

# vitamins



# OBJECTIVES

**Introduction**

**General characteristics**

**General Functions**

**Classification**

**Structure**

**Individual Characteristics**

**Individual Dietary Sources**

**Individual Mechanism of  
Action**

**Individual Function**



# INTRODUCTION

- The word "vitamin" comes from the Latin word “vita”, means "life".
- **Vitamins are organic components in food that are needed in very small amounts for growth and for maintaining good health.**
- Everybody must eat a certain amount of vitamins to stay healthy.
- Vitamins are chemicals found in very small amounts in many different foods.



# CHARACTERISTICS

- ❑ Vitamins are required in small quantities in the diet because they cannot be synthesized by the body.
- ❑ Water soluble vitamins cannot be stored in human tissues. Their excess is excreted with urine.
- ❑ Significant amounts of fat soluble vitamins can be stored in adipose tissue and the liver.
- ❑ Synthetic vitamins are identical to natural vitamins.
- ❑ Once growth and development are completed, vitamins remain essential nutrients for the healthy maintenance of the cells, tissues, and organs.

# FUNCTIONS

❖ Vitamins are helpful for the health and life of the body in the following respects:

(a) They build up the resistance of the body against diseases.

(b) Prevent and cure various diseases caused by deficiency.

(c) Help the digestion and utilization of mineral salts and Carbohydrates in the body.

(d) Stimulate and give strength to digestive and nervous system.

(e) Help health protection.

(f) Help maintenance of proper health and normal growth.

Vitamin	Essential For	Source
A	Eyes Immune System Skin	Carrots, Spinach, Sweet Potatoes, Milk, Eggs, Liver, Butter
B6	Brain Function Nerve Function Red Cell Production	Chicken, Fish, Turkey, Beef, Pork, Lamb, Veal
B12	Red Cell Production Nerve Function	Meat, Eggs, Dairy Products, Fish, Shellfish, Yeast
C	Bones Teeth Skin	Citrus Fruits, Strawberries, Raspberries, Blueberries, Tomatoes
D	Bones Calcium Absorption	Fatty Fish, Egg Yolks, Liver, Milk, Yogurt, Cheese
E	Red Blood Cells Protects Cell Damage	Wheat Germ Oil, Nuts, Seeds, Vegetables, Leafy Greens
Folic Acid	Cell Health Heart Disease	Leafy Greens, Beans, Peas, Lentils, Citrus Fruits
K	Blood Clotting	Leafy Greens, Broccoli, Brussels Sprouts, Cauliflower
Niacin	Promotes Conversion of Food to Energy	Meat, Fish, Eggs, Dairy Products, Grains, Legumes, Nuts
Riboflavin	Energy Chemical Processes	Milk, Eggs, Dairy Products, Meat, Fish, Yeast



# CLASSIFICATION

❖ On the basis of their solubility vitamins are mainly 2 types-

**Fat soluble vitamins:** Vitamins that dissolve in fat. Because fat is easily stored on our body, fat-soluble vitamins can be stored within our fat. This means they can accumulate and be saved for later use. The fat-soluble vitamins are **A, D, E** and **K**.



*Water soluble vitamins:* Vitamins that dissolve in water. Because our body is a watery environment, these vitamins can move through our body pretty easily, and they can also be flushed out by the kidneys. Water-soluble vitamins include the B-complex vitamins and vitamin C. There are eight B vitamins, including vitamin B1, B2, B3, B5, B6, B7, B9 and B12.



# Vitamins

## Water-soluble

## Fat-soluble

### Non-B-Complex

Ascorbic acid (vitamin C)

### B-Complex

#### Energy-releasing

- Thiamine (vitamin B<sub>1</sub>)
- Riboflavin (vitamin B<sub>2</sub>)
- Niacin (vitamin B<sub>3</sub>)
- Biotin
- Pantothenic acid

#### Hematopoietic

- Folic acid
- Vitamin B<sub>12</sub>

#### Other

- Pyridoxine (vitamin B<sub>6</sub>)
- Pyridoxal
- Pyridoxamine

- Vitamin A (retinol,  $\beta$ -carotenes)

- Vitamin D (cholecalciferol)

- Vitamin K (phyloquinones, menaquinones)

- Vitamin E (tocopherols)



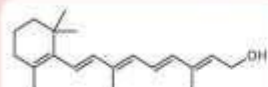
# WATER SOLUBLE VS FAT SOLUBLE VITAMINS

Criteria	Water Soluble	Fat Soluble
Absorption	Directly to blood	Lymph via CM
Transport	free	Require carrier
Storage	Circulate freely	In cells with fat
Excretion	In urine	Stored with fat
Toxicity	Possible w supplements	Likely w supplements
Requirements	Every 2-3 days	Every week

# THE CHEMICAL STRUCTURES OF VITAMINS

Vitamins are the essential nutrients that our body needs in small amounts. More specifically, an organic compound is defined as a vitamin when it is required by an organism, but not synthesised by that organism in the required amounts (or at all). There are thirteen recognised vitamins.

## VITAMIN A

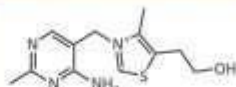


**RETINOL**

*active form in mammalian tissues*

Important for eyesight. Also strengthens immune system and keeps skin and fringes of parts of the body healthy.

## VITAMIN B1

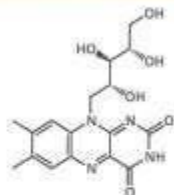


**THIAMIN**

*can also occur in pyrophosphate ester form*

Used to keep nerves & muscle tissue healthy. Also important for processing of carbohydrates and some proteins.

## VITAMIN B2

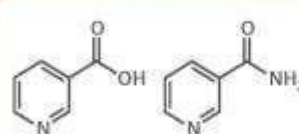


**RIBOFLAVIN**

*excess turns urine bright yellow*

Important for body growth, red blood cell production, and keeping the eyes healthy. Also helps processing of carbohydrates.

## VITAMIN B3



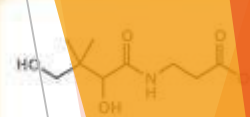
**NICOTINIC ACID**

*nicotin is collective name for these compounds*

**NICOTINEAMIDE**

Helps with digestion and digestive system health. Also helps with the processing of carbohydrates.

## VITAMIN B5

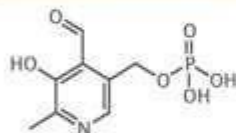


**PANTOTHENIC ACID**

*can also occur in pyrophosphate ester*

Important for manufacturing red blood cells and maintaining a healthy digestive system. Also helps process carbohydrates.

## VITAMIN B6

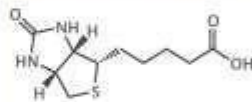


**PYRIDOXAL PHOSPHATE**

*active form in mammalian tissues*

Helps make some brain chemicals, needed for normal brain function. Also helps make red blood cells and immune system cells.

## VITAMIN B7

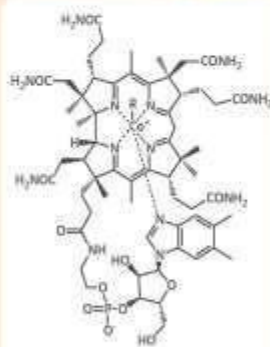


**BIOTIN**

*produced by intestinal bacteria*

Needed for metabolism of various compounds. Often recommended for strengthening hair, but evidence is variable.

## VITAMIN B12

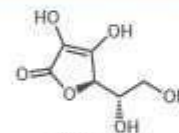


**COBALAMIN**

*usually contains CN as the R group*

Important for the nervous system, for making red blood cells, and helps in the production of DNA and RNA.

## VITAMIN C

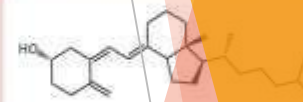


**ASCORBIC ACID**

*deficiency can cause scurvy*

Important for a healthy immune system; helps produce collagen, used to make skin and other tissues. Also helps wound healing.

## VITAMIN D



**CHOLECALCIFEROL**

*natural form; different form used in supplements*

Important for bone health and maintaining the immune system function. May also have a preventative role in cancer.

## VITAMIN E

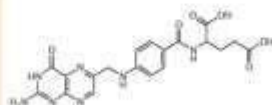


**ALPHA-TOCOPHEROL**

*group includes tocopherols & tocotrienols*

An antioxidant that helps prevent damage to cells and may have a preventative role in cancer. Also helps make red blood cells.

## VITAMIN B9

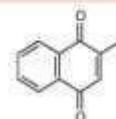


**FOLIC ACID**

*found as tetrahydrofolate in food*

Important for brain function & mental health. Aids production of DNA & RNA. Important when tissues are growing quickly.

## VITAMIN K



**MENADIOLONE**

*all K vitamins are menadiolone or derivatives*

helps blood clot properly, & plays a key role in bone health. Newborns receive vitamin K injections to prevent bleeding.

## Key

Vitamins can be divided broadly into two groups:

- WATER SOLUBLE VITAMINS**  
These vitamins are not stored in the body. As such, generally, they are required more frequently than the fat soluble vitamins.
- FAT SOLUBLE VITAMINS**  
These vitamins are stored in the body's fatty tissues until required. As such, they can be harmful if too much is taken in.



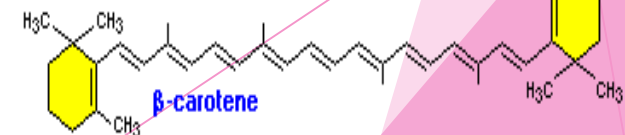
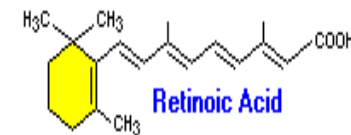
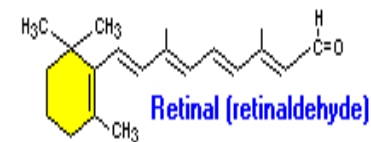
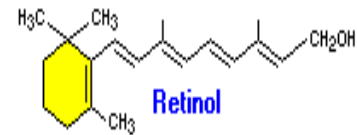
# FAT SOLUBLE VITAMINS (A, D, E, K)

## ❖ VITAMIN A

- Vitamin A is a group of unsaturated nutritional organic compounds, that includes **retinol**, **retinal**, **retinoic acid**, and several provitamin A carotenoids, among which **beta-carotene** is the most important. Its active form is present only in Animal Tissue.

## DAILY REQUIREMENT

- Men and women – 600 mcg.
- Pregnancy and lactation – 950 mcg.
- Infants – 350mcg.
- Children – 600mcg.





