University of Fallujah
College of Medicine

Vitamin K

Lecture : 5

Stage : 2nd Stage

Lecturer : Dr. Mustafa Saleam

Department: Chemistry and Biochemistry

Date: 1 / 10/ 2025

Learning Objectives

-Understand what is vit K

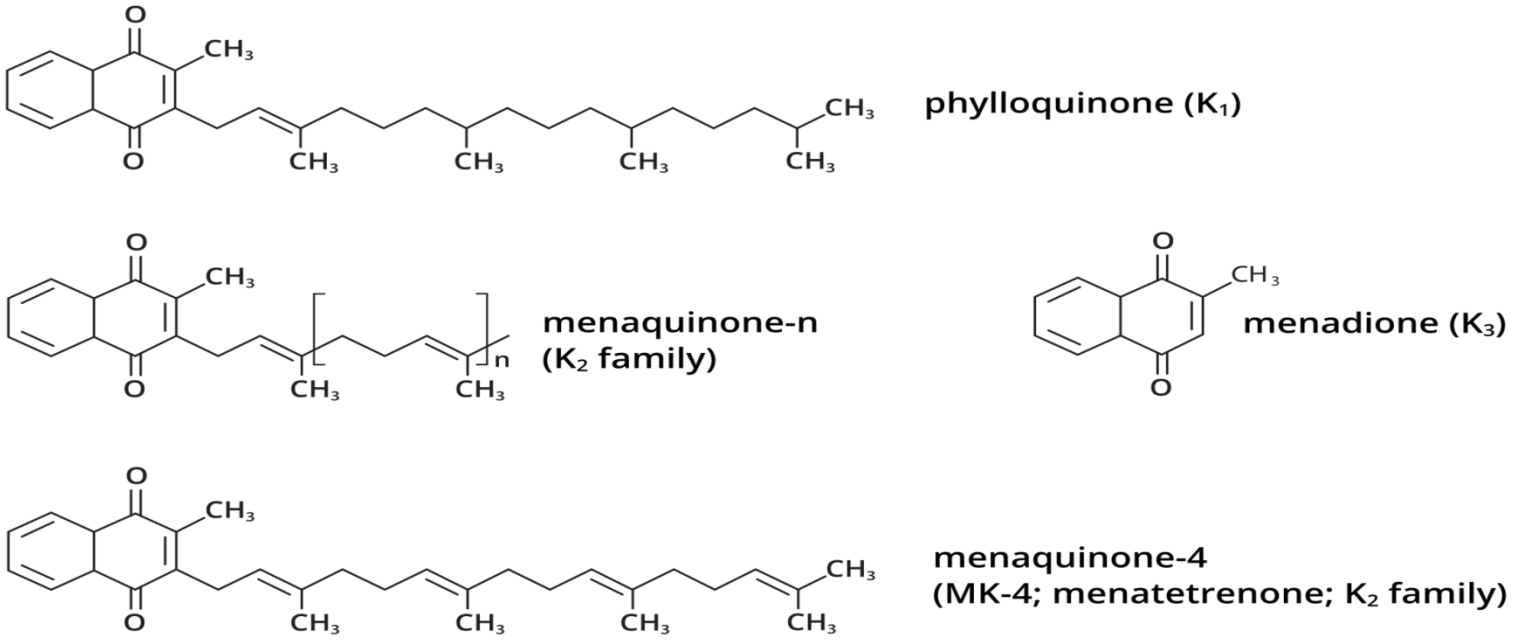
-Understand the structures and forms of vit K.

-Identify the clinical roles of vit k with deficiency it

vitamin K, any of several fat-soluble naphthoquinone compounds, it is the blood-clotting vitamin.

A form of vitamin K known as phylloquinone (vitamin K_1) is synthesized by plants. A second form of vitamin K known as menaquinone (vitamin K_2) is synthesized by bacteria, including bacteria in the intestines of mammals. These bacteria produce the majority of vitamin K that mammals require. A synthetic vitamin K precursor called menadione (vitamin K_3) is used as a vitamin supplement.

