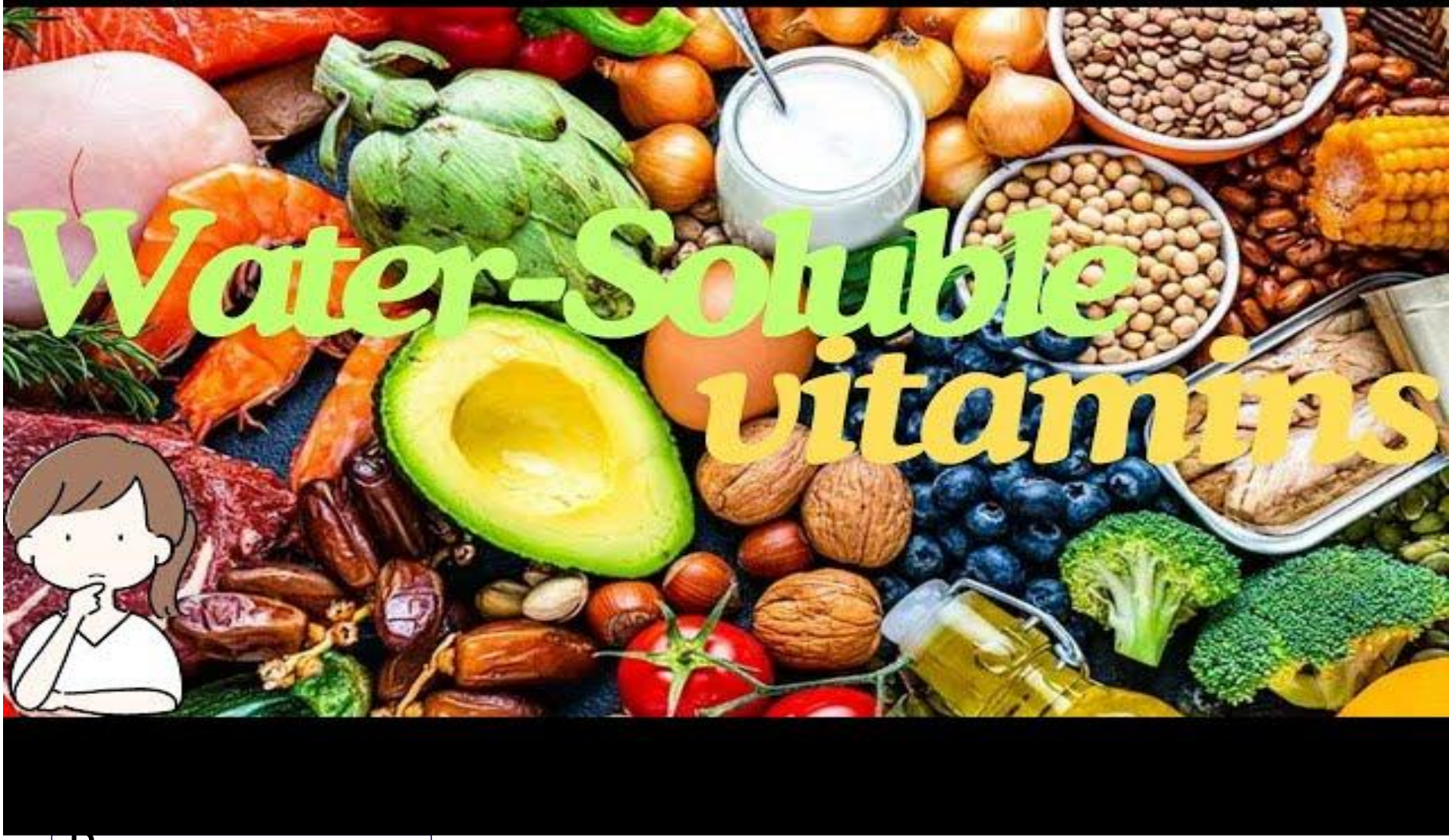


By
Hadeel luay

WATER SOLUBLE VITAMINS

Vitamins B and C

- Functions
- Effects of deficiency
- Sources
- Properties
- RDA

VITAMINS

- "VITAMIN" means "vital for life"

