



biochemistry



LEC. 1

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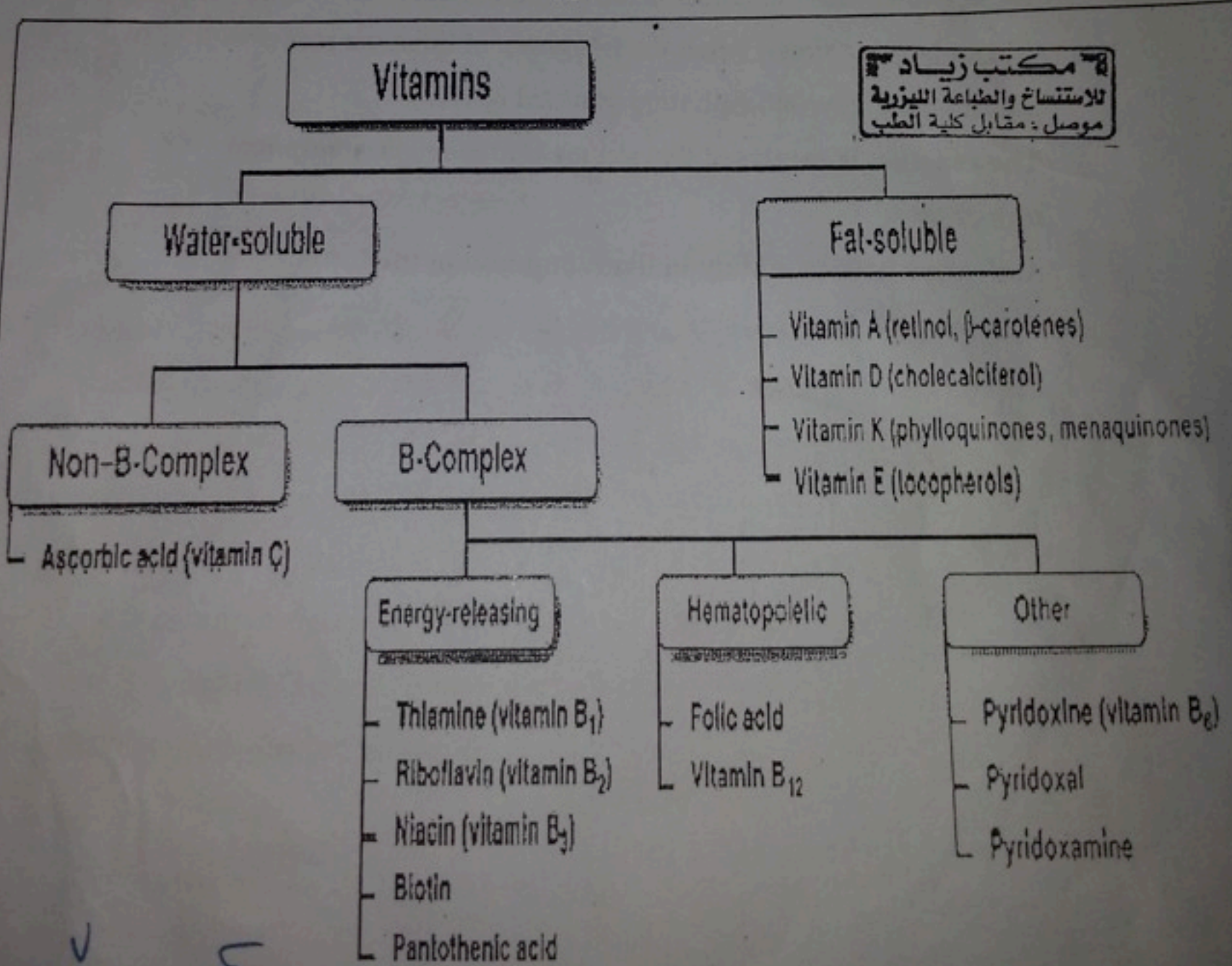
Vitamins:

The word Vitamin comes from the Greek word "VITAMINE" which means 'Vital for Life.'

Vitamins are organic compounds, they are essential for the normal processes of metabolism, including growth and maintenance of health.

Vitamins are required in small amount, they must be taken in diet because the body either cannot synthesized them or synthesis are insufficient. E.g. of vitamins synthesized by the body are vitamin D synthesized from cholesterol and niacin from tryptophane.