# DIETARY SOURCES OF VITAMIN A



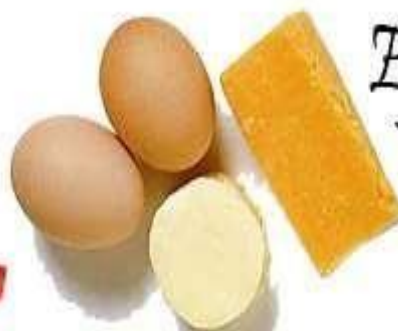
Carrots



Papaya



Meat



Eggs & Cheese



Squash



Broccoli



Fish



Mangoes



Sweet potato

Peppers



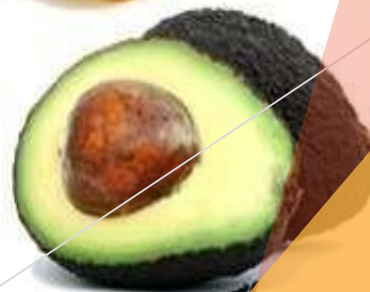
Apricots



Peaches



Melon



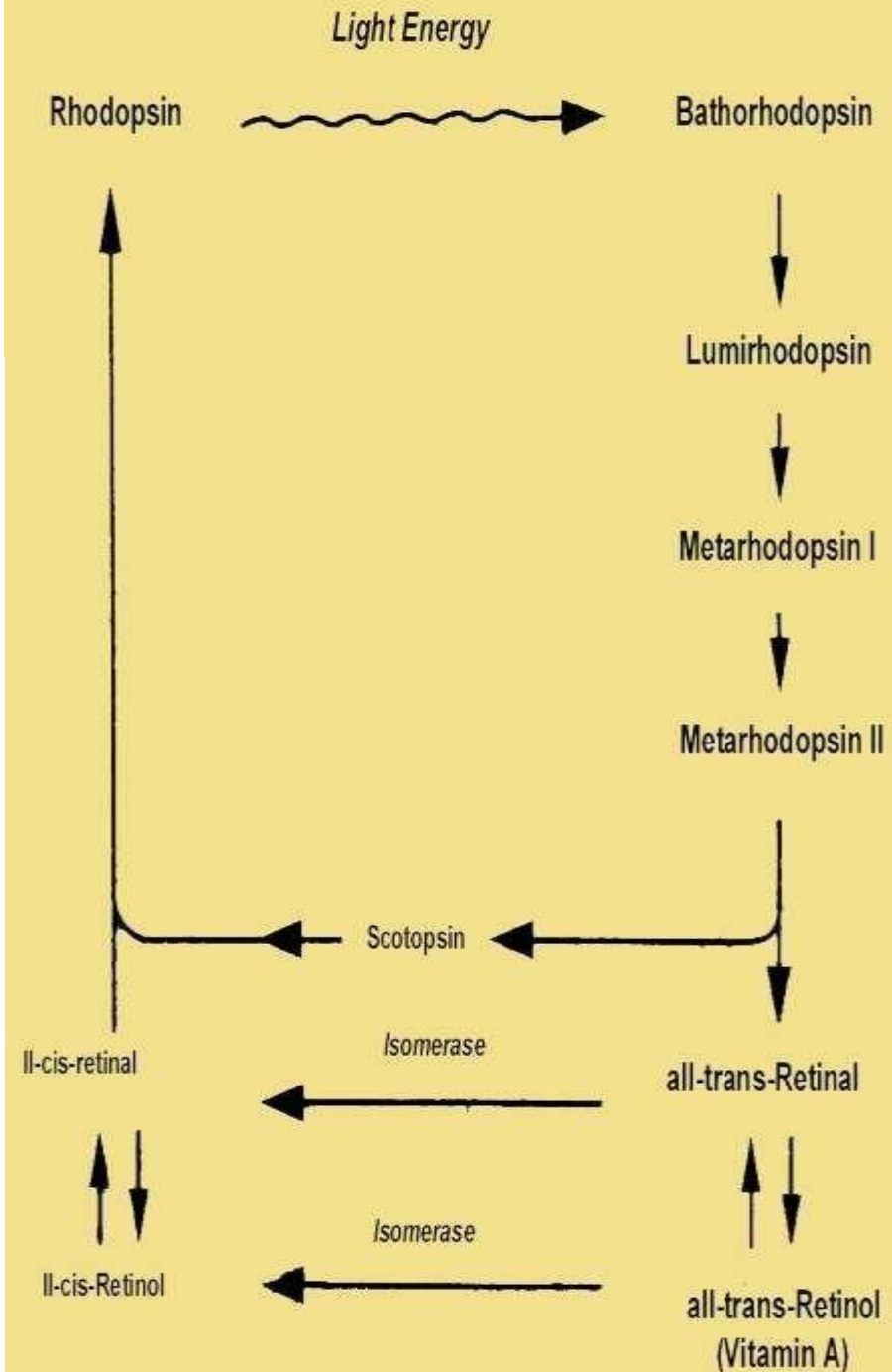
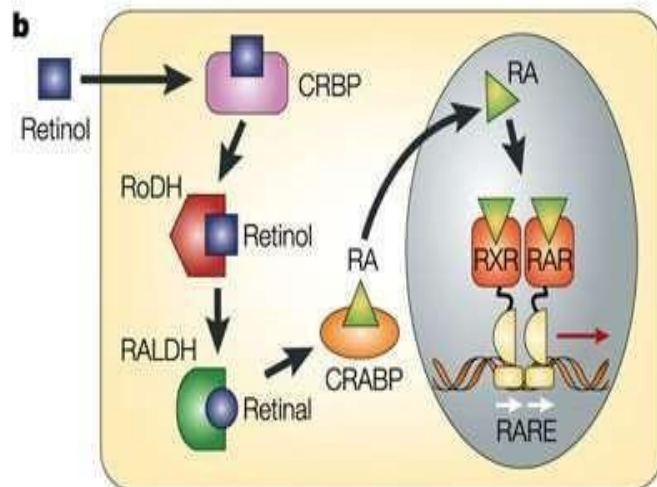
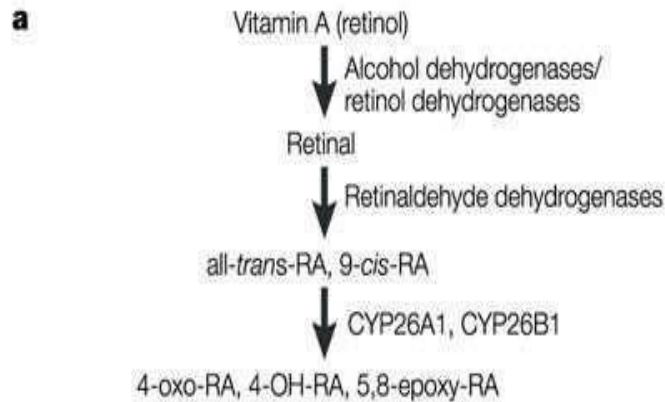
Avocado



# M/A OF VITAMIN A

- Dietary retinyl esters are hydrolysed by pancreatic/intestinal hydrolases in intestine releasing retinol & free fatty acids.
- Carotenes are hydrolysed by  $\beta$ -carotene 15-15' dioxygenase of intestinal cells to release 2 moles of retinal which is reduced to retinol.
- In intestinal mucosal cells, retinol is re-esterified to LCFA incorporated into chylomicrons & transferred to lymph.
- Retinol esters of chylomicrons are taken up by liver & stored.
- When required Vitamin A is released from liver as free retinol.
- Retinol is transported in circulation by Plasma Retinol Binding Protein in association with albumin (transthyretin).
- Retinol-RBP complex binds to specific receptors on cell membrane of peripheral tissues & enters cells.
- Carry retinol by Cellular Retinol Binding Protein (CRBP) and Cellular Retinoic Acid Binding Protein (CRABP-I, CRABP-II) to nucleus & binds to chromatin (DNA).

❑ **RHODOPSIN** is the membrane protein in photoreceptor of retina



# FUNCTIONS

- ❖ Vitamin A plays a role in a variety of functions throughout the body, such as:
  - **Vision**
  - **Gene transcription**
  - **Immune function**
  - **Embryonic development and reproduction**
  - **Bone metabolism**
  - **Hematopoiesis (the production of blood cells and platelets)**
  - **Skin and cellular health**
  - **Antioxidant activity**

# VITAMIN D

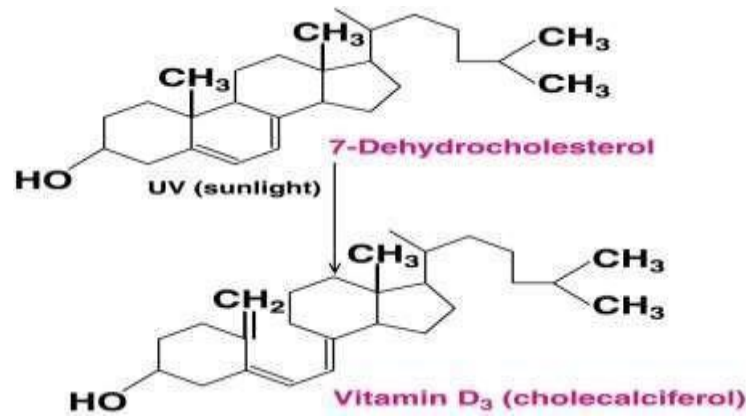
- Vitamin D refers to a group of fat-soluble secosteroids (a type of steroid with a "broken" ring) found in liver and fish oils, or obtained by irradiating provitamin D with ultraviolet light and are responsible for enhancing intestinal absorption of calcium, iron, magnesium, phosphate and zinc. It is also called ***SUNSHINE VITAMIN***.  
it is available in 2 forms-

## Cholecalciferol (vitamin D3)

is made from 7-dehydrocholesterol in the skin of animals and humans.

## Calciferol - D2

is obtained artificially by irradiation of ergo- sterol and is called ergocalciferol.





# DIETARY SOURCES OF VITAMIN D

## Vitamin D

The body makes vitamin D when it is exposed to Ultraviolet (UV) rays from the sun.

### DAILY REQUIREMENT

- Men and women- 0.01 mg.
- Pregnancy and lactation - 0.01 mg
- Infants & Children -0.01 mg

### FOOD SOURCES:

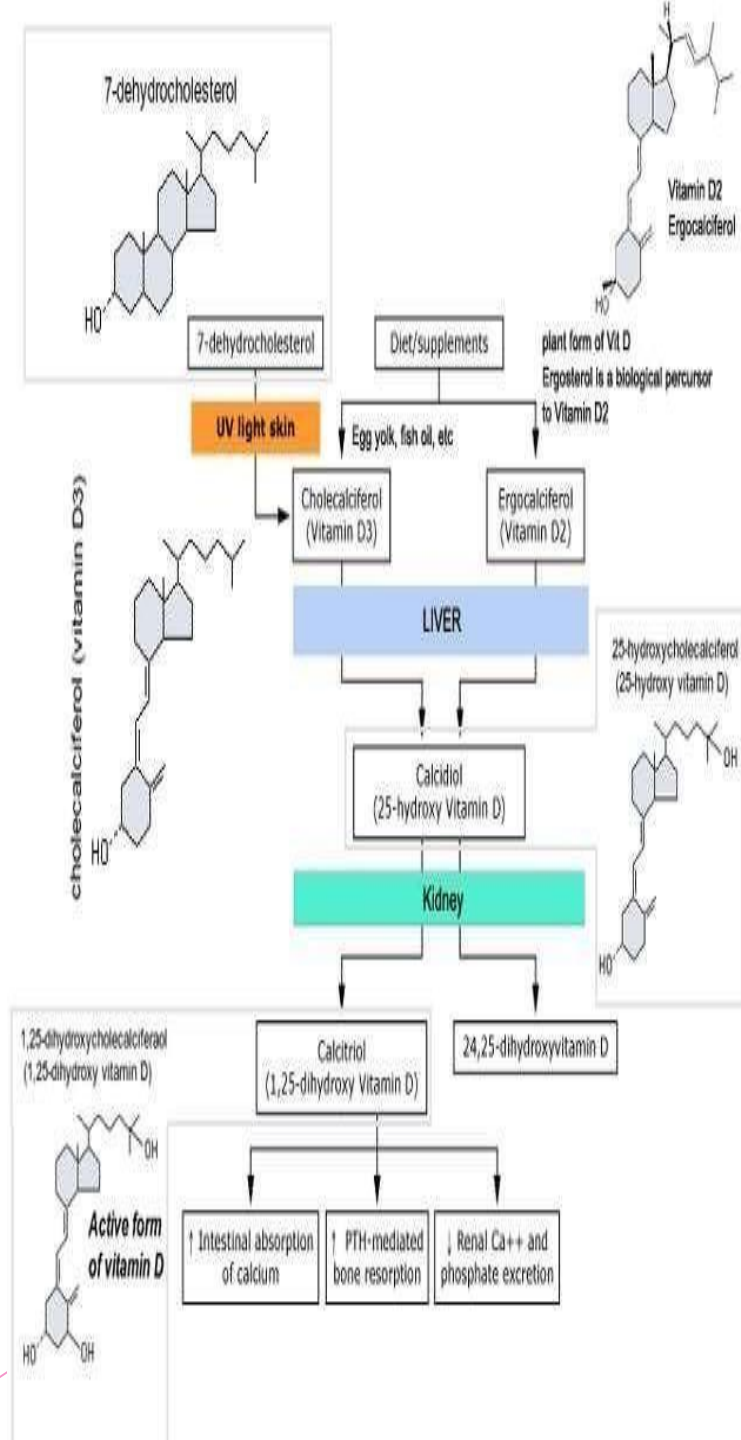
Cheese  
Margarine  
Butter  
Fortified Milk  
Healthy Cereals  
Fatty Fish



# M/A OF VITAMIN D

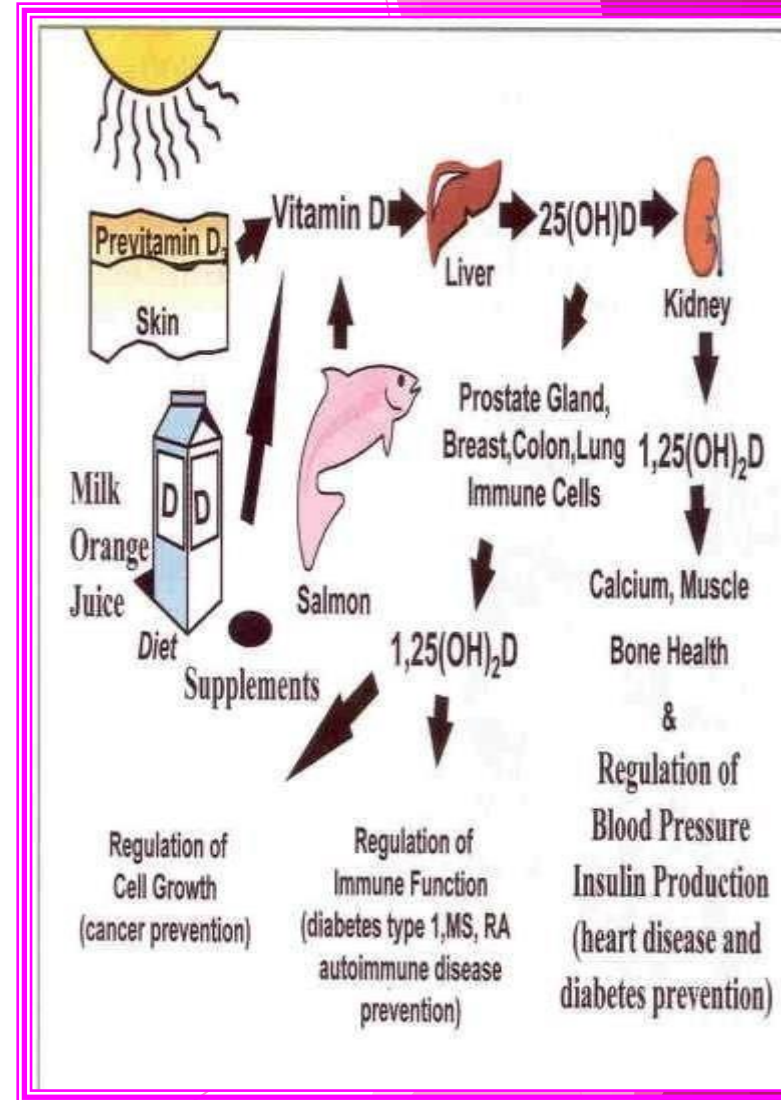
- Vitamin D is carried in the bloodstream to the liver, where it is converted into the prohormone calcidiol.
- Circulating calcidiol may then be converted into calcitriol, the biologically active form of vitamin D, in the kidneys.
- Following the final converting step in the kidney, calcitriol is released into the circulation.
- By binding to vitamin D-binding protein, a carrier protein in the plasma, calcitriol is transported to various target organs.
- In addition to the kidneys, calcitriol is also synthesized by monocyte-macrophages in the immune system. When synthesized by monocyte-macrophages, calcitriol acts locally as a cytokine, defending the body against microbial invaders by stimulating the innate immune system.

