

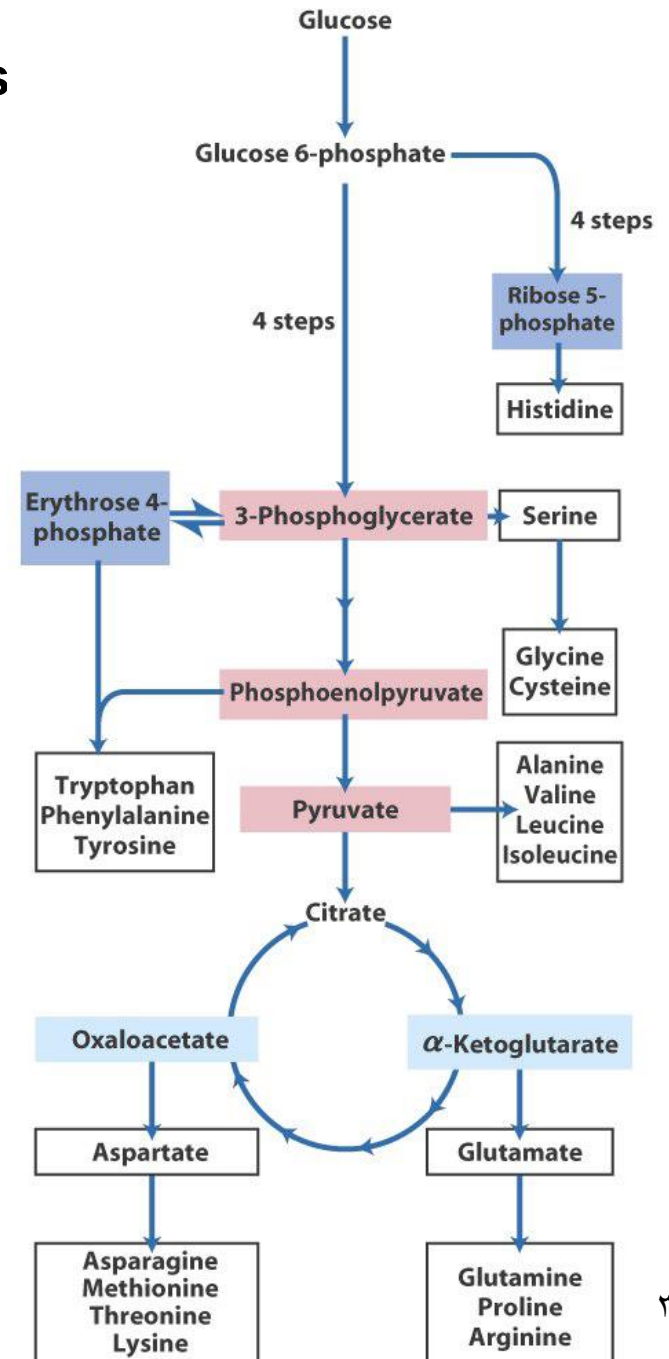
Metabolism of amino acids and proteins

- Plants and bacteria synthesize all twenty amino acids , whereas , most other organisms obtain at least some of the required amino acids from their diet . Humans can only synthesize about half of the twenty amino acids .
- In general , the more complex amino acids are essential amino acids in humans as they require enzymes that have been lost from the human genome over evolutionary time .
- Concentration of total protein in serum ranges from (6 – 8) g / dl and about 0.3 g / dl higher for plasma because of the presence of fibrinogen .
- Amino acids classified as ketogenic and glucogenic according to their metabolic end product (ketogenic a.a. whose catabolism produce acetyl coA or KBs while glucogenic a.a. whose catabolism produce pyruvate or intermediates of the CAC).

Overview of Amino Acids Biosynthesis

Twenty amino acids are used during synthesis of protein, which occurs in ribosomes. Ten of these can be synthesized in the body from glucose (NEAA). The other ten are required in the diet (EAA), can not be synthesized in the body.