Vitamins are divided in to 2 main types:

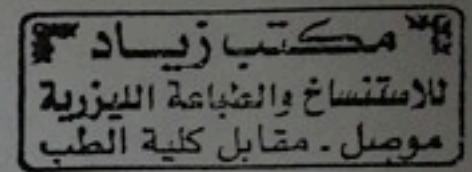


Statement

nikola
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Water soluble vitamins:

They include B-complex vitamins and vitamin C. because their water-solubility, these vitamins have no stable storage form and must be provided continuously in diet. Vitamin B₁₂ is an exception in that normal human liver can store it several years. As they are water soluble, so excess concentration are excreted in urine so rarely accumulated in toxic concentration.



Thiamine (B₁):

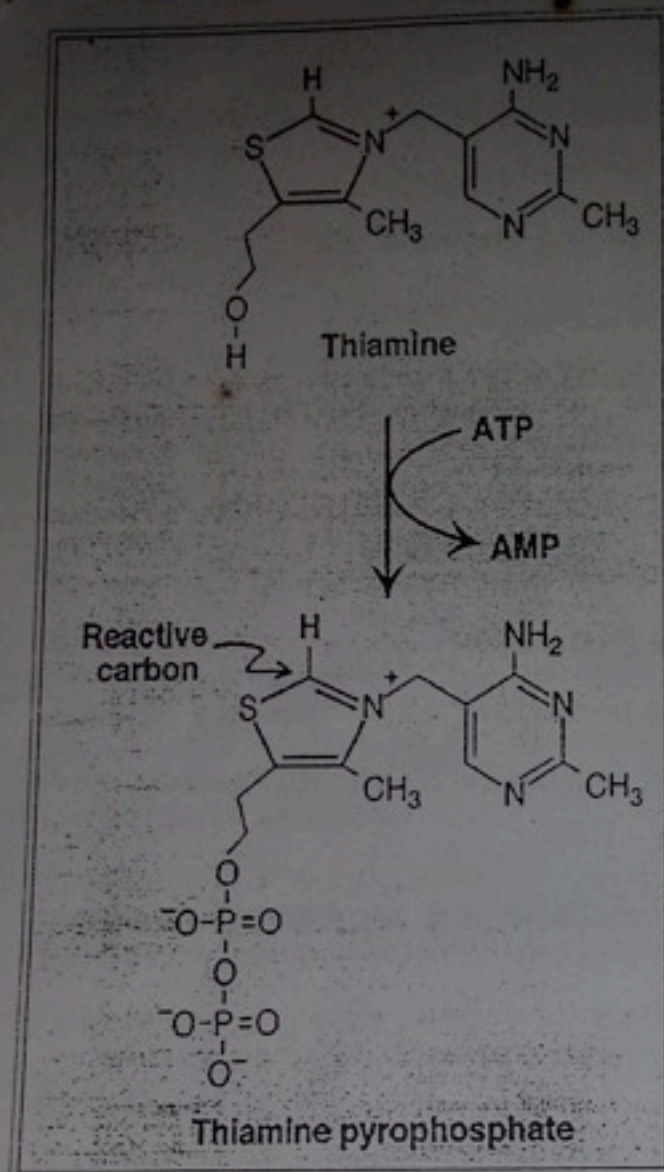
Structure And Active Form

Thiamine contains a pyrimidine ring and a thiazole ring.

The active form of thiamine is the coenzyme Thiamine Pyrophosphate (TPP) which is formed when the OH group of thiamine reacts with two phosphates (pyrophosphates) donated by ATP.

The reaction is catalysed by enzyme *thiamine pyrophosphate transferase*.

Activation occurs mainly in liver, and also in the brain.



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Dietary thiamine is readily absorbed and phosphorylated to its active form thiamine diphosphate (thiamine pyrophosphate) this needs to the presence of ATP dependent thiamine diphosphotransferase. that present in the brain and liver.

Sources:

- Whole grain cereals, legumes, yeast, liver, meat.
- Unpolished Rice and Whole wheat bread

~~Thiamine deficiency is caused by lack of thiamine~~

Biochemical function:

Thiamine diphosphate is an important coenzyme in carbohydrate metabolism, being necessary for 2 types of reaction:

1. oxidative decarboxylation reactions (e.g. conversion of pyruvate to acetyl CoA)
2. Transketolation reactions e.g. *transketolase* catalyzed reactions of the pentose phosphate pathway.

