



بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ



# Vitamins





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# Vitamin B9

Folate



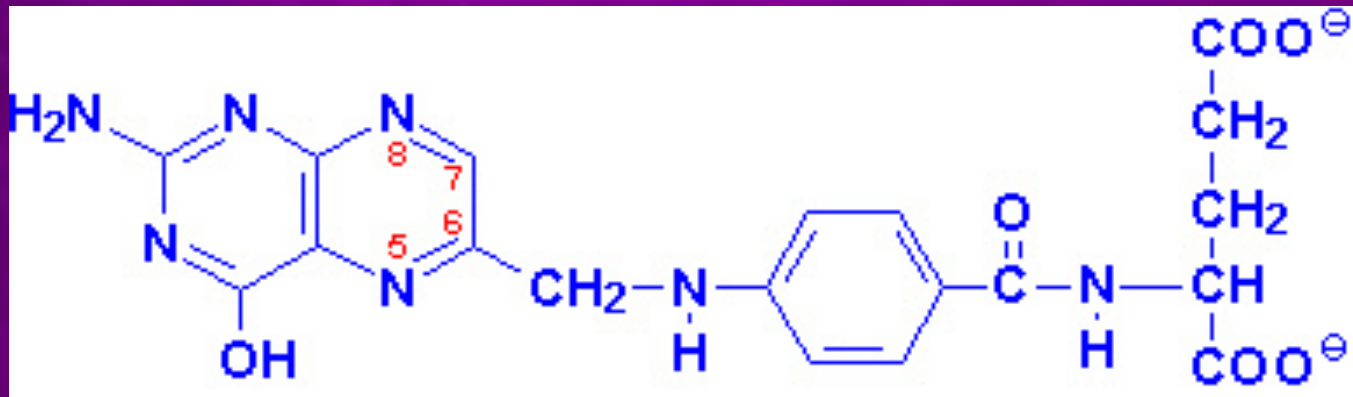
ADAM.

# Vitamin B9 (folic acid)

- Chemistry:

– It is a combination of:

- Pteridine nucleus.
- P-amino benzoic acid.
- Glutamic acid.



- Properties:

- *Folic acid is inactive and it is activated in the liver by help of vitamin C into folinic acid.*
- *Folinic acid is essential for the growth of a certain bacillus called leuconostoc citrovorum. So it is called citrovorm factor.*

- Sources:

- *Widely distributed in nature. They are abundant in green leafy vegetables, wheat, yeast and liver.*
- *In man, it is synthesized by bacteria of larg intestine.*

- Requirements:

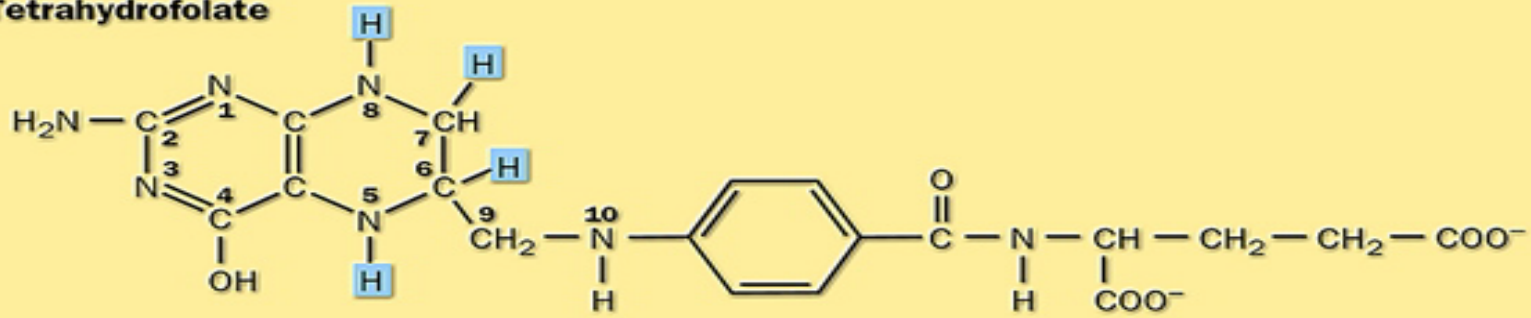
- *Adults: 0.5 mg/day.*
- *Pregnant and Lactating women: 0.7mg/day.*