- Whether it is made in the skin or ingested, cholecalciferol is hydroxylated in the liver.
- This reaction is catalyzed by the microsomal enzyme vitamin D 25 hydroxylase, which is produced by hepatocytes. Once made, the product is released into the plasma, where it is bound to an  $\alpha$ -globulin, vitamin D-binding protein.
- Calcidiol is transported to the proximal tubules of the kidneys, where it is hydroxylated to form calcitriol. This product is a potent ligand of the vitamin D receptor, which mediates most of the physiological actions of the vitamin.



# FUNCTIONS OF VITAMIN D

- **Calcium Balance**
- **Cell Differentiation**
- **Immunity**
- **Blood Pressure Regulation**
- **Development of Bones & Teeth**

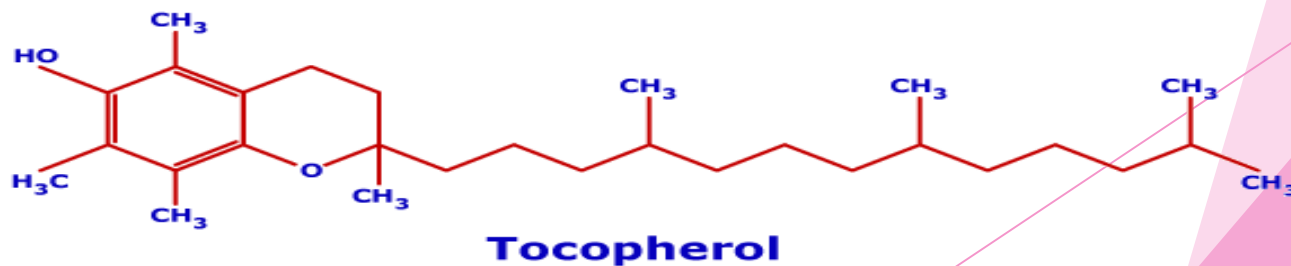




# VITAMIN E

- ❑ Vitamin **E** refers to a group of compounds that include both *tocopherols* and *tocotrienols*. They are naturally occurring **anti-oxidant**.
- It is also called **anti-aging** factor.
- The word tocopherol is derived from the word **toco** meaning child birth and **pheros** meaning to bear.
- It is yellow oily liquid freely soluble in fat solvent.
- Tocopherol  **$\alpha, \beta, \gamma, \delta$**  have been obtained from the natural sources.

**Figure 10.11**



# DIETARY SOURCES OF VITAMIN E



## □ DAILY RECOMMENDED DOSE

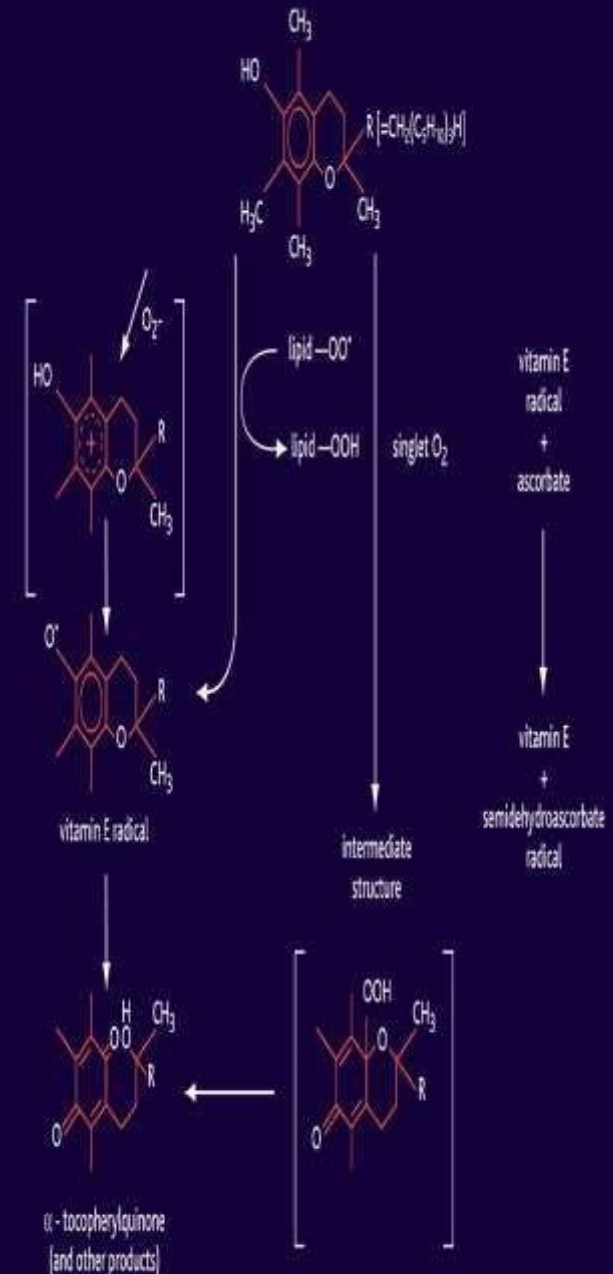
➤ men -  
8 -  
10mg

➤ wome  
n - 5-  
8mg

➤ Childre  
n -  
8.3mg

# M/A OF VITAMIN E

- Free radicals, such as superoxide, hydroxyl ions and nitric oxide all contain an unpaired electron. These radicals can have a negative effect on cells causing oxidative damage that leads to cell death.
- Antioxidants, such as vitamin E, prevent cell damage by binding to the free radical and neutralising its unpaired electron. For example, when vitamin E binds to  $\text{OO}\cdot$  or  $\text{O}_2\cdot$  they form an intermediate structure that is converted to  $\alpha$ -tocopherylquinone.
- A recent population based study of antioxidants concluded that a diet rich in foods containing vitamin E might help protect some people against Alzheimer's disease (AD). Vitamin E in the form of supplements was not associated with a reduction in the risk of AD.



# FUNCTIONS OF VITAMIN E

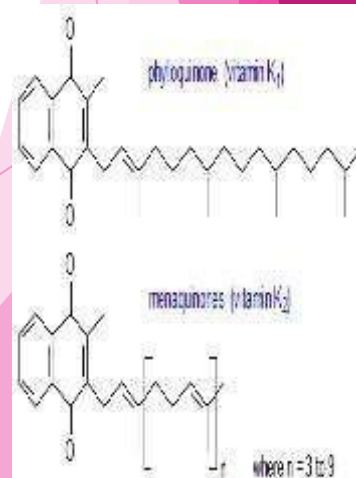
- Antioxidant (most powerful natural)
  - Free radical scavenger
  - Protects cell membranes
  - Protects LDL from oxidation
  - Protection of double bonds in polyunsaturated fatty acids
  - Prevention of rancidity
  - Works in conjunction with selenium
- Vitamin E also plays a role in neurological functions, and inhibition of platelet aggregation.
- Vitamin E also protects lipids and prevents the oxidation of polyunsaturated fatty acids.





# VITAMIN K

- **Vitamin K** refers to a group of structurally similar, fat-soluble vitamins the human body needs for complete synthesis of certain proteins that are required for blood coagulation, and also certain proteins that the body uses to manipulate binding of calcium in bone and other tissues.
- Vitamin K is naturally produced by the bacteria in the intestines.
- It is essential for production of a type of protein called prothrombin & other factor involve in blood clotting mechanism. Hence it is known as **anti – hemorrhagic vitamin**.
- Vitamin K includes two natural vitamers :  
vitamin **K<sub>1</sub>** (**phylloquinone**)  
and vitamin **K<sub>2</sub>** (**menaquinones**)



# DIETARY SOURCES OF VITAMIN K



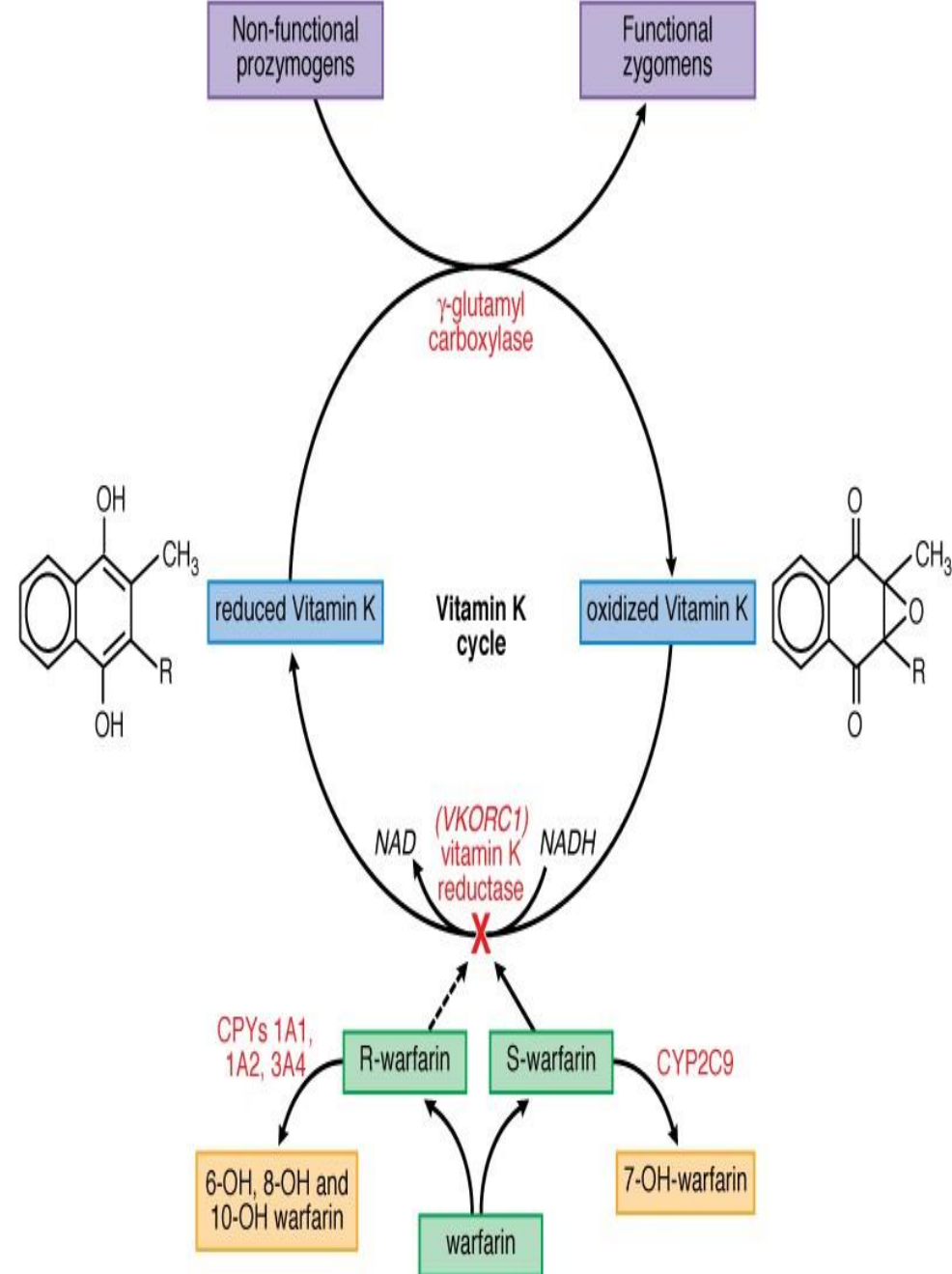
## DIETARY REQUIREMENT

- men and women – 70 – 140 mcg.
- children – 35 – 75mcg

# M/A OF VITAMIN K

- Vitamin K-induced synthesis of prothrombin in a vitamin K-deficient rat is only slightly inhibited by cycloheximide treatment.
- Vitamin K is a co-factor for the enzyme, gammaglutamate carboxylase (GGCX). This enzyme is required for the post-translational modifications of proteins that contain the amino acid residue, glutamic acid (Glu).
- In the presence of vitamin K and GGCX, these proteins go through a carboxylation process that alters the structure by converting Glu residues into  $\gamma$ -carboxyglutamic acid (Gla) residues
- The functional significance of this change is that Gla residues have a strong binding affinity to calcium. Thus in support of the blood clotting pathway, Vitamin K is required for the activation of prothrombin, factors VII, IX and X

- The isolated prothrombin does contain radioactivity if the vitamin K-deficient rats are treated with vitamin K but no cycloheximide.
- When radioactive amino acids were given to deficient rats 1 hr before cycloheximide and vitamin K, radioactivity was found in prothrombin.
- These data suggest that, in the intact rat, the action of vitamin K is to convert a protein precursor with a short biological half life to prothrombin.



