Sem – II (PG)
Paper ZOO-202
Group B: Biochemistry

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Protein metabolism

Deamination and transamination

Deamination

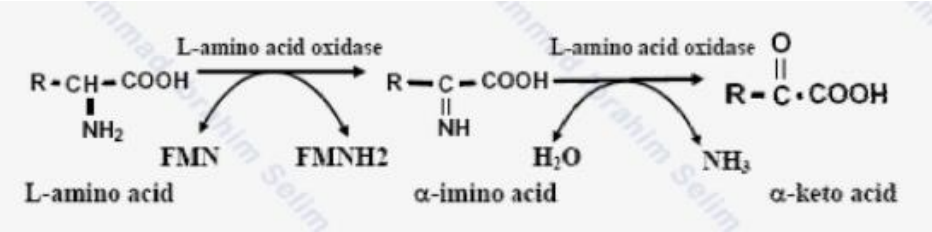
Deamination is the removal of the amine group from α-amino acid as ammonia (NH_3) with formation of α-keto acid.

- The liver and kidney are the main sites for deamination.
- Deamination may be oxidative or non-oxidative.

A. Oxidative deamination:

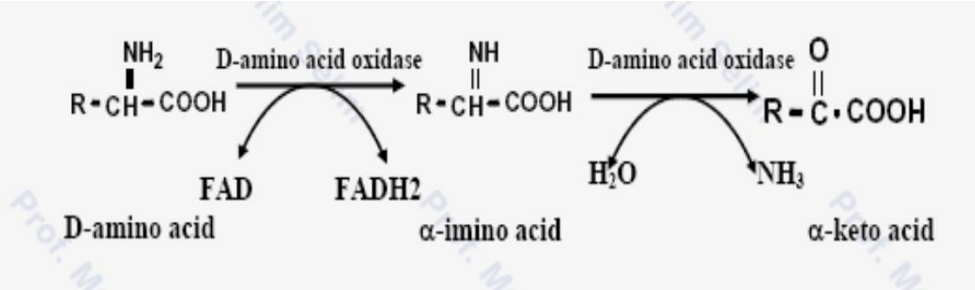
It is catalysed by one of the following enzymes:

1. *L-amino acid oxidases* –
   - ✓ This enzyme is present in the liver and kidney. Its activity is low.
   - ✓ It is an aerobic dehydrogenase that needs FMN as a coenzyme.
   - ✓ It deaminates most of the naturally occurring L-amino acids.

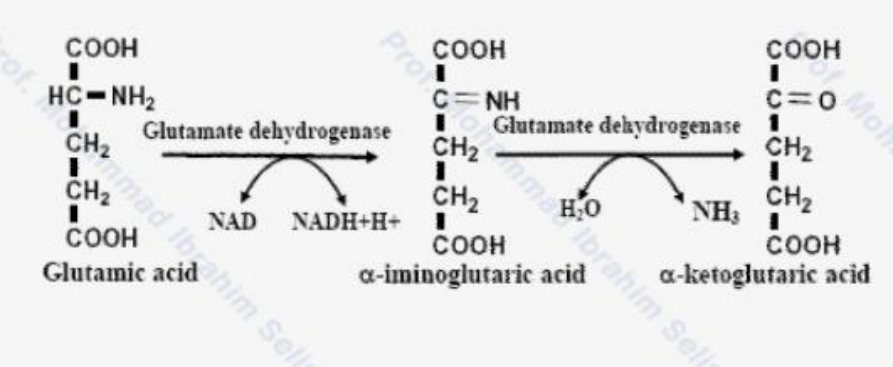


2. *D-amino acid oxidases* –
   - ✓ D-amino acids are present in plants and bacterial cell wall.
   - ✓ They are not used in protein biosynthesis in humans & animals.

- ✓ D-amino acids are deaminated by D-amino acid oxidase resulting in ammonia & α-keto acids.
- ✓ This is present in liver.
- ✓ It is an aerobic dehydrogenase.
- ✓ It needs FAD as a coenzyme.



