Synthesis, Degradation &Biomolecules Derived From Amino Acids III

lec 47

By
Dr/ Nagla El-Melegy
Professor of Medical Biochemistry
Medical Biochemistry Department
Faculty of Medicine- Assiut University

Objectives

- **Discuss products formed by amino acids decarboxylation (Histamine and GABA) .**
- **Discuss metabolism of S-adenosylmethionine.**
- **Enumerate biomolecules derived from amino acids, their functions.**

I-Amino acid Decarboxylation

Definition of amino acid decarboxylation :

Decarboxylation is the removal of carboxylic group from amino acids (AAs) as CO_2 resulting in formation of biological amines.

The enzyme of the decarboxylation is AA decarboxylase.

The coenzyme of the decarboxylation is pyridoxal phosphate (PLP).

Significance of amino acids decarboxylation

- **Formation of physiologically active compounds:**

Decarboxylation results in formation of neurotransmitters, hormones and constituents of metabolites:

Examples

- **Dopa**
- **Histamine**
- **Gamma-aminobutyric acid (GABA)**

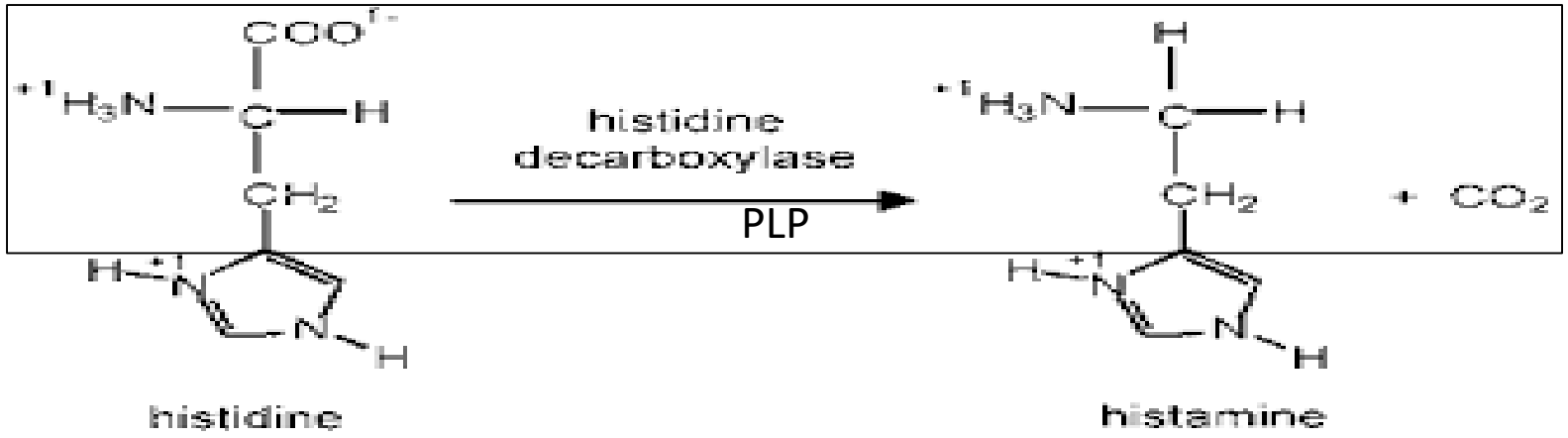
1-Histamine

Formation of histamine

- **Histamine results from decarboxylation of the amino acid histidine.**

- **It is synthesized by** histaminergic neurons, gastric mucosa, mast cells and basophils.