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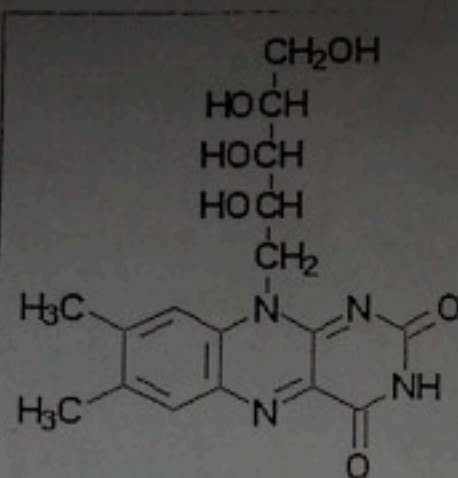
Deficiency of thiamine:

Clinical Significances of Thiamine Deficiency

1. Deficiency of thiamine causes beriberi in which anorexia, nausea, as well as mental depression, peripheral neuropathy and fatigue. This form called dry beriberi.
wet beriberi there is peripheral oedema, sometimes associated with cardiac failure.
2. An additional thiamine deficiency related disease is known as **Wernicke-Korsakoff syndrome**
: occur due to thiamine deficiency, it found in chronic alcoholics consuming little food, which characterized by apathy, loss of memory, and nystagmus.

Riboflavin .

vitamin B₂



Riboflavin structure

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It is relatively heat stable but sensitive to irreversible decomposition when exposed to visible light.

Biochemical function :

Riboflavin is the precursor for the coenzymes, **flavin mononucleotide (FMN)** and **flavin adenine dinucleotide (FAD)**. Both classes of enzymes are involved in a wide range of oxidation-reduction reactions.

Sources:

- Milk and milk products, meat, eggs, liver are rich sources.
- Cereals, fruits, vegetables and fish are moderate sources.

Deficiency Manifestation

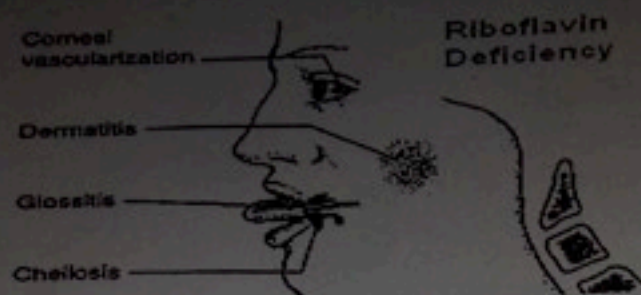
Mostly seen with other vitamin Deficiencies.

Glossitis: Smooth and purplish tongue.

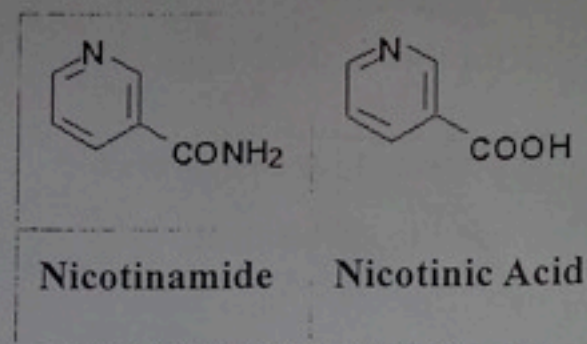
Circumcorneal Vascularization and conjunctivitis.

Dermatitis: Inflammation of the facial skin in particular

Cheilosis: Fissures at the corner of the mouth



Niacin (vitamin B₃):

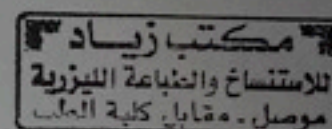


Niacin (nicotinic acid and nicotinamide) is also known as vitamin B₃.

It is heat stable; little cooking loss

■ Sources:

- • Whole grains, cereals, nuts, milk
- • Meat, Fish, Liver and Yeast.
- Synthesized endogenously from Tryptophan".
- Tryptophan Vit. B₃ — Niacin
- 60 mg of Tryptophan forms 1 mg of Niacin"



Biochemical function:

The Coenzymes NAD⁺(NADH) and NADP⁺(NADPH) are involved in oxidation–reduction reactions catalyzed by enzymes belonging to 'oxidoreductases' in carbohydrate, lipid and protein metabolisms.