- VITAMINS are ***Micronutrients**

which are necessary for everyday healthy functioning of the body

* **Nutrients** required in very small amounts - mg or µg

VITAMINS -

Two main categories

Water soluble

B

C

Fat Soluble

A

D

E

K

Vitamin B_1 - Thiamine

Active Form of Thiamine

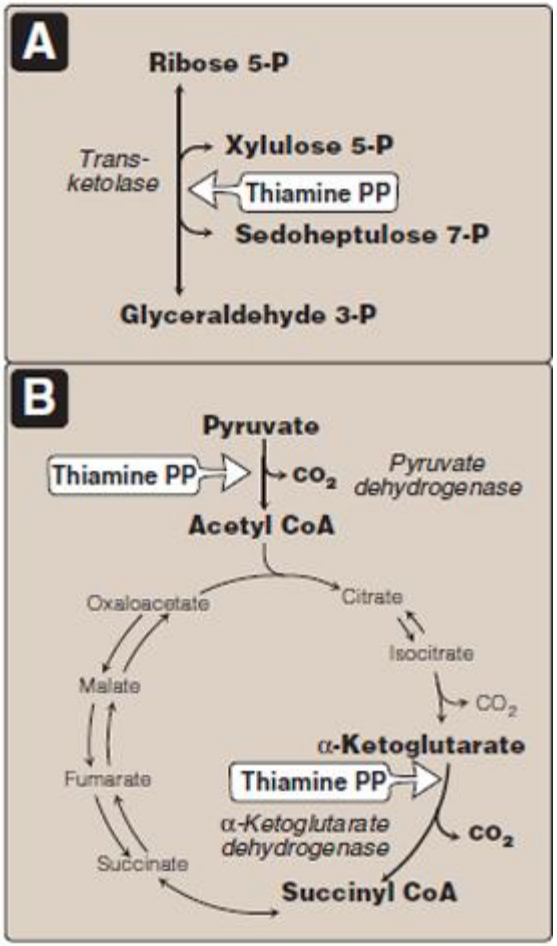
Thiamine pyrophosphate) TPP) is the biologically active form of the vitamin B1, formed by the transfer of a pyrophosphate group from adenosine triphosphate (ATP) to thiamine.

Thiamine pyrophosphate serves as a

1-coenzyme for the enzyme transketolase in the pentose phosphate pathway of glucose oxidation

2-in the oxidative decarboxylation of pyruvate and a ketoglutarate.

3-plays a key role in energy metabolism of most cells, is particularly important in tissues of the nervous system



Vitamin B_1 - Thiamine

Deficiency

Fatigue, depression, irritability

Beri-beri - disease of nervous system

Common in countries where polished rice is staple food

Vitamin B_1 - Thiamine

Sources

Meat

breakfast cereals

Wheatgerm

Fortified white flour

Milk

Eggs

Vegetables

Vitamin B_1 - Thiamine

Properties

- Water soluble
- Destroyed by high temperatures
- Destroyed by alkalis
- Lost by milling flour

RDA

1mg per day -

Requirement increases with energy expenditure

Vitamin B_2 -Riboflavin

Active Forms of Riboflavin and Functions

The active or coenzyme forms of the riboflavin are:

- Flavin mononucleotide (FMN), and
- Flavin adenine dinucleotide (FAD).

which are required by several oxidation reduction reactions in metabolism of carbohydrate, protein, lipid, nucleic acid metabolism and electron transport chain.