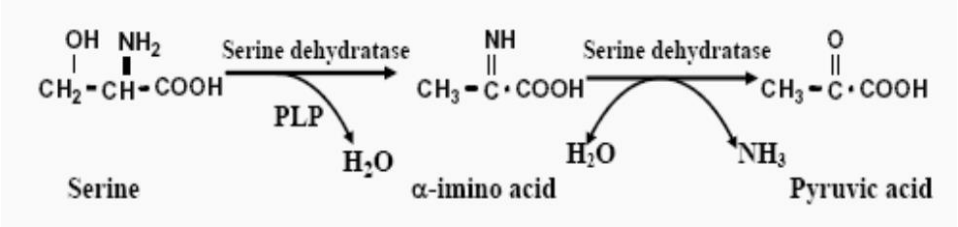
3. *Glutamate dehydrogenase* –
   - ✓ This enzyme is present in cytoplasm & mitochondria in most tissues. Its activity is high.
   - ✓ It is an anaerobic dehydrogenase. Needs NAD or NADP as a coenzyme.
   - ✓ It deaminates glutamic acid resulting in α-ketoglutaric acid and ammonia.



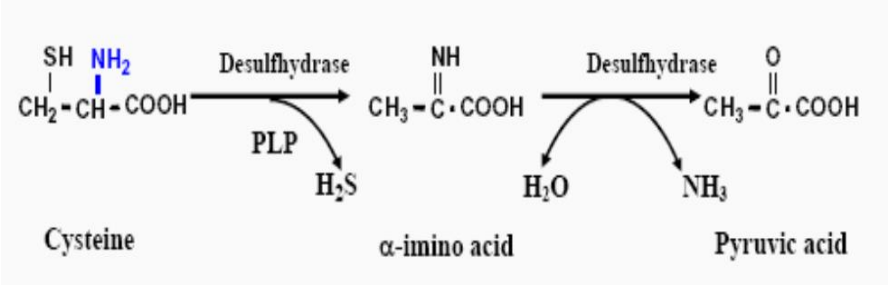
B. Non-oxidative deamination:

It is catalysed by one of the following enzymes:

1. *Dehydratases* –
   - ✓ This enzyme deaminates amino acids containing hydroxyl group e.g. serine, homoserine & threonine.
   - ✓ It needs pyridoxal phosphate as coenzyme.



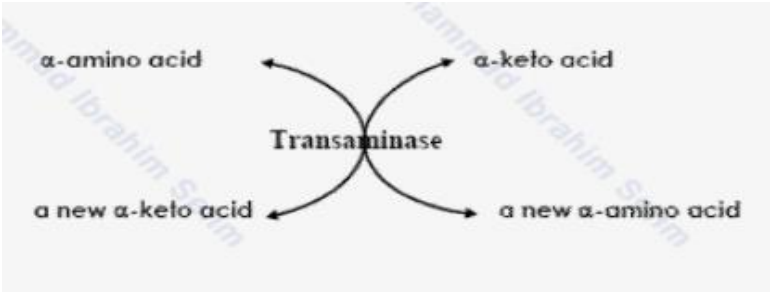
2. *Desulfhydrase* –
    - ✓ This enzyme deaminates sulphur containing amino acids e.g. cysteine and cystine.
    - ✓ It needs pyridoxal phosphate as a coenzyme.