<i>Essential Amino Acids</i>	<i>Nonessential Amino Acids</i>
<i>Arginine*</i> <i>Histidine</i> <i>Isoleucine</i> <i>Leucine</i> <i>Lysine</i> <i>Methionine</i> <i>Phenylalanine</i> <i>Threonine</i> <i>Tryptophan</i> <i>Valine</i>	Alanine Asparagine Aspartate Cysteine Glutamate Glutamine Glycine Proline Serine Tyrosine*



Arginine is listed as an essential amino acid because humans require arginine in their diet to support rapid growth during childhood and pregnancy . However , arginine is actually generated from argininosuccinate in the ***urea cycle*** , which means that a small amount of this "essential" amino acid is made available for protein synthesis through this route .

Notes :

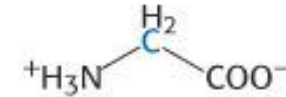
- 1 . The carbon skeletons of the 10 NEAA derived from glucose are produced from intermediates of the glycolysis and the CAC .
- 2 . Three example of protein functions :
 - Catalysis (almost all chemical reactions in a living cells are catalyzed by protein enzymes) .
 - Transport (some proteins transports various substances , such as oxygen , ions , fatty acids ,.....) .
 - Information transfer for examples hormones .

Amino Acids as Metabolic Precursors

The nitrogen content of amino acids (the α -amino group), they are also used as metabolic precursors for numerous biomolecules, including **heme groups** (hemoglobin and cytochromes), **nucleotide bases** (purines and pyrimidines) and a variety of **signaling molecules** (hormones, and neurotransmitters).

For example, the prosthetic group of hemoglobin, myoglobin and cytochromes is **heme**, a porphyrin ring containing iron.

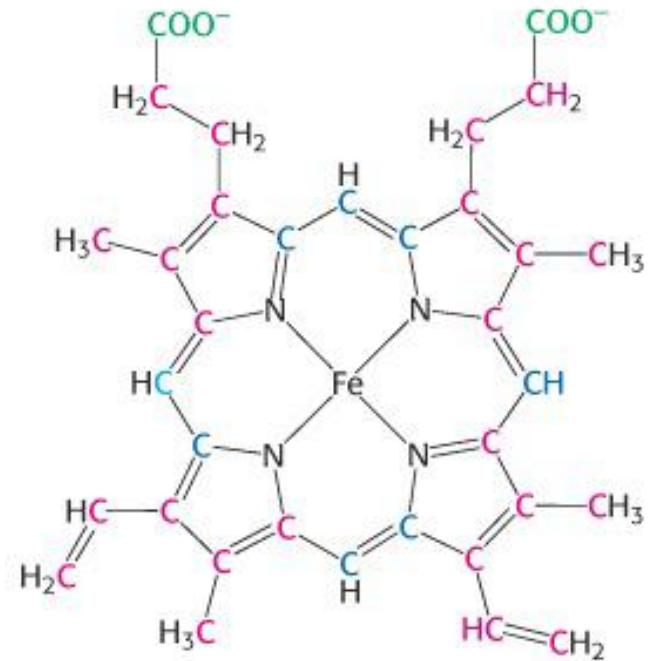
The first step in heme synthesis take place in the mitochondria with the condensation of succinyl CoA and glycine by ALA synthase to form 5-amino levulic acid (ALA).



