

الكيمياء الحياتية  
أعداد د. أيمن عبد الوهاب  
المرحلة الأولى

Lec 6

# Digestion and Absorption of Proteins

## Digestion:

In stomach : enzyme are:    **1. Rennin**        **2. Pepsin**

**Rennin** is active in infants and is involved in curdling of milk.

**Pepsin** is secreted from chief cells of stomach as inactive pepsinogen.

**Pancreatic juice** : contain **trypsin , chymotrypsin , elastas etc .**

Intestinal digestion of proteins: complete digestion of the small peptides to amino acids.

Absorption of amino acids is mainly in small intestine, the process require of an energy.

## Dynamic Equilibrium:

It means there are balance in **synthesis** and **Break down** of tissues(protein).

All tissues and blood have constant 1.**composition** and 2. **size** of proteins. In man 70 k gm , about **400** gm of protein is **synthesized** daily and **much** is also **degraded**.

Nitrogen balance: means amount of nitrogen intake in food(mainly as protein ) is equal to the amount of nitrogen excretion in urine as urea, uric acid ,creatinin. ex: healthy adult.

Positive nitrogen: means amount of nitrogen intake in food is more than nitrogen excretion in urine. ex: growing periods, pregnancy, adolescence

**Negative nitrogen:** means nitrogen intake in food is less than nitrogen excretion in urine. ex: starvation, malnutrition, low protein intake, old age.

## **Pathway of protein metabolism**

1. **Anabolism:** synthesis of

a. tissue proteins, blood proteins, enzymes, hormones.

b. synthesis of non protein nitrogen compound.

like creatinin, urea, purine, pyrimidine.

2. **Catabolism:** break down

a. transamination      b. oxidative deamination

c. decarboxylation      d. formation of urea

e. utilization of nitrogen to glutamine

## Amino acids in the blood:

All amino acids occur in blood in varying concentration.

In post absorptive state: **30- 50** mg/ dl of total amino acids is present in the blood(amino acid contain **4- 5** mg/dl of nitrogen).

Following protein containing meal: the total level of amino acids rise to **45- 100** mg/dl and(amino acid nitrogen **6-10** mg/dl).

## Amino acids in the tissues:

The amount of **amino acids** in **tissues** at any moment = amino acids **absorbed** from **intestine(diet)** + amino acids result from **break down of tissue**.

In starvation: The amount of amino acids increased in tissue due to **tissue break down** only because no absorption from intestine(no diet).

# Pathway of proteins and amino acid metabolism

Proteins from: **diet** and **tissue break down**  $\longrightarrow$  A.As  
 $\downarrow$   
 keto acid + NH<sub>3</sub>

NH<sub>3</sub>  $\begin{cases} \longrightarrow \text{urea, creatinine, uric acid, etc---} \\ \longrightarrow \text{new a.as (non essential a.as).} \end{cases}$

**Keto acid**  $\xrightarrow{\text{TCA cycle}}$  CO<sub>2</sub> + H<sub>2</sub>O

$\xrightarrow{\text{glucogenic a.as}}$  Glucose

$\xrightarrow{\text{ketogenic a.as}}$  Acetyl CoA

Glucogenic a.as

Ketogenic a.as

Glucogenic and Ketogenic a.as

valine, serine, glycine,  
lysine, phenylalanine,

leucine

isoleucine,

alanine, cystine, cysteine,

tyrosine, tryptophanes

Threonine, methionine, histidine, Arginine.

# Metabolism of amino acids

1. Transamination: transfer of NH<sub>2</sub> group from one amino acid to keto acid resulting in the formation of new amino acid and new keto acid.

Importance: 1. synthesis of any non essential amino acids body needs. 2. convert excess amino acids to keto acids to make control blood level amino acids.

Examples:

L- glutamic acid + oxaloacetic acid  $\xrightarrow{\text{sGOT or AST}}$  keto-glutaric acid + L- aspartic acid

L-glutamic acid + pyruvic acid  $\xrightarrow{\text{sGPT or ALT}}$  keto- glutaric acid + L-alanine

Enzymes Transaminas are:

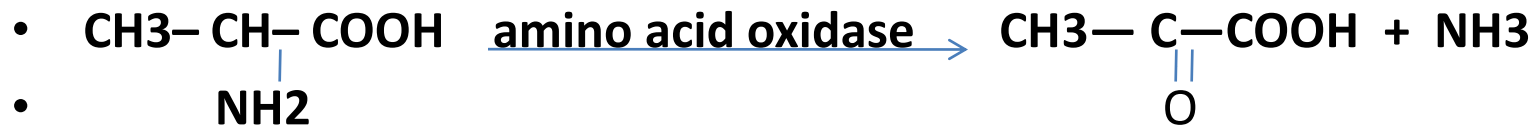
1. Glutamate oxaloacetate transaminase (GOT) or Aspartate transaminase(AST). Increased in cardiac infraction and in liver cirrhosis.

2. Glutamate pyruvate transaminase(GPT) or Alanine transaminase(ALT).

Increased in liver diseases infective hepatitis.

## 2. Oxidative Deamination:

- Removal of **amino group** from **amino acids** to form **keto acid** and **ammonia(NH<sub>2</sub>)**. The enzyme is **amino oxidase**.



