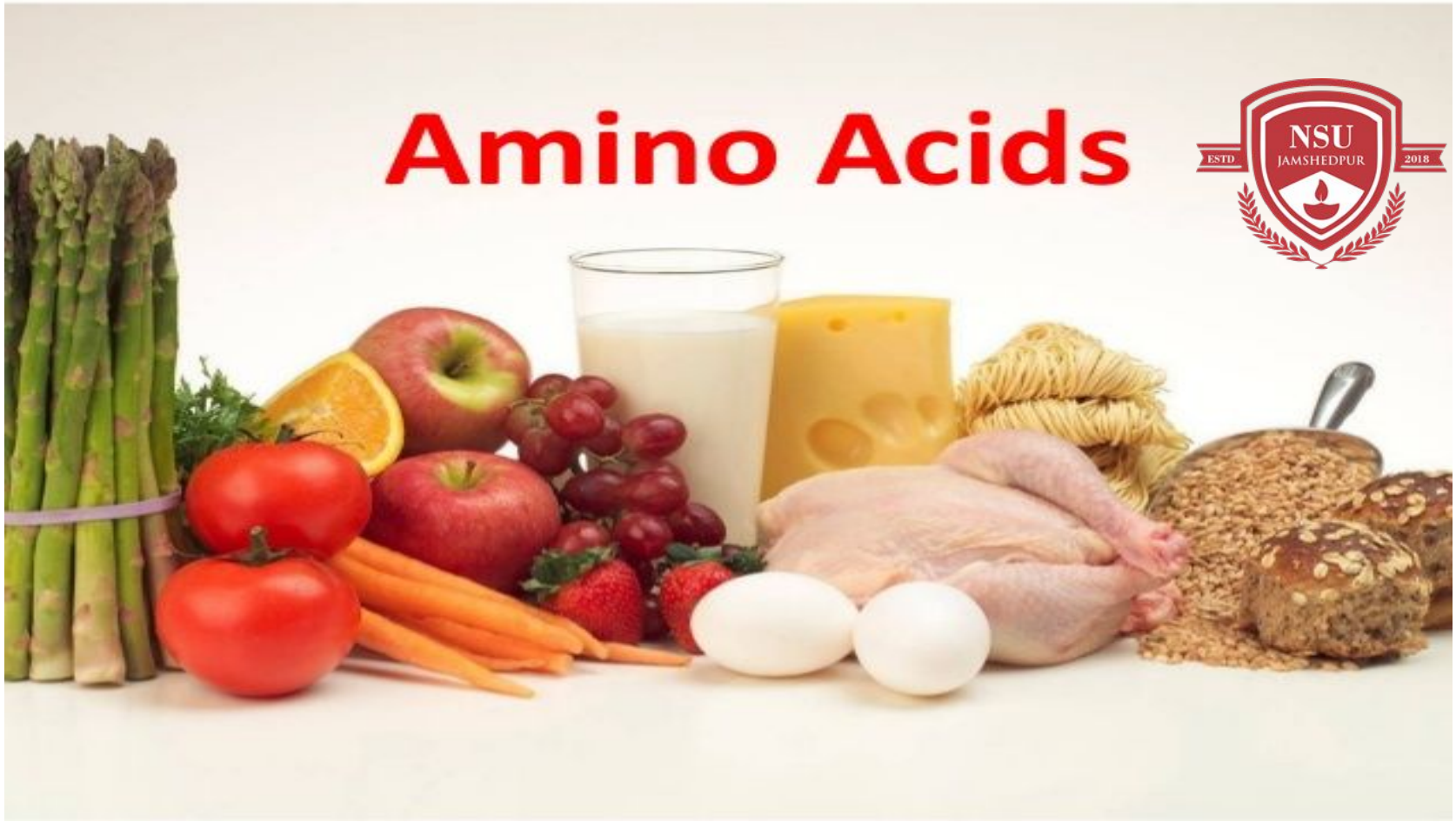

Topics :

Amino acid- Classification, essential and non-essential amino acid, nutritional significance of amino acid.

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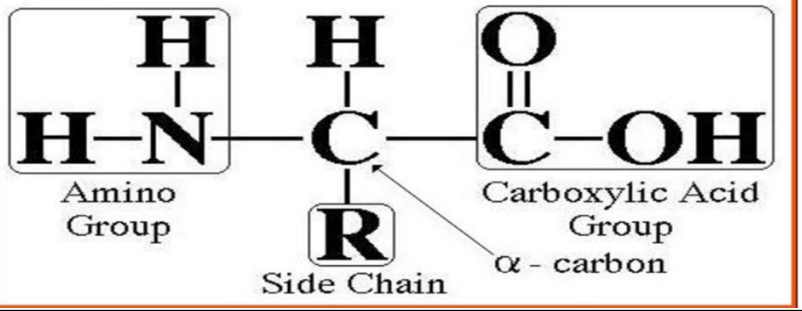
What is amino acid?