Figure 1. Chemical Structures of Vitamin K



- **Newborn babies lack the intestinal bacteria** tnemelppus a deen dna K nimativ ecudorp ot .keew tsrif eht rof

- doolb) People on **anticoagulant drugs** .K nimativ ni tneicifed emoceb yam (srenniht

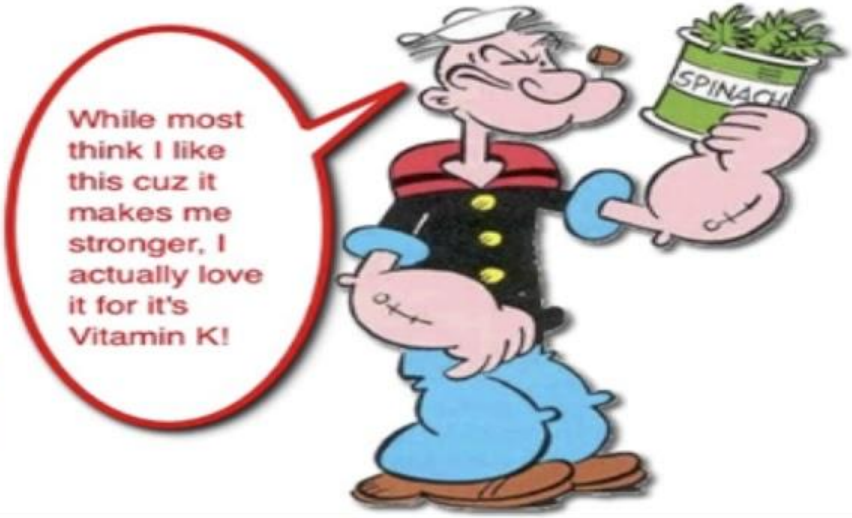
- K nimativ kcal yam **People taking antibiotics** era airetcab lanitsetni esuaceb yliraropmet esu mret-gnol fo tluser a sa dellik semitemos .scitoibitna fo

Sources of Vitamin K

DR.Pharmacist

Functions of Vitamin K

- ✓ It has another physiologic functions include electron transport chain, and photosynthesis.
- ✓ It has role in Immune Functioning and produces energy.
- ✓ It acts as Antioxidant.