Niacin can be derived from the amino acid tryptophan. However, the ability to utilize tryptophan for niacin synthesis is inefficient (60 mg of tryptophan are required to synthesize 1 mg of niacin). Also, synthesis of

niacin from tryptophan requires vitamins B₆, B₇ and B₉ which would be limiting in themselves on a marginal diet.

Distribution of niacin:

Niacin is found in unrefined grain and cereal, milk, and lean meats, liver.

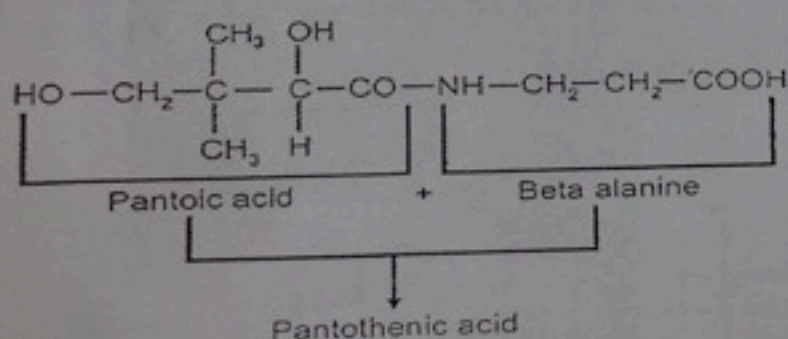
Clinical Significances of Niacin and Nicotinic Acid

A diet deficient in niacin (as well as tryptophan) leads to glossitis of the tongue, dermatitis, weight loss, diarrhea, depression and dementia. The severe symptoms, depression, dermatitis and diarrhea, are associated with the condition known as pellagra (the symptoms of pellagra progress through the three Ds: dermatitis, diarrhea, dementia and if untreated, death).

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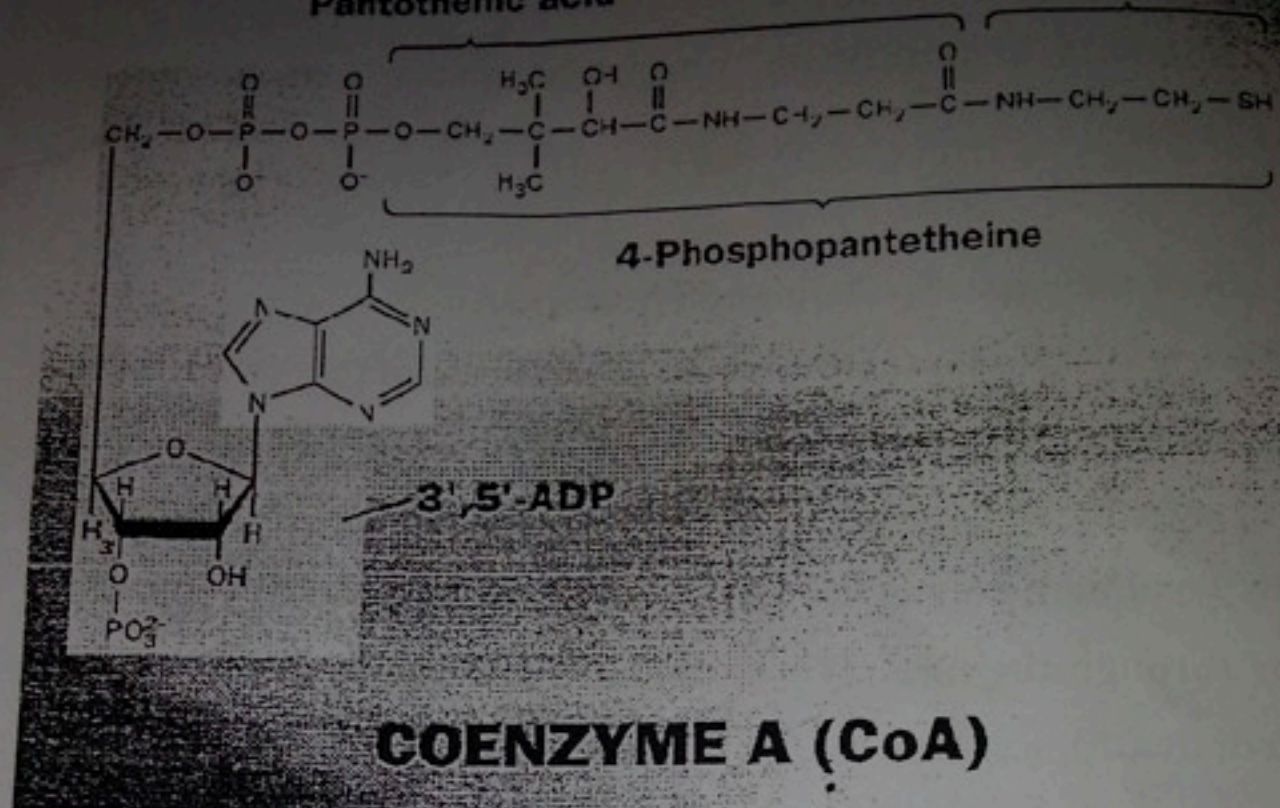
Pantothenic Acid