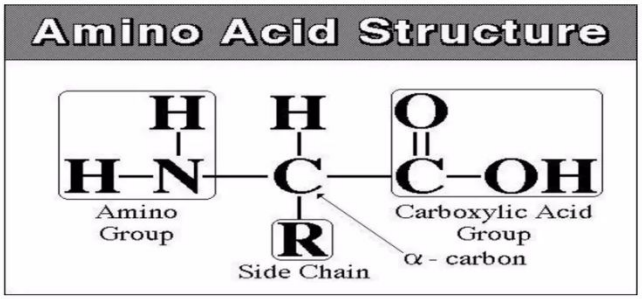
- Amino acids are the molecules having one amino group , one carboxyl group, one H atom and one specific group (R group) attached to the central C atom.
- R group varies in structure, size , electric charge and influence the solubility of amino acid in water.
- The key elements of amino acids are C,N,O,H.
- Amino acids are basic structural **building blocks of protein.**

Basic structure of amino acid



Ionic properties of amino acids

- Amino acids contain acidic (COOH) and basic (NH2) groups.

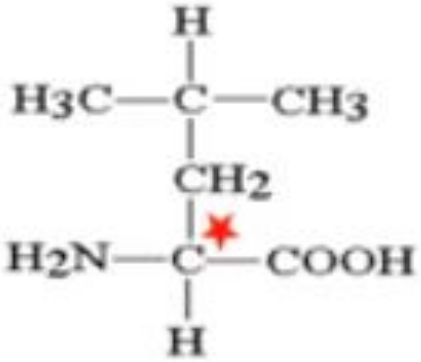


- Amino acids are usually ionized at physiologic pH

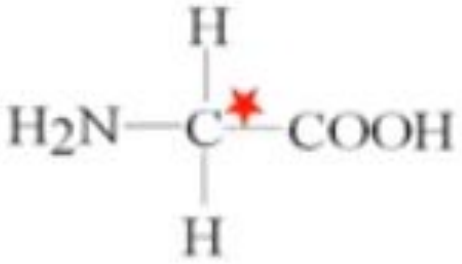
- Therefore, amino acids have amphoteric properties:
  - In acidic medium ; the amino acid is positively charged, so it behaves as a base (proton acceptor).
  - In alkaline medium ; the amino acid is negatively charged, so it behaves as an acid (proton donor).

Chirality

All amino acids contain at least one asymmetric carbon except for glycine=> all amino acids are chiral except for glycine



leucine



glycine

Stereoisomers

Pairs of isomers having

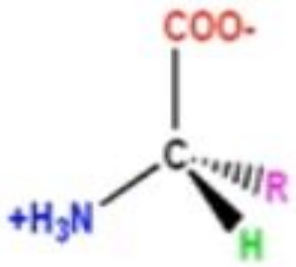
1- same connectivity to atoms

2- different spatial arrangement of atoms

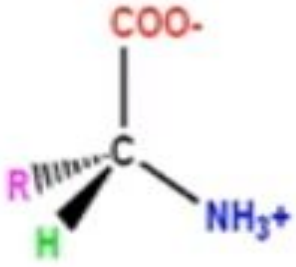
Chiral objects
Nonsuperimposable
mirror images

Enantiomers are a non superimposable mirror images

The two amino acids configurations are : **D** (Dextro) and **L** (Levo)



L- Amino acid



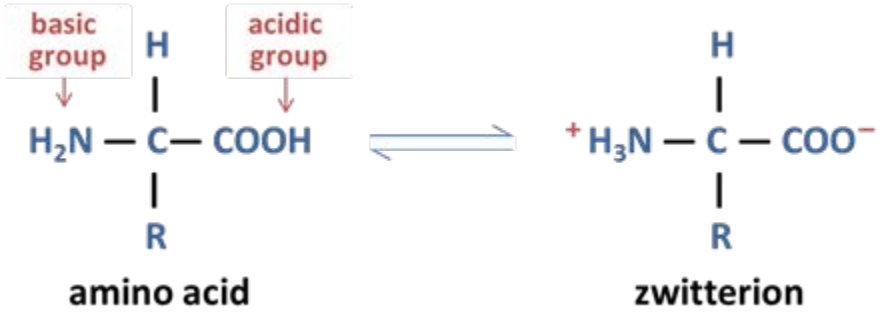
D- Amino acid

Most naturally occurring amino acids have a L−configuration.

