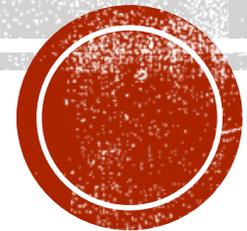


Amino acid pool & catabolic pathway of amino acids



Content

I. Amino acids pool

- a) Source
- b) Fate

II. General catabolic pathway

1. Decarboxylation
2. Transamination
3. Deamination
4. Transdeamination

Amino acid pool

- 1. Definition**
- 2. Plasma level**
- 3. Source**
- 4. Fate**

just a reminder:



GENERAL STRUCTURE OF AMINO ACIDS

- **Each amino acid has:**

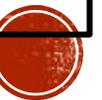
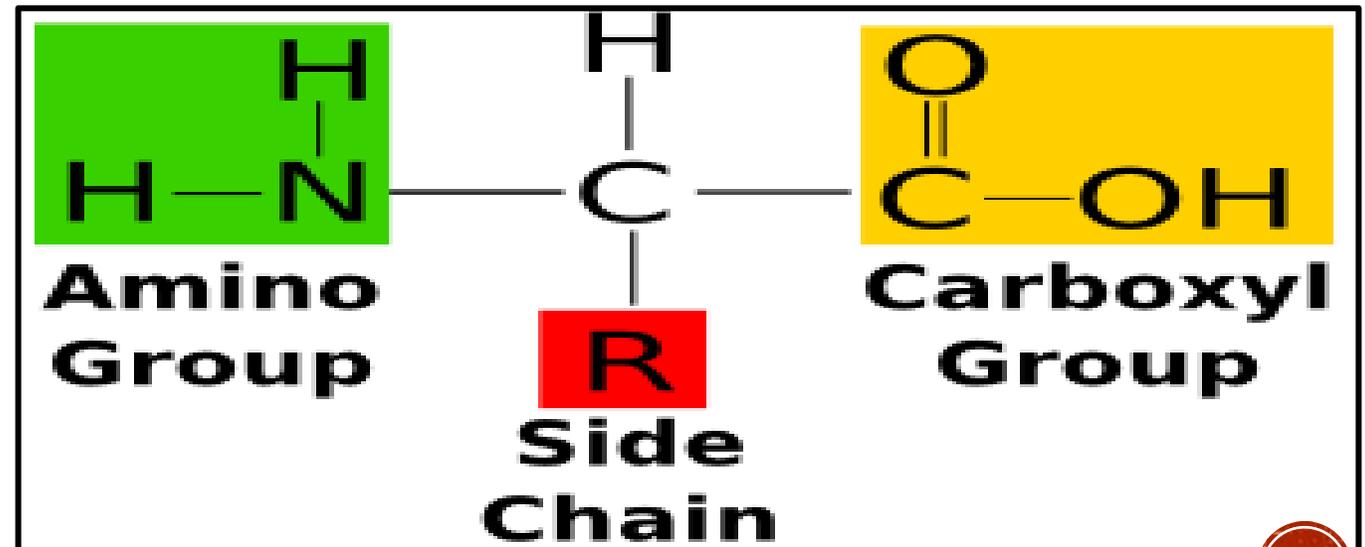
a- COOH group.

b- NH₂ group attached to α -carbon (α -amino acid).

c- Side chain (R) which is characteristic for each amino acids.



- Amino acids are **20**.



Amino acids Pool

Definition:

- ❖ The amount of free amino acids distributed throughout the body is called amino acid pool.

Plasma level of amino acids:

- ❖ For most amino acids varies widely throughout the day.
 - It ranges between **4–5 mg/dl**.
 - Following a protein containing meal, amino acid levels rise to **45 -100 mg/dl**.

Source of amino acid pool:

1. Dietary protein
2. Breakdown of tissue proteins
3. Biosynthesis of nonessential amino acids in liver

Fate of amino acid pool:

A) Synthetic reaction: Biosynthesis of

1-Structural proteins e.g. tissue proteins (collagen, elastin).

2-Functional proteins e.g. plasma protein, hemoglobin, myoglobin, protein hormones and enzymes

3- Small peptides of biological importance e.g. glutathione, enkephalins, endorphins.

4- Non-protein nitrogenous compounds (NPN) as urea, uric acid, creatine, creatinine and ammonia

Overall Nitrogen Metabolism

I- Nitrogen intake:

- **Protein** is the *major source* for utilizable nitrogen. Each 100 gm proteins of diet contain 16 gm nitrogen. The average daily intake of protein is 90 gm provide the body with 14.5 gm nitrogen.
- Other *minor sources*: phospholipids, nucleic acid, inorganic nitrite and nitrate.

II – Nitrogen output:

- It is the nitrogen **excreted** from the body.
- It results from protein **catabolism**.
- Routes for nitrogen output include **urine, stool, sweat,**



Overall Nitrogen Metabolism

I- Urine:

- Urine is the major route for nitrogen excretion in the form of **non protein nitrogenous substances (NPN)** e.g.

Urea 20-40 gm/ day.

Uric acid 0.7 gm/day.

Ammonia 0.7 gm/ day.

