

M U N I
S C I

C5730 Biochemie - seminář

Mgr. Lukáš Faltinek

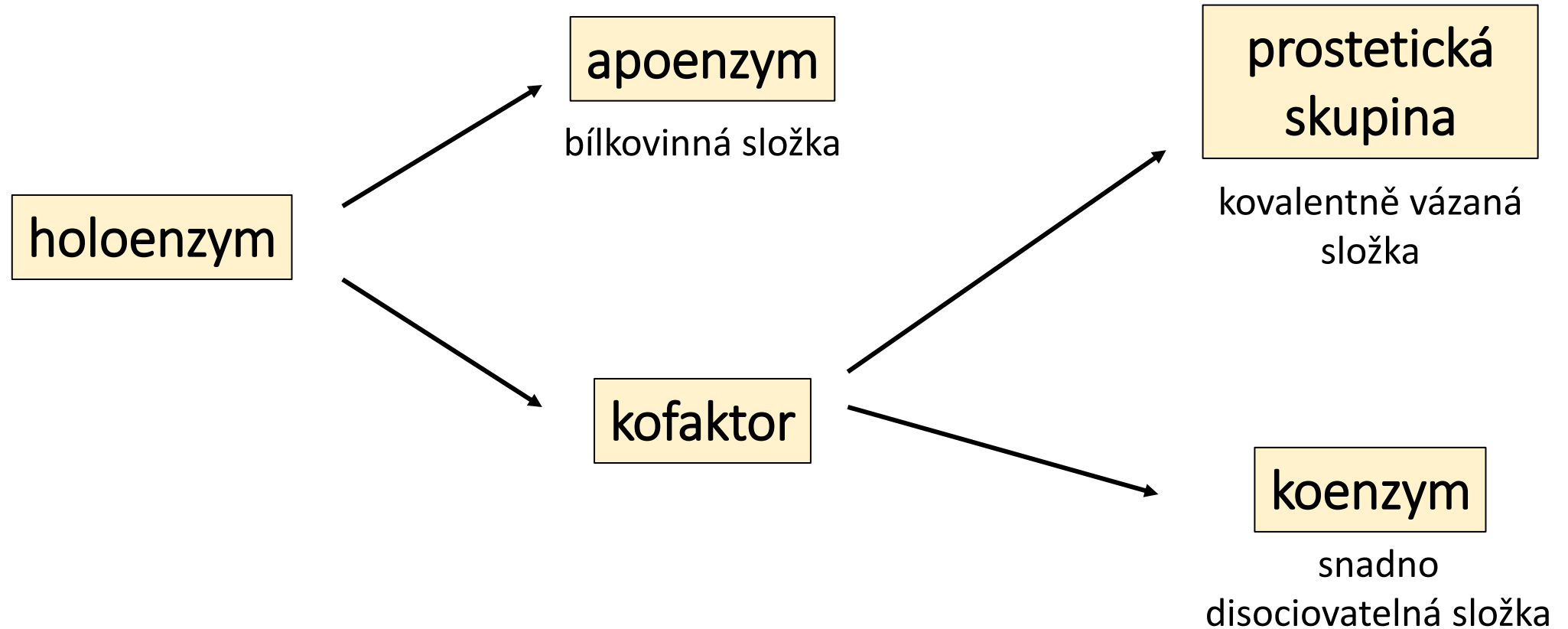
podzim 2023

M U N I
S C I

Enzymy

Charakteristika

- **biokatalyzátory**: urychlují biochemické reakce v živých soustavách
- zpravidla **bílkovinné** povahy



Rozdělení

Třída enzymu	Obecné schéma reakce
1. Oxidoreduktasy	$A_{\text{red}} + B_{\text{ox}} \rightleftharpoons A_{\text{ox}} + B_{\text{red}}$
2. Transferasy	$A-B + C \rightarrow A + C-B$
3. Hydrolasy	$A-B + H_2O \rightarrow A-H + B-OH$
4. Lyasy	$A-B \rightleftharpoons A + B$ (opačný směr: synthasy)
5. Isomerasy	$A-B-C \rightleftharpoons A-C-B$
6. Ligasy (synthetasy)	$A + B + ATP \rightarrow A-B + ADP + P_i$

7. translokasy: umožňují přesun molekul či iontů přes biomembrány katalýzou přenosových reakcí

Vybrané kofaktory

TABLE 6-1 Some Inorganic Ions That Serve as Cofactors for Enzymes	
Ions	Enzymes
Cu^{2+}	Cytochrome oxidase
Fe^{2+} or Fe^{3+}	Cytochrome oxidase, catalase, peroxidase
K^{+}	Pyruvate kinase
Mg^{2+}	Hexokinase, glucose 6-phosphatase, pyruvate kinase
Mn^{2+}	Arginase, ribonucleotide reductase
Mo	Dinitrogenase
Ni^{2+}	Urease
Se	Glutathione peroxidase
Zn^{2+}	Carbonic anhydrase, alcohol dehydrogenase, carboxypeptidases A and B

Table 6-1
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TABLE 6-2 Some Coenzymes That Serve as Transient Carriers of Specific Atoms or Functional Groups		
Coenzyme	Examples of chemical groups transferred	Dietary precursor in mammals
Biocytin	CO_2	Biotin
Coenzyme A	Acyl groups	Pantothenic acid and other compounds
5'-Deoxyadenosylcobalamin (coenzyme B_{12})	H atoms and alkyl groups	Vitamin B_{12}
Flavin adenine dinucleotide	Electrons	Riboflavin (vitamin B_2)
Lipoate	Electrons and acyl groups	Not required in diet
Nicotinamide adenine dinucleotide	Hydride ion ($:\text{H}^-$)	Nicotinic acid (niacin)
Pyridoxal phosphate	Amino groups	Pyridoxine (vitamin B_6)
Tetrahydrofolate	One-carbon groups	Folate
Thiamine pyrophosphate	Aldehydes	Thiamine (vitamin B_1)

Note: The structures and modes of action of these coenzymes are described in Part II.