## *Function:*

- *Folic acid is reduced to tetrahydrofolate, the active form.*
- *Folic acid in the form of tetrahydrofolate functions as a coenzyme in the transfer and utilization of one carbon fragments (moiety) the single carbon moiety may be:*
  - *Formyle group*
  - *Formimino group.*
  - *Hydroxy methyle group*
  - *Methyl group*
  - *Formate group*
- *Source of the one carbon moiety:*
  - *Glycine: it is  $\alpha$ -carbon.*
  - *Serine: it is  $\beta$ -carbon.*
  - *Tryptophane: through the formation of formic acid.*
  - *Histidine: through the formation of formiminoglutamic acid (FIGLU).*
  - *Dimethylglycine: one of its  $-\text{CH}_3$  groups being oxidized to hydroxymethyle group then transferred to FH<sub>4</sub> forming hydroxymethyl FH<sub>4</sub> and sarcosine.*
- *Folic acid has a fundamental role in growth and reproduction, since it is used for reactions leading to synthesis of purines and pyrimidines.*
- *It is necessary for phospholipid metabolism.*
- *Synthesis of deoxythymidylic acid (dTMP).*



**Tetrahydrofolate**



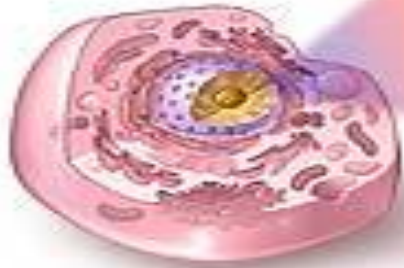
# Vitamin B9

## Folate

Folate aids in the production of red blood cells



Folate aids in the synthesis of DNA



Cell

Folate works with B12 and vitamin C to help the body digest and utilize proteins



## Deficiency

1. *Folic acid deficiency is common in such condition:*
  - *Haemolytic anaemia.*
  - *Anaemia of malignancy.*
  - *Alcoholism.*
  - *Pregnancy anemia.*
2. *The manifestations of deficiency result from the reduced rate of cell division. They include:*
3. *Impaired growth.*
4. *Impaired multiplication of alimentary canal epithelium.*
5. *Impaired haemopoiesis.*
6. *In the human blood picture shows macrocytic hyperchronic anemia accompanied by leucopenia and thrombocytopenia.*

# Vitamin B<sub>12</sub>

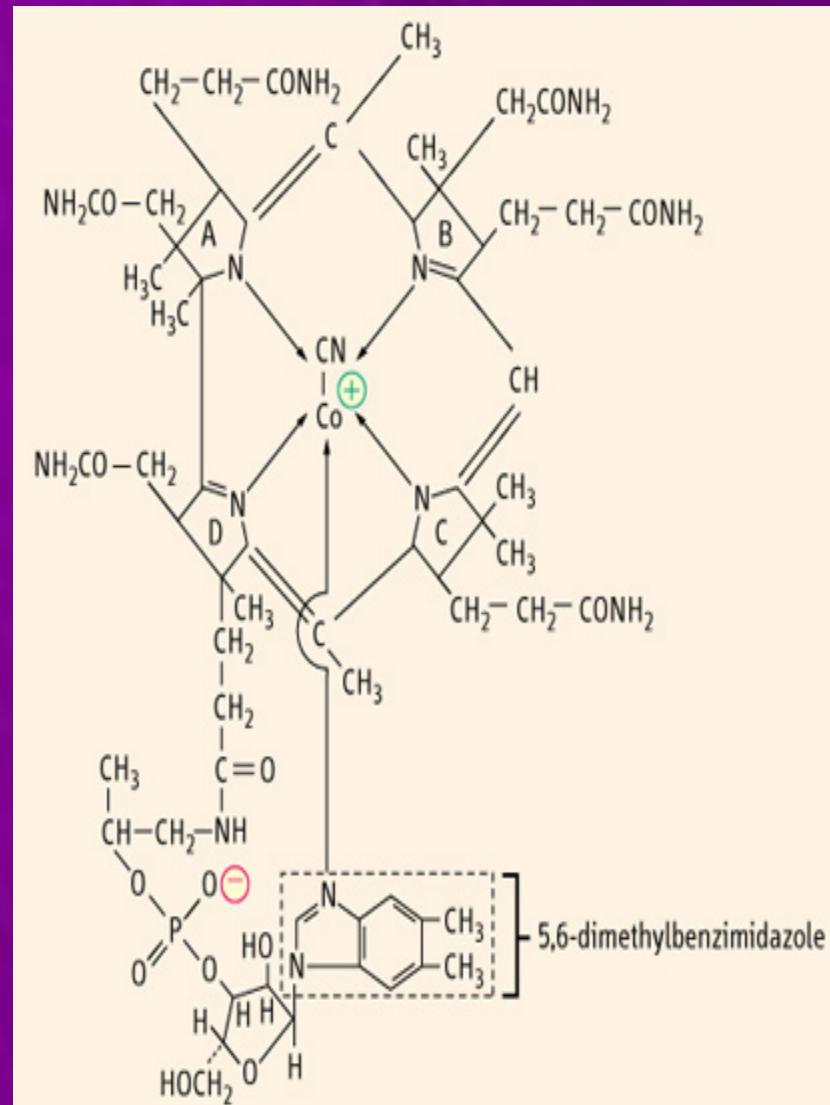


 ADAM.