Transamination

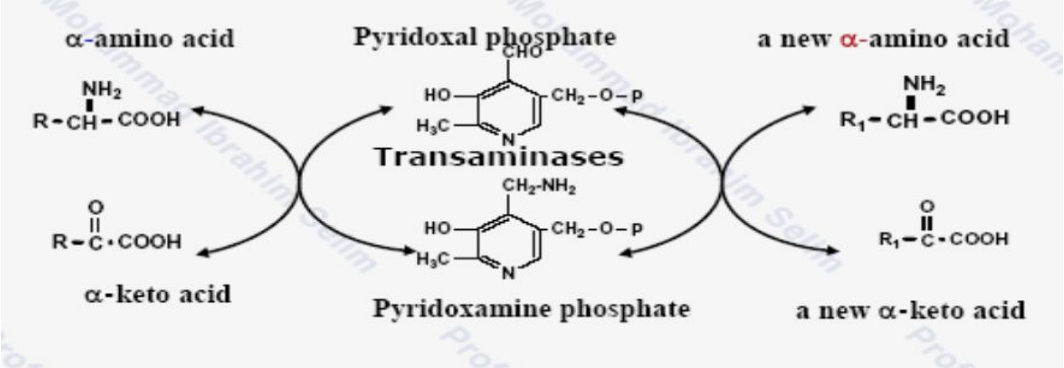
Transamination is the transfer of an amine group from α-amino acid to α-keto acid (amino acid without an amine group), thus creating a new α-amino acid and α-keto acid. This pathway is responsible for the deamination of most amino acids. This is one of the major degradation pathways which convert essential amino acids to non-essential amino acids (amino acids that can be synthesized de novo by the organism).

- The liver is the main site for transamination.
- All amino acids can be transaminated except lys, thr, pro & hy-Pro.
- All transamination reactions are reversible.
- It is catalysed by aminotransferases (transaminases).
- It needs pyridoxal phosphate as a coenzyme.



Role of pyridoxal phosphate in transamination:

Pyridoxal phosphate acts as an intermediate carrier for amino group. It accepts the amino group from amino acid to form pyridoxamine phosphate which in turn gives the amino group to α-keto acid.

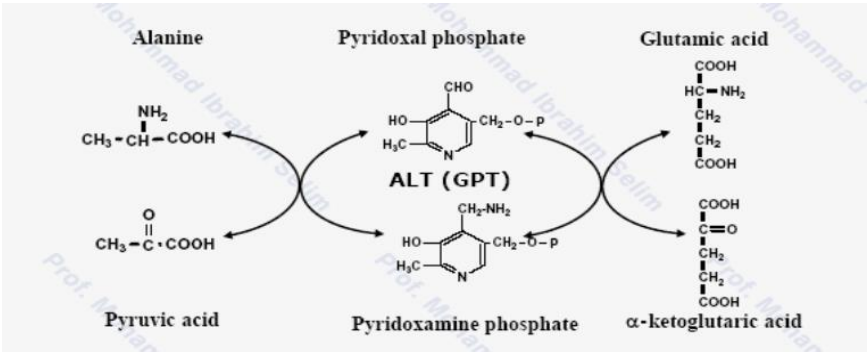


Examples of transaminases:

A. Alanine transaminase
B. Aspartate transaminase
C. Glutamate transaminase

A. Alanine transaminase (ALT):

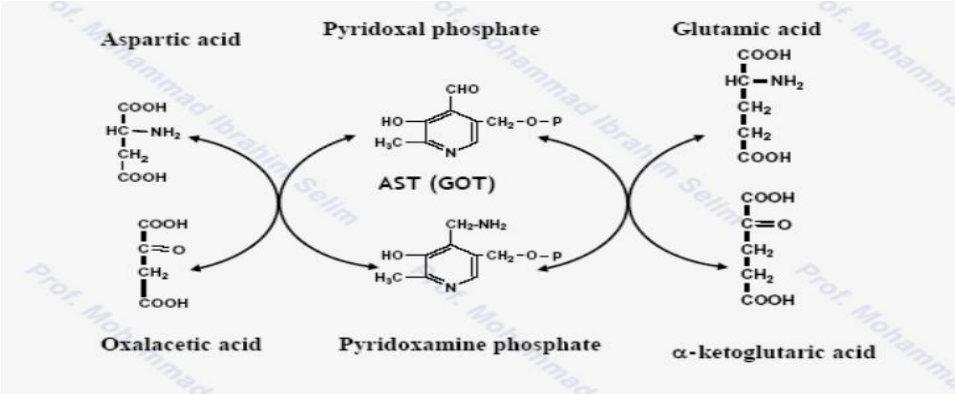
- It is also called glutamic pyruvic transaminase (GPT).
- It also catalyses the reverse reaction.
- It catalyses the transfer of amino group from glutamic acid to pyruvic acid to form alanine and α-ketoglutaric acid.
- It is present in the cytoplasm of liver cells.