Table 6-2
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Reakční koordináta a vliv enzymu

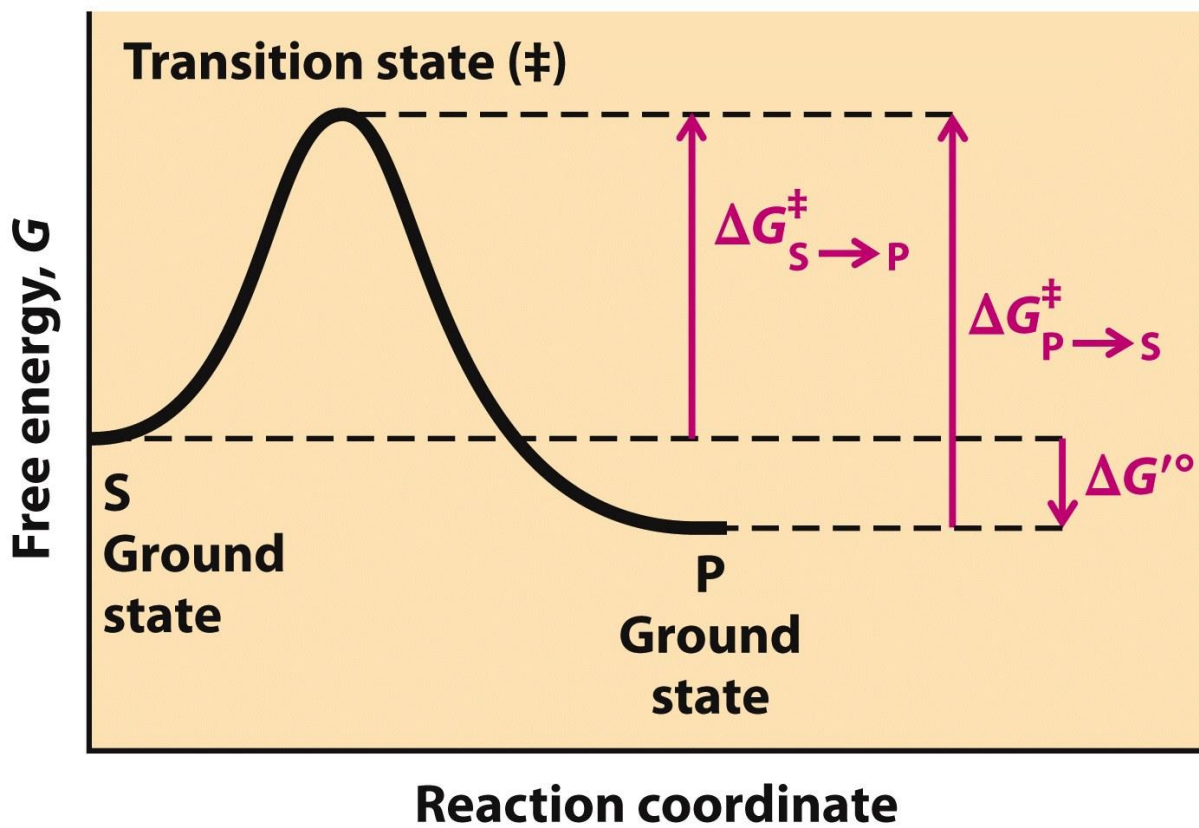


Figure 6-2
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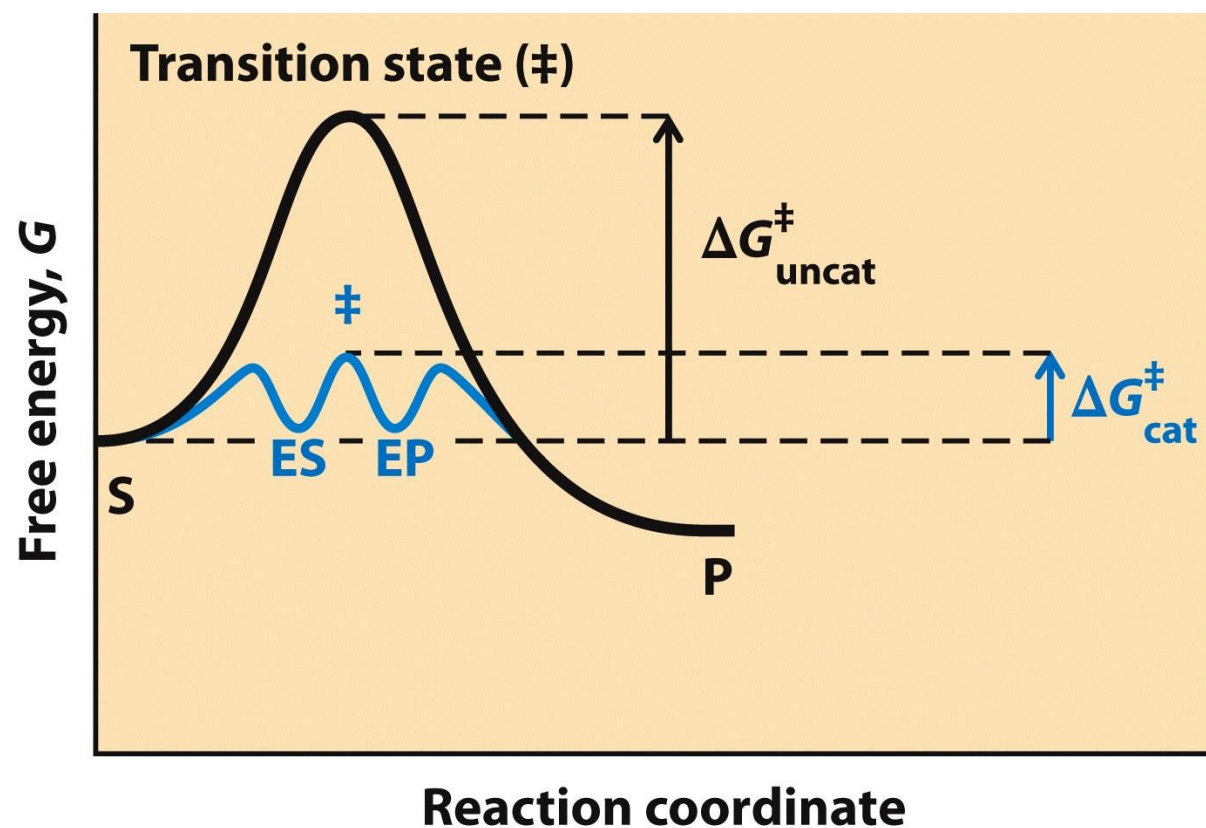