Source: Brunton LL, Chabner BA, Knollmann BC: *Goodman & Gilman's The Pharmacological Basis of Therapeutics, 12th Edition*: www.accessmedicine.com

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# FUNCTIONS OF VITAMIN K

- It is essential for the hepatic synthesis of coagulation factor **II, V, VII, IX, X**.
- **CLOTTING** – it prevents hemorrhage only in cases when there is defective production of prothrombin
- **OXIDATIVE PHOSPHORYLATION** – it acts as a co- factor in oxidative phosphorylation associated with lipid
- Vitamin-K is needed for carboxylation of glutamyl residue of  $\text{Ca}^{++}$  binding transport between the flavin coenzyme and the cytochrome system.

## VITAMIN K

[www.botanical-online.com](http://www.botanical-online.com)

- Vitamin K helps blood clotting, essential to stop bleeding from wounds.

- People with vitamin K deficiency may experience easy bruising, nosebleeds, etc., although the deficit of this vitamin is rare to occur.

- The sources of vitamin K are animal fats (egg yolks, whole milk, red meat, ...) and dark green vegetables (spinach, asparagus, ...)



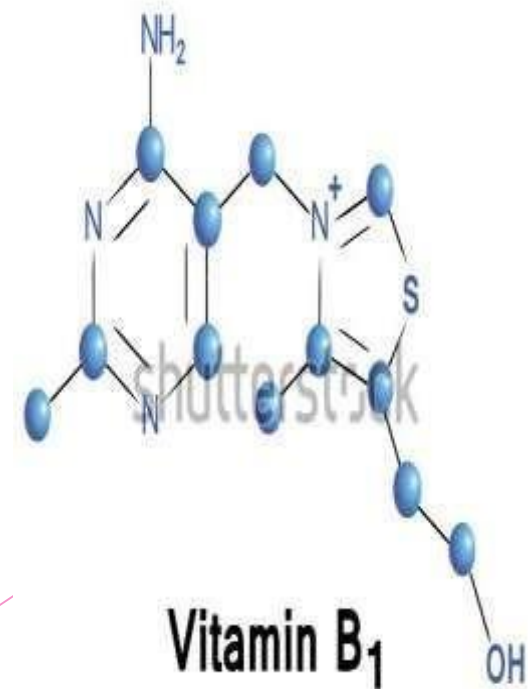
# WATER SOLUBLE VITAMINS

- Water soluble vitamins are found in yeast, grain, rice, vegetables, fish, and meat.
  - These are essential co-enzymes required in energy releasing mechanisms.
  - They also act as co-enzymes for metabolism of proteins, carbohydrates and fats.
- They include-
  - ✓ **B1-Thiamine**
  - ✓ **B2-Riboflavin**
  - ✓ **B3– Niacin**
  - ✓ **B5– pantothenic acid**
  - ✓ **B6–Pyridoxine**
  - ✓ **B7– Biotin**
  - ✓ **B9-Folicacid**
  - ✓ **B12–Cobalamin**

✓ **Vitamin C (ascorbic acid)**

# VITAMIN B1 (THIAMINE)

- It is also called **Anti Beri-Beri factor**, **Anti Neuritic factor**, and also **Aneurin**.
- It is colorless basic organic compound composed of a sulfated pyrimidizing ring.
- All living organisms use thiamine, but it is synthesized only in bacteria, fungi, and plants.
- Contains sulfur and nitrogen group
- Destroyed by alkaline and heat
- Coenzyme: Thiamin pyrophosphate (TPP)





# DIETARY SOURCES OF VITAMIN B1

- 1) Tuna
- 2) Sunflower Seeds
- 3) White Beans
- 4) Black Beans
- 5) Dried and Frozen Peas
- 6) Fresh Peas
- 7) Borlotti (Cranberry) Beans
- 8) Lentil
- 9) Green Beans
- 10) Sesame Seeds

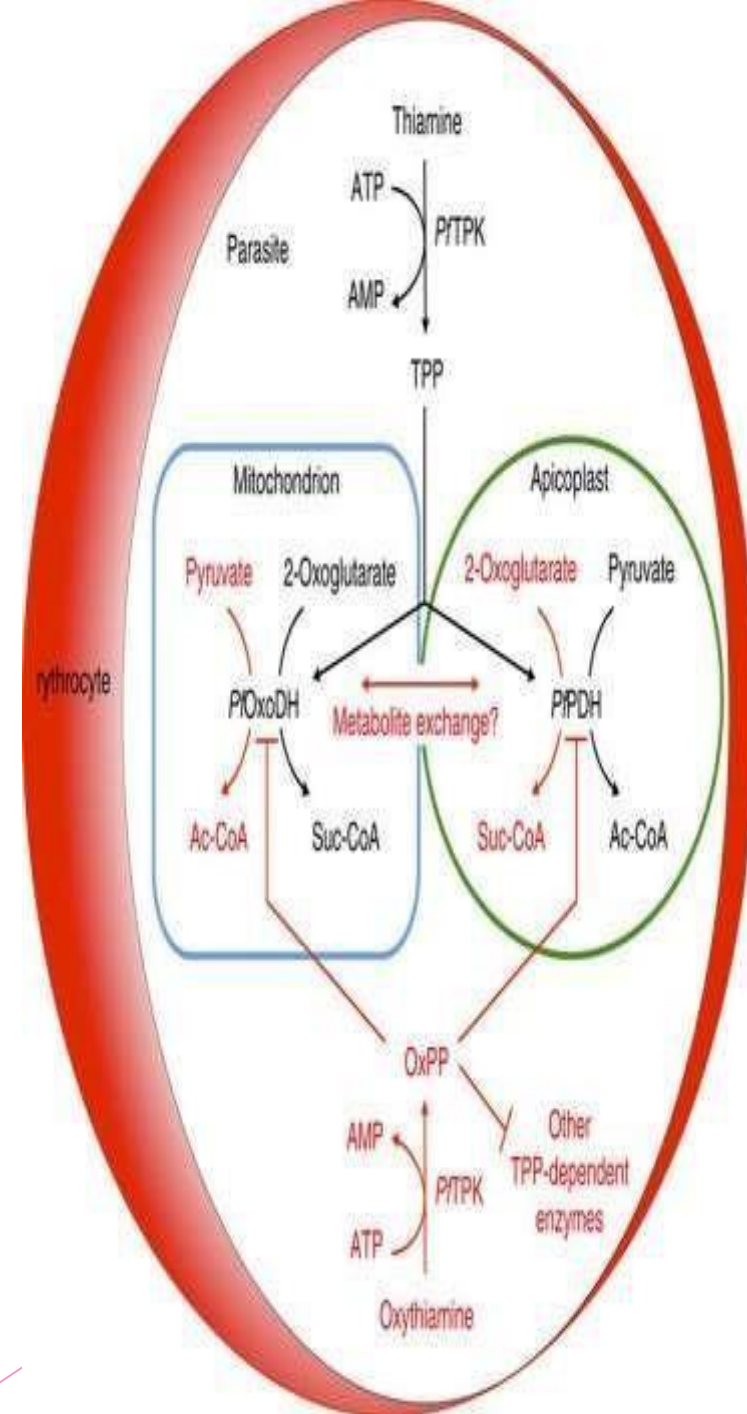


## Daily requirement

- Men – 1.3 mg
- women – 1.0 mg
- Pregnancy and lactation – 2mg .
- Children – 1.1mg.

# M/A OF THIAMINE

- The conversion of pyruvate to acetyl-CoA feeds important molecules into the Krebs cycle, which allows the cell to produce energy.
- The conversion of  $\alpha$ -ketoglutarate to succinyl-CoA is necessary for the Krebs cycle to continue "spinning". Without vitamin B1 (thiamine) the cycle would slow causing decreased energy production.
- Synthesis of neurotransmitter
- Convert pyruvate to acetyl-CoA
- Thiamine is metabolized to its active form, TPP, by *Pf*TPK in an ATP-dependent manner.

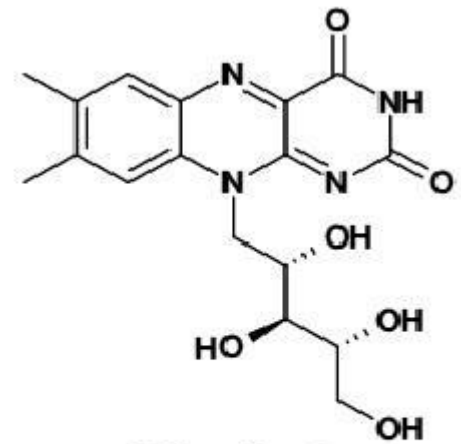


# FUNCTIONS OF THIAMINE

- ❑ Vitamin B1, is very essential for converting carbohydrate into energy.
- ❑ The most important use of thiamine is in the treatment of beriberi, a condition caused by a deficiency of thiamine in the diet. Symptoms include swelling, tingling or burning sensation in the hands and feet, confusion, difficulty breathing.
- ❑ Vitamin B1, helps in maintaining the healthy nervous system.
- ❑ Vitamin B1, is necessary for healthy mucous membranes.
- ❑ It helps in the digestion of food.
- ❑ It provides strength to muscles.
- ❑ It is very useful for the proper functioning of heart.

# VITAMIN B2 (RIBOFLAVIN)

- It is also called as beauty vitamin.
- it is yellowish green fluorescent compound soluble in water.
- The word riboflavin is derived from 2 sources
  - ribose** – means many ribose sugar found in several vitamins
  - flavin** – yellow.
- It is widely involved in oxidation-reduction reaction.



Riboflavin





# DIETARY SOURCES OF VITAMIN B2

- 1) Venison
- 2) Yoghurt
- 3) Soybeans
- 4) Milk
- 5) Cremini Mushrooms
- 6) Spinach
- 7) Tempeh
- 8) Goat Milk
- 9) Shiitake Mushrooms
- 10) Almonds



## Daily requirement

- Men – 1.5mg
- women – 1.2 mg
- Pregnancy and lactation – 2 to 2.3 mg .
- Children – 1.3mg.



# M/A OF RIBOFLAVIN

- ❑ Vitamin B6 is the collective term for a group of three related compounds, pyridoxine (PN), pyridoxal (PL) and pyridoxamine (PM), and their phosphorylated derivatives, pyridoxine 5'-phosphate (PNP), pyridoxal 5'-phosphate (PLP) and pyridoxamine 5'-phosphate (PMP).
- ❑ Although all six of these compounds should technically be referred to as vitamin B6, the term vitamin B6 is commonly used interchangeably with just one of them, pyridoxine. Vitamin B6, principally in the form of the coenzyme pyridoxal 5'-phosphate, is involved in a wide range of biochemical reactions, including the metabolism of amino acids and glycogen, the synthesis of nucleic acids, hemoglobin, sphingomyelin and other sphingolipids, and the synthesis of the neurotransmitters serotonin, dopamine, norepinephrine and gamma-aminobutyric acid (GABA).

# FUNCTIONS OF RIBOFLAVIN

- ❑ It is essential for normal growth.
- ❑ Metabolism – It is involved in the metabolism of carbohydrates, fat & proteins.
- ❑ Digestion – it helps in digestion
- ❑ Nervous system – it helps in proper functioning of Nervous system
- ❑ It is very useful for normal tissue respiration.
- ❑ Necessary for healthy mucous membranes
- ❑ Good for skin, nails and eyes
- ❑ It helps in protects the body against cancer.