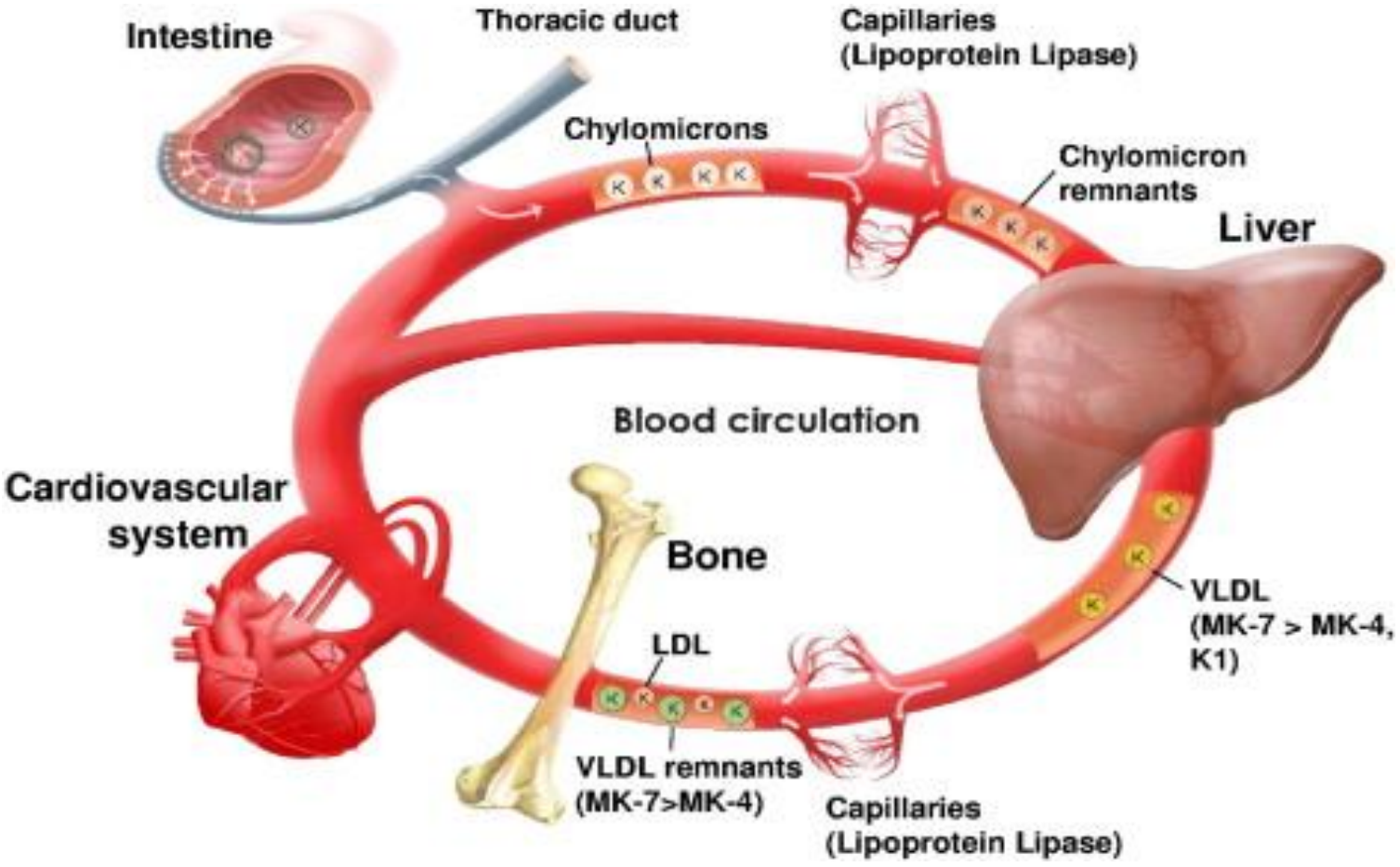


Absorption and transport

- As a fat-soluble vitamin, the digestion and absorption of vitamin K relies on the **absorption of fats within the food.**
- During the digestion process, the enzymes in the stomach and small intestine extract fats from the foods you eat, and then absorb them for use within the body.
- The vitamin K from the foods is dissolved in this fat; the body absorbs vitamin K via fat droplets.
- Vitamin **K requires bile to be absorbed** from the **small intestine**. It is carried through the bloodstream to **the liver by lipoproteins.** It can cross the placenta barrier and is available to the fetus.

- Once in the circulation, **phylloquinone is rapidly cleared** at a rate consistent with its continuing **association with chylomicron** and the chylomicron remnants which are produced by **lipoprotein lipase hydrolysis** at the surface of capillary endothelial cells.
- **After an overnight fast**, more than half of the circulating phylloquinone is still associated with **triglyceride-rich lipoproteins,** with the remainder being equally distributed **between low-density and high-density lipoproteins.**

Metabolism of vitamin K occurs mainly in the **liver**. In the first step, vitamin K is reduced to its **quinone** form by a **quinone reductase.**



Tissue stores and distribution

- Human liver stores normally comprise about **90 percent menaquinones and 10 percent phylloquinone.**

- Under conditions of severe dietary depletion, liver concentrations were reduced to about 25 percent of initial levels **after only 3 days** .This high turnover of hepatic reserves of phylloquinone is in accord with the high losses of this vitamer through excretion.

- **Other sites of storage may be adipose tissue and bone**; both are known to be sites where vitamin K-bearing chylomicron and chylomicron remnants may be taken up.

Excretion

- Vitamin K is extensively metabolized in the liver and excreted in the urine and bile.

- Two major human excretion products have been identified: carboxylic acids with 5 and 7-carbon side chains that are excreted in the urine as glucuronide conjugates.

Physiologic Effects of Vitamin K

1-Blood Clotting.

