

Topic 30. Biosynthesis and catabolism of pyrimidine nucleotides. Hereditary disorders of pyrimidine nucleotide metabolism.

Theoretical questions:

1. Catabolism of pyrimidine nucleotides. Reactions of catabolism of pyrimidine nucleotides on the example of CMP.
2. Biosynthesis of pyrimidine nucleotides and its regulation. Indicate the origin of the atoms of the pyrimidine ring.
3. Formation of deoxyribonucleotides. The role of thioredoxin.
4. Scheme of the conversion of UMP into TMP, the role of thymidylate synthase. The role of vitamins.

Study Questions and Tasks

1. Catabolism of pyrimidine nucleotides. Scheme of catabolism of pyrimidine nucleotides on the example of cytosine.

Metabolites	Names of enzymes and reactions
<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">cytosine</div>	
<div style="text-align: center;">↓ 1</div>	1. _____ _____
<div style="border: 1px solid black; height: 30px; width: 150px; margin: 0 auto;"></div>	
<div style="text-align: center;">↓ 2</div>	2. _____ _____
<div style="border: 1px solid black; height: 30px; width: 150px; margin: 0 auto;"></div>	
<div style="text-align: center;">↓ 3</div>	
<div style="border: 1px solid black; height: 30px; width: 150px; margin: 0 auto;"></div>	

2. Specify the origin of the atoms of a purine ring:

Nitrogen		Carbon
1. _____		2. _____
3. _____		4. _____
		5. _____
		6. _____

3. Write a scheme of the synthesis of UMP.

Metabolites	Names of enzymes and reactions
<div>Glutamine + CO₂ + 2ATP</div>	
↓ 1	1 _____
<div></div>	_____
↓ 2	2 _____
<div></div>	_____
↓ 3	3 _____
<div></div>	_____
↓ 4	4 _____
<div></div>	_____
↓ 5	5 _____
<div></div>	_____
↓ 6	6 _____
<div></div>	_____

4. Formation of deoxyribonucleotides. The role of thioredoxin.

<div></div>	<div>→</div>	<div></div>
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5. Scheme of conversion of UMP into CTP.

Metabolites	Names of enzymes and reactions
UMP	
↓ 1	1 _____ _____
↓ 2	2 _____ _____
↓ 3	3 _____ _____

6. Scheme of conversion of UMP into TMP

Metabolites	Names of enzymes and reactions
UMP	
↓ 1	1 _____ _____
↓ 2	2 _____ _____
↓ 3	3 _____ _____
↓ 4	4 _____ _____

Case tasks

1. A 3-year-old child has growth and mental retardation. The child has a severe form of megaloblastic anemia, resistant to treatment with iron, vitamin B₁₂, and folic acid. The child's urine contains a large number of orotic acid crystals. The synthesis of which substances is impaired in the child? The deficiency of which enzyme is the cause of hereditary orotic aciduria? Write a scheme for the synthesis of the analyzed metabolite.

2. Pterin derivatives – aminopterin and methotrexate are competitive inhibitors of dihydrofolate reductase, as a result of which they inhibit the reduction of dihydrofolate to tetrahydrofolic acid. These drugs lead to inhibition of intermolecular transport of one-carbon groups. The biosynthesis of which nucleotides is disrupted in this case?

Textbooks:

1. Biochemistry 5th Edition Ch.22, pp. 292-301.
2. Prasad textbook of biochemistry OCR. Topic 19, pp.405-415.