Creatinine 1gm/day for female , 1.5 gm/day for male

2- Stool: 1gm/ day

Nitrogen excreted in stool include nitrogen of **undigested protein, mucin, digestive enzymes.**

3- Sweat → 0.3 gm/day, nitrogen is excreted in the form of **urea.**

4- Other routes → **milk, hair and nail**

B) Catabolic reactions: breakdown of amino acids

- ❖ General common catabolic fate by
 - 1-decarboxylation, 2- transamination, 3- deamination, and 4- transdeamination**
- ❖ Catabolism of amino acids gives ammonia and alpha-keto acids
 - a. Ammonia** is transformed mainly into urea
 - b. Alpha-keto acids** that remain after removal of ammonia from amino acids are called the carbon skeleton used for:
 - ❑ Biosynthesis of nonessential aa. (Amino acids are converted to glucose (glucogenic amino acids), Ketone bodies (ketogenic amino acids) or glucose and ketone bodies (mixed amino acids). or
 - ❑ Enter krebs cycle to give **energy**.



CATABOLIC PATHWAYS OF AMINO ACIDS

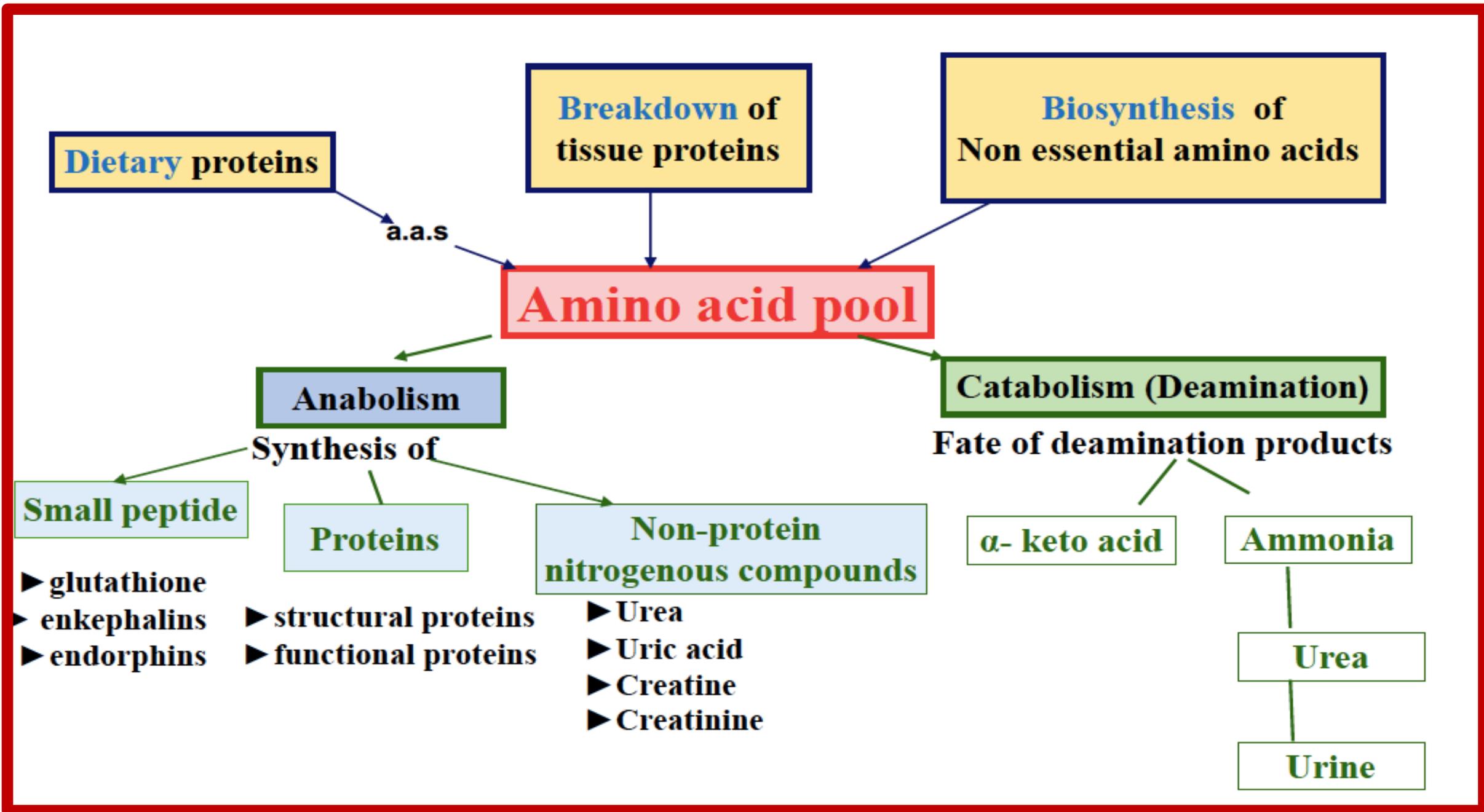


Amino acid	α -Keto acid
<p>Alanine</p> $\begin{array}{c} \text{NH}_2 \\ \\ \text{CH}_3 - \text{CH} - \text{COOH} \end{array}$	<p>Pyruvic acid</p> $\begin{array}{c} \text{O} \\ \\ \text{CH}_3 - \text{C} - \text{COOH} \end{array}$

