Water soluble vitamins

Vitamin B3

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Vitamin B Group

1. Vitamin B1 (Thiamine)	5. Vitamin B6 (Pyridoxine)
2. Vitamin B2 (Riboflavin)	6. Vitamin B7 or Vitamin H (Biotin)
3. Vitamin B3 (Niacin)	7. Vitamin B9 or Vitamin M or (Folic acid)
4. Vitamin B5 (Pantothenic acid)	8. Vitamin B12 (Cyanocobalamin)

VITAMIN B3
(NIACIN & NIACINAMIDE)

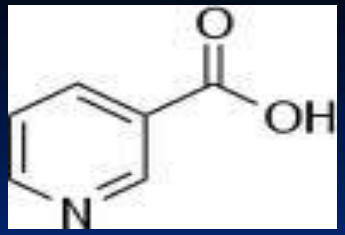
Vitamin B3 (Niacin & Niacinamide)

- Two main forms of Vitamin B3 are found in foods: nicotinic acid (niacin) and nicotinamide (niacinamide).
- Niacin can be partially satisfied by intake of tryptophan, which is converted by the liver into niacin.
- 60 mg of tryptophan can be converted into about 1mg of niacin.
- Dietary requirements for niacin are described in terms of niacin equivalents (NEs):

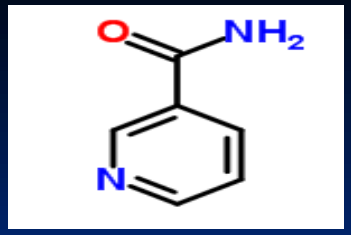
1NE = 60mg of tryptophan = 1mg of niacin

RDA: 13- 20 mg/day

Sources of Vitamin B3



Nicotinic acid or Niacin



Nicotinamide or Niacinamide

Meat

Fish

Sheep liver

Prawns

Cow's milk

Rice bran

Groundnuts

Chilgozas

Turnip

Beet greens

Yeast

Bran

Pharmacokinetics of Vitamin B3

Absorption:

At low concentration by active transportation.
At high concentration by passive diffusion.

Transportation:

Both Nicotinic acid and Nicotinamide bind to plasma proteins for transportation.

Biosynthesis:

The liver can synthesize Niacin from the essential amino acid Tryptophan, but the synthesis is extremely slow and requires vitamin B1, B2, and B6 (60 mg of Tryptophan → 1mg of niacin). Bacteria in the gut may also perform the conversion but are inefficient.

Functions of Vitamin B3

1. It acts as a co-enzyme in oxidation reduction reactions:

- **Catabolic Rxn: in form of NAD+/NADH**
- **Anabolic Rxn: in form of NADP+/NADPH**

Therefore, it is required for functions of >200 enzymes dealing with the biosynthesis of several compounds e.g. **fatty acids, steroids** and **catabolism of fuel molecules for energy.**

2. DNA replication and repair:

It is vital for synthesis of DNA-bound nuclear proteins (**histones**)

3. Antioxidant functions:

It plays an important role in antioxidant systems, particularly in the liver.

4. Blood sugar regulation:

It is a component of the glucose tolerance factor (GTF), which together with insulin, helps to control blood glucose.

5. Fat and cholesterol metabolism:

It lowers levels of total and LDL cholesterol in the blood, while increasing levels of HDL cholesterol (the healthy, protective form of cholesterol).

Vitamin B3 Deficiency Diseases

1. Milder deficiency of niacin (as well as tryptophan) can cause:

- ❖ Glossitis (inflammation of the tongue leading to purplish discoloration)
- ❖ Dermatitis around the mouth and rashes
- ❖ Fatigue
- ❖ Irritability
- ❖ Poor appetite
- ❖ Indigestion
- ❖ Weight loss
- ❖ Headache


Glossitis


Dermatitis around mouth


Fatigue


Poor appetite


Indigestion


Headache

2. Severe deficiency leads to Pellagra: Characterized by

- ❖Inflamed mouth (painful swollen tongue and fissured lips) and GIT.
- ❖Diarrhea
- ❖Dermatitis in the exposed skin of hands, face, neck (Casal's necklace)
- ❖Dementia and mental disorders
- ❖Death.

It is very rare now, except in alcoholics, strict vegetarians, and people with very poor nutrition (or niacin or tryptophan-deficient food e.g corn).

Inflamed mouth

Diarrhea

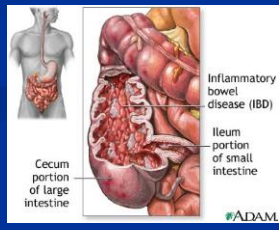

Dermatitis of exposed skin


Mental disorders

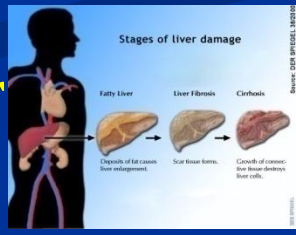

Death.

People at high risk of vitamin B3 deficiency

- People with very poor nutrition (or niacin or tryptophan- deficient food e.g corn).
- People with deficiencies in vitamin B6 or riboflavin (conversion of tryptophan to niacin is reduced ⟶ niacin stores in the body is reduced).
- People with inflammatory bowel disease and other digestive disorders ⟶ malabsorption of niacin.



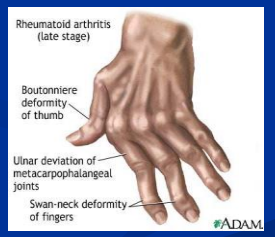
- Heavy alcohol consumption interferes with absorption and metabolism of niacin.
- People under high stress, chronic illnesses, liver disease.



Uses in prevention and Therapy

- **Mental illness** e.g. schizophrenia: Niacinamide can be effective with traditional medical treatment.

- **Atherosclerosis and heart attack:** Niacin in very large doses (2-3 g/day):
  (1) Lower total and LDL cholesterol and raising HDL cholesterol.
  (2) Dilates blood vessels lowers blood pressure.



- **Arthritis:** Niacin helps in treatment of osteoarthritis.

- **Diabetes:** Niacinamide slow down the development of nephropathy in diabetes and delay need for insulin therapy in juvenile diabetes.

- Protection against environmental toxins: The antioxidant function of niacin help protect liver against damage from pesticides, chemicals, alcohol, and drugs.

- Headache: Niacin help in prevention of headache.

- Treatment of Pellagra.

Toxicity and side effects of vitamin B3

- Large doses (500 mg) of niacin (but not niacinamide) can cause dilation of capillaries → tingling and flushing of the skin.
- Flushing of the skin is usually worse if nicotinic acid is taken on an empty stomach, therefore it should be taken just after meals.
- Niacin in the form of niacinamide does not produce these side effects.
- At doses of > 2.5 g / day, it can produce hypotension, dizziness, increased blood sugar and uric acid, liver dysfunction, and increased risk of peptic ulcer. These effects are gradually adopted and decreased and are reversible on withdrawal of nicotinic acid.

Vitamin B3 – Drug Interactions

- Niacin with antihypertensive drugs → severe hypotension.
- Extra niacin may be required in case of people taking Isoniazid (Inhibits biotransformation of tryptophan to niacin), by women taking oral contraceptives.
- Bile acid sequesterants e.g. Cholestyramine and cholestipol should be taken at a different time than niacin (not niacinamide) otherwise they will reduce its absorption.

- Carbamazepine may cause toxicity with niacin.

- The combination of niacin and statin is often used to treat lipid triad (high LDL and TG, low HDL) may cause myopathy (myopathy is a muscular disease in which the muscle fibers do not function, resulting in muscular weakness).

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