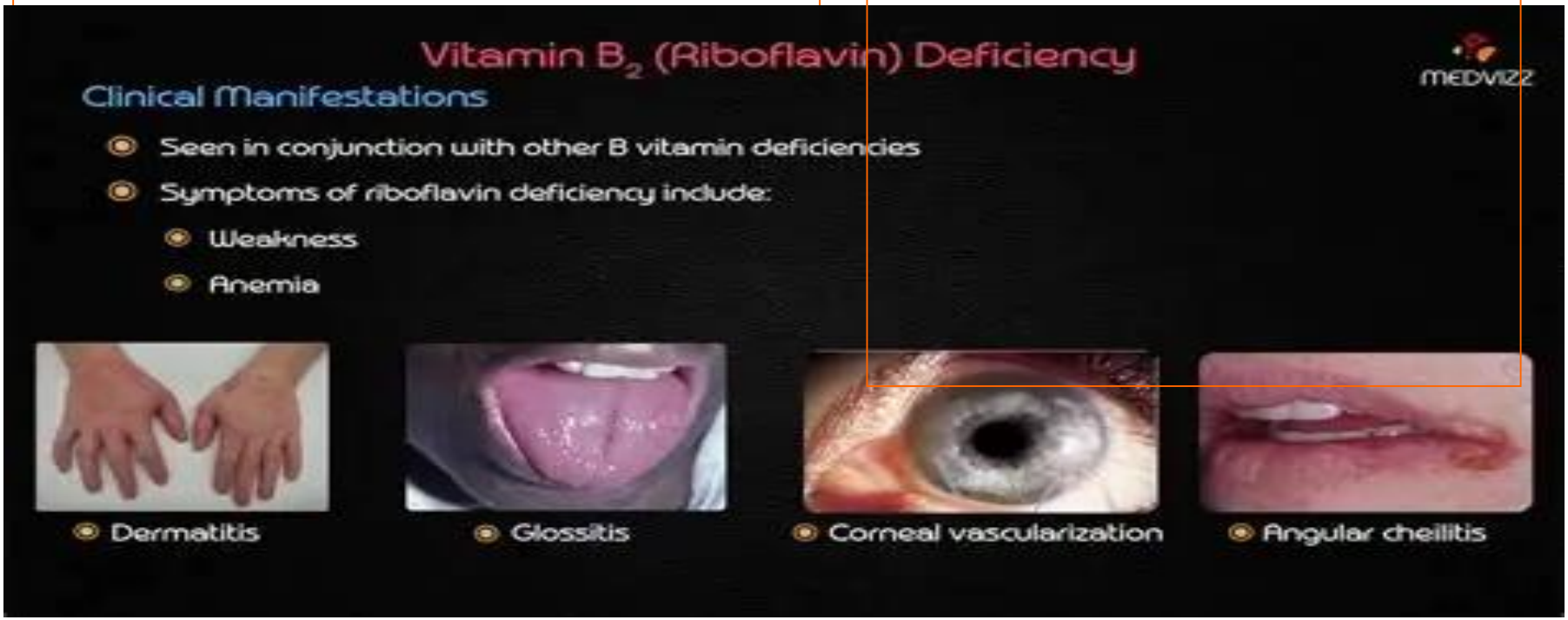
- It is needed for maintenance of mucosal epithelial and the ocular tissues.
-

Vitamin B_2 -Riboflavin

Deficiency

Loss of appetite

Swollen tongue, cracked lips, eye infection, dermatitis



Vitamin B_2 -Riboflavin

Sources

Milk

Cheese

Eggs

Yeast extracts

Green Vegetables

Vitamin B3 -Niacin (Nicotinic acid)

Active forms of niacin are:

- Nicotinamide adenine dinucleotide (NAD+)
- Nicotinamide adenine dinucleotide phosphate (NADP+)

which are essential for glycolysis and oxidative phosphorylation, and for many synthetic processes.

Functions

Metabolism of carbohydrates, proteins and fats

Needed for normal functioning of nervous system

Vitamin B3 -Niacin (Nicotinic acid)

Deficiency

nicotinamide deficiency cause clinical syndrome of pellagra.

The mnemonic 'three Ds' – dementia, dermatitis, diarrhea – may help in remembering the symptoms.

- Dementia, with delusions, may be preceded by irritability and depression.
- Dermatitis is a sunburn-like erythema, especially severe in areas exposed

to the sun, which may progress to pigmentation and thickening of the skin;

'pellagra' literally means 'rough skin'.

