Catabolism of Amino Acids

following stages are involved

(1) The removal of α-amino group in the form of ammonia by following reactions.

(i) Transamination: Catalysed by aminotranferase or transaminase

(ii) Deamination :- May be oxidative or nonoxidative

(a) Oxidative deamination:- Catalysed By glutamate dehydrogenase or aminoacid oxidase

(b) Nonoxidative deamination: Calalysed by amino acid dehydratase

(2) Disposal of ammonia in the form of urea in liver by reactions of urea cycle.

(3) Catabolism of remaining carbon skeleton of amino acid to CO_2 and water by reactions of "Citric Acid cycle"

Transamination

Defination:- Involves transfer of α-amino group from α-amino acid to α-keto acid to form new α-amino acid and a new α-keto acid. without any loss of amino group.

Reaction is cattalysed by aminotransfererase or transaminase.

⇒ α-ketoglutarate is most common acceptor of amino group.

⇒ All transaminase require Pyridoxal Phosphate as Coenzymes (PLP)

Common examples of transaminase are alanine transaminase (ALT) and Aspartate transaminase (AST)

ALT :- also called glutamate pyruvate transaminase (GPT) Catalyse transfer of amino grop of alanine to α-ketoglutarate resulting in formation of pyruvate and L-glutamate

$$\text{L-Alanine} + \alpha\text{-ketoglutarate} \xrightarrow[\text{PLP}]{\text{ALT}} \text{Pyruvate} + \text{L-glutamate}$$

AST :- Also Called glutamate oxaloacetate transaminase (GOT) which Catalyse transfer of amino gropof Aspartate to α-ketoglutarate resulting in formation of oxaloacetate & L-glutamate

$$\text{L-Aspartate} + \alpha\text{-Ketoglutarate} \xrightarrow[\text{PLP}]{\text{AST}} \text{Oxaloacetate} + \text{L-glutamate}$$

Teacher's Signature : _____

Metabolic significance of transamination reaction

⇒ Provide mechanism for collecting amino group from all α-amino acid and introducing in α-ketoglutarate to form L-glutamate

⇒ L-glutamate is the only amino acid whose amino group can easily removed by oxidative deamination than other amino acids.

⇒ Because transamination reaction is reversible so it can function as both catabolism & synthesis of amino acids.

Clinical significance of transaminase enzyme:

⇒ Elevated serum level of transaminase as SGPT, SGOT are an important in diagnosis of liver and heart damage.

liver → liver cirrhosis, Jaundice

Myocardial infarction, heart muscle shredding

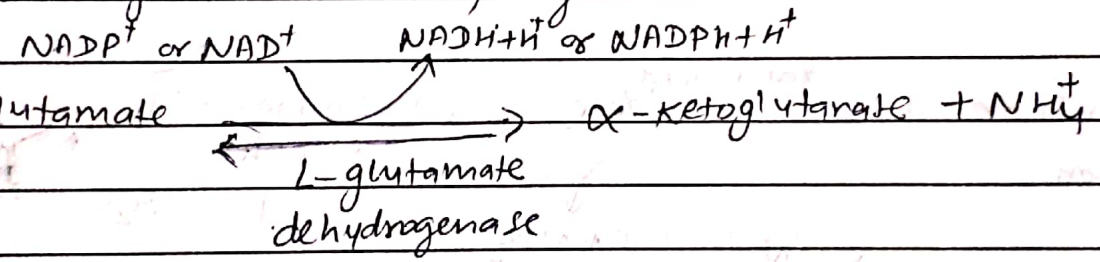
Deamination

Oxidative deamination :- By Glutamate dehydrogenase

The α-amino group of most of the α-amino acids are transfered to α-ketoglutarate by transaminase forming L-glutamate.

The L-glutamate next undergoes oxidative deamination by the action of L-glutamate dehydrogenase which require NAD^+ or $NADP^+$ as oxidising agents.

⇒ Thus the net removal of α-amino group to amonia requires the combined action of glutamate transaminase and glutamate dehydrogenase.



Metabolic significance :-

⇒ being reversible in nature, this reaction function both in catabolism and biosynthesis.

Clinical significance :- In normal stage glutamate dehydrogenase present in trace amount in serum. But increased activities are observed in cases of liver disease.

