CHAPTER 10
DEFICIENCY DISORDERS

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VITAMIN E

- The term **vitamin E** describes a family of 8 antioxidants,
  4 tocopherols (α,β, γ, & δ) and
  4 tocotrienols.
- **α-tocopherol** is the active form of vitamin E in the human body.

FUNCTIONS

- The main function of vitamin E is anti oxidant. It intercepts free radicals & prevents destruction of cell membrane.
- It protects the fat in LDL from oxidation.
- It inhibits platelets aggregation.
- It enhances vasodilatation.
- It inhibits the activity of protein kinase C.

Vitamin E Dietary Sources

- Vegetable oils
- Almonds & peanuts
- Avocado
- Spinach
- Carrots (least)

Vitamin E deficiency

- **Severe vitamin E deficiency causes:**
  - Neurological symptoms (impaired coordination) & muscle weakness.
  - Increased risk of cardiovascular diseases
  - Hemolytic anemia in children

RISK FACTORS

- Severe PEM
- Genetics defects affecting the transfer protein of α-tocopherol
- Fat malabsorption syndrome

THERAPEUTIC USES

- Prevention of cardiovascular diseases
- Diabetes Mellitus
- Cancer prevention
- Boost immunity
- Dementia

TOXICITY

Excess vitamin E may cause:

- **Impaired blood clotting leading to increased risk of bleeding in some persons.**
- **It is recommended that vitamin E supplements to be stopped one month before elective surgery.**

VITAMIN K

- The K is derived from the German word Koagulation.

- There are 2 naturally occurring forms of vitamin K. Plants synthesize phylloquinone (vitamin K1) & bacteria synthesize menaquinone-3 (vit K2).

- Menaquinone-4 is produced in animals from vit K1, but its function is yet to be discovered.

FUNCTIONS

- **Vitamin K is needed for production of vitamin K-dependent coagulation factors in the liver.**
- **Other functions include:**
  - **Assist in bone mineralization. The mineral binding capacity of osteocalcin requires vit K.**
  - **Gas6 is vit K-dependent protein identified in 1993. It is important for neuronal function.**

SOURCES OF VITAMIN K

Bacteria in large intestine produce vit K2 and supply 40-50% of human requirement.