- Diarrhoea is due to widespread inflammation of the mucosal membranes of the gastrointestinal tract

Vitamin B3 -Niacin (Nicotinic acid)

Sources

Meat

Yeast extracts

Yeast

Bran, wheatgerm, flour

Some pulses, dried fruit

Vitamin B_5 -Pantothenic Acid

Active form and function

Active forms of pantothenic acid are:

- Coenzyme-A (CoA-SH): participates in reactions concerned with:- Reactions of citric acid cycle- Fatty acid synthesis and oxidation
- Acyl carrier protein (ACP): participate in reactions concerned with fatty acid synthesis.

Deficiency

No clearcut case of pantothenic acid deficiency has been reported (becuase the substance is widely distributed in foods) except in malnourished prisoners of war in the far East in 1940s, where neurological condition, known as the burning feet syndrome

Vitamin B_6 -Pyridoxine

Chemistry and Active Form of Vitamin B6

- • Pyridoxine, pyridoxal and pyridoxamine, as a group are designated
- vitamin B6. All are equally active and they have a pyridine ring
- Pyridoxal phosphate (PLP) is the active form of vitamin B6.
- PLP is formed from phosphorylation of all three forms of vitamin B6 .

Deficiency

- Isoniazid a drug frequently used to treat tuberculosis, can induce a vitamin B6
- deficiency by forming an inactive derivative with pyridoxal phosphate.
- Deficiency may cause roughening of the skin, peripheral neuropathy and a sore tongue.
- A rare hypochromic microcytic anemia, with increased iron stores (sideroblastic anemia), responds to large doses of pyridoxine ('pyridoxine-responsive' anaemia)

Vitamin B6 -Pyridoxine

- pyridoxal phosphate (PLP) acts as coenzyme in large
- number of reactions of amino acid metabolism

- For example:–
- *Transamination

*Decarboxylation

*Nonoxidative deamination

*Condensation reactions of amino acids

Vitamin B_6 -Pyridoxine

Sources

Pyridoxine occurs mainly in plants, whereas pyridoxal and pyridoxamine are present mainly in animal products.

Meat,Eggs ,Yeast extracts

Fish, Cereals

Vitamin B_{12} - (Cyano) Cobalamin

Vitamin B 12 is important haematopoietic vitamin (together with folic acid)

It acts as coenzyme for the mutase enzyme which converts methyl

malonyl CoA into succinyl CoA Methylcobalamin is required in the conversion of homocysteine to methionine