## 6 VITAMIN B2 HEALTH BENEFITS



1 PREVENTS  
MIGRAINES



2 SUPPORTS  
EYE HEALTH



3 PREVENTS & TREATS  
ANEMIA



4 HELPS MAINTAIN  
ENERGY LEVELS



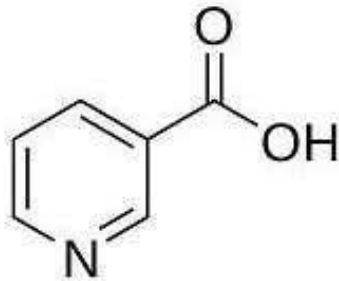
5 ANTIOXIDANT &  
CANCER  
PREVENTION



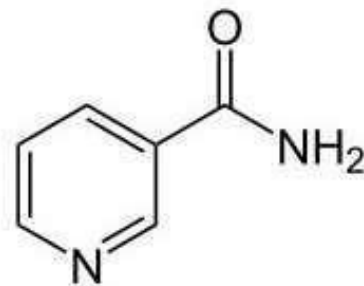
6 PROTECTS  
HAIR & SKIN

# VITAMIN B3 (NIACIN)

- Vitamin B3 is also known as **niacin** or **nicotinic acid**.
- it is essential for metabolism of carbohydrate, protein & fat.
- It is a colorless, water-soluble solid derivative of pyridine, with a carboxyl group (COOH) at the 3-position.
- It is a pyridine derivative and is a precursor of the coenzyme NAD (**Nicotinamide adenine dinucleotide**).



Niacin



Nicotinamide

# DIETARY SOURCES OF NIACIN

## 12 FOODS

containing Niacin (vitamin B3)

Niacin is important for us to include in our daily diet. It has been shown to greatly reduce anxiety and depression. Niacin is also needed to help lower cholesterol levels.



Avocados



Broccoli



Tomatoes



Dates



Mushrooms



Asparagus



Swiss Chard



Pumpkin Seeds



Sweet Potatoes



Carrots



Almonds



Spinach

Please Tag on Facebook: Authentic Self Wellness

### Daily requirement

➤ **Men – 17mg**

➤ **women – 13 mg**

➤ **Pregnancy and lactation – 12 to 15 mg .**

➤ **Children – 15mg.**



# M/A OF NIACIN

- Niacin and its precursor, tryptophan, which is converted to niacin in the liver, form the active co-enzymes nicotine adenine dinucleotide (NAD) and nicotine adenine dinucleotide phosphate (NADP).
- Niacin can decrease the synthesis of apoB (**Apolipoprotein B**)-containing lipoproteins—VLDL, LDL, IDL and Lp(a)—via several mechanisms:

- (1) direct inhibition of DGAT2, a key enzyme for triglyceride synthesis;
- (2) binding to the receptor HCAR2 (also called GPR109A), thereby decreasing lipolysis and FFA flux to the liver for triglyceride synthesis; and
- (3)

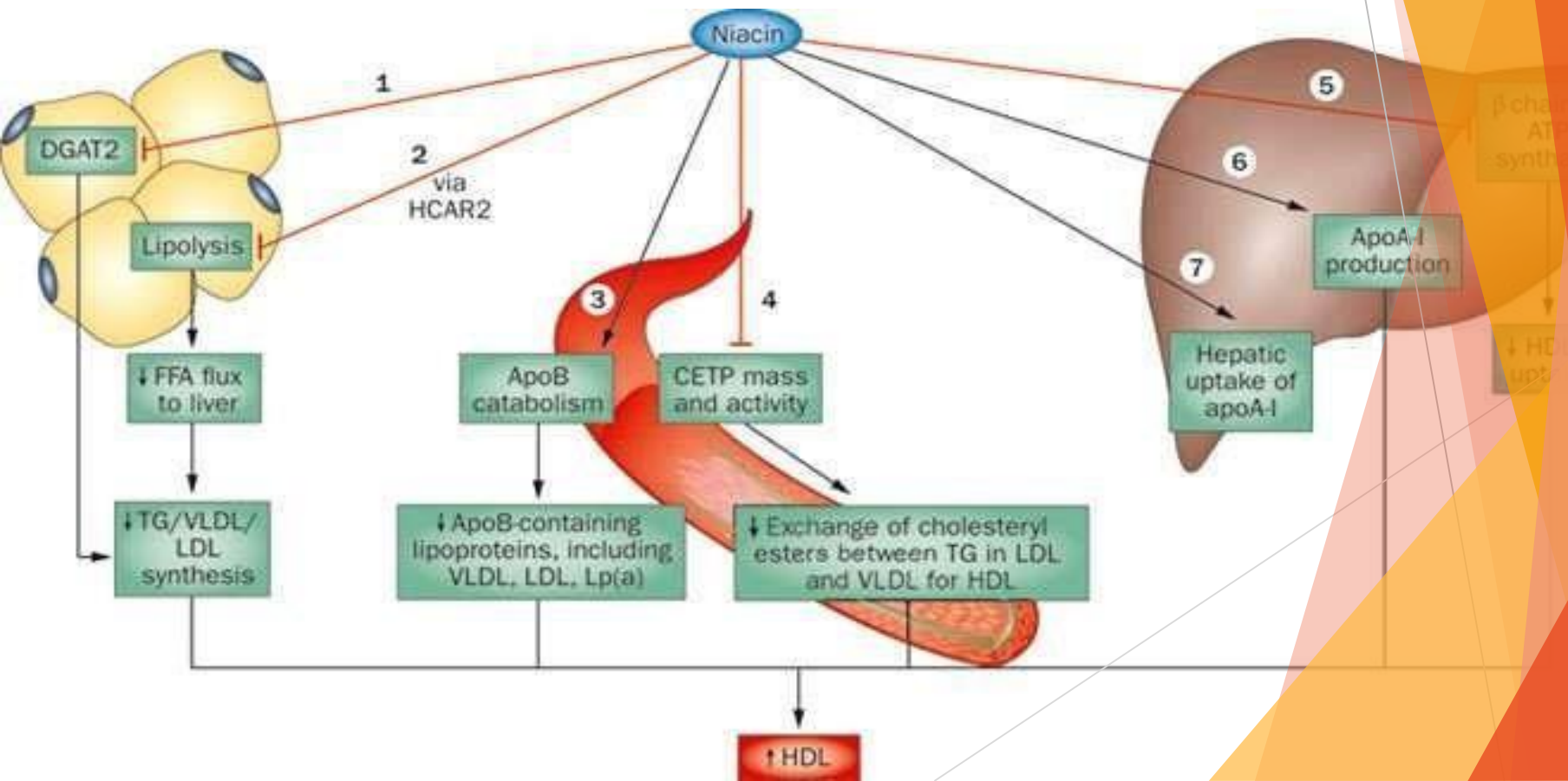
increased apoB catabolism. Meanwhile, HDL cholesterol levels are increased by niacin through direct and indirect pathways.

(4) Niacin decreases CETP mass and activity, and this effect, together with the decrease in triglyceride levels, can indirectly raise HDL cholesterol levels. Direct effects on the  $\beta$  chain of ATP synthase

(5) and on production

(6) and hepatic uptake

(7) of apoA-I also increase HDL cholesterol levels. Abbreviations: apo, apolipoprotein; CETP, cholesteryl ester transfer protein; DGAT2, diacylglycerol acyltransferase 2; FFA, free fatty acids; HCAR2, hydroxycarboxylic acid receptor 2; Lp(a), lipoprotein(a); TG, triglycerides.

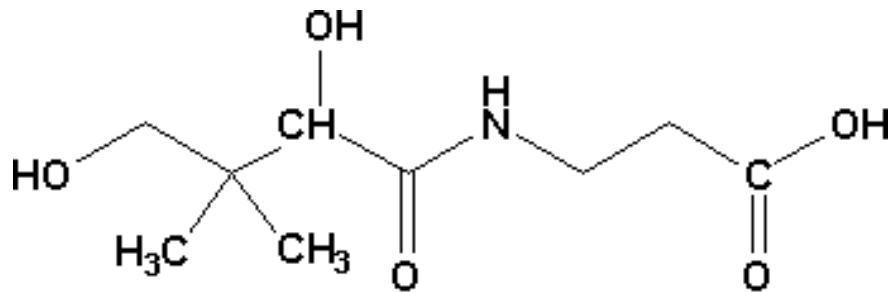


# FUNCTIONS OF NIACIN (VIT B3)

- ❑ Vitamin B3, helps in releasing energy from carbohydrates, fats and proteins.
- ❑ vitamin B3, is very essential for the DNA synthesis.
- ❑ it is essential for production of estrogen progesterone & testosterone
- ❑ It is also helpful in reducing migraine headaches.
- ❑ Vitamin B3, as niacinamide, may improve arthritis symptoms, including increasing joint mobility and reducing the amount of anti-inflammatory medications needed.
- ❑ It is necessary for healthy skin, nerves and digestive system.
- ❑ High doses of niacin medications are used to prevent development of atherosclerosis and to reduce recurrent complications such as heart attack and peripheral vascular disease in those with the condition.
- ❑ It helps to detoxify the body.
- ❑ Vitamin B3, is very essential for the proper digestion of the food.

# VITAMIN B5(PANTOTHENIC ACID)

- Vitamin B5 is also known as **Pantothenic Acid**, is a water-soluble vitamin.
- It was discovered by Roger J. Williams in 1919.
- Tissue extracts from a variety of biological materials provide a growth factor for yeast this growth factor identified as pantothenic acid
- This word derived from greek word **pantos** meaning **everywhere**.
- Part of Coenzyme-A
- Essential for metabolism of CHO, fat, protein



**Pantothenic Acid**

# DIETARY SOURCES OF VIT B5

TOP 10 VITAMIN B5 FOODS	
 <b>1</b>	<b>CHICKEN LIVER</b> 8.3 MG (83%DV) 3 OZ
<b>AVOCADOS</b> 2 MG (20%DV) 1 FRUIT	<b>2</b> 
 <b>3</b>	<b>SUNFLOWER SEEDS</b> 1.98 MG (20%DV) 1 OZ
<b>SALMON</b> 1.9 MG (20%DV) 3 OZ	<b>4</b> 
 <b>5</b>	<b>YOGURT</b> 1.45 MG (14%DV) 1 CUP
<b>MUSHROOMS</b> 1.3 MG (13%DV) 1 CUP	<b>6</b> 
 <b>7</b>	<b>CORN</b> 1.18 MG (12%DV) 1 CUP
<b>SUN DRIED TOMATOES</b> 1.1 MG (10%DV) 1 CUP	<b>8</b> 
 <b>9</b>	<b>CAULIFLOWER</b> 0.71 MG (7%DV) 1 CUP
<b>BROCCOLI</b> 0.52 MG (5%DV) 1 CUP	<b>10</b> 

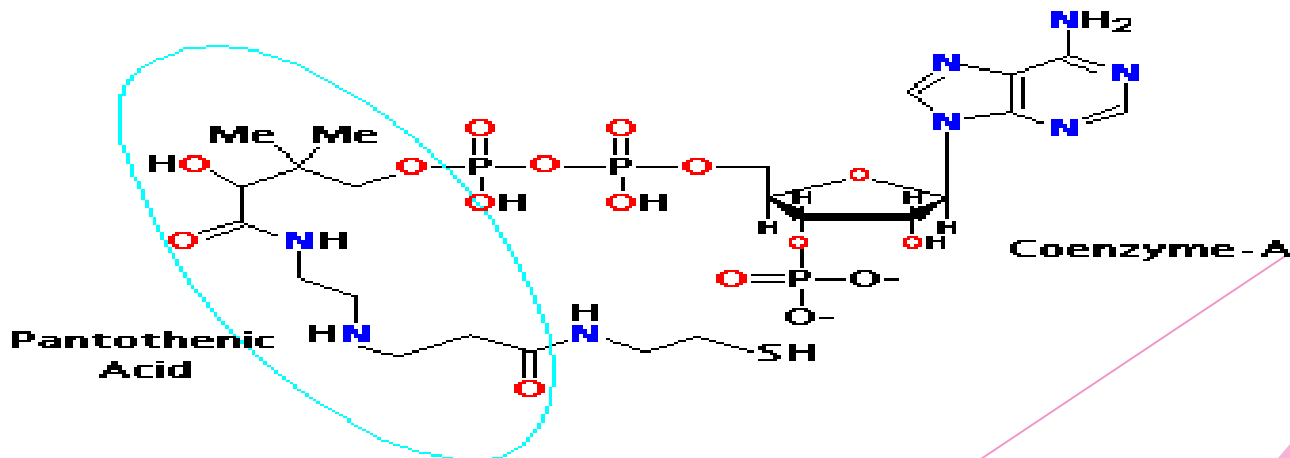
## Daily requirement

- Men – 10 mg
- women – 10 mg
- Children – 5.5mg.



# M/A OF PANTOTHENIC ACID

- Pantothenic acid is a precursor of coenzyme A, which is a cofactor for a variety of enzyme-catalyzed reactions involving transfer of acetyl groups.
- Functions of pantothenic acid include oxidative metabolism of carbohydrates, gluconeogenesis, synthesis and degradation of fatty acids, and synthesis of steroids (cholesterol), steroid hormones, sphingosine, citrate, acetoacetate, and porphyrins.
- Taking additional B5 increases the amount of Coenzyme A available for use in the cell.
- The more Co-Enzyme A, the more fatty acids can be metabolized, which means they are oxidized or burned up as energy production.