Amino acid	α -Keto acid
<p>Aspartic acid</p> $\begin{array}{c} \text{COOH} \\ \\ \text{HC} - \text{NH}_2 \\ \\ \text{CH}_2 \\ \\ \text{COOH} \end{array}$	<p>Oxaloacetic acid</p> $\begin{array}{c} \text{COOH} \\ \\ \text{C} = \text{O} \\ \\ \text{CH}_2 \\ \\ \text{COOH} \end{array}$

Amino acid	α -Keto acid
<p>Glutamic acid</p> $\begin{array}{c} \text{COOH} \\ \\ \text{HC} - \text{NH}_2 \\ \\ \text{CH}_2 \\ \\ \text{CH}_2 \\ \\ \text{COOH} \end{array}$	<p>α-keto glutaric acid</p> $\begin{array}{c} \text{COOH} \\ \\ \text{C} = \text{O} \\ \\ \text{CH}_2 \\ \\ \text{CH}_2 \\ \\ \text{COOH} \end{array}$

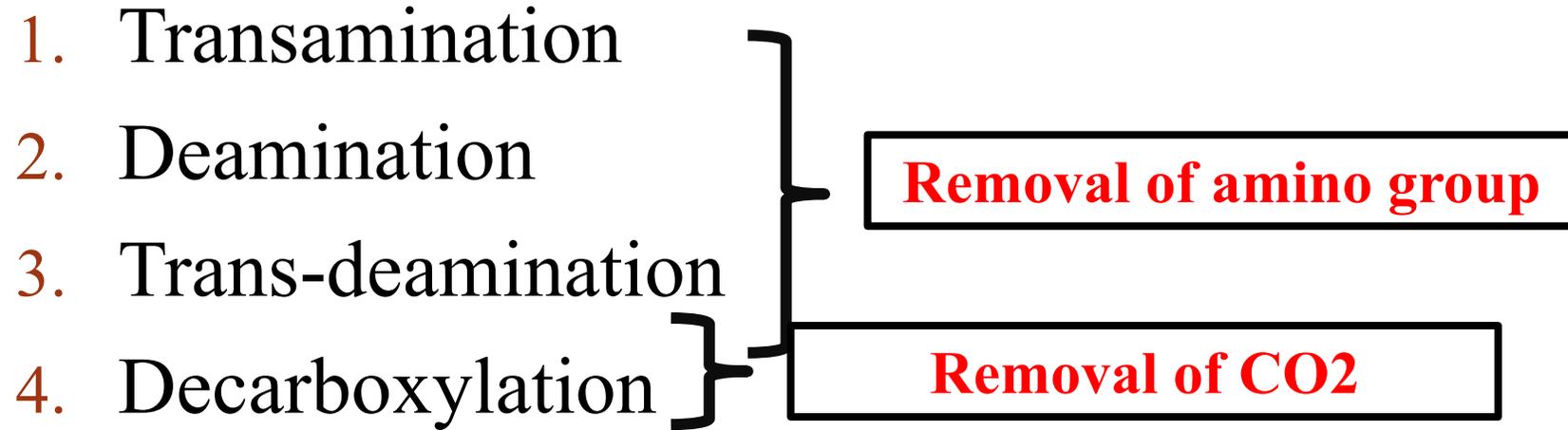




General catabolic pathway (Breakdown of Amino Acids)

- 1. Decarboxylation**
- 2. Transamination**
- 3. Deamination**
- 4. Transdeamination**

CATABOLIC PATHWAYS OF AMINO ACIDS

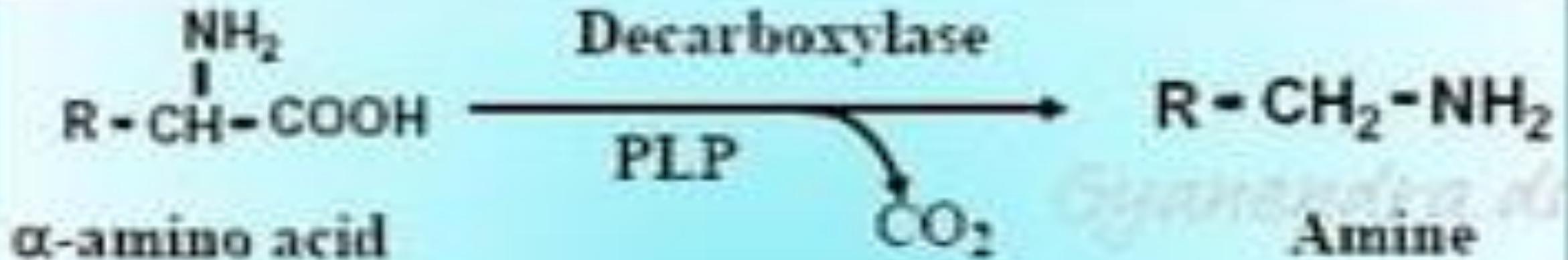


1- Decarboxylation of AAs

Definition: it is the removal of CO₂ from an amino acids to form corresponding **amine**

Enzyme: Decarboxylase

Coenzyme: Pyridoxal Phosphate (PLP) (active vit B6) act as a **carrier** of carboxylic group



Example of decarboxylation of AAs

CO₂

1.Histidine

1.Histamine (Vasodilator, Bronchoconstrictor , incr HCL)

2.Serine

2.Ethanolamine → Cephalin, (phospholipid)

3.Cysteine

3.Thioethanolamine → Pantothenic acid (vit B5)

4.Glutamate

4.γ amino butyric acid (Inhibitory neurotransmitter)

2- Transamination of AAs

Definition: it is the transfer of an amino group from α -amino acid to an α -keto acid forming a new amino acid and a new α -keto acid.