- **It has two types of receptors : H_1(hypothalamus) and H_2 receptors(stomach).**



➢ Importance of histamine

Histamine has role in allergy and inflammation

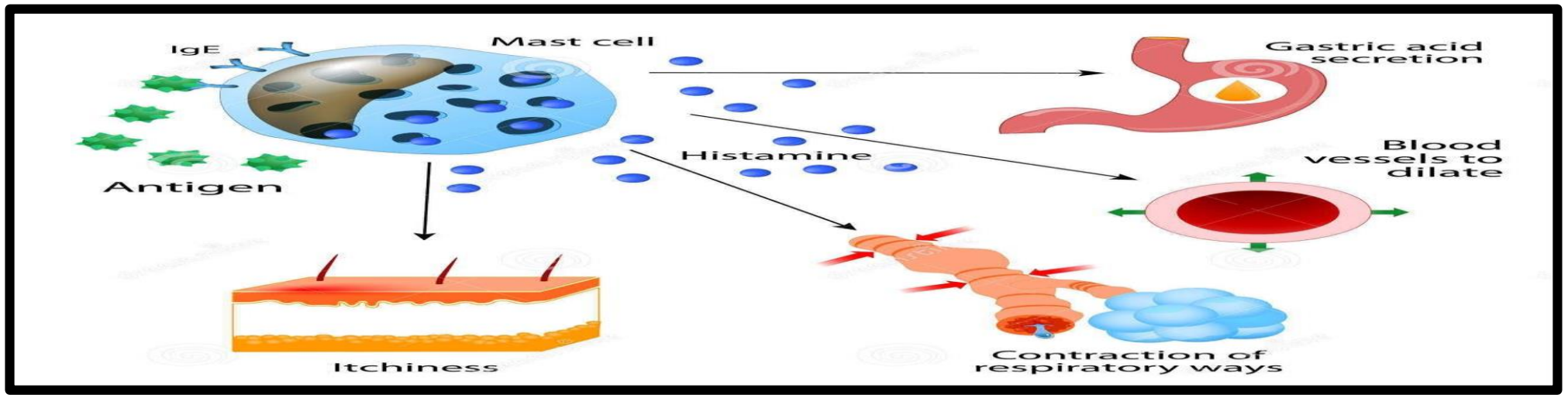
A) Histamine contributes to the inflammatory response .

B) Histamine causes several allergic symptoms as skin redness, itching and bronchial asthma through the following:

1. Constriction of smooth muscle of bronchi

2. Vasodilation of blood vessels .

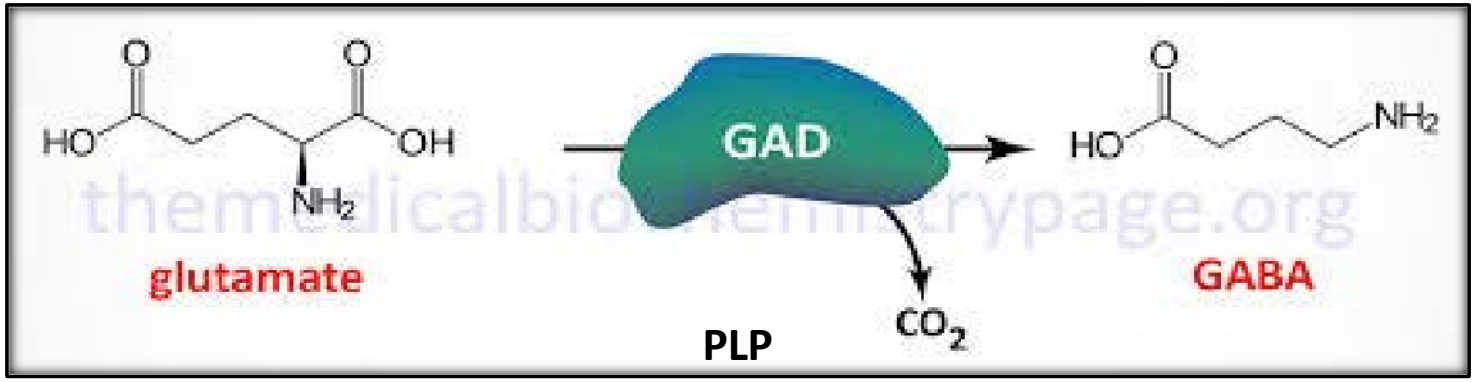
C) Histamine receptor antagonists are used in asthma and allergy treatment.