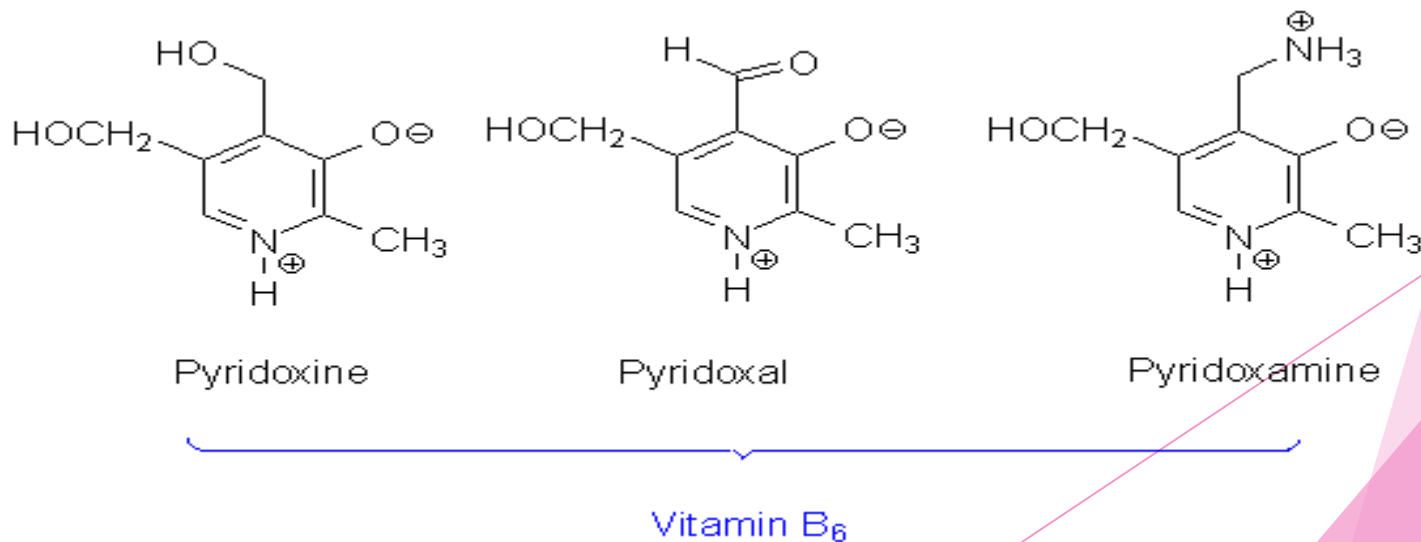


# FUNCTIONS OF VIT B5 (PANTOTHENIC ACID)

- ❑ Vitamin B5 plays an important role in helping release energy from sugars, starches, and fats.
- ❑ Vitamin B5 is important for releasing energy stored as fat, it is equally important for the creation of fat. Two basic types of fats - fatty acids and cholesterol - both require the CoA form of B5 for their synthesis.
- ❑ Sometimes it is important for the body to make small chemical changes in the shape of cell proteins, thus vitamin B5 is used in this case.
- ❑ They are essential for the cell metabolism.
- ❑ They are very helpful in the cholesterol metabolism.
- ❑ Accelerates wound healing.
- ❑ It is also used as anti-stress factor.
- ❑ Allergies, headaches, arthritis, psoriasis, insomnia, asthma, and infections have all been treated with some effectiveness using vitamin B5.

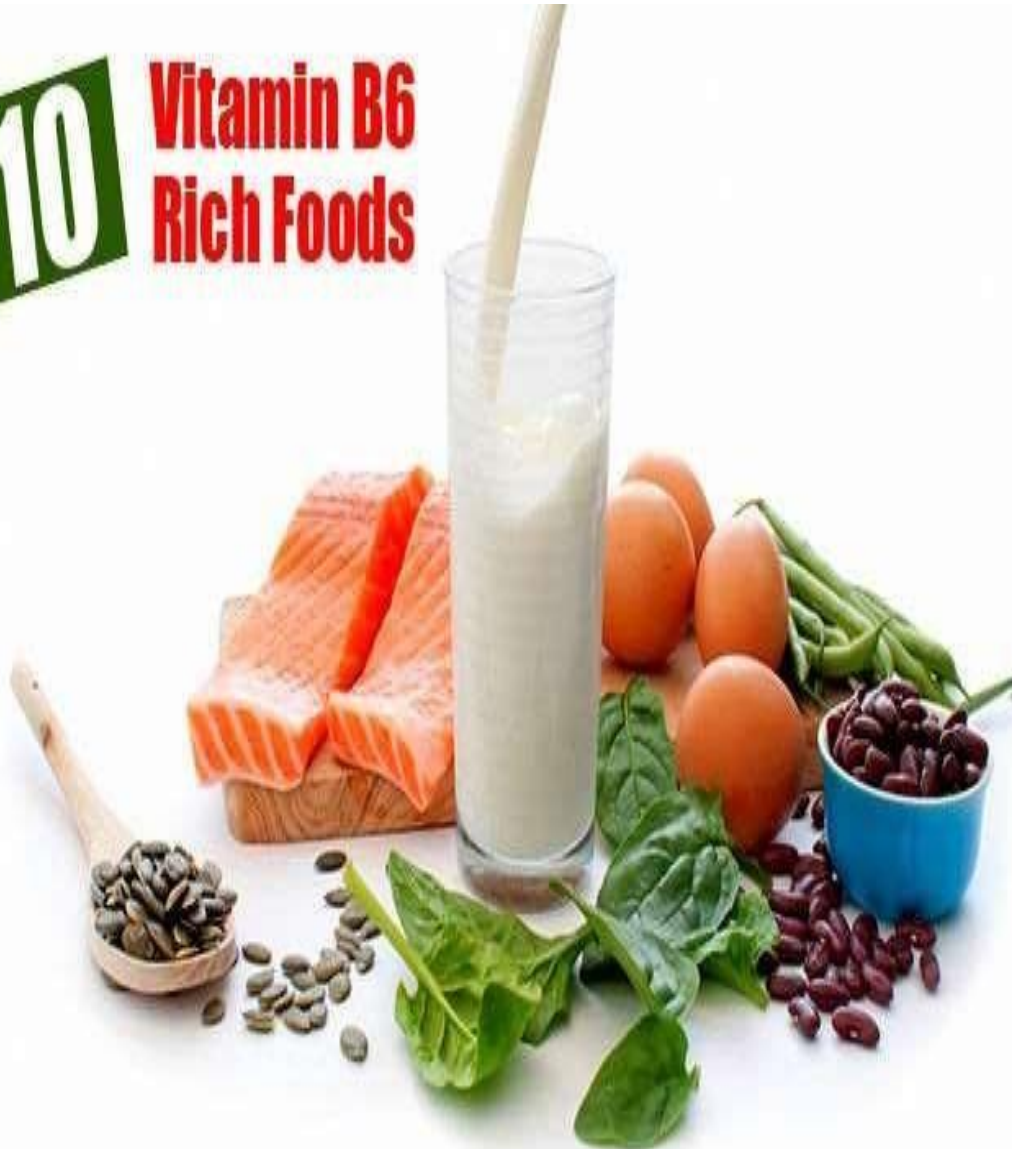
# VITAMIN B6(PYRIDOXINE B6)

- Vitamin B<sub>6</sub> refers to a group of chemically very similar compounds which can be interconverted in biological systems.
- Vitamin B<sub>6</sub> is part of the vitamin B complex group, and its active form, Pyridoxal 5'-phosphate (PLP) serves as a cofactor in many enzyme reactions in amino acid, glucose, and lipid metabolism.
- It is white crystalline substance soluble in water and alcohol.



# DIETARY SOURCE OF VIT B6

## **10** Vitamin B6 Rich Foods

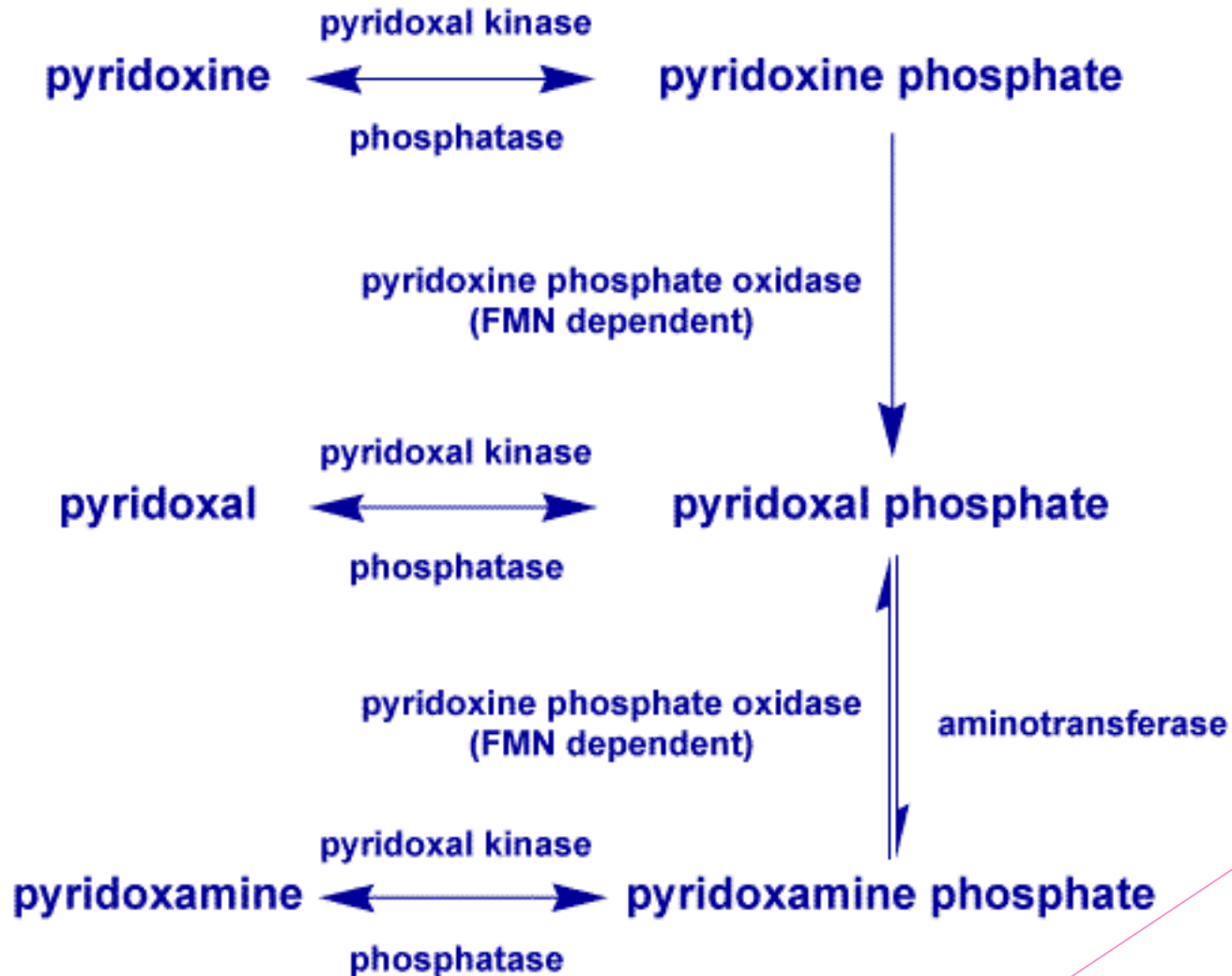


**Milk**  
**Fish**  
**Vegetables**  
**Beans**  
**Eggs**  
**Peanuts,**  
**sunflower seeds, etc.**

### Daily requirement

- **Men – women – 2 mg**
- **Children – 1.7 mg.**
- **Infant – 0.1-0.4 mg**

# M/A OF VITAMIN B6



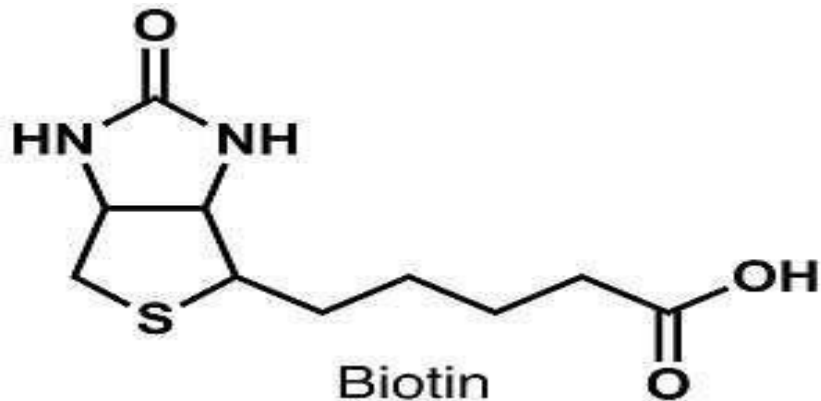


# FUNCTIONS OF VITAMIN B6

- Make antibodies. Antibodies are needed to fight many diseases.
- Maintain normal nerve function
- Make hemoglobin. Hemoglobin carries oxygen in the red blood cells to the tissues. A vitamin B6 deficiency can cause a form of anemia.
- Break down proteins. The more protein you eat, the more vitamin B6 you need.
- Keep blood sugar (glucose) in normal ranges
- Assists in the balancing of Sodium and Potassium levels.
- Promotes RBC production.
- Production of Serotonin, Dopamine, Noradrenaline and Adrenaline

