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## Types and Chemistry :

Occurs in several forms

Vit K1

And

vit K2

stored in  
the liver !

but k3  
converted

to ( k1, k2)

Vitamin K<sub>1</sub>  
(Phylloquinone)

Green leafy vegetables •

Vitamin K<sub>2</sub>  
(Menaquinone)

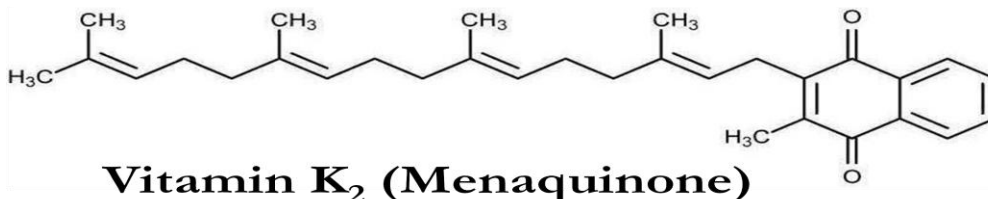
Intestinal bacteria •  
Intestinal bacterial synthesis meets the daily  
requirement of Vitamin K even without dietary  
supplement

Vitamin K<sub>3</sub>  
(Menadione)

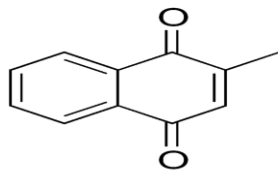
synthetic form •



**Vitamin K<sub>1</sub> (Phylloquinone)**



**Vitamin K<sub>2</sub> (Menaquinone)**



**Vitamin K<sub>3</sub> (Menadione)**

## RDA for Vitamin K (mg/day)

- Infant (0-1 year): 2-2.5
- Children (1-8): 30-55
- Men (19+): 120
- Women (19+): 90
- Pregnancy / lactation: 90 / 90
- UL: Not established " upper limit for Pregnancy "



We don't need to memorize these no. for the exam ! = )

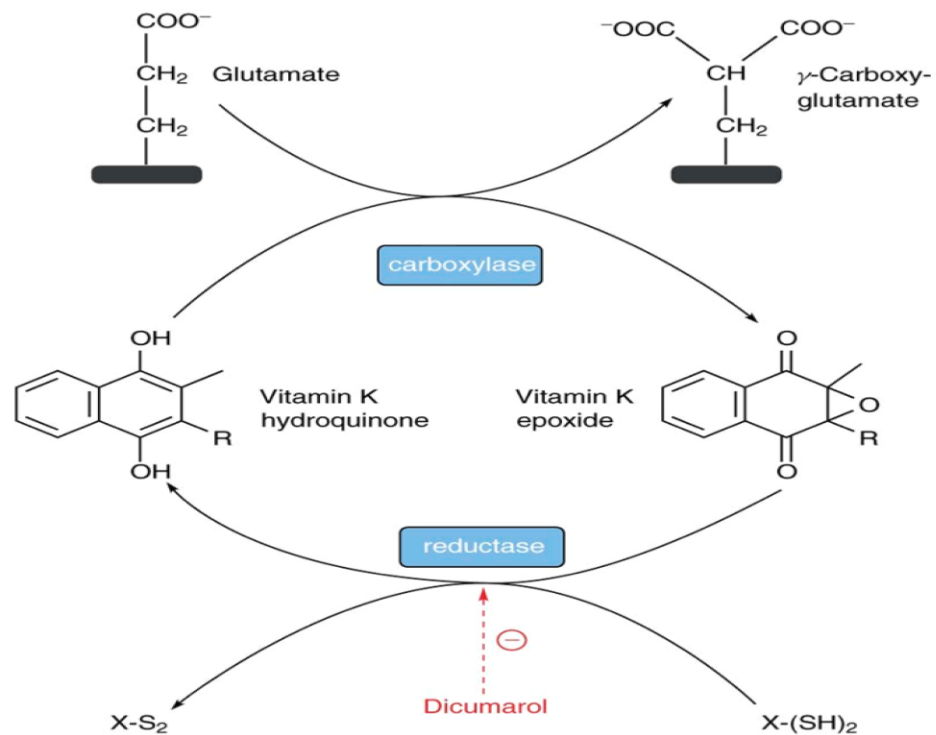
## Functions of Vitamin K :

- **Coenzyme** for the synthesis of prothrombin and blood clotting factors in the liver
- Prothrombin and clotting factors are **protein** in nature
- Synthesis of prothrombin and clotting factors VII, IX, X require carboxylation of their glutamic acid (Glu)
- Mature prothrombin and clotting factors contain g-carboxyglutamate (Gla) after carboxylation reaction
- Vitamin K is essential for the carboxylase enzyme involved
- Dihydroquinone form of vitamin K is essential for this reaction

