

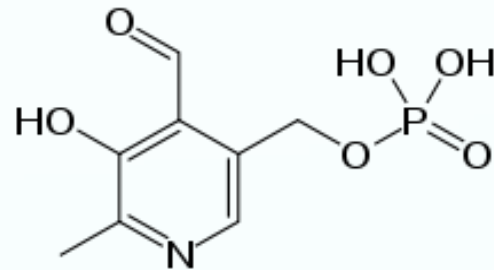
# Pyridoxine

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# General

- Vitamin B<sub>6</sub> refers to a group of chemically similar compounds which can be interconverted in biological systems:

- Pyridoxine (PN)
- Pyridoxamine (PM)
- Pyridoxal (PL)
- Pyridoxine 5-phosphate (PNP)
- **Pyridoxal 5'phosphate (PLP)**
- Pyridoxamine 5-phosphate (PMP)
- 4-Pyridoxic acid (PA)



# General

- It is a coenzyme for more than 50 enzymatic reactions
  - Decarboxylase and transaminases
  - Synthesis of acid nicotinic (NADH and NADPH) and arachidonic acid (inflammation)
  - Affects the function of the nervous system (Sphingomyelin)
  - Immune reactions
  - Synthesis of hemoglobin (Heme)

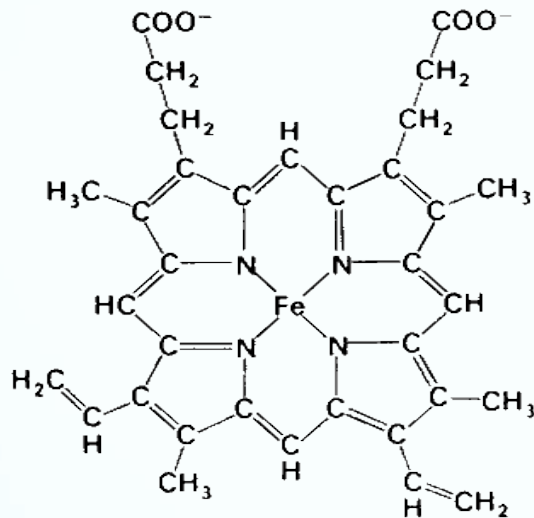
# B<sub>6</sub> + Hemeoglobin

PLP aids in the synthesis of hemoglobin, by serving as a coenzyme for the enzyme d-aminolevulinic acid synthase (ALA).

- Heme synthesis begins with condensation of glycine & succinyl-CoA, with decarboxylation, to form ALA.
- Pyridoxal phosphate (PLP) serves as coenzyme for d-Aminolevulinate Synthase (ALA Synthase), an enzyme is evolutionarily related to transaminases.

It also binds to two sites on hemoglobin to enhance the oxygen binding of hemoglobin.

# Heme



- Heme is a cofactor consisting of an Fe<sup>2+</sup> (ferrous) ion contained in the center of a large heterocyclic organic ring called a porphyrin—in Hemoglobin.
- Heme component of hemoglobin, myoglobin, cytochrome, catalase, and endothelial nitric oxide synthase.

# Vitamin Deficiency Anemia

- Vitamin-deficiency anemia occurs because a person's body is not getting enough of the nutritional building blocks used to produce healthy red blood cells
- **Vitamin B6**, vitamin B12, and folate all play a role in creating the red blood cells necessary for delivering oxygen to cells throughout the body.
- Megaloblastic anemia refers to an abnormally large type of red blood cell (megaloblast). Megaloblasts are produced in the bone marrow when B12 vitamins are low.
- Microcytic anemia refers to small red blood cells with low levels of hemoglobin. It reflects decreased hemoglobin synthesis which can be caused by B6 deficiency

# Microcytic Anemia

- The red blood cells are small due to a failure of hemoglobin synthesis or insufficient quantities of hemoglobin available.
- Three biochemical tests are widely used in vitamin B<sub>6</sub> assessment:
  1. The activation coefficient for the erythrocyte enzyme aspartate aminotransferase
  2. Plasma PLP concentrations
  3. Urinary excretion of vitamin B<sub>6</sub> degradation products (specifically urinary PA)

# Microcytic Anemia

- This type of anemia is uncommon but is seen in vegetarians and pregnant women.
- Vegetarians have an increased risk of acquiring vitamin-deficiency anemia because meat is a main source of vitamin B6

# Pregnant Women

- For women who follow conventional dietary advice, pregnancy is often accompanied by the risk of several vitamin and mineral deficiencies, including vitamin B6 and iron.
- Both are critical nutrients for the developing fetus; vitamin B6 is essential for the proper development of the central nervous system.
- Most women will be counseled to increase their intake of iron-rich foods and/or given a prescription for an iron supplement to avoid or treat the anemia of pregnancy, but rarely is the same advice given concerning vitamin B6.

# Pregnant Women

- This oversight is unfortunate since during the third trimester the mother's iron and B6 levels often fall sharply, creating a situation where iron-deficiency anemia can be exacerbated by a concurrent vitamin B6 deficiency anemia.
- The levels of PLP (active B6) in umbilical cord blood are determined by the intake of B6 by the mother during pregnancy.

# Breast Milk

- The content of vitamin B6 in breast milk is likewise affected by the vitamin B6 status of the mother.
- It appears that the body does not have a way to regulate the B6 content of the milk when the mother's intake is low (as it does for some nutrients such as calcium), so mothers who do not eat sufficient B6-rich foods and do not make up the shortfall by supplementing with B6 will produce breast milk with inadequate levels of B6 for their infants.

# Vitamin B6 Deficiency Anemia

- This form of vitamin-deficiency anemia occurs most often when foods rich in vitamin B6 are not being eaten, such as:
  1. fortified cereals
  2. beans
  3. bananas
  4. nuts
  5. meat
  6. poultry
  7. fish
  8. Some fruits and vegetables

# Vitamin B6 Deficiency Anemia

- Vitamin B6 deficiency can also be caused by certain medications, including Nydravid (isoniazid), used to treat tuberculosis and L-DOPA, a treatment for Parkinson's disease and other neurological conditions.
- Megaloblastic anemia can also be caused by other disease of the bone marrow and can be a side effect of some cancer chemotherapy drugs.

# Treatment

- Treatment of vitamin-deficiency anemia most often involves improving the diet to include foods rich in the vitamins that are lacking.
- Vitamin supplements can be taken orally or, in serious cases, by injection.
- If the vitamin-deficiency anemia is caused by an intestinal or digestive disorder, a physician will need to treat the cause

# Prognosis

- In all cases, once the body begins receiving adequate amounts of the needed vitamins, the vitamin-deficiency anemia should reverse itself within weeks.

# Case Study

- Mary has come to you for pre-natal nutritional advice. She is a gluten free vegan and wants to make sure she is healthy enough to get pregnant. She has no history of anemia or other medical conditions.
1. Do you have any concerns for Mary?
  2. Would you advice her to take a supplement during pregnancy and breastfeeding?

# References

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