Site: liver, Muscle, heart (**Mitochondria, cytoplasm**).

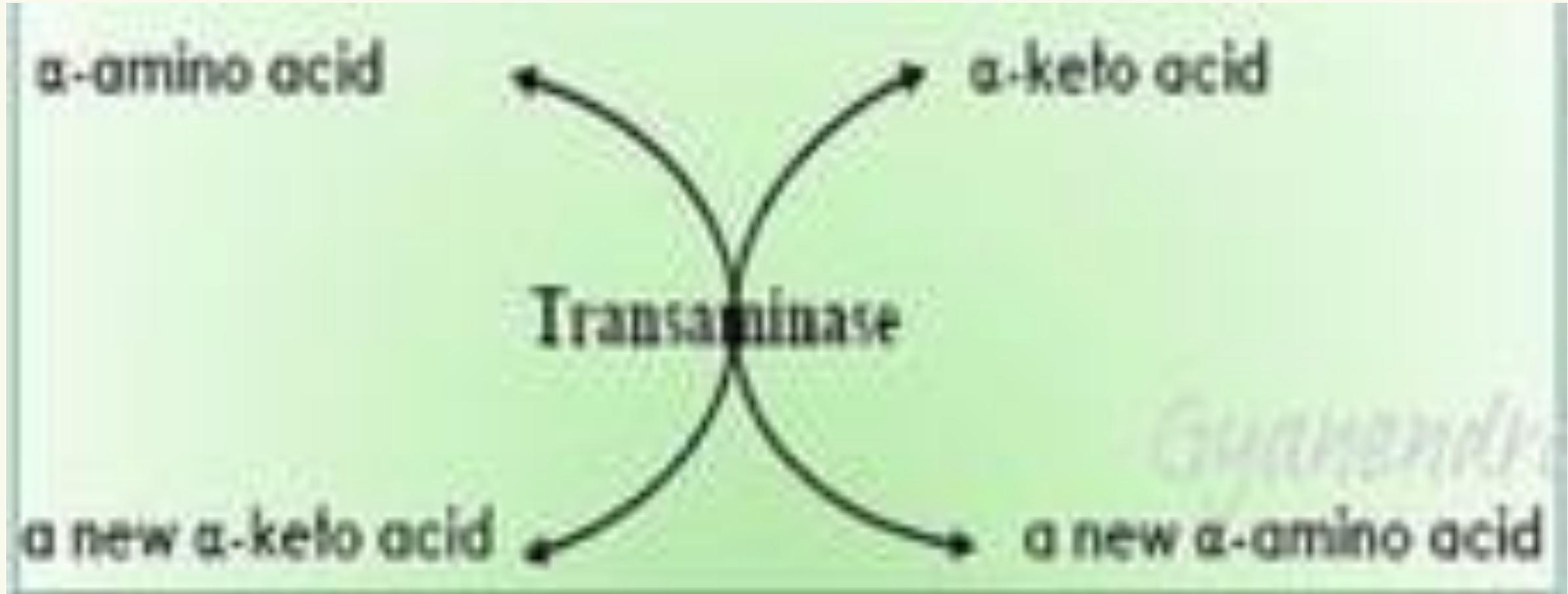
Enzyme: Transaminases (ALT, AST)