Figure 6-3
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Ukázka vlivu enzymu na rychlost vzniku produktu

TABLE 6–5

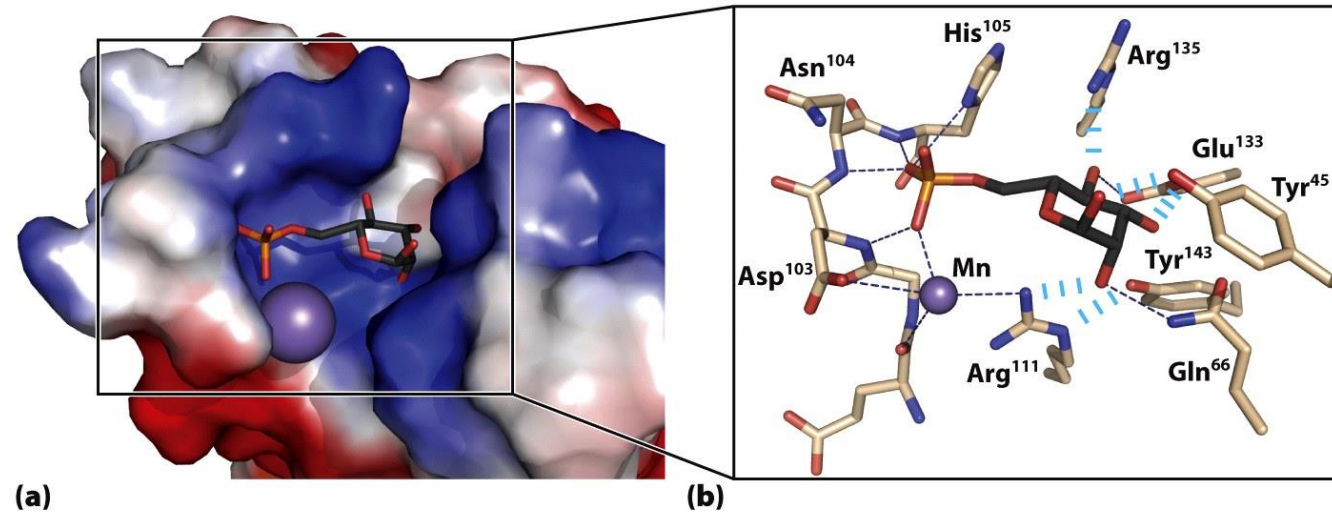
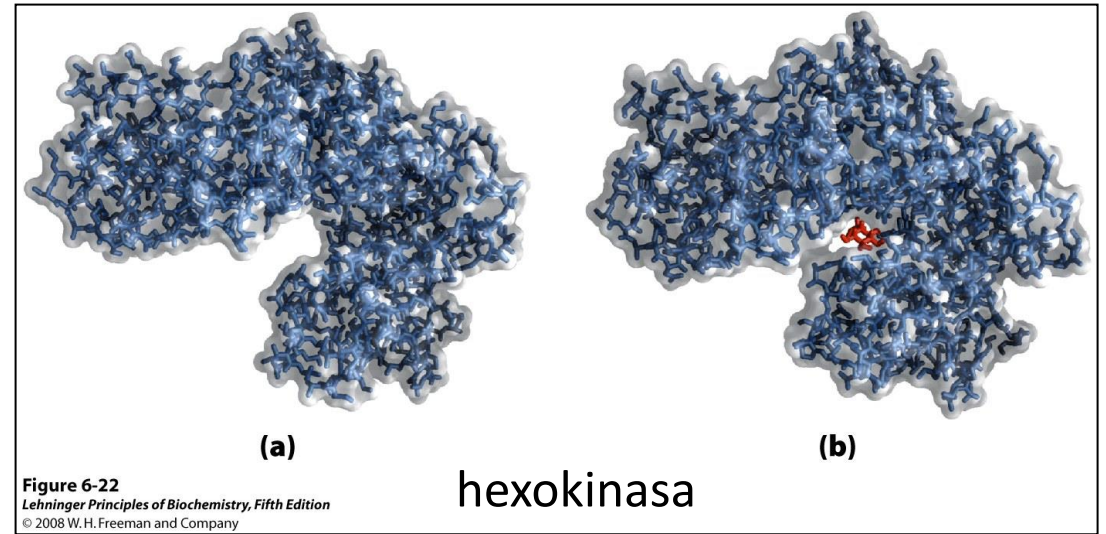
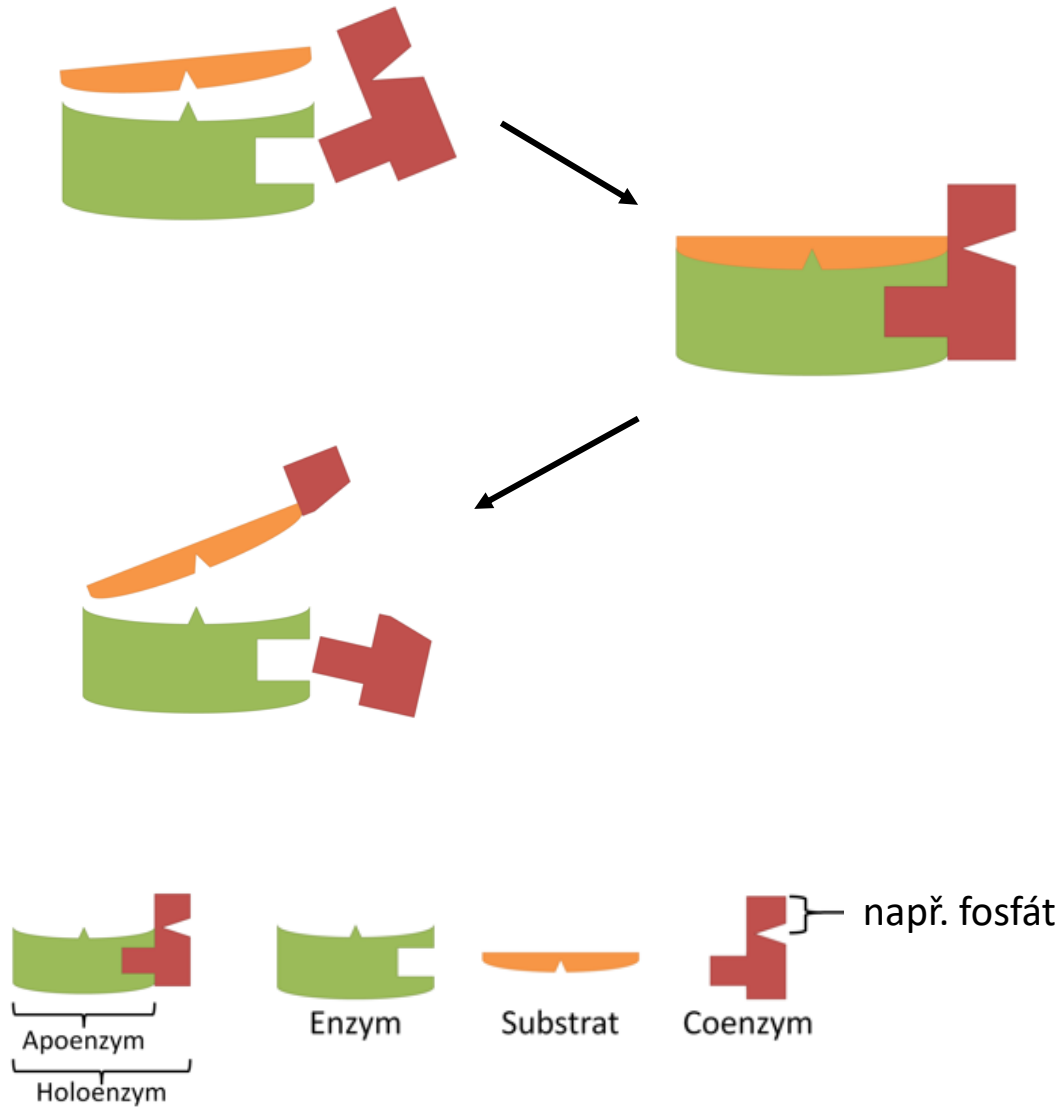
Some Rate Enhancements Produced by Enzymes