# Vitamin B12 (cyanocobalamin)

- *Anti-pernicious anemia or extrinsic factor of Castle.*
- *It consists of:*
- *Four pyrrole rings surrounding a single cobalt atom. The replaceable hydrogen of every pyrrole ring is substituted by a side chain.*
- *The central cobalt atom is attached at one side to a cyanide group (CN) and the other side to 5,6-dimethylbenzimidazole which is attached to the side chain on ring D through ribose, phosphate and aminopropanol.*
- *Since vitamin B12 contains a cobalt atom and a cyanide group, so it is also called cyanocobalamin.*
- *If the cyanide group is removed, it is called cobalamin.*



- **Properties:**
  - Red in colour.
  - It is stable to heating at 100° C.
  - It is destroyed rapidly at pH9 on heating.
  - It can give certain coenzymes called cobamides.

- **Absorption:**
  - From ileum.
  - It depends on presence of gastric HCL and a constituent of normal gastric juice which has been called Intrinsic factor of castle.
  - It is a constituent of gastric mucoprotein.
  - It is found in the fundus and cardiac end of stomach but not in the pylorus.

- **Sources:**
  - Liver and kidney are the best sources.
  - Milk, egg and meats.
  - Vegetables are deficient in vitamin B12.

- **Requirements:**
  - Adults: 5ug/day.
  - Pregnant and lactating female: 7 ug/day.



## Function

1. *It is important for transformation of RNA to DNA.*
2. *It is essential in protein and nucleic acid synthesis.*
3. *It is essential for metabolism of haemopoietic and nervous system.*
4. *It is important in methyl group neogenesis for transmethylation reaction.*
5. *It provides a group of coenzymes known as cobamides these function as coenzymes in isomerase enzyme.*
6. *Treatment of pernicious anemia, it is regarded as the extrinsic factor, which unites with the intrinsic factor present in the stomach, to give certain factor which prevents pernicious anemia.*

# Vitamin B12

Brain

Spinal  
cord



Red blood  
cells

Vitamin B12 is important for metabolism, the formation of red blood cells, and the maintenance of the central nervous system, which includes the brain and spinal cord



## Deficiency

1. *Pernicious anaemia which is characterized by:*
2. *Atrophy of gastric mucosa.*
3. *Hyperchronic macrocytic anemia.*
4. *Nervous lesions.*

### *Causes of vitamin B12 deficiency:*

- *Malabsorption syndrome.*
- *Destruction of gastric mucosa or after gastrectomy.*
- *Absence of secretion of the intrinsic factor.*

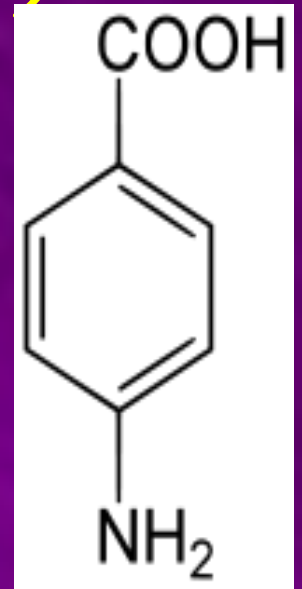
# *Para aminobenzoic acid (PABA).*

- Sources :

- *It is widely distributed in animal and plant tissues.*
- *Present in good amounts in yeast.*

- Function:

- *It enter in the structure of folic acid.*
- *It is a growth factor of certain pathogenic bacteria.*
- *It is antagonized by sulphonamide which has similar structure.*



dihydropteroate diphosphate + p-aminobenzoic acid (PABA)