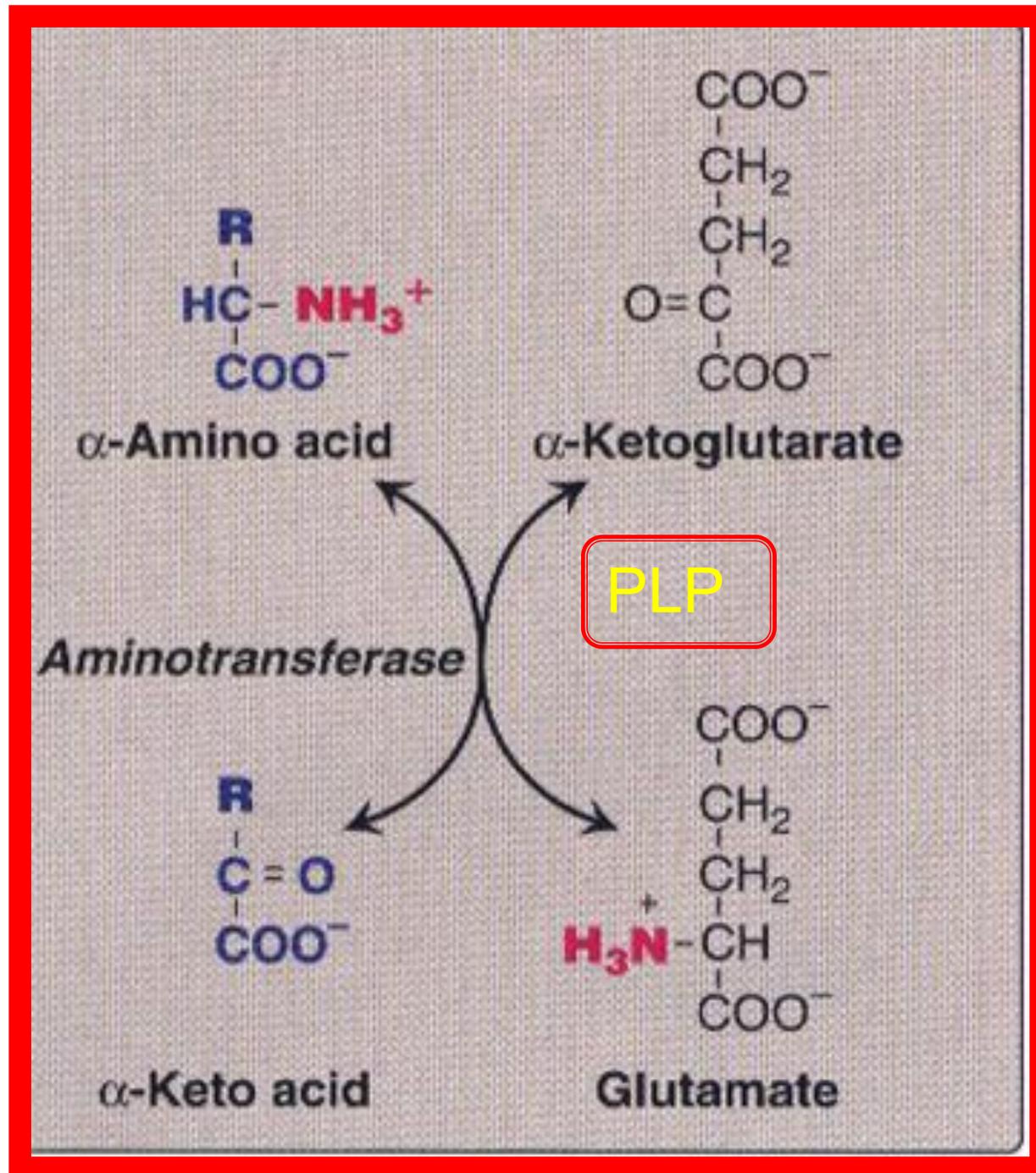
Coenzyme: Pyridoxal Phosphate (PLP) (active vit B6) act as a **carrier** of amino group

Reaction of transaminase is reversible

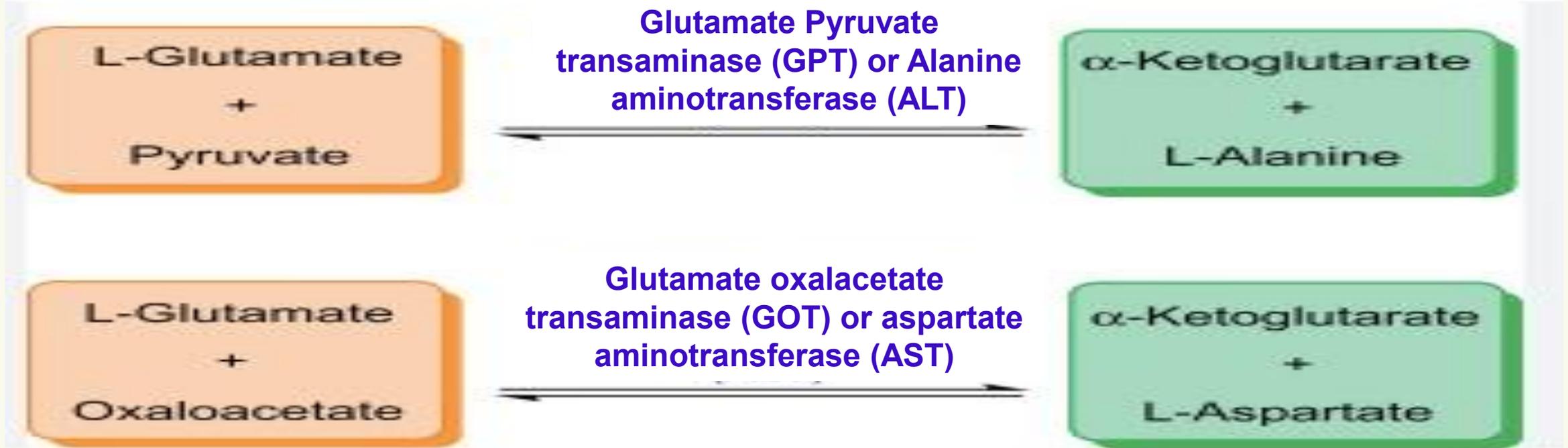


Reaction of transaminase is reversible





Examples of transaminase: (ALT & AST)



Biomedical importance of transaminases: nonfunctional enzymes

- ❖ **AST (GOT)** → increase in myocardial infarction & liver disease (chronic)
- ❖ **ALT (GPT)** → increase in liver disease (acute)

3- Deamination of AAs

Definition: It means removal of amino group NH_2 from amino acid in the form of ammonia (NH_3)

Types of deamination:

