficiency of biotin because it combines with it forming avidin-biotin complex and this prevents absorption of biotin. This property impairs the value of biotin and causes what is called egg white injury.*



Thank You