- **L−Amino acids are represented by writing the −NH2 group on the left-hand side and**
- **D− amino acids are represented by writing the −NH2 group on the right-hand side.**

Zwitter ion

- **A zwitter ion** of an amino acid is a molecule that has a net charge of zero, but has both a positively-charged amino group and a negatively-charged carboxyl group.



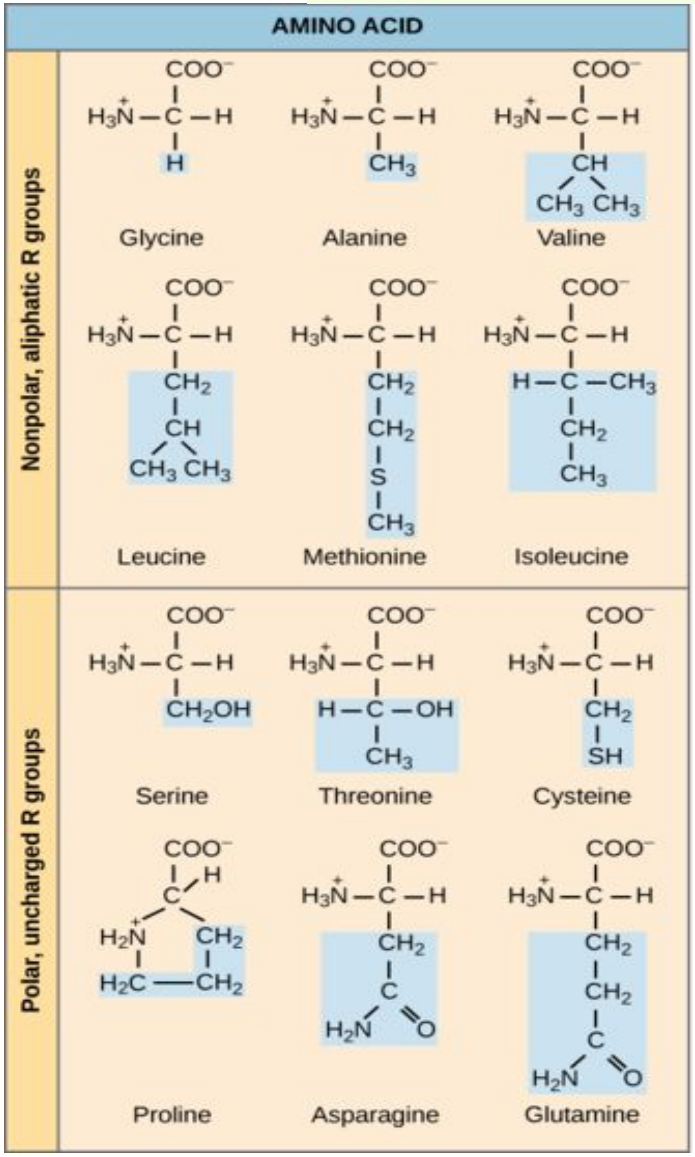
Zwitter=Charge group

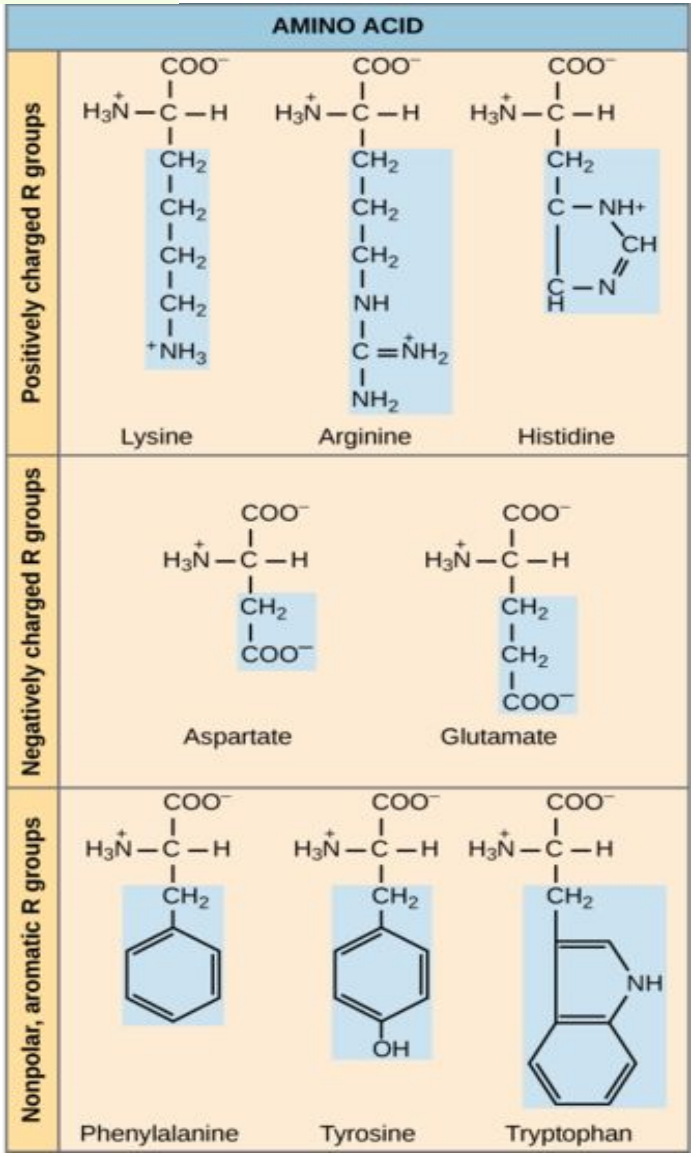
Acid: Donate H+ ion
Base: Accept H+ ion

Amino acids are the best-known examples of zwitterions. They contain an amine group (basic) and a carboxylic group (acidic).

- The -NH2 group is the stronger base, and so it picks up H+ from the -COOH group to leave a zwitterion (i.e. the amine group de-protonates the carboxylic acid):

Structure of amino acid





Nutritional classification of amino acid

Essential Amino Acids	Nonessential Amino Acids
1. They are those amino acids which the human body cannot synthesise from raw materials. 2. They are seven in number. 3. Essential amino acids are obtained from dietary proteins. ***e.g.,*** Threonine, Valine, Leucine, Isoleucine, Lysine, Methionine, Phenylalanine Tryptophan, arginine, Histidine. **Arginine and Histidine are semi essential.**	1. They are amino acids which can be sythesized by human body from raw materials. 