2-Gamma-amino butyric acid (GABA)

Gamma-amino butyric acid (GABA) results from Glutamic acid **by decarboxylation via glutamic acid decarboxylase enzyme (GAD) and PLP.**

GABA is an inhibitory neurotransmitter (CNS).



Deficiency of GABA and PLP results in convulsions.

II. Metabolism of methionine

Methionine is activated to S-adenosyl-methionine(SAM) and it helps transmethylation reaction

- **1-Transmethylation**

Definition

- **Transmethylation is transfer of methyl group from methyl donor to methyl acceptor.**

Enzymes : Methyltransferases.

Methyl donors:

- **1- S-adenosyl-methionine.**
- **2-Methyl-cobalamin.**
- **3-Glycine-betaine.**
- **4-N5-methyl-FH4**

- **Coenzymes: methylcoblamin and methyltetrahydrofolic acid(FH4).**

- **Important products produced by transmethylation**

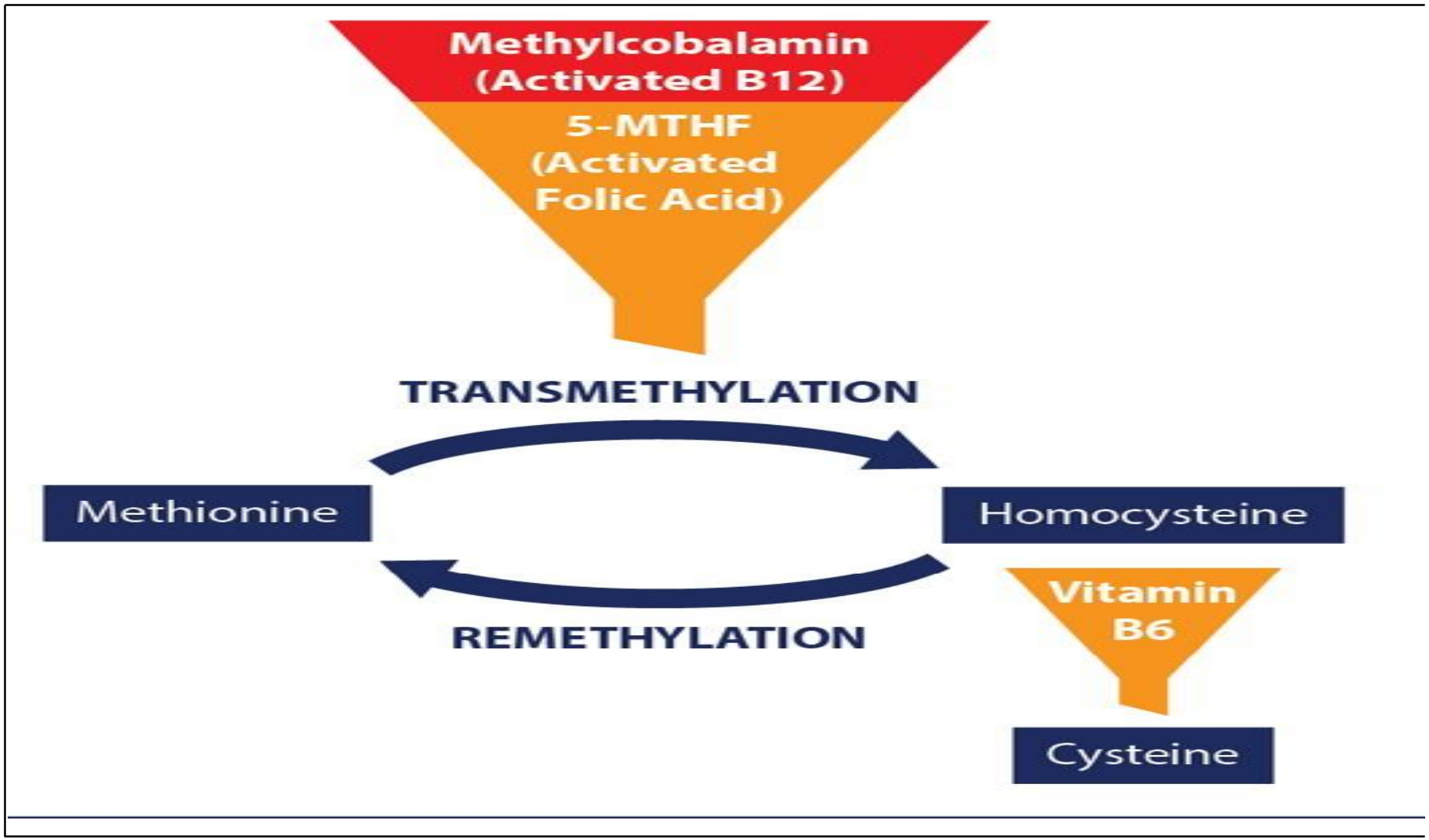
- **Creatine.**
- **Choline**
- **Epinephrine.**
- **Melatonin.**
- **Methylated polyneucleotides.**