Vegetable oils

Almonds & peanuts

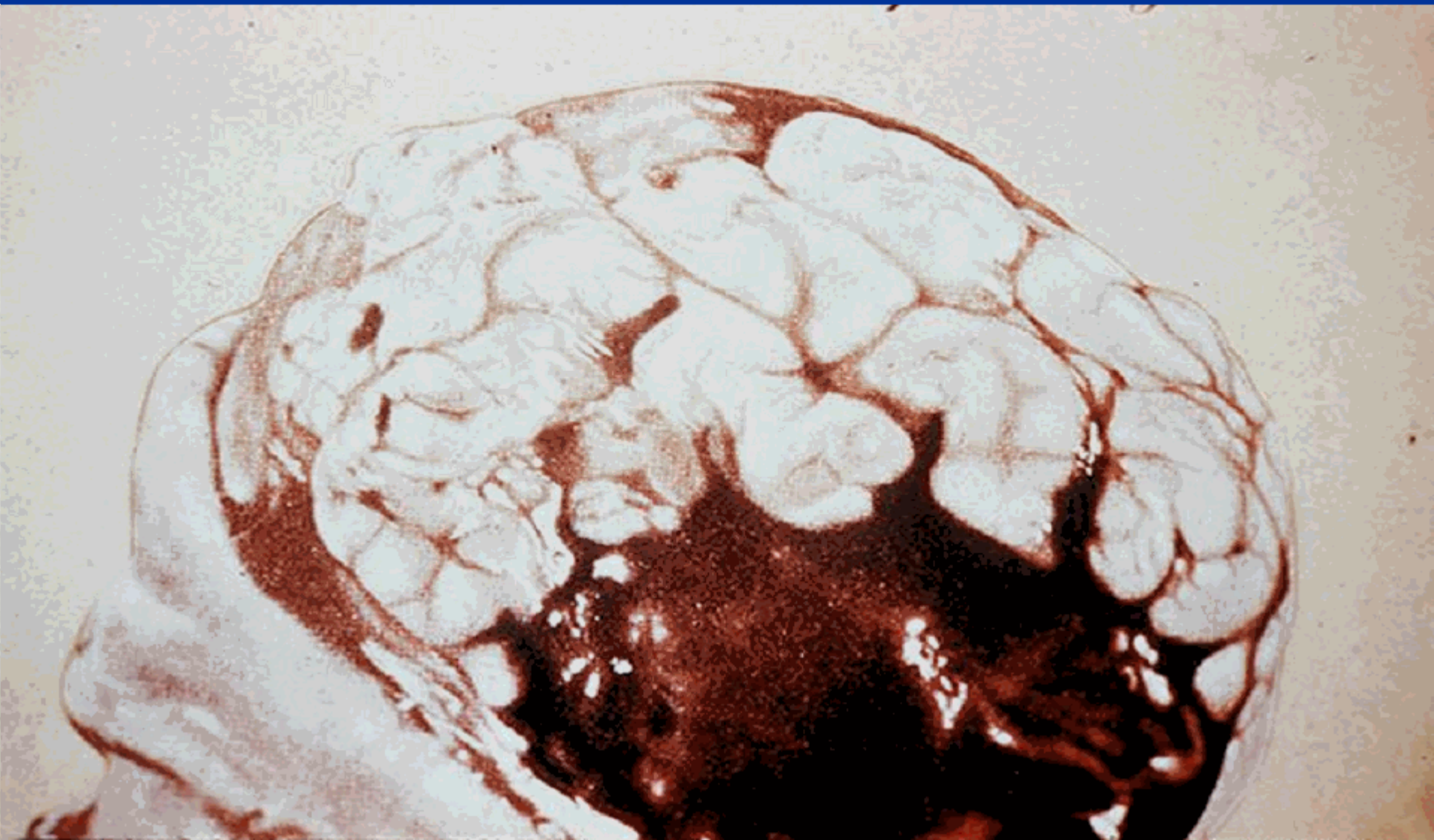
Avocado & Broccoli

Spinach, Lettuce, parsley (raw)

Vitamin K deficiency

- Is uncommon in adults. Only those with severe liver disease & those on oral anticoagulants are at risk.
- Exclusively breast fed & premature babies are at risk coz human milk is low in vitamin E & their gut is not yet colonized with bacteria.
- Hemorrhagic disease of the newborn is a serious threat to life & routine vit k prophylaxis is recommended by the AAP.

HDN



VITAMIN C

- Humans, unlike other mammals, are unable to make ascorbic acid & they get it from food.

- Rich dietary sources are citrus juices (orange, grapefruit & lime), strawberry, Guava, tomato, sweet red pepper & broccoli.

- Recommended daily intake is between 15-120 mg/day depending on age. Smokers & lactating mother needs the higher range.

FUNCTIONS

- Collagen synthesis
- Antioxidant
- Synthesize of noradrenaline
- Carnitine synthesize
- Metabolism of cholesterol to bile salts

Vitamin C deficiency

- Severe deficiency leads to Scurvy with the following manifestations:
  - Bleeding & bruising easily
  - Hair & teeth loss
  - Joint pain & swelling
  - Fatigue & lack of concentration