Pantothenic acid is also known as vitamin B₅. Pantothenic acid is formed from β -alanine and pantoic acid.

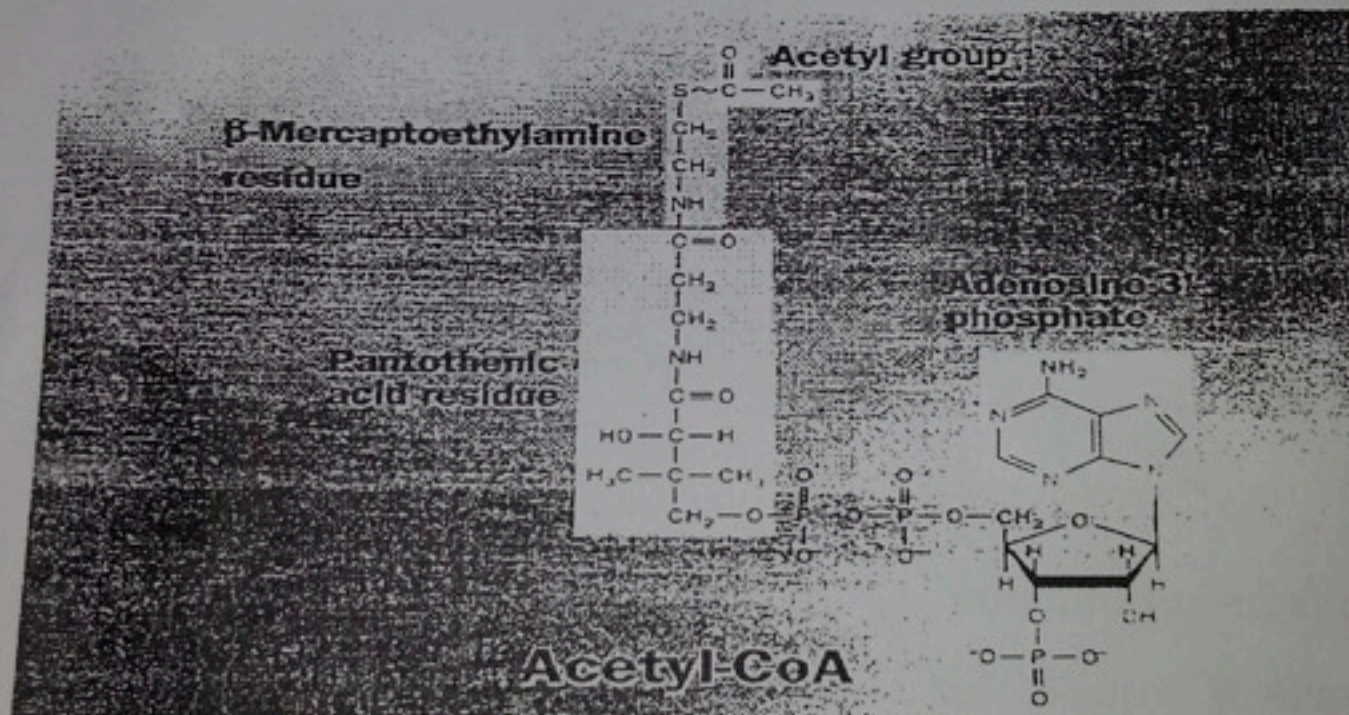


■ Biochemical function:

Pantothenate is required for synthesis of coenzyme A (CoA), which functions in the transfer of acyl groups. Pantothenate is a component of fatty acid synthase. Pantothenate is, therefore, required for the metabolism of carbohydrate via the TCA cycle and all fats and proteins.