2. Metabolism of s adenosylmethionine and homocyteine

Methionine is converted to homocysteine after transmethylation reaction.

- - Methionine is regenerated by help of **5 methyltetrahydrofolic acid and methylcoblamin.**

Homcytseine can be converted to cysteine amino acids by cystathionine β synthase enzyme and vitamin B6.


Methylcobalamin
(Activated B12)
5-MTHF
(Activated
Folic Acid)
TRANSMETHYLATION
Methionine
Homocysteine
Vitamin
B6
REMETHYLATION
Cysteine

III . Important biomolecules from amino acids

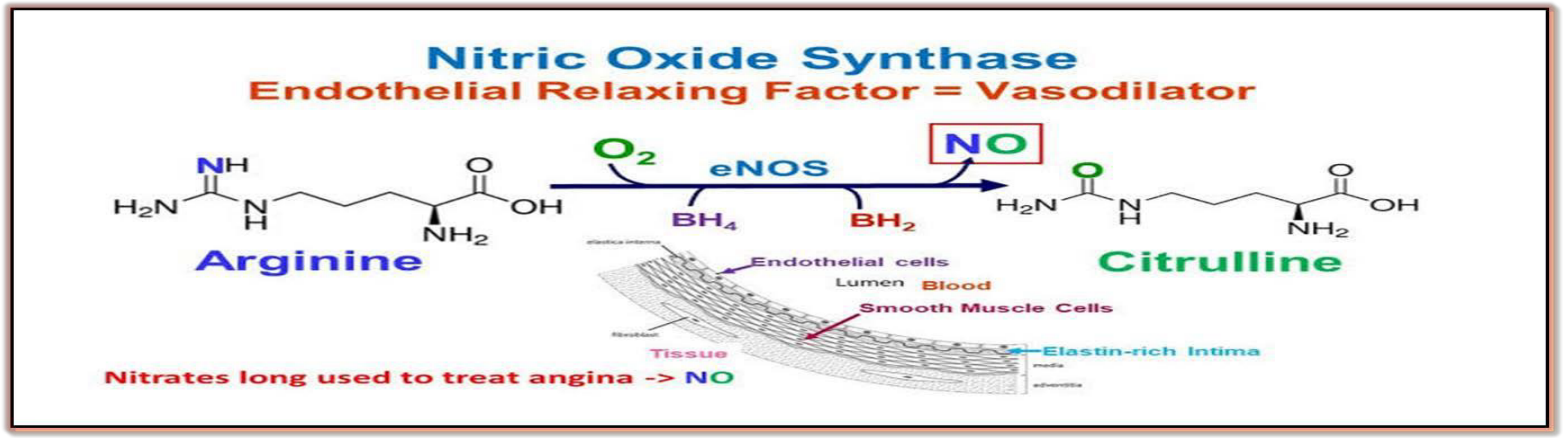
- **A-Nitric oxide (NO) formation:**

Nitric oxide is produced from arginine amino acid by nitric oxide synthase enzyme.