Alanine(amino acid)

pyruvic acid (keto acid)

## 3. Decarboxylation:

Removal of carboxyl group from amino acids gives rise to some of the biologically active amines. The enzyme is decarboxylase and phosphate as coenzyme.

histidine  $\longrightarrow$  histamine (powerful vasodilator)

tyrosine  $\longrightarrow$  tyramine (increase blood pressure)

glutamic acid  $\longrightarrow$  aminobutyric acid (stimulates neuronal activity).

tryptophan  $\longrightarrow$  tryptamine



**Blood Proteins:** includes

1. **Albumin(A)**   2. **Globulin(G)**   3. **Fibrinogen**

Normal value:

**A** = 3.5 - 5.0 mg/dl (53%)

**G** = 2.3 - 3.5 mg/dl (47%)

Normal ratio A/ G = 1.2 / 1

**Hyperproteinemia** : increase level of plasma protein from their normal value (**increase both A and G**).

↑ is shown in **dehydration and multiple myeloma**.

**Hypoproteienemia**: decrease level of plasma protein from their normal value ( decrease both A and G). A/G also decrease. Is shown in:

**1. malnutrition   2. mal absorption**  
**3. hemorrhage   4. kidney disorder   5. liver disease.**

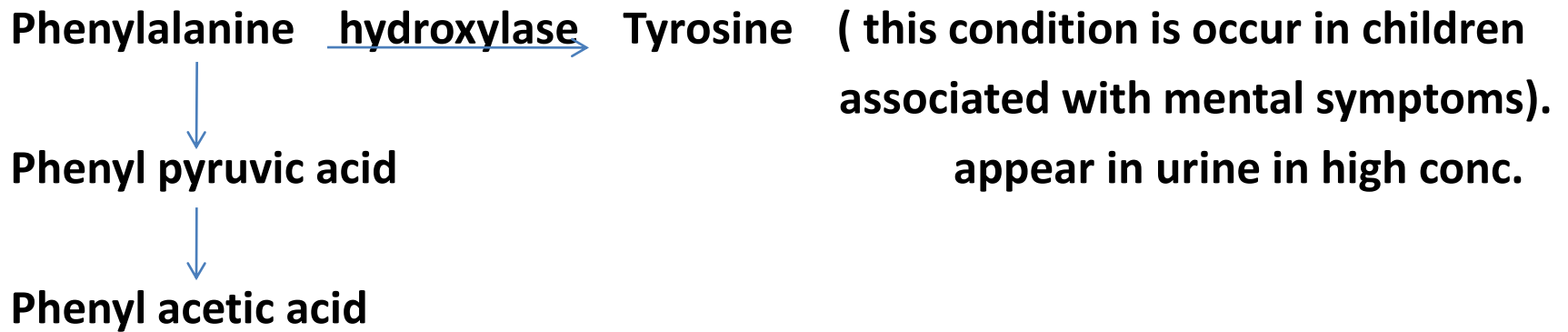
## Disturbance in protein metabolism:

Occur due to :

1. lower or inadequate protein intake(especially E.A.A).
2. Incomplete digestion and absorption of proteins.
3. Disorder in CHO and lipids metabolism.
4. Genetic impairment . Ex: abnormal hemoglobin, clotting factor deficiency).

## Inborn error metabolism of amino acids

1. **phenyl ketonuria**: accumulation of phenylketonic compound due to absence of enzyme phenylalanine hydroxylase in liver ,which responsible for conversion of phenylalanine into tyrosine lead to formation of phenyl pyruvic acid and phenyl acetic acid appear in urine.

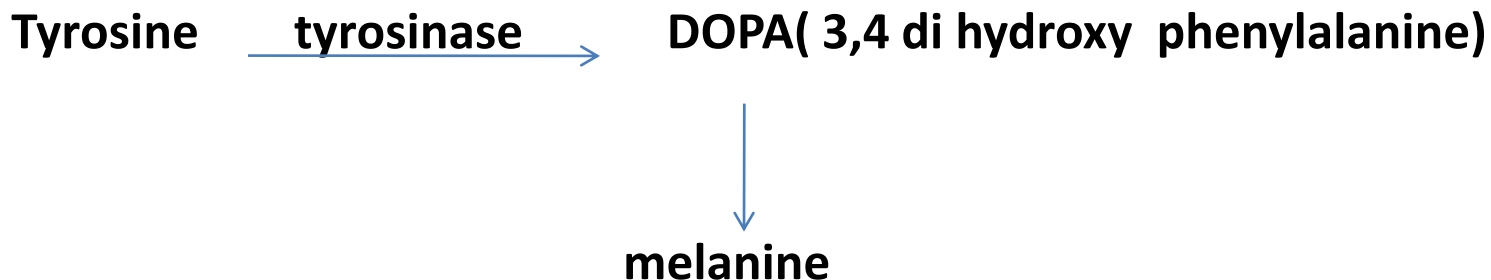


## 2. Tyrosinosis:

## 3. Albinism:

Greek word, albino means, white. it is disease with an incidence of one in 20.000

population . Albinism is defect in melanin synthesis due to completely absent of tyrosinase enzyme. ( the skin has low pigmentation and sensitive to UV rays, iris may be grey, hair white).



## Non protein nitrogen compound:

They are non protein compounds however they have nitrogen group and formed from elimination of amine group from amino acid such as , urea, creatinin, uric acid , ammonia, etc---

## Transportation of ammonia:

- 1. The final de amination and production of ammonia is taking place in liver.**
- 2. Glutamic acid the major transport form of ammonia from the tissues to the liver. The concentration of glutamic acid in the blood is 10 times than other amino acids.**
- 3. glutamine and asparagine are the transport forms of ammonia in brain. (they are the first line of defense against ammonia toxicity).**