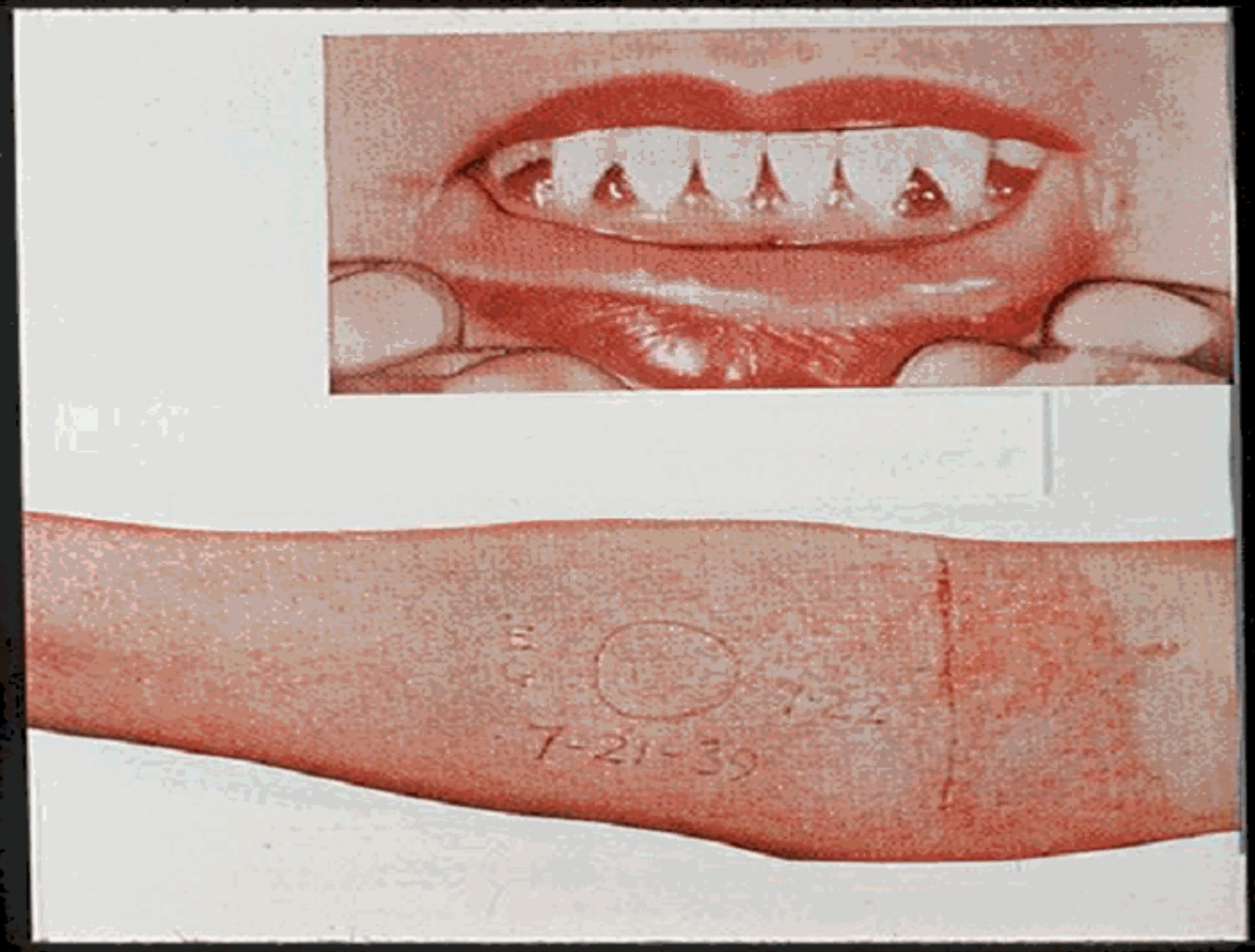
THERAPEUTIC USES

- Cardiovascular diseases
- Cataracts
- Diabetes Mellitus
- Cancer prevention
- Common cold
- Lead toxicity

DRUG INTERACTIONS

- Contraceptive pills & aspirin lower vitamin C level in plasma & WBC.
- Vitamin C in large dose blocks the action of warfarin & interferes with interpretation of certain lab tests (bilirubin & creatinine in serum and guaiac assay for occult blood).
- Previous claims of serious toxic effects of vit C are not evidence-based.