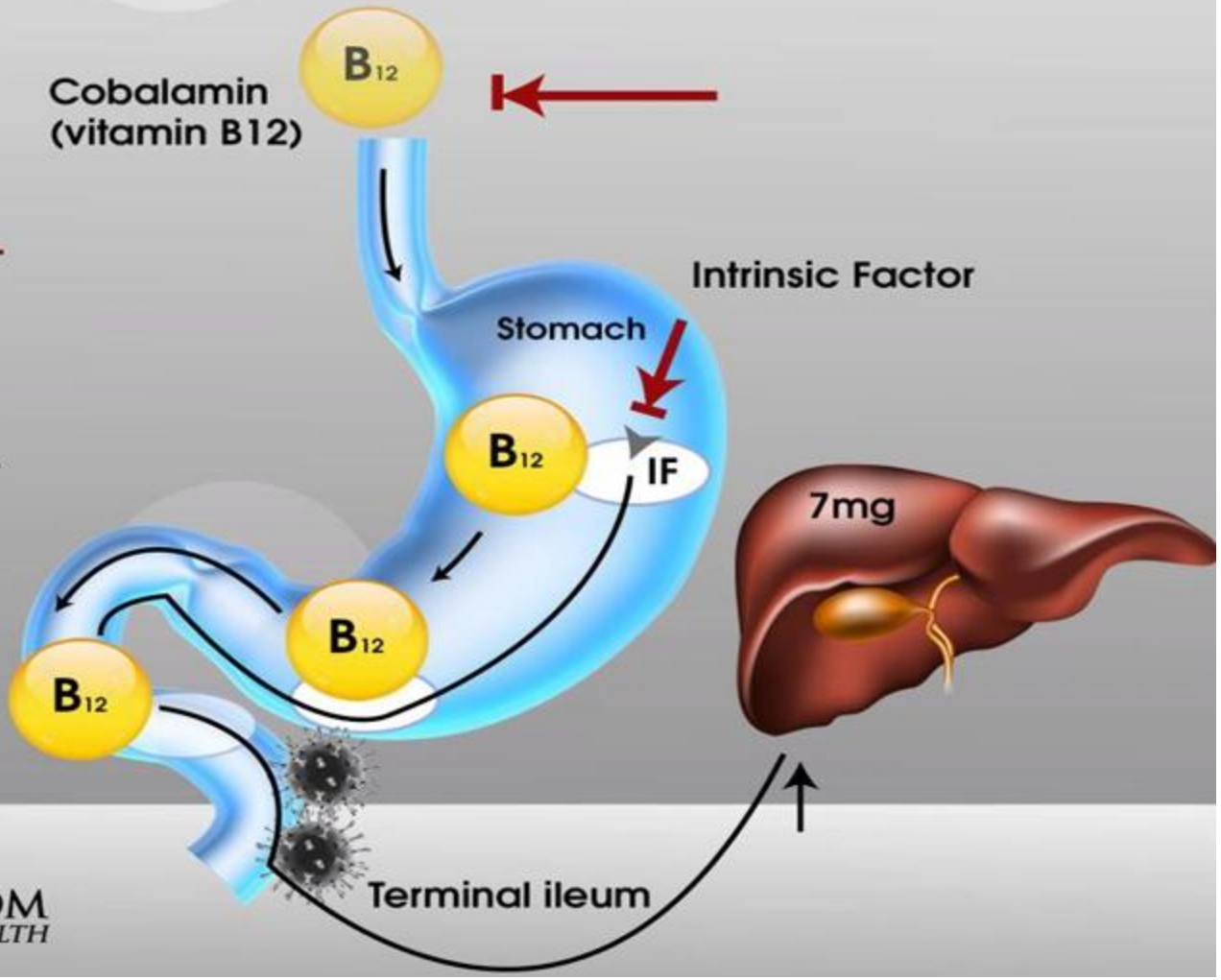
Vitamin B12 - (Cyano) Cobalamin

- Active form of Vitamin B12
- The active coenzyme forms of vitamin B 12 are:
- Methylcobalamin
- Deoxyadenosylcobalamin
- Cynocobalamin is the commercial available form of vitamin B12

Vitamin B12 - (Cyano) Cobalamin

- Absorption, Transport and Storage
- • The intestinal absorption of vitamin B 12 requires an intrinsic factor (IF), a glycoprotein secreted by parietal cells of the stomach.
- • In stomach IF binds the dietary vitamin B 12 to form vitamin B12 -IF complex.
- This complex binds to specific receptors on the surface of
- the mucosal cells of the ileum.
- • The vitamin in mucosal cell is converted into its main plasma transport form to methylcobalamin.
- It is then transported by a vitamin B 12 binding protein known as transcobalamin.
- Liver can store about 4-5 mg of vitamin B 12in adults, an amount sufficient to meet the body requirements of vitamin B 12 for 3–6 years

Absorption of Vitamin B12



Intrinsic factor is a glycoprotein of M.W. 4500.

Vit. B12 combine with intrinsic factor forming a complex that resist digestion by GIT enzymes.

This complex is absorbed at terminal ileum by pinocytosis.

Vit. B12 is transported to the liver where it is stored.

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Deficiency

In contrast to other water-soluble vitamins, significant amounts (4–5 mg) of vitamin B12 are stored in the body. As a result, it may take several years for the clinical symptoms of B12 deficiency to develop in individuals who have had a partial or total gastrectomy and can no longer absorb the vitamin. Dietary deficiency is seen in strict vegetarians, since the vitamin found only in foods of animal origin or in microorganisms.

Deficiency of vitamin B 12 leads to:

- 1- Pernicious anemia: It is caused by a deficiency of intrinsic factor in the stomach, a result of an autoimmune destruction of the gastric parietal cells.