**Dihydroquinone** ( active form )  $\longrightarrow$  epoxide (inactive form)

In the same time

• **Glutamate**  $\longrightarrow$  g-carboxyglutamate

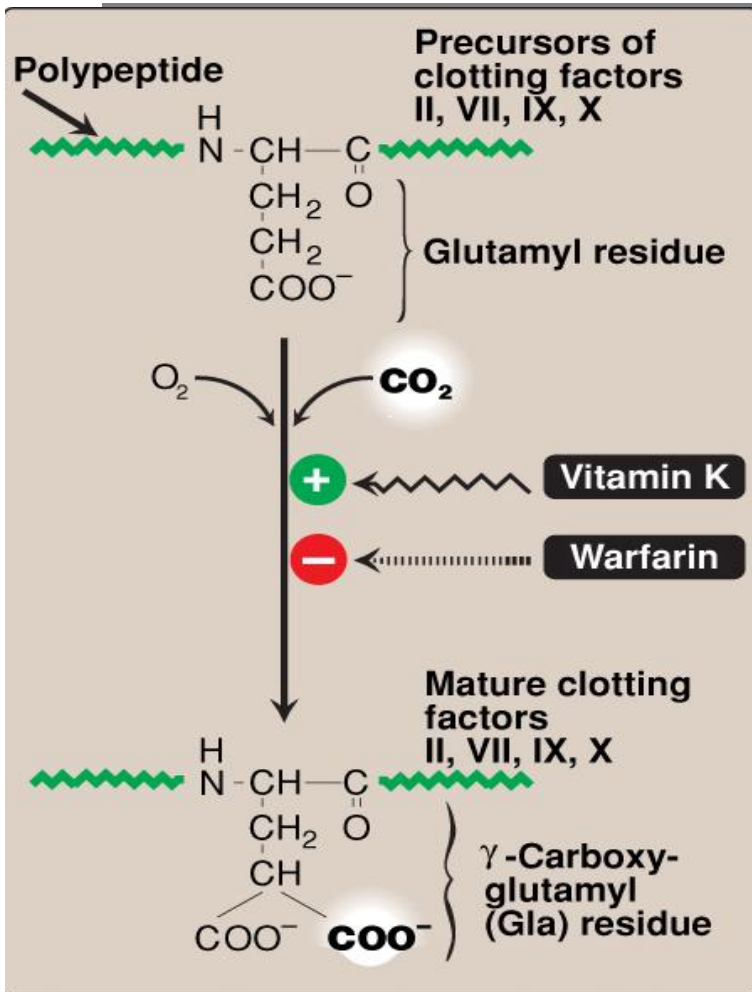


**Figure 28.7. Function of Vitamin K.**

*Biochemistry With Clinical Correlations, Sixth Edition, Edited by Thomas M. Devlin, Copyright © 2006 John Wiley & Sons, Inc.*

## Analogs of Vitamin K

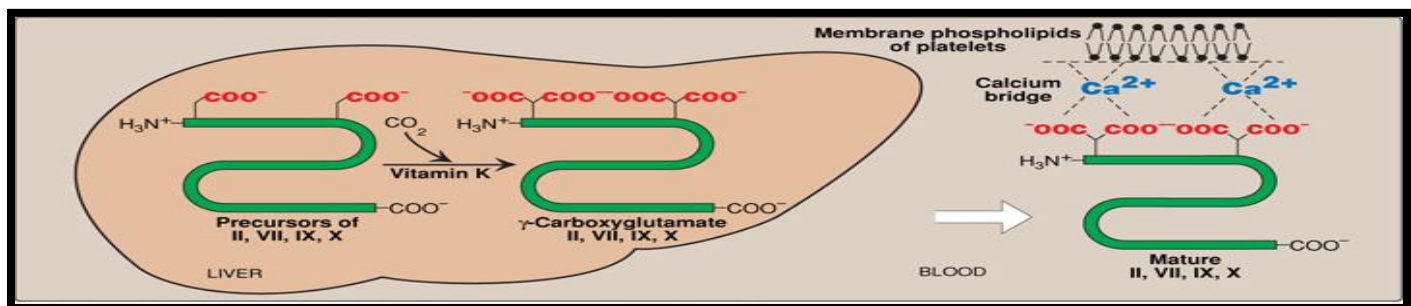
- Anticoagulant drugs (warfarin and dicoumarol) are structural analogs of vitamin K •
- They **inhibit** the activation of vitamin K •
- Hence prothrombin and clotting factors are not carboxylated •
- Blood coagulation time increases upon injury •



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### Functions of Vitamin K – Prothrombin – platelets interaction

- Carboxylated prothrombin contains • two carboxylate groups ( $\text{COO}^-$ )
- These groups bind to  $\text{Ca}^{2+}$  forming • **prothrombin-calcium complex**
- The complex then binds to • phospholipids on the surface of platelets (important for blood clotting)
- Converting prothrombin to • thrombin and clot formation



### Functions of Vitamin K in other proteins

Synthesis of  $\gamma$ -carboxyglutamate in osteocalcin •

**Osteocalcin is a bone protein •**

May have a role in bone formation and mineralization •

$\gamma$ -carboxyglutamate is required for its binding to hydroxyapatite (a mineral) in the bone □

The function of bone osteocalcin is unclear •

### ■ *Deficiency of Vitamin K- Causes :*

- Deficiencies are rare: it is synthesized by the intestinal bacteria
- Malabsorption of lipids due to obstructive jaundice leads to vitamin K deficiency
- Deficiency most common in newborn infants
- Newborns lack intestinal flora
- Human milk cannot provide enough vitamin K
- Supplements are given by injection
- Hypoprothrombinemia: increased blood coagulation time
- May affect bone growth and mineralization

### *Clinical manifestations of the deficiency:*

- Hemorrhagic disease of the newborn
- Bruising tendency, ecchymotic patches, mucus membrane hemorrhage, post-traumatic bleeding and internal bleeding
- Prolongation of the prothrombin time

Extra information :

Prolong administration of large dose of vit k lead to ( **hemolytic anemia** ) and ( **jaundice** ) in infant .. " effect on membrane of RBCs"