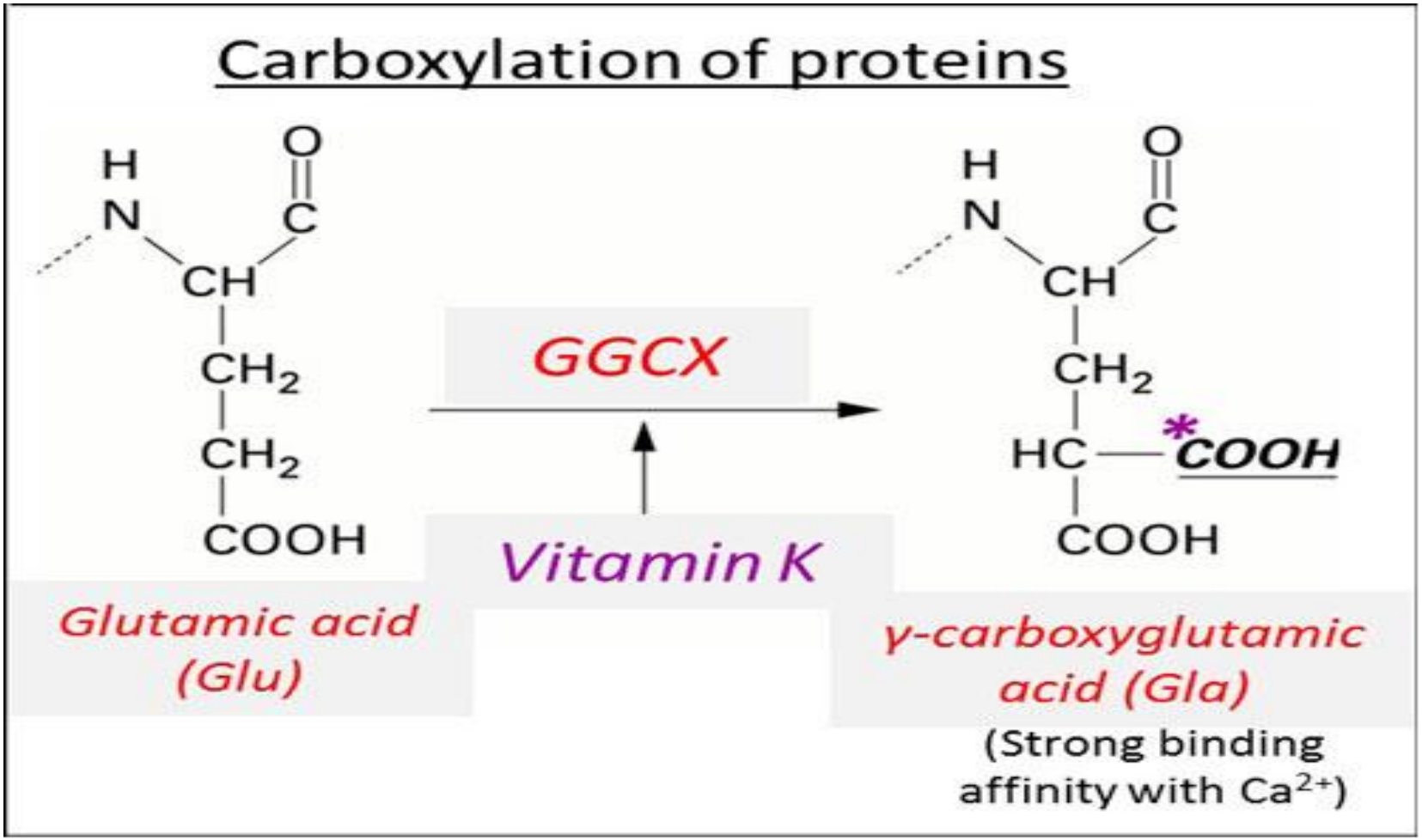
Vitamin K controls the **clotting mechanism** of the blood because its action is directed at **the precursor of prothrombin**.