- **Importance of Nitric oxide (NO):**

➢ **Relaxation of blood vessels.**

➢ **Nitroglycerin drug is converted to NO and dilates coronary arteries. Nitroglycerin is used in treating angina pectoris and sever hypertension.**



- **B- Branched chain amino acids (valine, leucine, isoleucine)**

➢ Importance

Branched chain amino acids(valine ,leucine and isoleucine) are important sources of Krebs intermediates and source of energy in muscles.

Metabolism of branched chain amino acids

- **Branched-chain -keto acid dehydrogenase is responsible for oxidative decarboxylation of branched chain keto acids.**
- **Coenzymes of oxidative decarboxylation are thiamine pyrophosphate, lipoic acid, NAD+ , and FAD.**

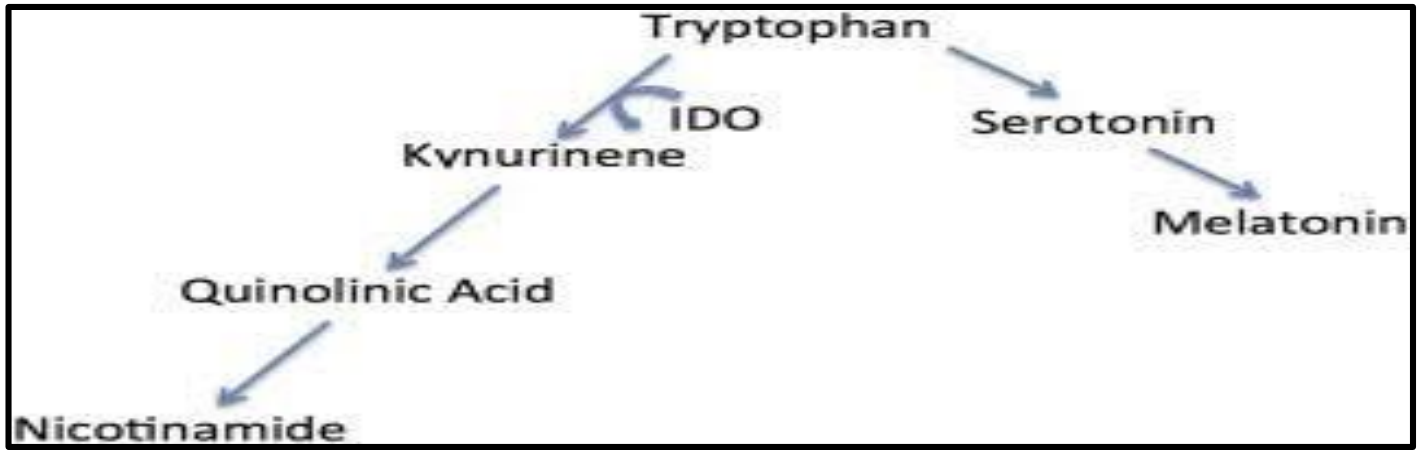
MAPLE SYRUP

خشب القيقب URINE DISEASE

- **Genetic disease results from deficiency of branched chain alpha keto acid dehydrogenase.**
- **Symptoms**
- **Urine has odor of maple syrup.**
- **Intellectual disability.**
- **Ketosis and abnormal muscle tone.**
- **Coma and death.**

C-TRYPTOPHAN AMINO ACID

- **Importance of tryptophan**
- **1-Formation of serotonin and melatonin.**
- **2-Formation of niacin ,NAD and NADP.**



IMPORTANCE OF SEROTONIN

- **Serotonin is a stimulatory transmitter of cerebral activity (excitation).**
- **Deficiency of serotonin results in depression.**
- **Treatment of depression can be by drugs that inhibit serotonin catabolism(serotonin reuptake inhibition).**

Importance of melatonin(youth hormone) :

- Melatonin is produced from serotonin in pineal gland during light /dark cycle .
- Melatonin is involved in regulating of sleep/dark cycle.
- Melatonin is a strong antioxidant

THANK YOU