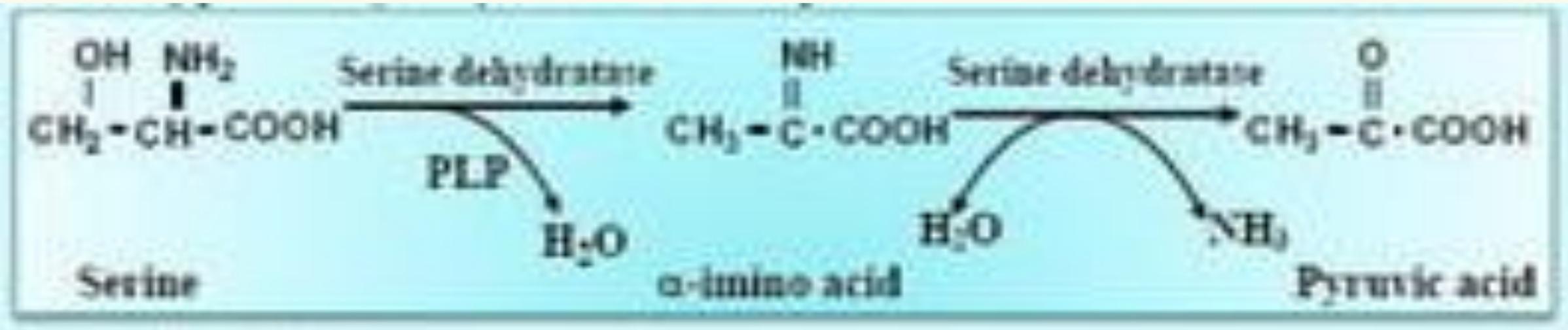
A. Non-Oxidative deamination

B. Oxidative deamination

A. Non-Oxidative deamination

Definition: it is the removal of amino group without the removal of hydrogen

Example: Serine dehydratase (need PLP as coenzyme)



B. Oxidative deamination

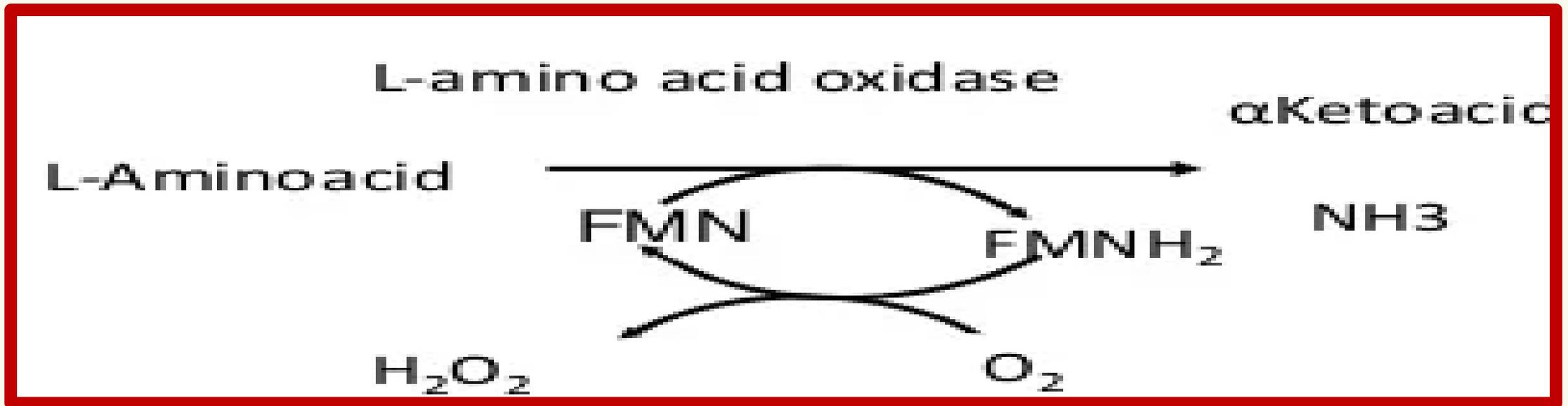
Definition: it is the removal of amino group which is combined with oxidation (with the removal of hydrogen)

Example: 3 enzymes

- 1. L- amino acid oxidase (dehydrogenase)**
- 2. D- amino acid oxidase (dehydrogenase)**
- 3. L- glutamate dehydrogenase**