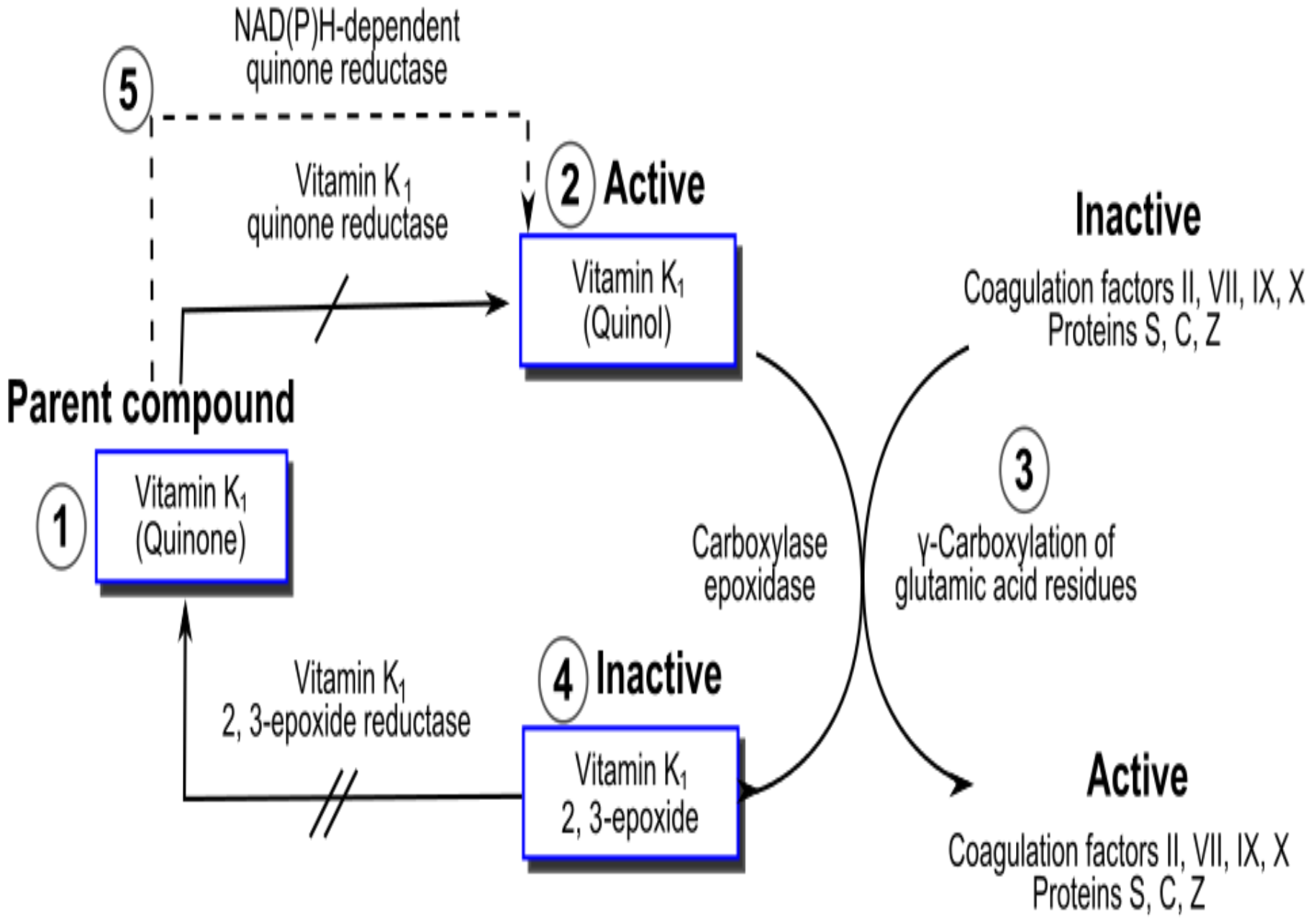
Prothrombin is activated to form thrombin, an enzyme which, in turn, **converts fibrinogen to fibrin,** the insoluble protein that solidifies the blood clot.

Vitamin K is first converted to its **hydroquinone form in the liver microsomes** by dehydrogenase. It then functions as coenzyme for carboxylase