dihydropteroate  
synthetase

← sulfonamides

dihydropteroic acid

dihydrofolic acid

dihydrofolate  
reductase

← trimethoprim

tetrahydrofolic acid



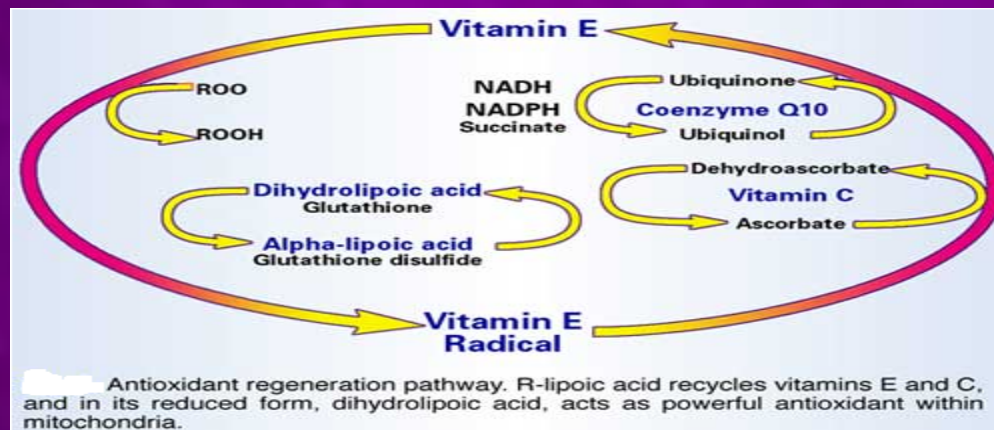
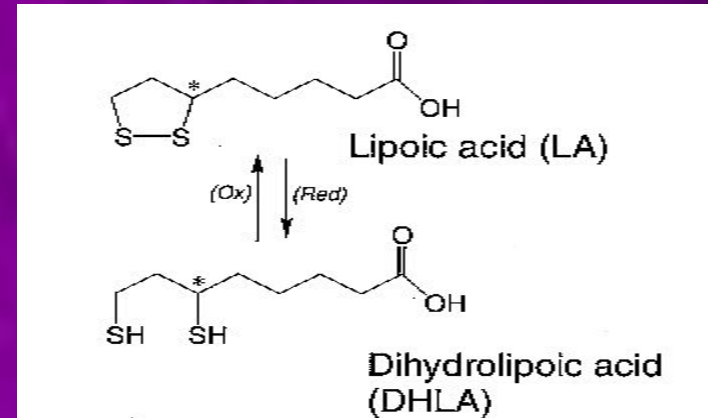
# Lipoic acid

- Chemistry:

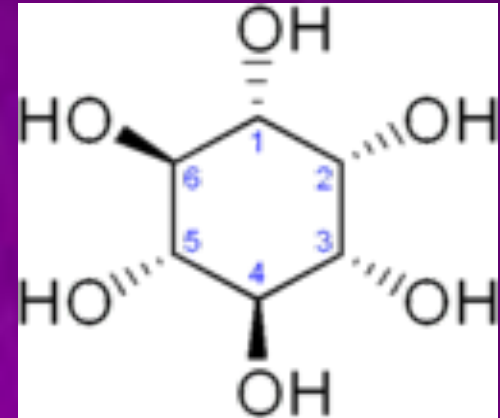
- It is sulfur containing vitamin.
- It is 6-8 dithio-octanoic acid.

- Function:

- It acts in the process of oxidative decarboxylation of  $\alpha$ -keto acids e.g. pyruvic acid and  $\alpha$ -ketoglutaric acid.



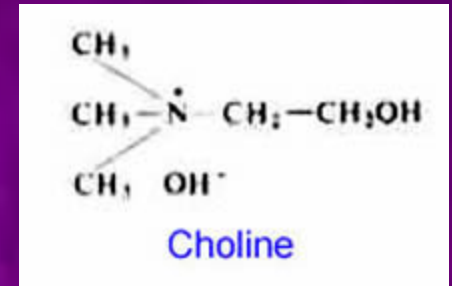
# Inositol



- **Chemistry:**
  - It is hexa-hydroxycyclohexane (sugar alcohol).
  - It is derived from glucose.
  - It is a cyclic compound present mainly in muscles.
  - It has 9 isomers, myoinositol is the most common biologically important.
- **Function:**
  - It is a lipotropic factor (prevents accumulation of fat in hepatic cells).
  - Hexaphosphoric acid (phytic acid): prevents  $Ca^{++}$  absorption due to formation of insoluble salts.
  - Enter in structure of certain phospholipids.
- **Deficiency:**
  - Failure of lactation and growth.
  - Alopecia: falling of hair.



# Choline



- Chemistry:

- *it is a trimethyl ethanolamine.*
- *It contains 3 methyl groups so it is a methyl donor.*

- Properties:

- *It was considered a member of vitamin B complex but it is no longer considered so because:*
- *It can be synthesized or formed in the body.*
- *It enters in the structure of choline of the tissues.*
- *It is need in a big amount.*

- Function:

- *It enters in formation of lecithin, acetyl choline and sphingomyelin.*
- *It is a lipotropic factor prevent accumulation of fat in the liver.*
- *On oxidation it gives betain which acts as a methyl donor in creatine, adrenaline and thymine synthesis.*



Control of  
phospholipid  
**concentration** in liver  
and blood

Phosphatidylcholine  
and **sphingomyelin**  
synthesis

**CHOLINE**

Synthesis of  
internal cell  
messengers

Methyl group  
donor

Acetylcholine  
synthesis

Diagram showing the major functions of choline in the body

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