Glycine



Acetate



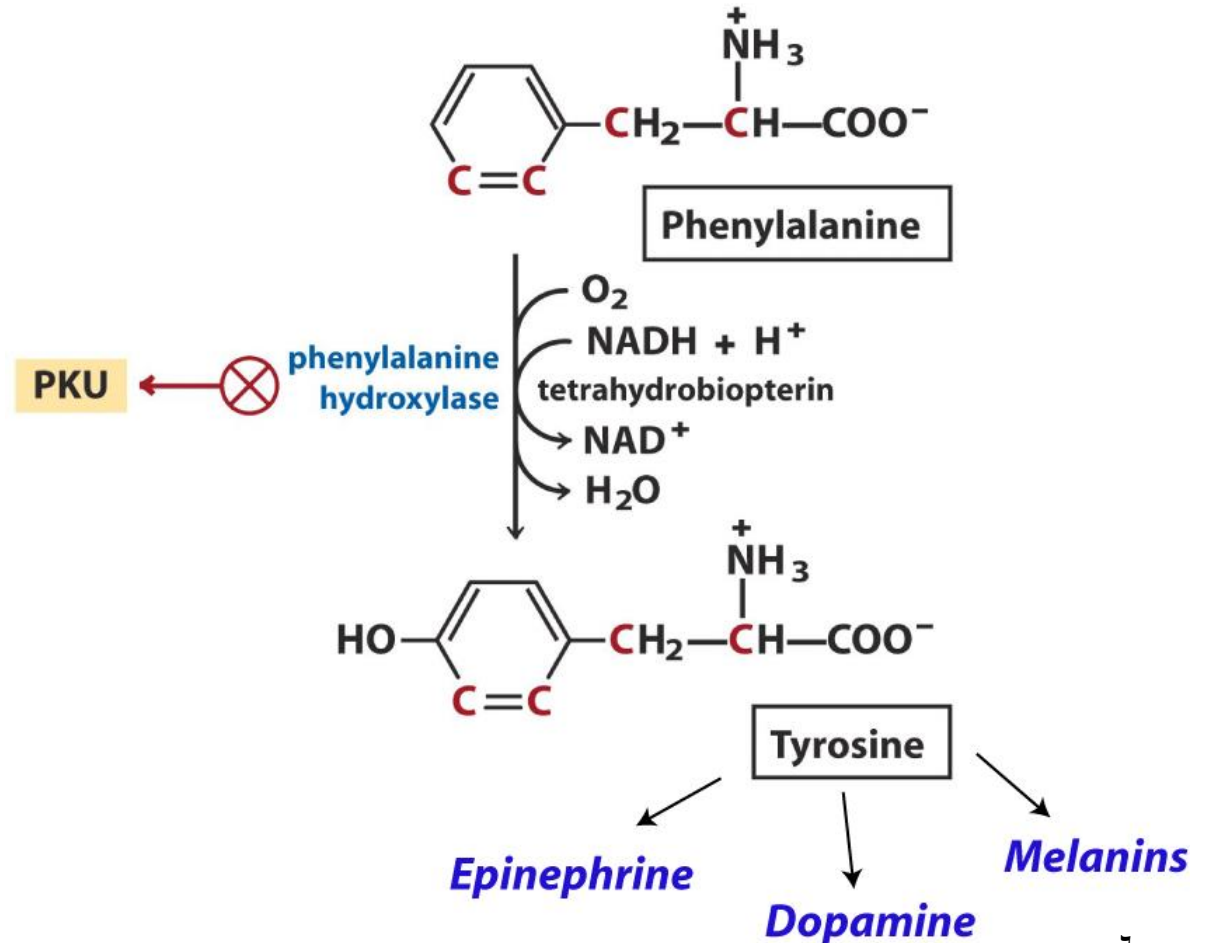
Heme

PKU and Parkinson's disease

A genetic defect in the gene encoding phenylalanine hydroxylase is responsible for the metabolic disease **phenylketonuria (PKU)**.