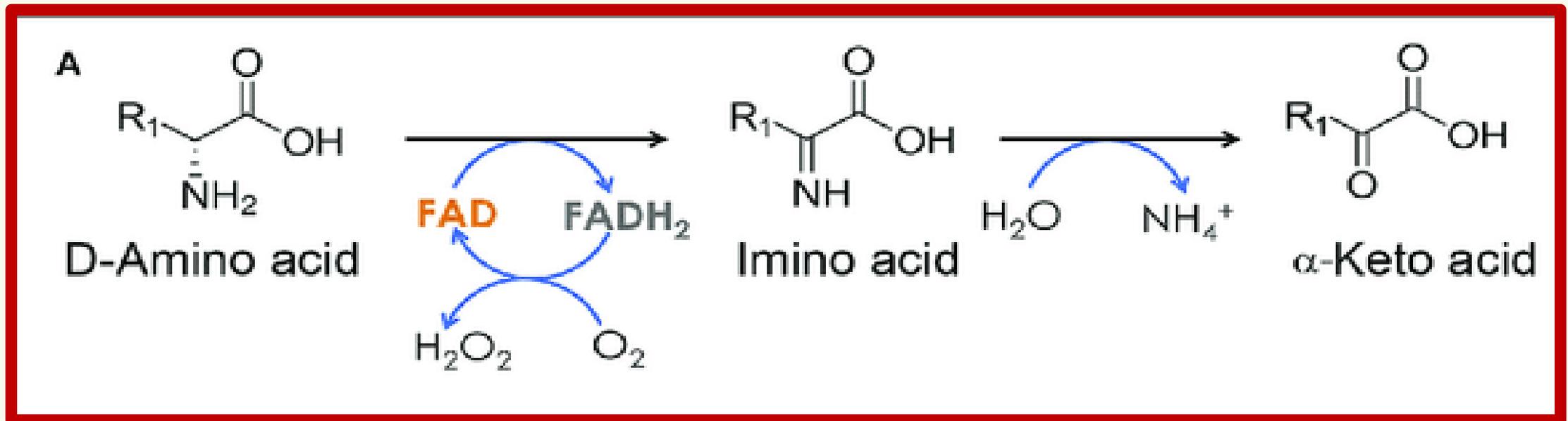
1. L- amino acid oxidase (dehydrogenase)

- ✓ Action: deaminate **L-amino acids** except glutamic acid.
- ✓ Coenzyme **FMN** (as a hydrogen carrier).



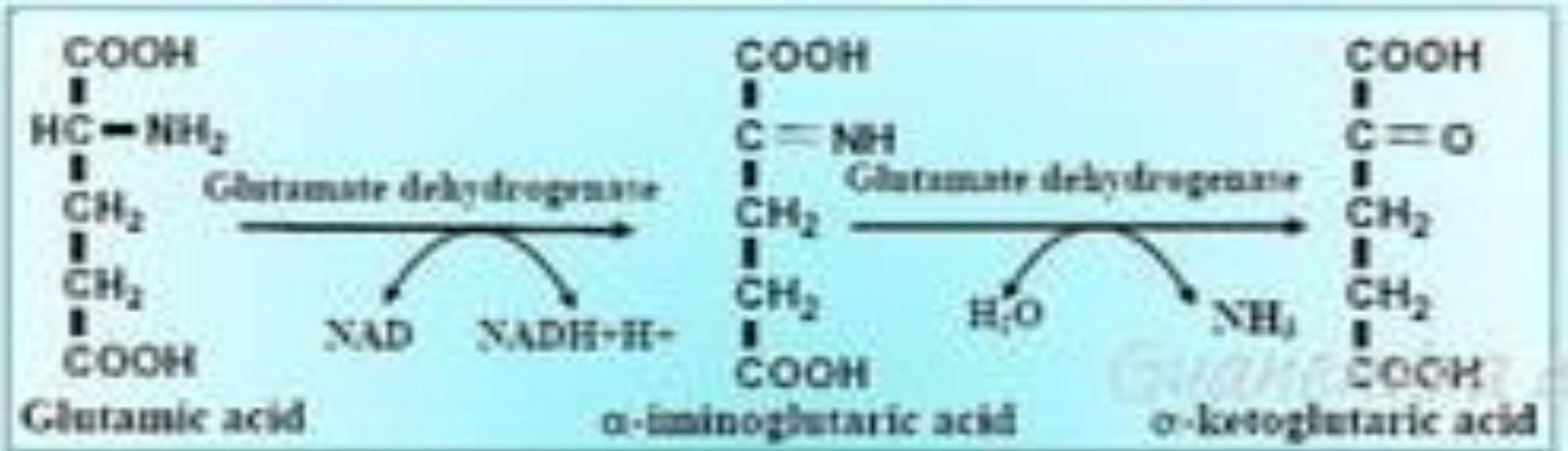
2. D- amino acid oxidase (dehydrogenase)

- ✓ **Action:** Deaminate **D-amino acids**
- ✓ **Present:** on plant and bacterial cell wall
- ✓ **Coenzyme :** **FAD** (as a carrier of Hydrogen).