Cyclophilin	10^5
Carbonic anhydrase	10^7
Triose phosphate isomerase	10^9
Carboxypeptidase A	10^{11}
Phosphoglucomutase	10^{12}
Succinyl-CoA transferase	10^{13}
Urease	10^{14}
Orotidine monophosphate decarboxylase	10^{17}

Jak dlouho by vznikalo množství produktu, které ureasa vytvoří za 1 s?

Table 6-5
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Princip enzymové reakce



Působení HIV proteasy

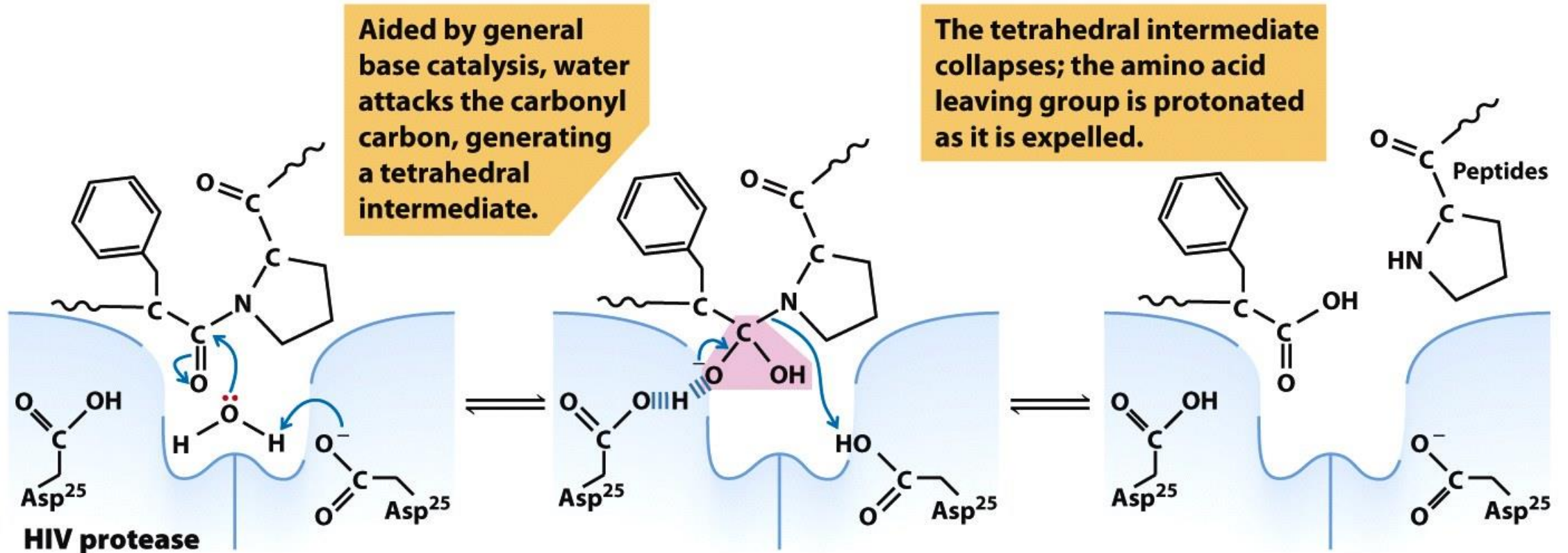


Figure 6-29

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Enzymová kinetika

➤ zkoumá rychlost biochemických reakcí katalyzovaných enzymy

➤ jednotky:

- **katal** (**kat**; množství enzymu potřebné pro přeměnu 1 molu substrátu za 1 sekundu)

mol/s

- **enzymová jednotka** (**U**)

μmol/min

Faktory ovlivňující rychlost enzymové reakce:

➤ množství enzymu, množství substrátu

➤ teplota, pH

➤ aktivátory a inhibitory

Rovnice Michaelise a Mentenové

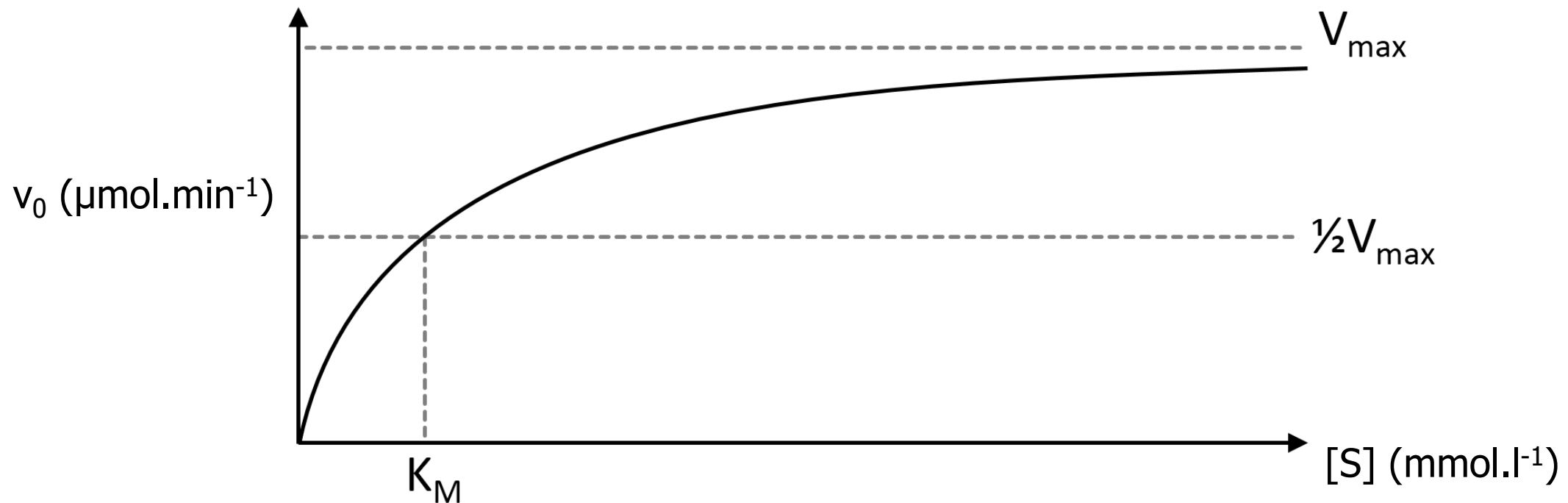
$$V = V_{\max} \frac{[S]}{[S] + K_M}$$



Leonor Michaelis
1875–1949



Maud Menten
1879–1960



Vliv teploty a pH

- s rostoucí **teplotou** roste rychlost reakce (ale pouze do určité teploty, pak rychlost rapidně klesá)
- pro většinu enzymů klesá rychlost reakce v extrémně nízkém či vysokém pH
 - každý enzym má své pH optimum

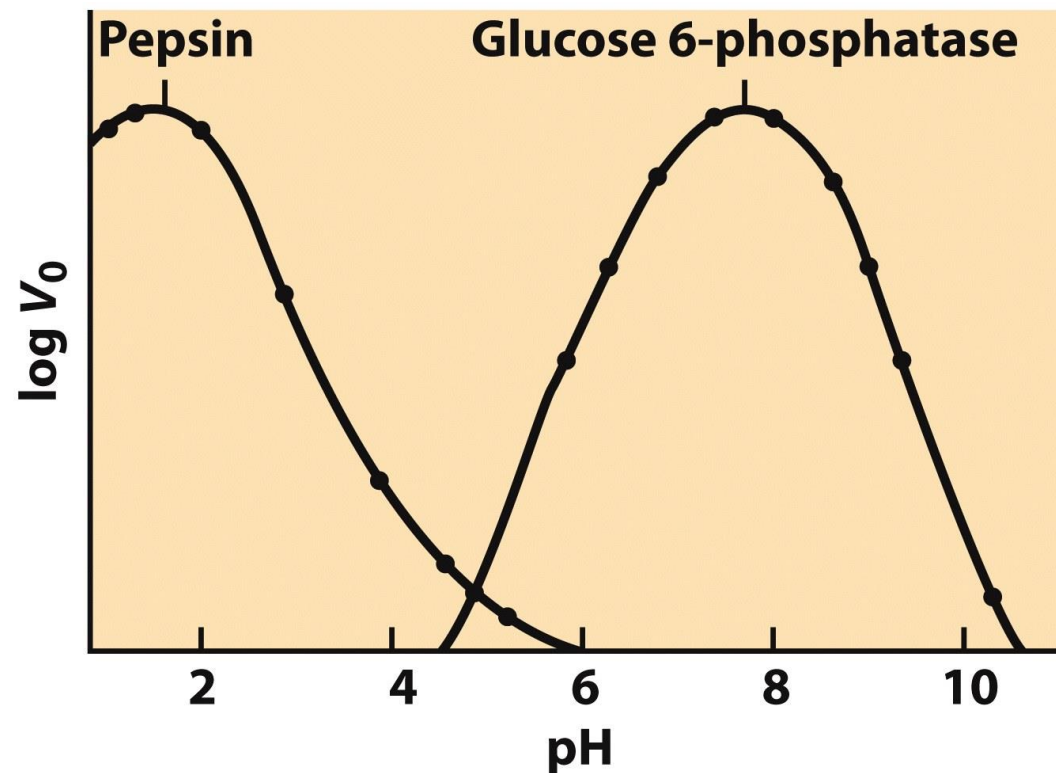
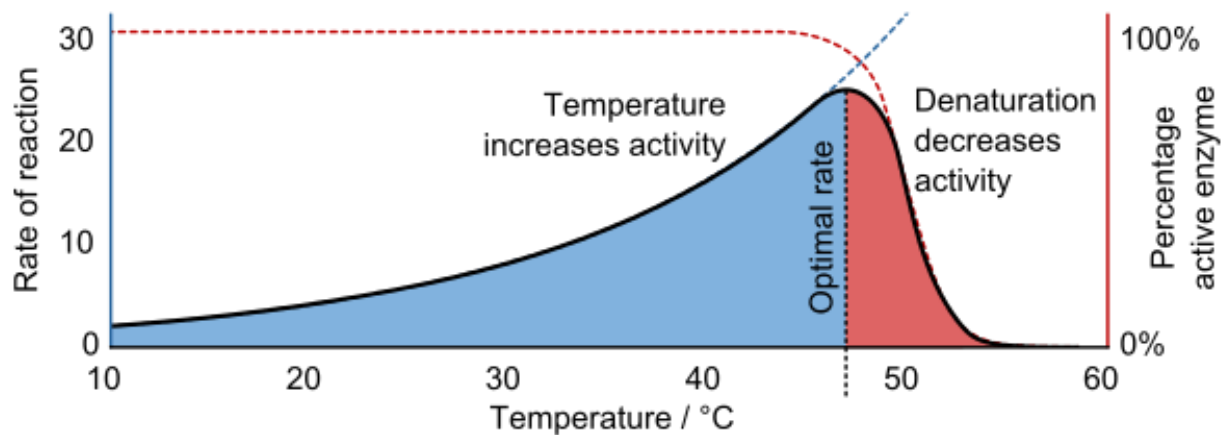