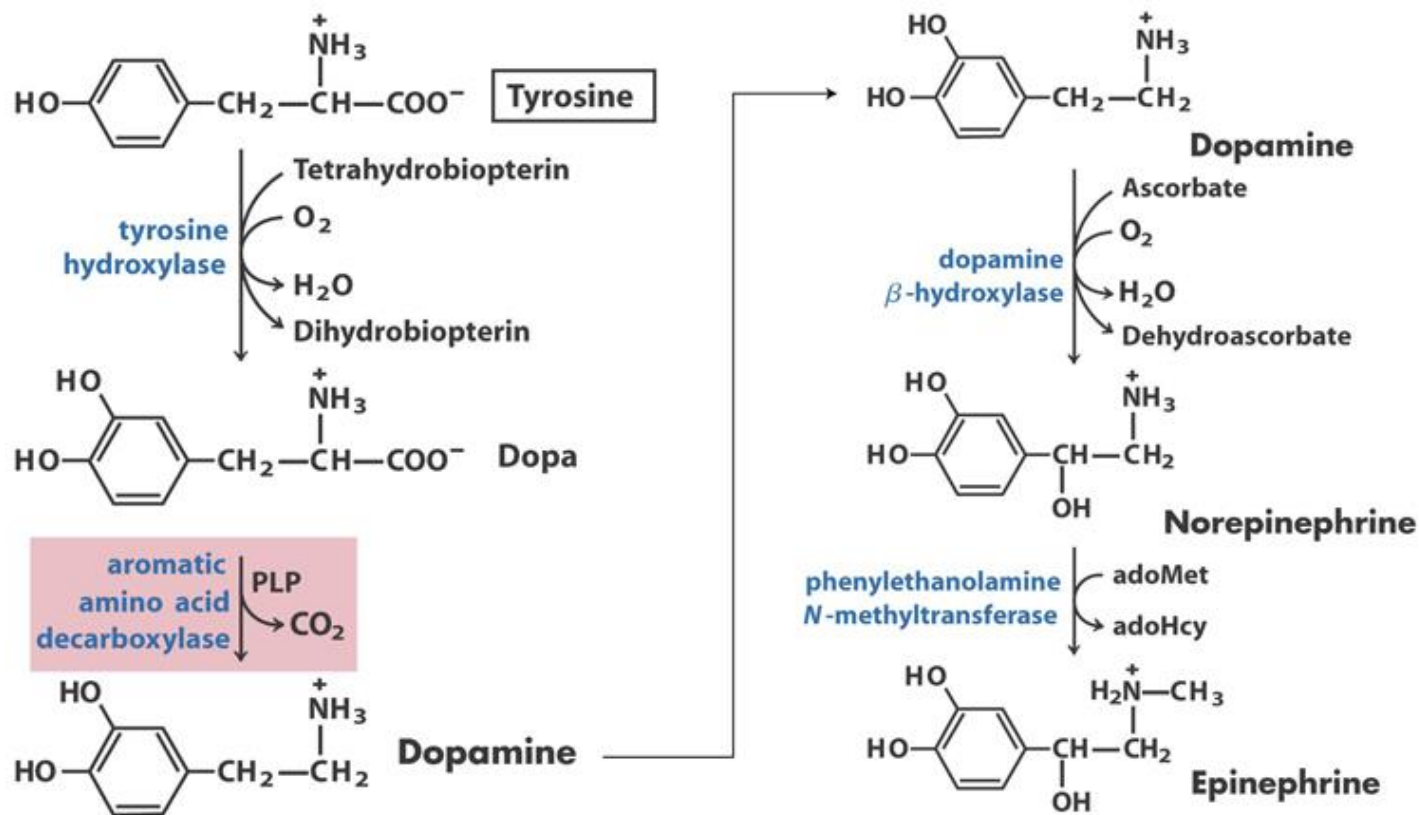
Defect in phenylalanine hydroxylase lead to PKU in which patients suffered from mental retardation, psychoses and eczema.

In parkinsons disease, dopamine level in the CNS are decreased because deficiency of cells that produce dopamine or deficiency in conversion of dopa to dopamine.



Conversion of tyrosine to norepinephrine and epinephrine in neural and adrenal cells

Many amino acids serve as neurotransmitters (e.g. glutamate , glycine) or are converted to other compounds that serve as neurotransmitters { e.g. γ - amino butyric acid (GABA) from glutamate and catecholamines from tyrosine } .