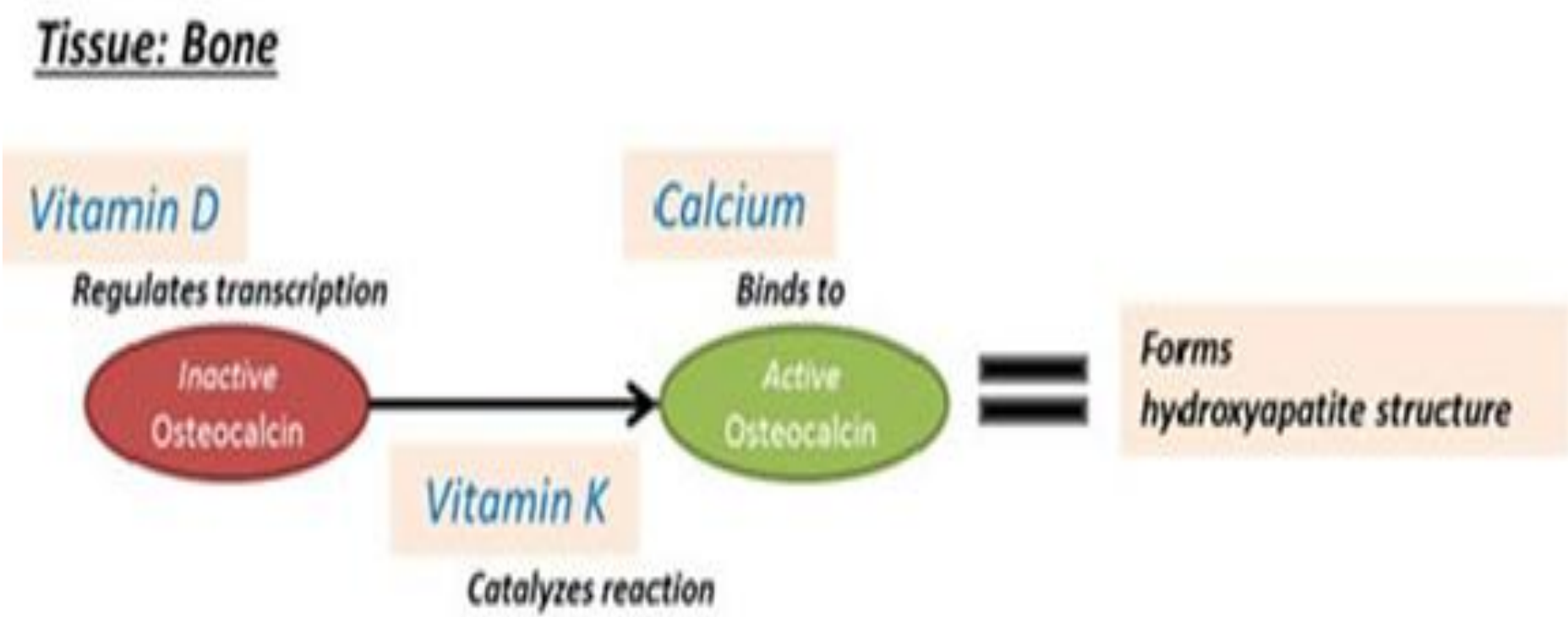
To **become active**, the **glutamate residue** on the **inactive prothrombin precursor must acquire a carboxyl group** to form a carboxylglutamate residue.

Each **converted glutamyl residue** produces a molecule of vitamin **K epoxide**, and certain proteins may have more than one residue requiring carboxylation. **To complete the cycle**, the **vitamin K epoxide** is returned to **vitamin K via the vitamin K epoxide reductase** enzyme




NAD(P)H-dependent
quinone reductase
5
Vitamin K1
quinone reductase
2 Active
Vitamin K1
(Quinol)
Inactive
Coagulation factors II, VII, IX, X
Proteins S, C, Z
Parent compound
1
Vitamin K1
(Quinone)
3
Carboxylase
epoxidase
γ-Carboxylation of
glutamic acid residues
Vitamin K1
2, 3-epoxide reductase
4 Inactive
Vitamin K1
2, 3-epoxide
Active
Coagulation factors II, VII, IX, X
Proteins S, C, Z

Osteocalcin is a protein produced by the osteoblasts (cells responsible for bone formation), osteocalcin must be **"carboxylated"** before it can be effective. Vitamin K functions as a cofactor for the enzyme that catalyzes the carboxylation of osteocalcin.



Vitamin K Deficiencies •

1-Poisoning with vitamin K antagonists: Coumarin derivatives such as Warfarin interfere with recycling of vitamin K and thereby lead to vitamin K deficiency.

2-Fat malabsorption syndrome.

3-Liver disease.

4-Absence of vitamin K –synthesizing bacterial flora :

1. Broad spectrum antibiotics can destroy it.
2. Not fully developed in neonates (therefore vitamin K given prophylactically to all newborn).

. •

Diagnosis

- Vitamin K status is measured by **the** prothrombin time test.
- The normal prothrombin time is about **13 seconds**. With vitamin K deficiency, the prothrombin time can be several minutes.