B. Aspartate transaminase (AST):

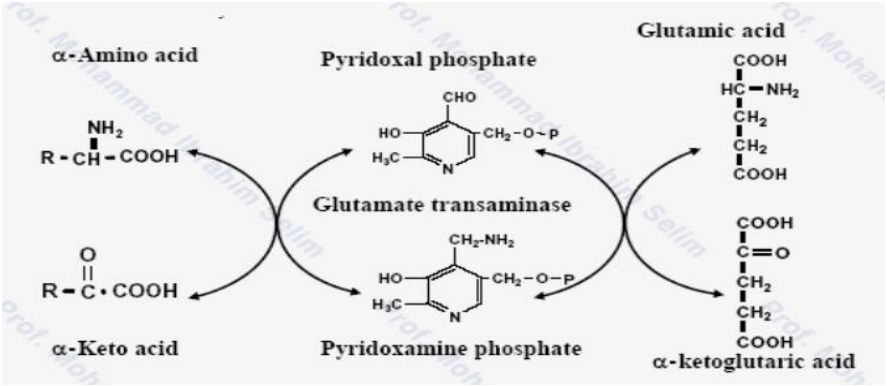
- It is also called glutamic oxalacetic transaminase (GOT).
- It also catalyses the reverse reaction.
- It catalyses the transfer of amino group from glutamic acid to oxalacetic acid to form aspartic acid and α-ketoglutaric acid.

- It is present in both cytoplasm and mitochondria of liver, heart and skeletal muscle cells.



C. *Glutamate transaminase:*

- It also catalyses the reverse reaction.
- It catalyses the transfer of amino group from any amino acid (except lys, thr, pro and Hy-Pro) to α-ketoglutaric acid to form glutamic acid and the corresponding α-keto acid.
- It is widely distributed in all tissues.



Clinical significance of serum transaminases:

- Transaminases are intracellular enzymes.
- Their levels in blood plasma are low under normal conditions.
- Any damage to the organs associated with these enzymes (liver, heart, skeletal muscles) will increase the level of transaminases in blood.
- In liver diseases, there is an increase in both serum ALT (SGPT) and AST (SGOT) levels.
- In acute liver diseases (acute viral hepatitis), the increase is more in SGPT.
- In chronic liver diseases (liver cirrhosis), the increase is more in SGOT.
- In heart diseases (myocardial infarction) and skeletal muscle diseases (myasthenia gravis), there is an increase in SGOT only.

Differences between transamination and deamination:

Topic	Transamination	Deamination
Process:	The transfer of an amino group from one molecule to another, especially from an amino acid to a keto acid.	The removal of an amino group from an amino acid to form a keto acid.
Finalization:	This process involves in the synthesis of non-essential amino acids.	This process involves in the breakdown of excess proteins.
Sites:	It occurs mainly in liver cells (also heart & skeletal muscle cells) of the body.	It occurs in liver & kidney cells.
Respective enzymes:	Transaminases (Ala, Asp, Glu) or aminotransferases catalyse this reaction.	Oxidases, dehydrogenases, dehydratases, desulfhydrases catalyse this reaction.
Result:	Results in an exchange of an amine group with a keto group.	Results in the elimination of ammonia.
Speciality:	Glutamic acid is the main form of amino acid produced in this reaction.	Glutamic acid is the primary form of amino acid, which undergo deamination.
Reversibility:	This is reversible.	This is irreversible.
Associated Coenzymes:	Pyridoxal phosphate	Oxidative: FMN, FAD, NAD/NADP Non-oxidative: Pyridoxal phosphate