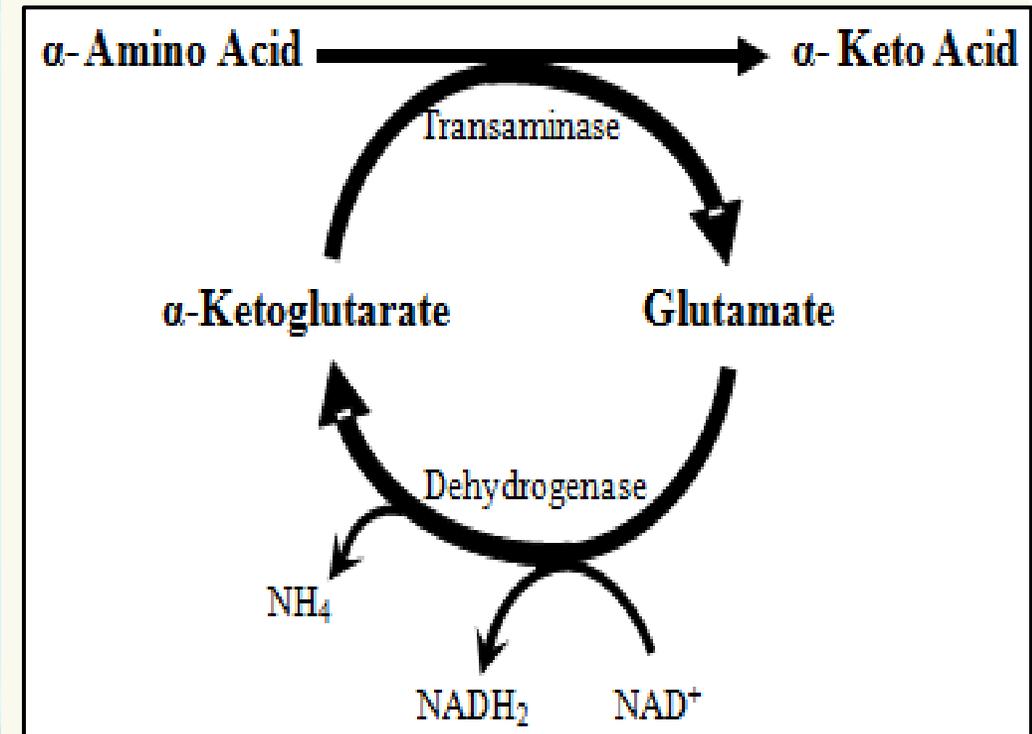
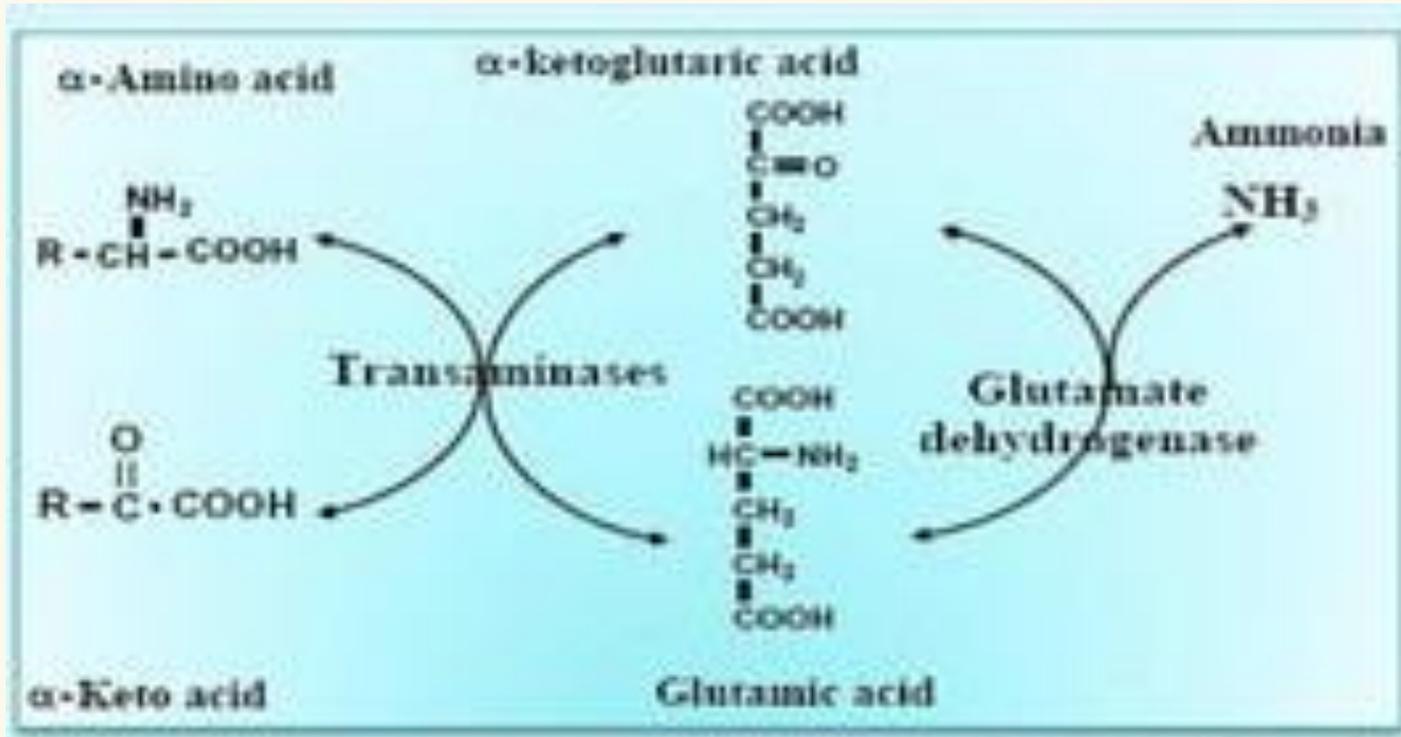
3. L- glutamate dehydrogenase

- ✓ The most important AA to deaminate is **glutamic acid**
- ✓ **Action:** Deaminate **L- glutamic acid**
- ✓ **Coenzyme :** **NAD or NADP**



4- Trans-deamination of AAs

Definition: A combination of transamination and oxidative deamination.



- **Importance:** It is the **main** catabolic pathway of amino acids. Widely distributed system & highly active.

Life
isn't about
finding yourself.

...

Life
is about
creating yourself.