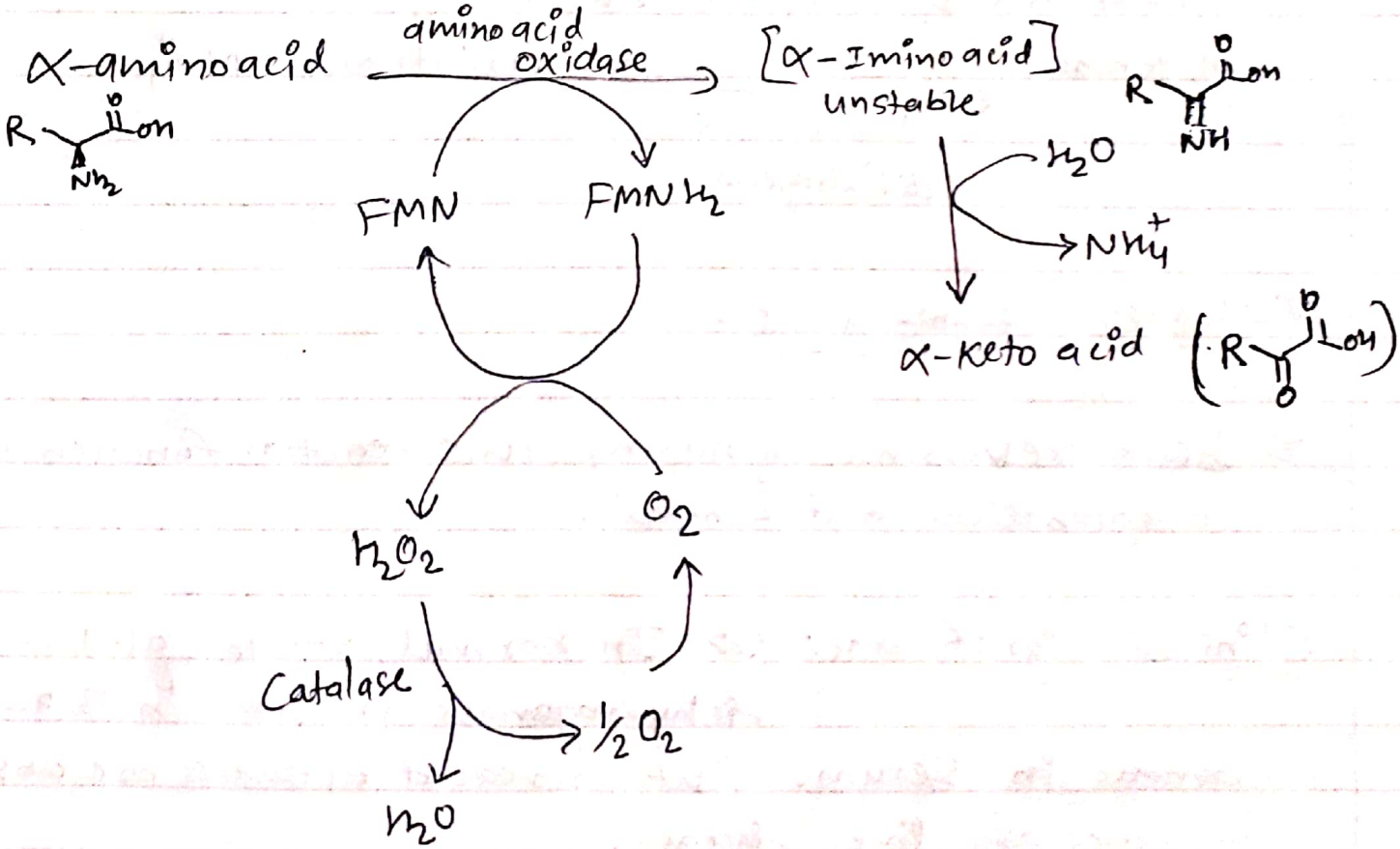
Oxidative deamination by amino acid oxidases :-

⇒ Both D & L-amino acid oxidases occurs in the Kidney & liver with low activities.

⇒ These enzyme uses alto oxidisable FMN or FAD as ~~oxidising~~ coenzyme.

⇒ The enzyme oxidise α-amino acid to less stable α-imino acid which upon ~~undergoes~~ decomposition form α-Keto glutarate and ammonium ion.

⇒ In this reaction oxygen is reduced to H_2O_2, which is later decomposed to H_2O & O_2 by Catalase.



Metabolic Significance :-

By this ~~reaction~~ reaction, D-amino acid is metabolised in liver using D-amino acid oxidase.

Non oxidative deamination ~~by~~ amino acid dehydratase

⇒ The α-amino group of serine and threonine can be directly deaminated in to NH_4^+ ion. These amino acid contain OH group attached to it's β-carbon

⇒ These reaction are catalysed by serine dehydratase and Threonine dehydratase using Pyridoxal phosphate as coenzyme (PLP)

Serine $\xrightarrow{\text{Serine dehydratase}}$ pyruvate + NH_4^+

Threonine $\xrightarrow{\text{Threonine dehydratase}}$ α-Ketobutyrate + NH_4^+