# VITAMIN B7 (BIOTIN)

- ❖ Vitamin B7 or **Biotin**, also known as **vitamin H** or **coenzyme R**, is a water-soluble B-vitamin.
- ❖ Biotin is a coenzyme for carboxylase enzymes, involved in the synthesis of fatty acids, isoleucine, and valine, and in gluconeogenesis



# DIETARY SOURCES OF VIT B7

## #2. Biotin or Vitamin B7

### Vitamin B7 rich foods

- Eggs
- Yeast
- Cauliflower
- Raspberries
- Bananas
- Walnuts
- Almonds



### Daily requirement

- **Men – women – 100-200 mcg**
- **Children – 50-200 mcg.**
- **Infant – 35 mcg**

# FUNCTIONS OF VITAMIN B7

sufficient intake of vitamin B7 (biotin) is important as it helps the body to-

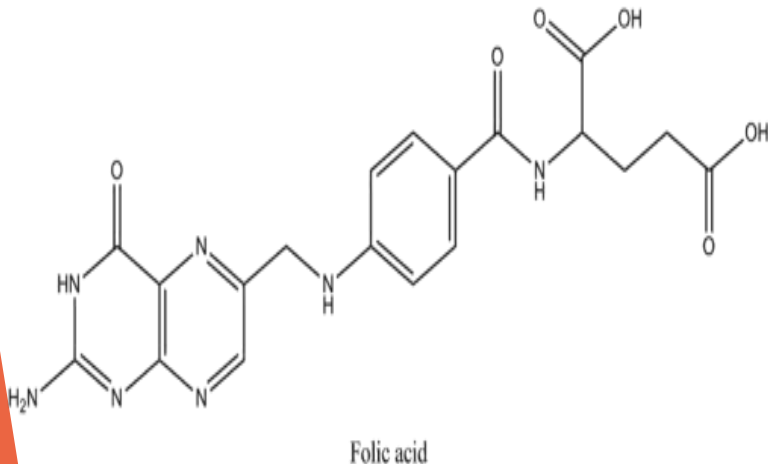
- convert food into glucose, which is used to produce energy
- produce fatty acids and amino acids (the building blocks of protein)
- activate protein/amino acid metabolism in the hair roots and fingernail cells.

The **European Food Safety Authority (EFSA)**, which provides scientific advice to assist policy makers, has confirmed that clear health benefits have been established for the dietary intake of biotin (vitamin B7) in contributing to:

- normal macronutrient metabolism;
- normal energy yielding metabolism;
- the maintenance of normal skin and mucous membranes;
- the normal function of the nervous system;
- the maintenance of normal hair;
- normal psychological functions.

# VITAMIN B9(FOLICACID)

- Vitamin b7 is also known as **folic acid, folacin or folate.**
- It is a water soluble vitamin.
- It is a yellow crystalline substance.



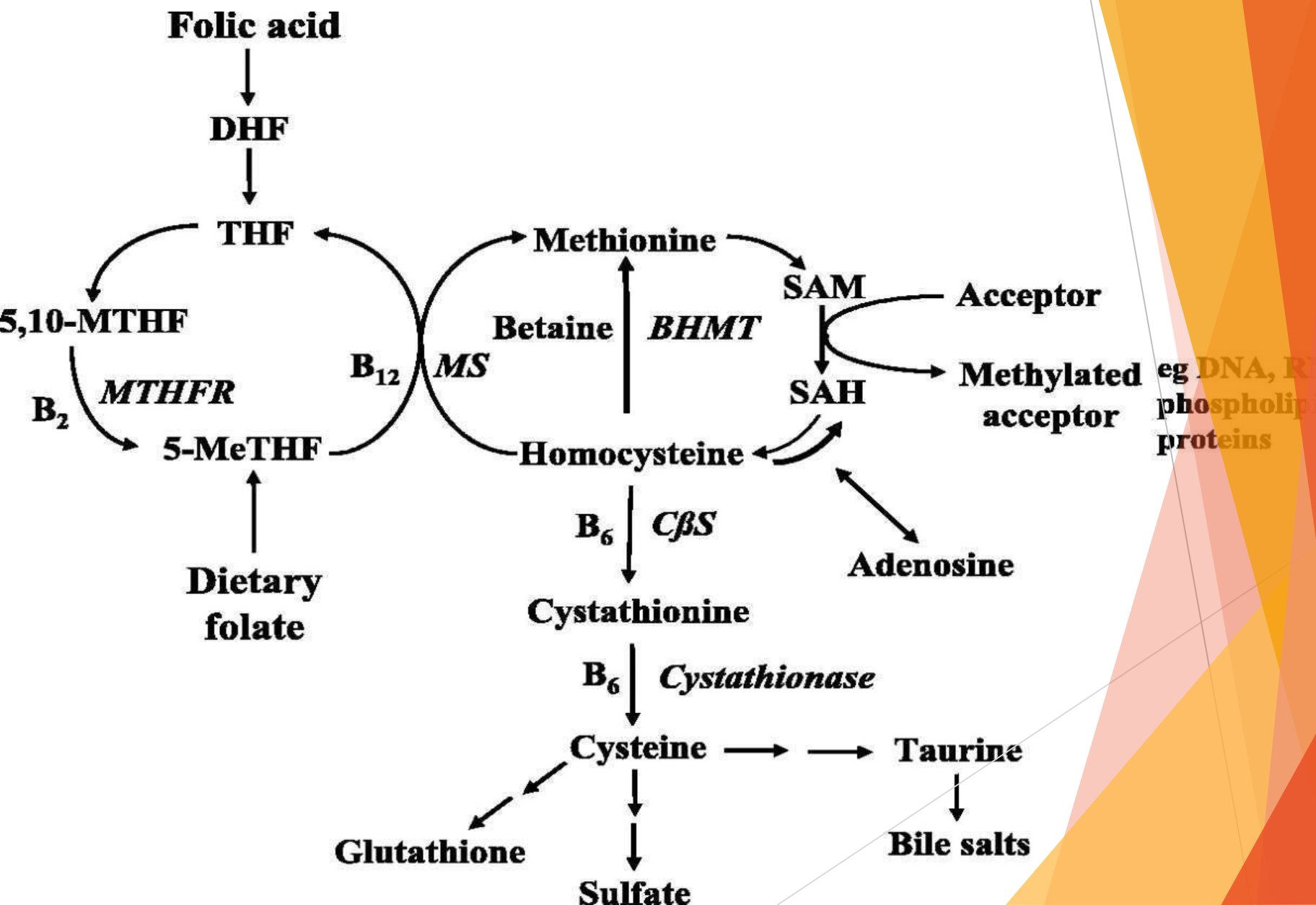
## DIETARY SOURCE

- 1) Lentil
- 2) Borlotti Beans
- 3) Chickpeas
- 4) Spinach
- 5) Black Beans
- 6) White Beans
- 7) Red Beans
- 8) Cabbage
- 9) Turnip Greens
- 10) Lima beans





# M/A OF FOLICACID

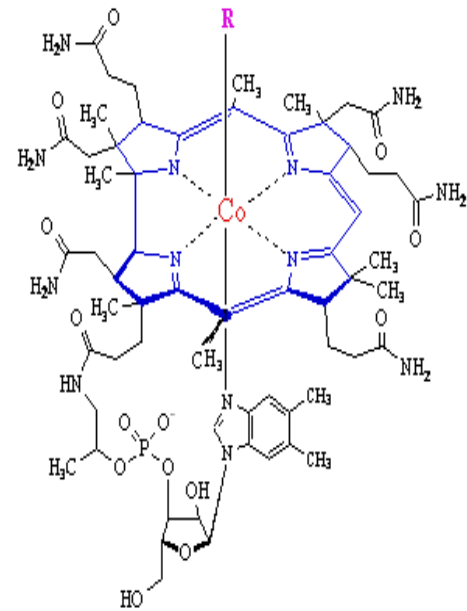


# FUNCTIONS OF VIT B9

- **Formation of RBC** – folic acid in combination with vitamin B12 is essential for formation, maturation.
- **Nerve** – it is necessary for growth & division of all body cells,
- **Hair & Skin** – it is essential for the health of skin & hair
- **Pregnancy** – it is an important nutrient for the pregnant women & her developing fetus.& folic acid improves the lactation.
- **DNA synthesis**
  - Transfer of single carbon units
  - Synthesis of adenine and guanine
  - Anticancer drug methotrexate
- Homocysteine metabolism
- Neurotransmitter formation

# VITAMIN B12 (COBALAMIN)

- Vitamin B12 is complex organomatrix compound called as **cobalamin** which is cobalt containing porphyrin. It is freely soluble in water.



## SOURCES

Vitamin B12 is mostly found in animal products such as meat, shellfish, milk, cheese, and eggs. Clams, Oysters, Mussels, Caviar (Fish Eggs), Octopus, Crab and Lobster r the great source of B12.



## Vitamin B12 Rich Foods

# M/A OF VITAMIN B12

Coenzyme B<sub>12</sub>'s reactive C-Co bond participates in three main types of enzyme-catalyzed reactions.

## 1. Isomerases

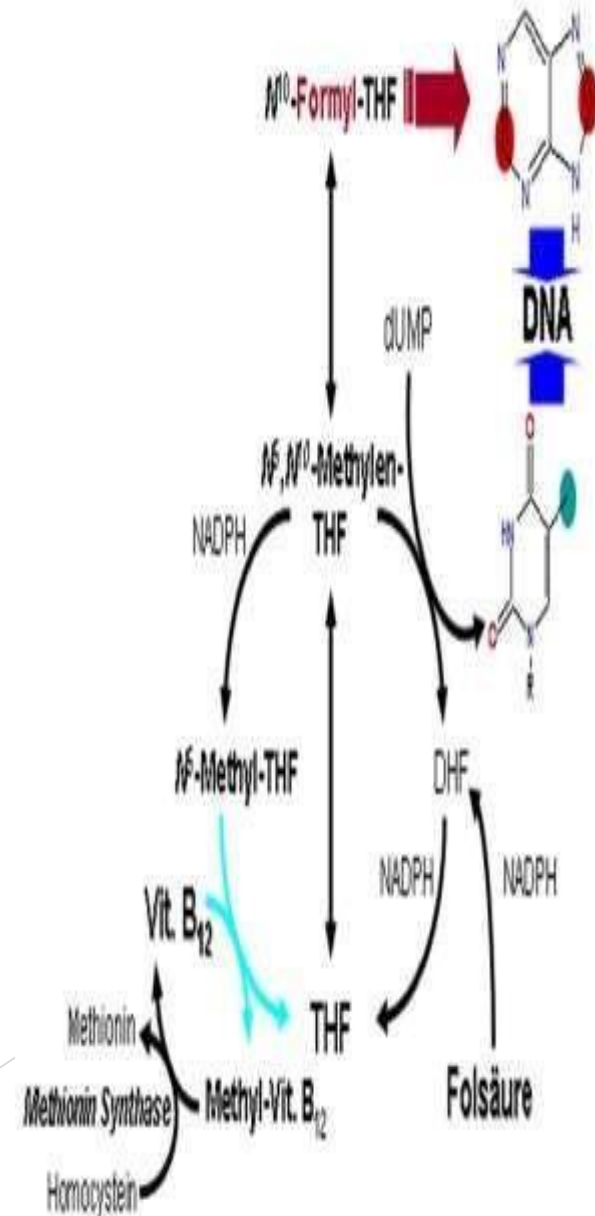
Rearrangements in which a hydrogen atom is directly transferred between two adjacent atoms with concomitant exchange of the second substituent, X, which may be a carbon atom with substituents, an oxygen atom of an alcohol, or an amine. These use the adoB<sub>12</sub> (adenosylcobalamin) form of the vitamin.

## 2. Methyltransferases

Methyl (-CH<sub>3</sub>) group transfers between two molecules. These use MeB<sub>12</sub> (methylcobalamin) form of the vitamin.

## 3. Dehalogenases

Reactions in which a halogen atom is removed from an organic molecule. Enzymes in this class have not been identified in humans.



# FUNCTIONS OF VITAMIN B12

- **Red Blood Cells** – it is essential for production of RBCs
- **Nervous** – It improves concentration, memory, & balance.
- It is important for metabolism of fat, carbohydrate, proteins, folic acid.
- It promotes growth and increases appetite.

## DEFICIENCY

- **ANEMIA** → it leads to Megaloblastic or pernicious anemia
- Demyelination & irreversible nerve cell death.