Lack of intrinsic factor prevents the absorption of vitamin B12, resulting in pernicious anemia. which leads to impaired absorption of vitamin B12 .

It is characterized by megaloblastic anemia and low hemoglobin level with neurological disorders.

Deficiency

2. Megaloblastic anemia: It occurs due to functional folate deficiency.
The functional folate deficiency is seen in vitamin B 12 deficiency

3. Neurological disorders: The neurological damage may sometimes occur in the absence of haematological abnormalities.

This is known as subacute combined degeneration of the cord and is unique to B 12 deficiency (not associated with folate deficiency).

Because when the vitamin is deficient, unusual fatty acids accumulate and become incorporated into cell membranes, including those of the nervous system

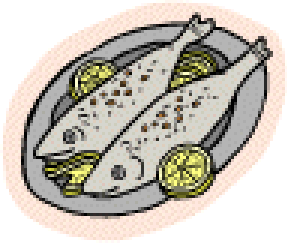
Note : The anaemia of B 12 deficiency is haematologically indistinguishable from that of folate deficiency, but a similar neurological disorder is not seen in patients with folate deficiency

Vitamin B_{12} - (Cyano) Cobalamin

Sources

Dietary sources of vitamin B 12 are of animal origin and is absent in plant foods.

- Humans obtain small amounts of vitamin B 12 from their intestinal flora.



Vitamin B -Folic Acid

Active Form of Folic Acid

Tetrahydrofolate (THF) is the active form of folic acid. Folate is enzymatically

reduced in a two-stage process in tissues to yield the dihydro and then

tetrahydrofolate, which requires vitamin C

Vitamin B -Folic Acid

Functions

- The active form of the vitamin is tetrahydrofolate, which is essential for the transfer of one-carbon units from donors such as serine, glycine, and histidine and it is particularly important in (DNA) and(RNA) synthesis.

Synthesis of methionine from homocysteine:

Homocysteine is converted to methionine in presence of N5 -methyl THF, and vitamin B12 .

In this reaction the methyl group bound to cobalamin (Vitamin B12) is

transferred to homocysteine to form methionine and the cobalamin

then removes the methyl group from N5 -methyl THF to form THF

This step is essential for the liberation of free THF

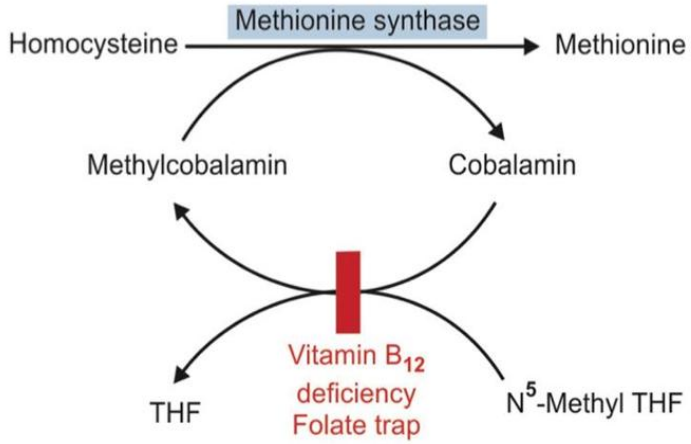


Figure 7.12: The combined roles of vitamin B_{12} and folate in the synthesis of methionine

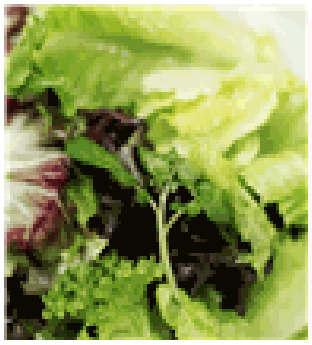
- FOLATE TRAP
- • Methylation of homocysteine to methionine depends on vitamine B 12 and N5 -methyl THF.
- When vitamine B 12 is deficient N5 -methyl THF cannot be converted to free THF. Thus, most of folic acid of the body is irreversibly “trapped” as its methyl derivative (N5 -methyl THF).
- This is called folate trap.
- Folate trap creates folate deficiency and an adequate supply of free THF is not available for the synthesis of purine and pyrimidine bases.
- Thus, a B 12 deficiency can lead to a folate deficiency

Vitamin B -Folic Acid

Sources

. Folic acid is found in green leafy vegetables, liver, yeast.