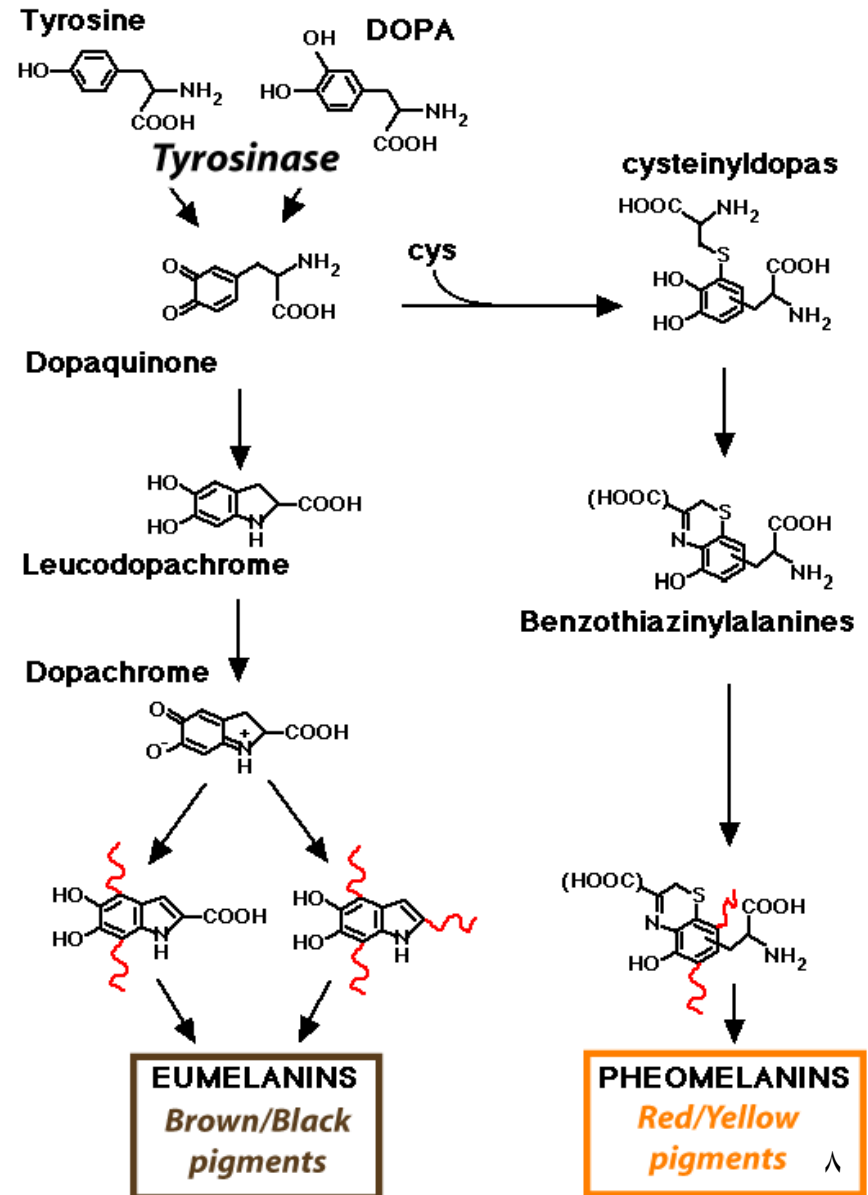


Amino Acids as Metabolic Precursors

Tyrosine is also the precursor to pigment molecules called **melanins**.

The two primary melanins are **eumelanins**, which are dark pigments having a brown or black color, and **pheomelanins** that have red or yellow color.

The yellow color of pheomelanin pigments comes from the sulfur in cysteine that is combined with dopaquinone.



Epinephrine :

Also known as adrenaline , it stimulates glycogenolysis and a variety of physiological event such as increasing depth and frequency of heart beats .

Norepinephrine :

It cause greater constriction of the blood vessels of muscles .It act as a neurotransmitter between sympathetic synthesis of catecholamines in nervous system and smooth muscle .

Note :

The levels of catecholamines are related with changes in the blood pressure of animals .

Histamine :

In the stomach , histamine promotes secretion of HcL and pepsin as digestion aids . It is a potent vasodilator , released at sites of trauma , inflammation or allergic reaction .

Serotonin :

Serotonin is synthesized from tryptophan , it is a neurotransmitter . In the intestine , serotonin regulates intestinal peristalsis . It is also a potent vasoconstrictor which helps regulate blood pressure .

Notes

- 1. In albinism , either the copper dependent tyrosine hydroxylase of melanocytes or other enzymes that convert tyrosine to melanins may be defective .**
- 2 . Parkinson's disease characterized by tremors , Shuffling gait and masking face with a staring expression .**
- 3 . Amino acids such as tyrosine and leucine are important because their clinical significance .**
- 4 . All of the diseases related with amino acid cause mental retardation .**
- 5 . Deficiency of phenyl alanine hydroxylase is**

6 . Alanine transaminase (ALT) also called glutamate pyruvate transaminase (GPT) and aspartate transaminase (AST) also called glutaruate oxaloacetate transaminase (GOT) are the two most important transaminases of clinical importance .

These enzymes are abundant in heart and liver , they are released as part of cell injury that occurs in MI , infections hepatitis and damage to either organ .

An elevated level of both SGOT and SGPT indicates damage to the liver .