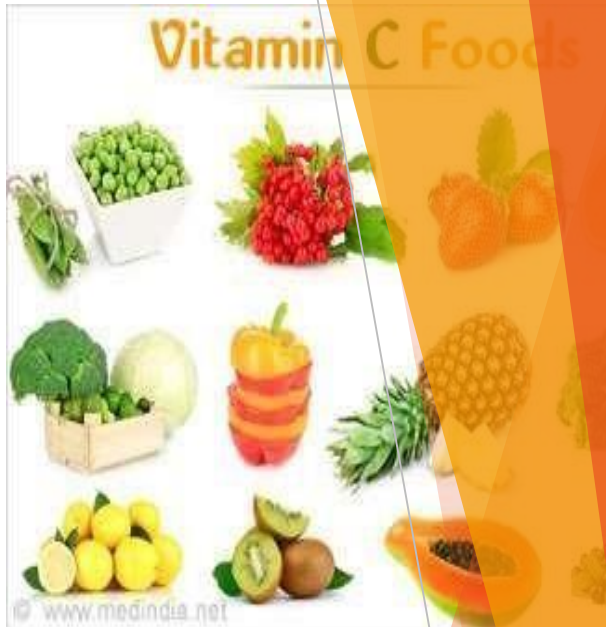
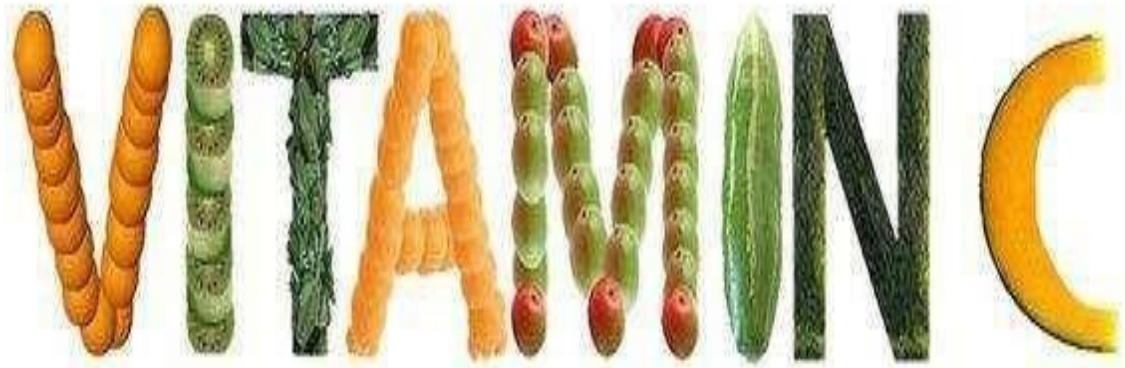


# VITAMIN C(ASCORBIC ACID)

- It is also called **ascorbic acid** and **antibiotic vitamin**.
- it is the most active reducing agent.
- it is powerful antioxidant
- Synthesized by most animals (not by human)



# DIETARY SOURCES OF VITAMIN C



## Foods Sources

V Valencia Orange  
 I Issai Kiwi Fruit  
 T Turnip Greens  
 A Apricots  
 M Mango  
 I Ivy Gourd  
 N Nori  
 C Cantaloupe

Apricots  
 Beans, Yellow Snap  
 Bell Pepper  
 Blackberries  
 Broccoli  
 Brussels Sprouts  
 Cabbage, Green  
 Cabbage, Pe-Tsai  
 Cabbage, Red  
 Cantaloupe  
 Carambola  
 Cauliflower  
 Cauliflower, Green  
 Collard Greens

Chili Pepper, Hot  
 Gooseberries  
 Grapefruit  
 Guavas  
 Kiwifruit  
 Lemon  
 Lime  
 Melon, Honeydew  
 Okra  
 Onion  
 Orange  
 Papaya  
 Pineapple

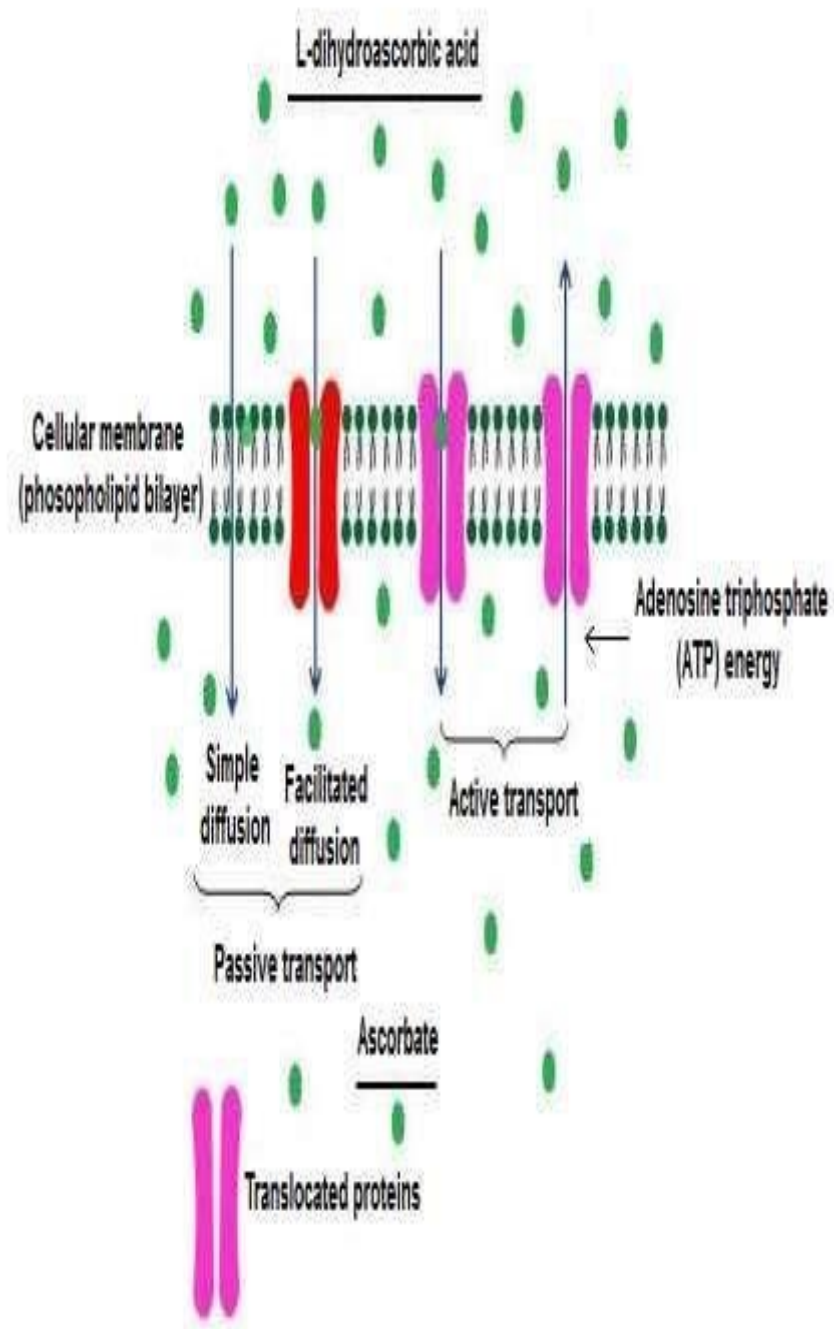
Potato  
 Prickly Pears  
 Pummelo  
 Radishes  
 Raspberries  
 Rutabagas  
 Spinach  
 Squash, Summer  
 Strawberries  
 Sweet Potato  
 Tangerines  
 Tomato  
 Watermelon

## Daily requirement

- Men – women – 70-90mg
- Children –40mg
- Infant – 25mg
- Pregnancy & lactation – 80mg

# M/A OF VITAMIN C

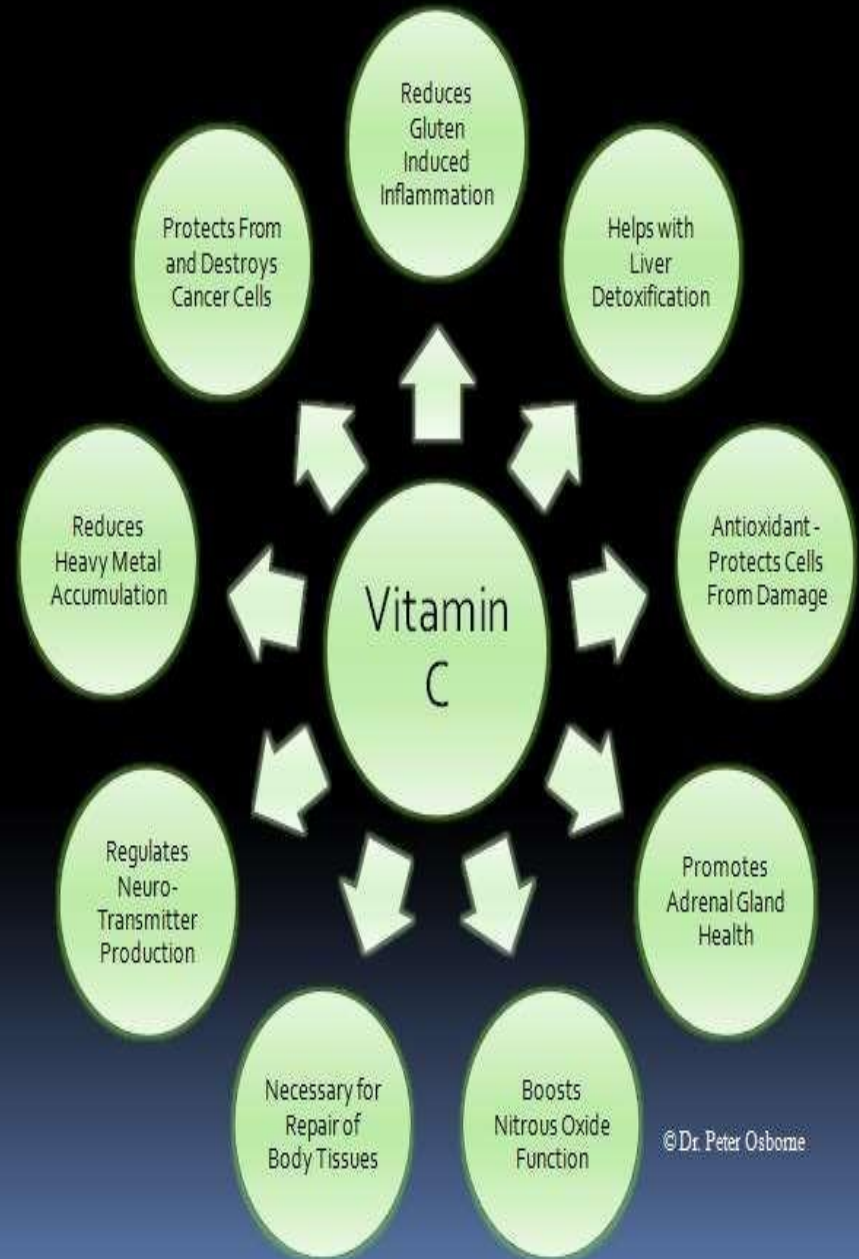
- The chemopreventive action of vitamin C is attributed to two of its functions. It is a water-soluble chain breaking antioxidant (*Ishwarial et al 1991*). As an antioxidant, it scavenges free radicals and reactive oxygen molecules, which are produced during metabolic pathways of detoxification. It also prevents formation of carcinogens from precursor compounds (*Block and Menkes, 1988*). The structure of ascorbic acid is reminiscent of glucose, from which it is derived in the majority of mammals.



# FUNCTIONS OF VITAMIN C

- Synthesis of collagen.
- Maintenance – necessary for maintenance of bones & proper functioning of the adrenal & thyroid gland .
- Antioxidant
- It stimulates immune function, combats bacterial infection, reduces effects of allergy-producing substances and protects vitamins, A, E and some B complex vitamins from oxidation.

## The 9 Critical Functions of Vitamin C





# VITAMIN C DEFICIENCY

- **SCURVY**
- **Fragility of blood vessels**
- **Easy bruising, hemorrhage**
- **Poor healing**
- **Pain in Bones & Muscle**
- **Poor Bone & Dentin formation**
- **Compromised immunity**

## Do You Know ?

Studies show that **large doses of Vitamin C** intake (At least 500mg and above daily) have the ability to **prevent diseases** such as Coronary Heart Disease, Cancer, Stroke and Gout.

To obtain 500mg of vitamin C daily, you require either:

- 7 medium Oranges
- 7 Medium Kiwifruits
- 7 cup of Strawberries
- 8 cup of Orange juices





# REFERENCES

- <http://en.wikipedia.org/wiki/Vitamin>
- <http://www.precisionnutrition.com/all-about-vitamins-minerals>
- <http://www.encyclopedia.com/topic/vitamin.aspx>
- <http://www.preservearticles.com/201107309552/what-are-the-characteristics-and-function-of-vitamins.html>
- <http://www.medicalnewstoday.com/articles/195878.php>

**THANK YOU!**