SCURVY



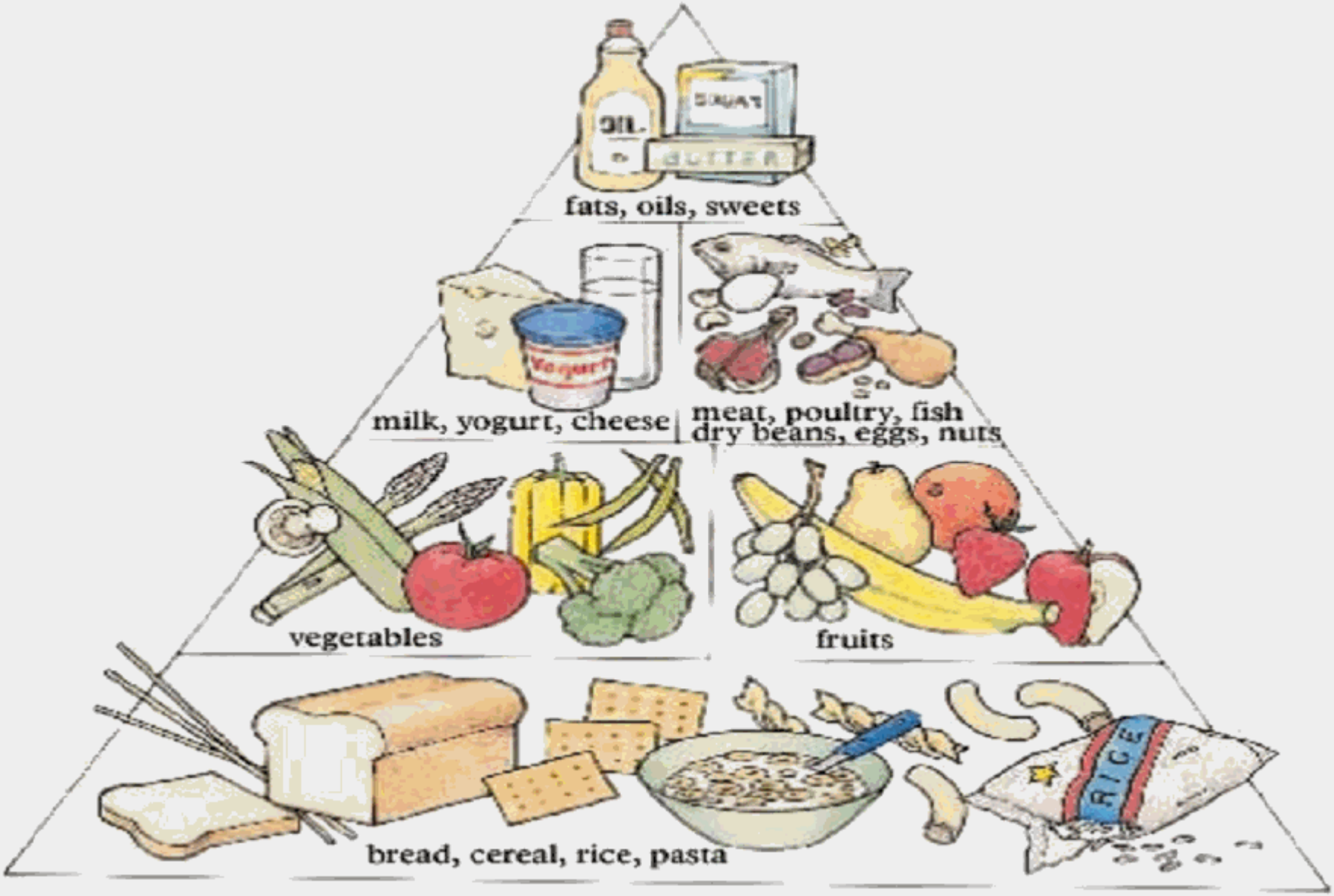
VITAMIN B Complex

- Group of 7 water soluble vitamins, thiamin, riboflavin, niacin, pyridoxine, cobalamin, biotin & pantothenic acid.

- Biotin & pantothenic acid deficiencies are extremely rare coz it is found in numerous foods and also is synthesized by intestinal bacteria.

- Biotin deficiency may occur with prolonged antibiotic therapy & ingestion of raw eggs.

Vitamin Rich Diet



THIAMIN (VIT B1)

- Thiamin is rapidly converted to its active form, thiamin pyrophosphate in the brain and liver by a specific enzymes, thiamin diphosphotransferase.

- TPP is necessary as a cofactor for the reactions of the pentose phosphate pathway.

- The dietary requirement for thiamin is proportional to the caloric intake of the diet and ranges from 1.0 - 1.5 mg/day for normal adults.

RISK OF THIAMIN DEFICIENCY

- Low intake & alcoholism
- Increased consumption: Malaria & AIDS
- Excessive loss: hemodialysis and diuretics
- Anti-thiamin factors: tea & coffee.
- Thiaminases found in raw fish, raw shellfish & in silkworms.

DEFICIENCY & USES

- Severe thiamin deficiency can lead to:
  - Beri-Beri
  - Wernicke-Korsakoff syndrome
- Thiamin is used for treatment of congestive heart failure & Alzheimer's disease as well as in cancer prevention.

RIBOFLAVIN (VIT B2)

- Adequate amounts of B2 is present in eggs, milk, meat & cereals. Deficiency is often seen in chronic alcoholics due to their poor dietetic habits.
- Symptoms associated with riboflavin deficiency include, glossitis, seborrhea, angular stomatitis, cheilosis and photophobia.
- Riboflavin decomposes when exposed to visible light. This characteristic can lead to riboflavin deficiencies in newborns treated by phototherapy.

NIACIN (VIT B3)

- Niacin is available in both animal & plant food and is made in the body from tryptophane.
- Severe deficiency causes pellagra with glossitis, dermatitis, diarrhea, depression and dementia.
- Hartnup disease, malignant carcinoid syndrome & Isoniazid can lead to niacin deficiency .
- In large doses niacin lowers plasma cholesterol but it elevates blood glucose & uric acid levels, so it is not recommended with diabetes & gout.

PELLAGRA

PYRIDOXINE (VIT B6)

- Pyridoxine functions as a cofactor in enzymes reactions required for the synthesis & catabolism of the amino acids as well as in glycogenolysis.
- Widely available in diet & deficiency may follow INH & pencillamine therapy.
- Deficiency can cause neonatal seizures, cheilosis, glossitis & neuroitis.

COBALOMIN (VIT B12)

- B12 functions as a cofactor for enzymes required for the catabolism of fatty acids & the conversion of homocysteine to methionine.
- B12 is not available in plant & deficiency may occur in strict vegetarians & in pts with GIT problems & those on prolonged antibiotic treatment.
- Deficiency causes megaloblastic anemia, SACDC, & high homocysteine in blood which is a risk of IHD & stroke.

FOLIC ACID

- Folic acid is obtained from yeasts and leafy vegetables as well as animal liver. Animals can't synthesize folate, thus, it must come from diet.

- Folate is needed for synthesis of nucleic acids

- Deficiency causes megaloblastic anemia & neural tube defects in utero.
- Used for treatment of chronic hemolytic anemia.