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Aktivace a inhibice

- **aktivace:** kovové ionty, kofaktory, přeměna neaktivní formy v aktivní (štěpení)
- **inhibice:** přeměna aktivní formy v neaktivní, přítomnost **inhibitorů**

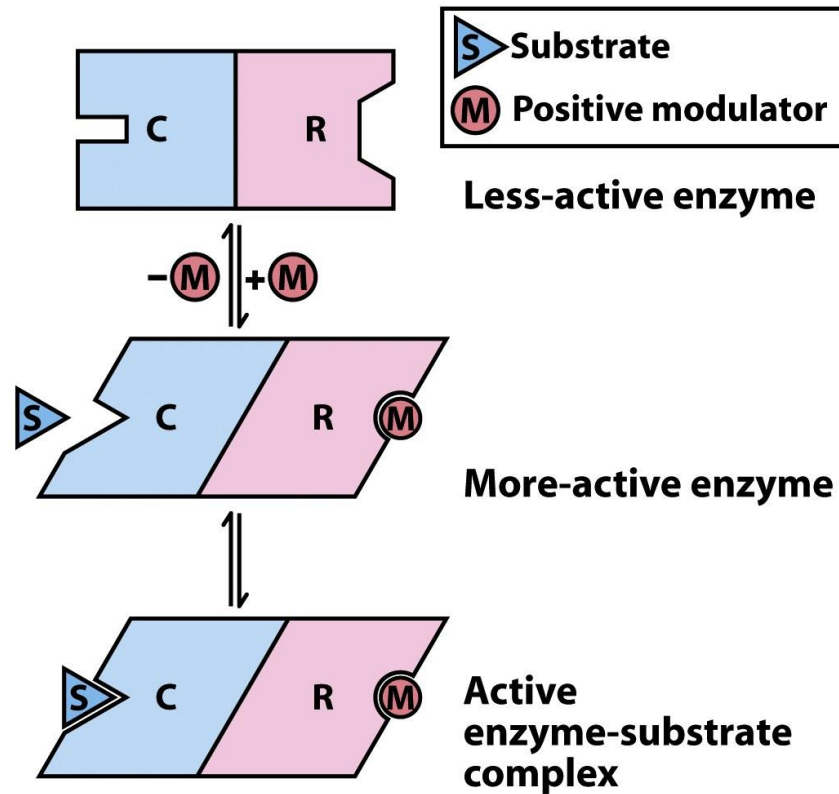
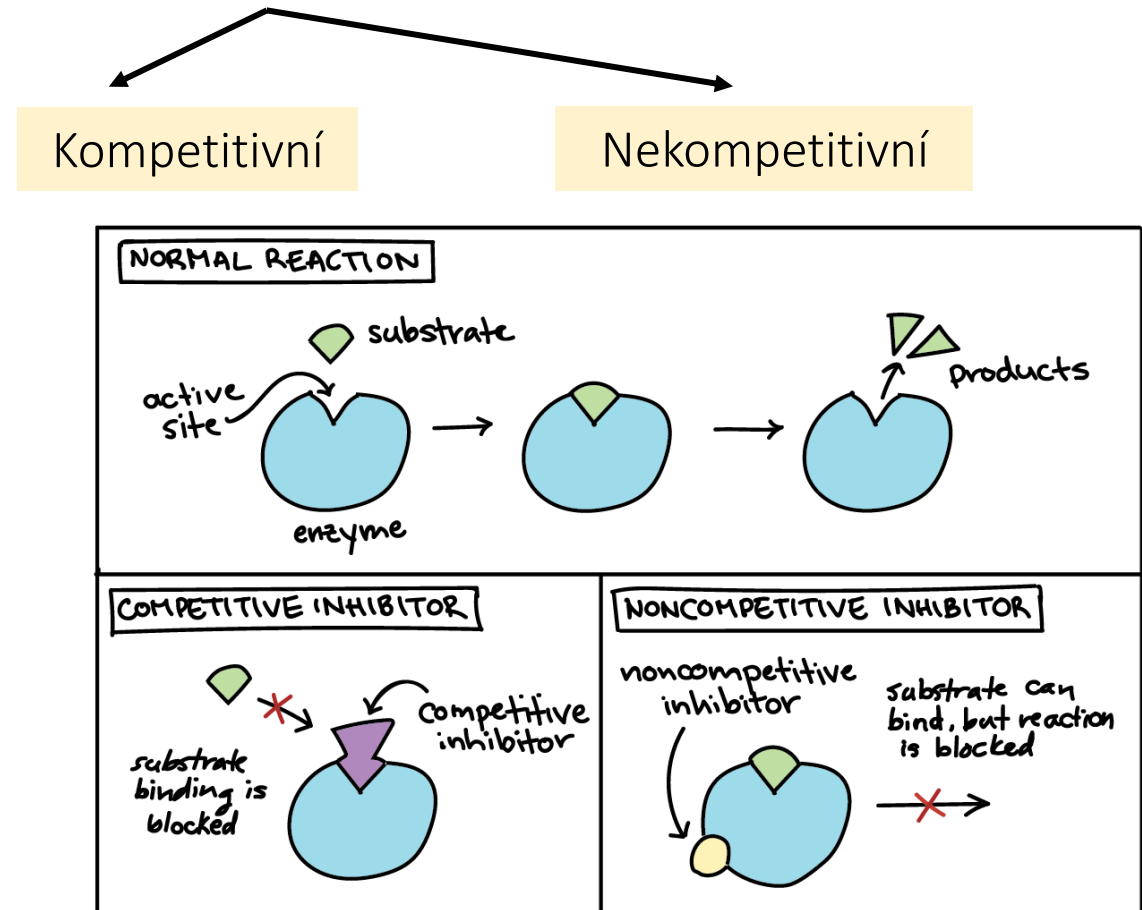
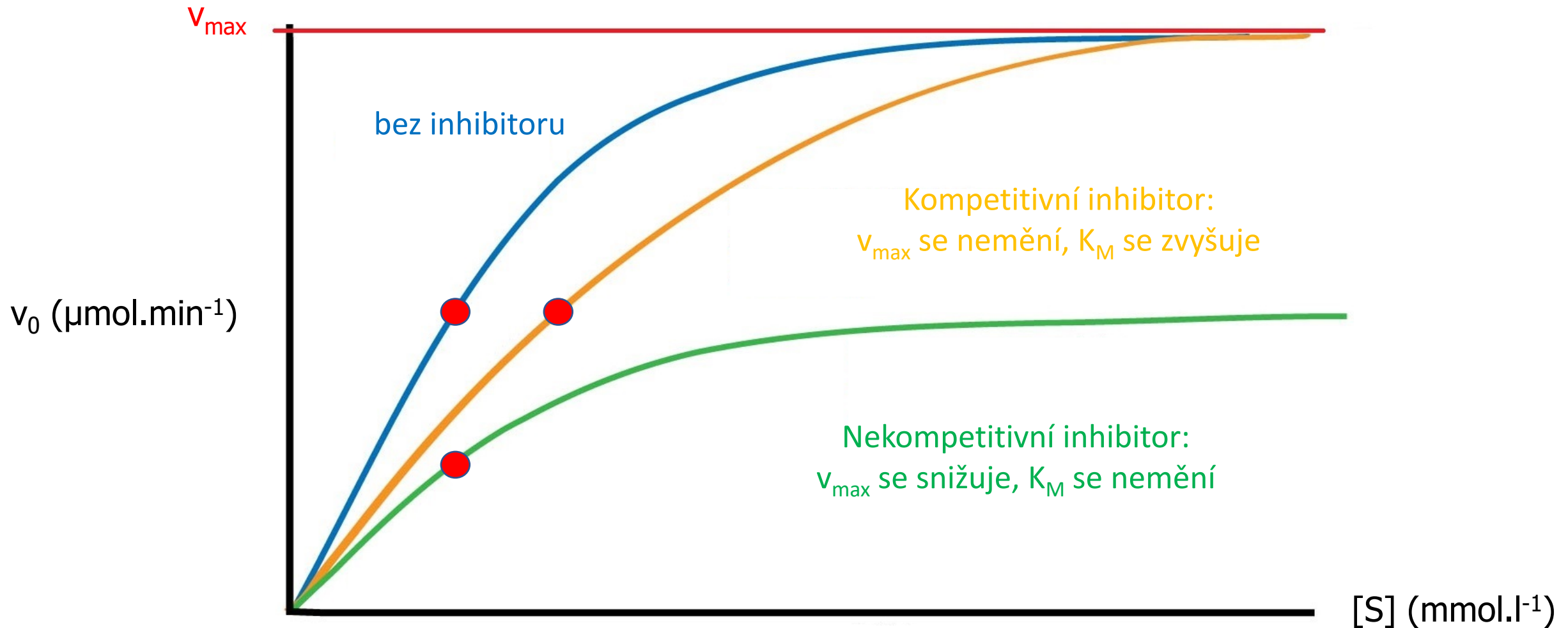