The active Coenzyme A (CoA) differ according the group added in place of H in the --SH (sulphahydryl group)



Acetate is added to form acetyl CoA.

- Succinate is added to form succinyl CoA.

Deficiency of pantothenic acid :

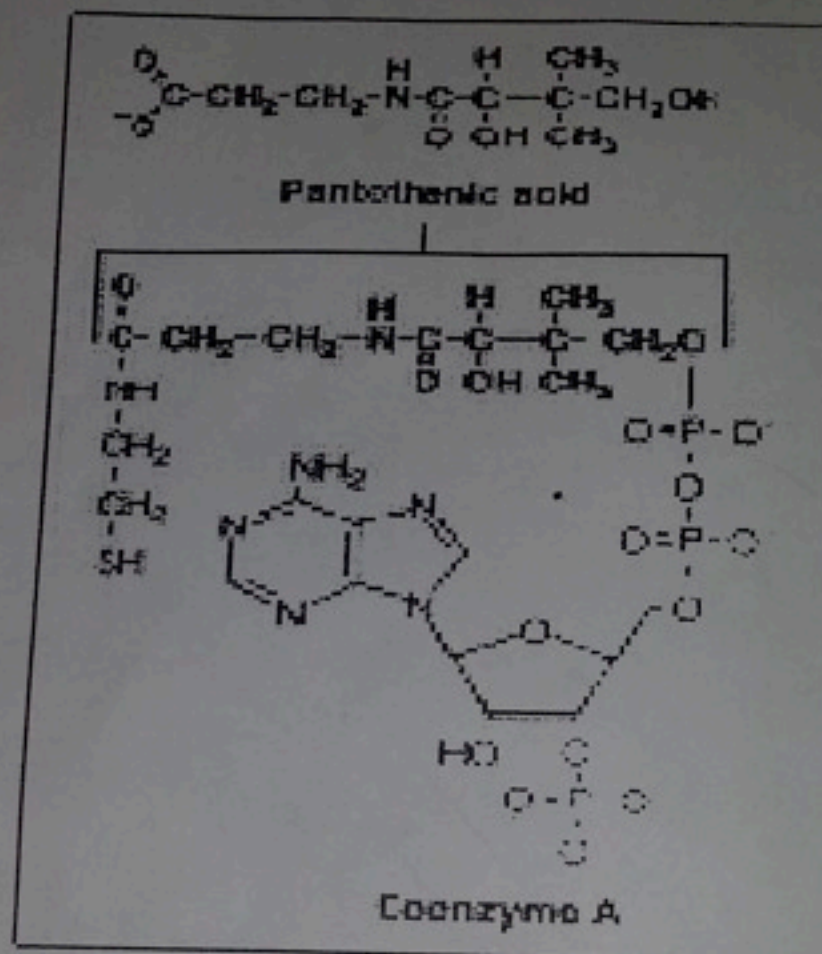
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Deficiency of pantothenic acid is extremely rare due to its widespread distribution in whole grain cereals, legumes and meat.

Deficiency Manifestation

- Because of wide distribution deficiency manifestation is very rare.
- Pain and numbness in the toes, sleeplessness and fatigue.

STRUCTURE OF PANTOTHENIC ACID AND CoA:



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Summary:

١. vitamins are essential organic compounds
٢. vitamins should be supplied in diet
٣. two major types of vitamins:
 - a. water soluble (B-complex and vit. C).

b. fat soluble. (A, K, E, D)

٤. active form of thiamin is thiamin pyrophosphate.

٥. active form of riboflavin are FMN and FAD.

٦. the active forms of vitamin B₃, nicotinamide adenine dinucleotide (NAD⁺) and nicotinamide adenine dinucleotide phosphate (NADP⁺). Both NAD⁺ and NADP⁺ function as cofactors.

٧. Niacin can be derived from the amino acid tryptophan. However, the ability to utilize tryptophan for niacin synthesis is inefficient.

٨. niacin deficiency lead to pellagra (pellagra progress through the three Ds: dermatitis, diarrhea, dementia and if untreated, death).

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