Folic acid is little or not stored in tissues



Vitamin B -Folic Acid

Deficiency Manifestations

Folate deficiency frequently occurs particularly in pregnant women and in alcoholics.

Clinical symptoms of folic acid deficiency include:

1- Megaloblastic or macrocytic anemia:

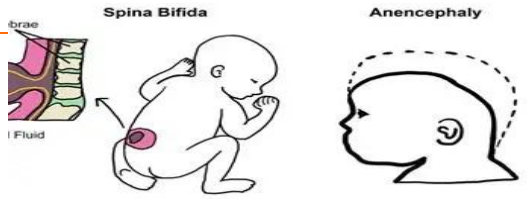
The deficiency of folic acid leads to impairement of synthesis of DNA.

Impaired DNA synthesis, impairs the maturation of erythrocytes.

Consequently,large, immature red cell precursors, known a megaloblasts are accumulated in the bone marrow and leads to megaloblastic anemia

Vitamin B -Folic Acid

Deficiency Manifestations



2- Neural tube defect in fetus:

Since, folate is required for the formation of neural tube in early stage of gestation, the folate deficiency during early stage of pregnancy increases the risk of neural tube defect.

Spina bifida and anencephaly, most common neural tube defects.

- Folate supplements are therefore provided for all pregnant women

Vitamin B -Folic Acid

Properties

- Water soluble
- Unaffected by acids
- Sensitive to light and oxidation

RDA

300 μg per day

More during pregnancy

Biotin

Biotin was known formerly as vitamin H.

Functions

Biotin is a coenzyme of carboxylase reactions, where it is a carrier of CO2.

Deficiency

- The natural deficiency of biotin is not well characterized in humans but can induced experimentally. symptoms of biotin deficiency, namely, dermatitis, glossitis, loss of appetite, and nausea

Deficiency of biotin occurs in the people with the unusual dietary habit of consuming large amounts of uncooked eggs?

Egg white contains the glycoprotein avidin, which binds the imidazole group of biotin and prevents biotin absorption.

it has been estimated that 20 eggs/day would be required to induce a deficiency syndrome

Vitamin C -Ascorbic Acid

The active form of vitamin C is ascorbic acid The main function of

*ascorbate is as a reducing agent in several different reactions.

Vitamin C has a well-documented role as a coenzyme in hydroxylation reactions of collagen

- Ascorbic acid functions
- Vitamin C is, therefore, required for the maintenance of normal connective tissue, as well as for wound healing.
- Vitamin C also facilitates the absorption of dietary iron from the intestine.
- Is on of an antioxidant as (Vit E. and B-carotene) it helps remove unwanted substances known as reactive oxidative species (ROS) from the body and in prevention of chronic diseases

Deficiency of ascorbic acid

A deficiency of ascorbic acid results in scurvy, a

disease characterized

by sore and spongy gums, loose teeth, fragile

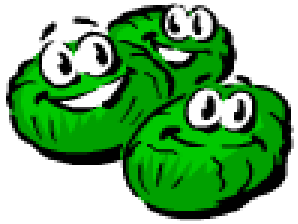
blood vessels, swollen joints, and anemia.

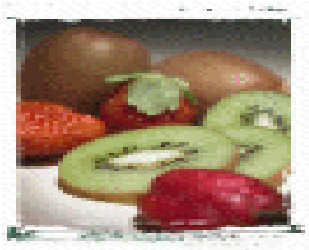
Many of the deficiency symptoms can be explained by a deficiency in the hydroxylation of collagen, resulting in defective connective tissue.

Vitamin C -Ascorbic Acid

Sources

green peppers, kiwi, citrus fruits, strawberries, spinach, cabbage, broccoli






THANK YOU
FOR YOUR
ATTENTION