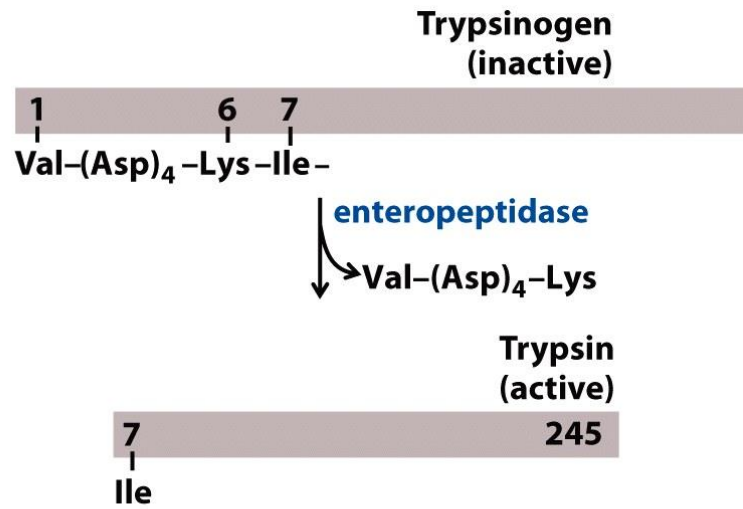
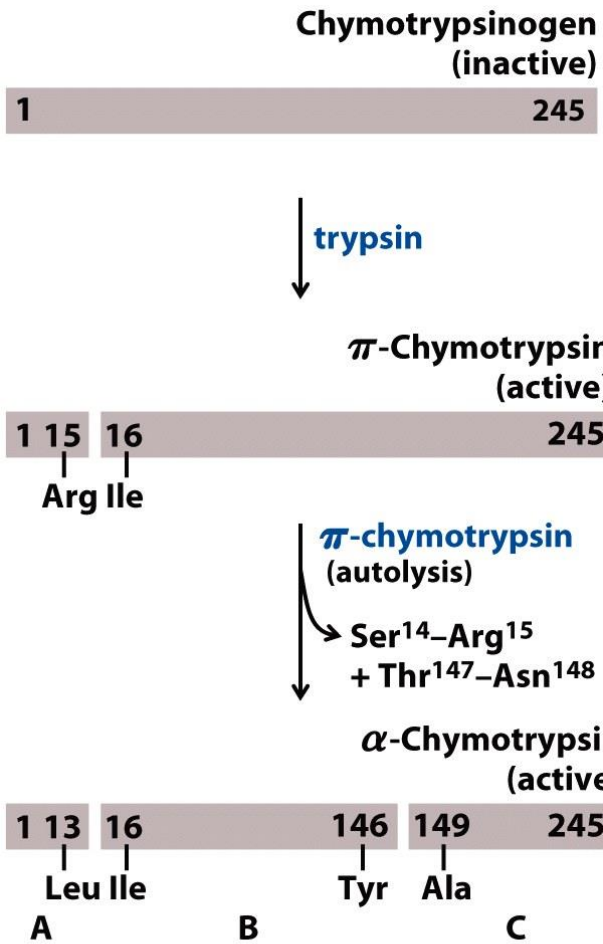
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Vliv inhibitorů na K_M a v_{max}





Vybrané procesy, v nichž se uplatňují aktivace a inhibice enzymů

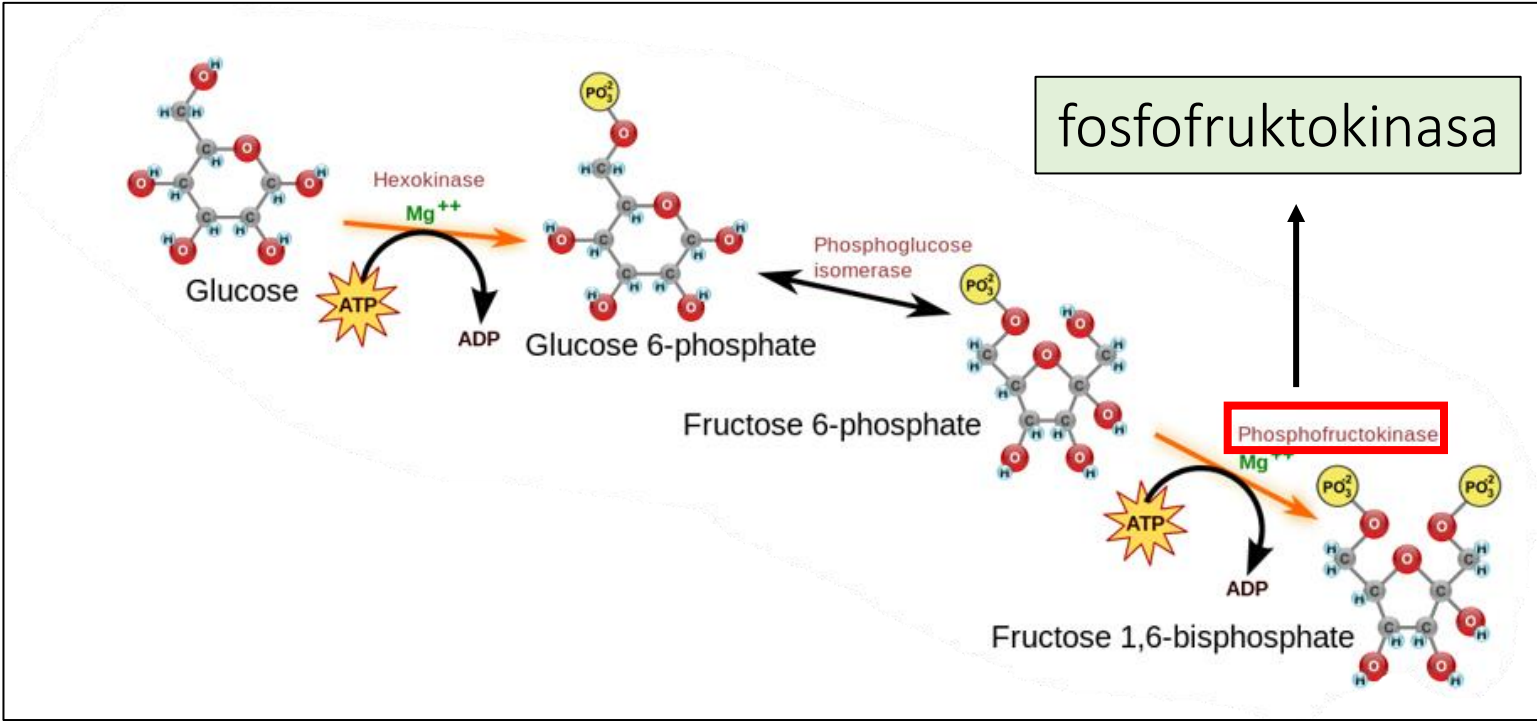


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