2. They are 13 in number but one in adults and two in children are slow to be formed. 3. They need not be present in the diet. ***e.g.,*** Glycine, Alanine, Serine, Cysteine, Aspartic acid, Glutamic acid, Asparagine, Glutamine, Tyrosine, Proline

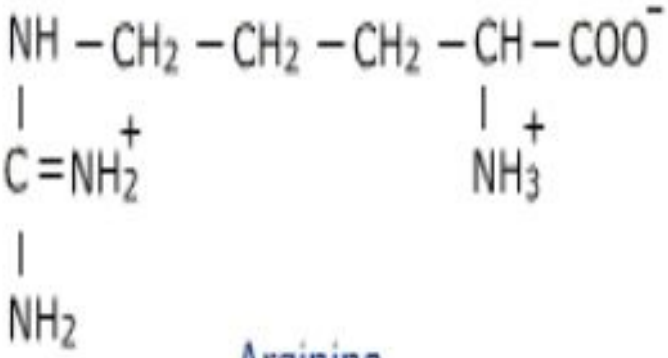
Essential amino acid

- Essential amino acids are ***not synthesized by the body.***
- Need to be ***supplied through diet.***
- Required for proper growth and maintainance of individual.

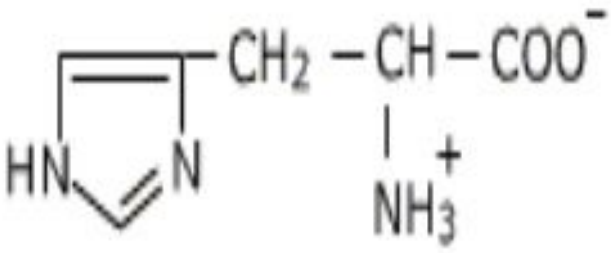
Arginine,Valine,Histidine,Isoleucine,Leucine, Lysine, Methionine, Threonine, Tryptophan, Phenylalanine

Semi-essential amino acid

- **Arginine and Histidine can be synthesized by adults but not by growing children, hence these are considered as semi-essential amino acids.**



Arginine



Histidine

Non-essential amino acid

- These **can be synthesized by the body** to meet the biological needs.
- need not to be consumed through the diet.

Glycine, Alanine, Serine, Cysteine, Aspartate, Asparagine, Glutamate, Glutamine, Proline, Tyrosine.

Essential amino acids

These cannot be synthesized within the body

- Threonine
- Histidine
- Tryptophan
- Methionine
- Phenylalanine
- Lysine

Valine **Leucine** **Isoleucine**

These are included in protein that forms muscles.
They account for 30-40% of essential amino acids.

Non-essential amino acids

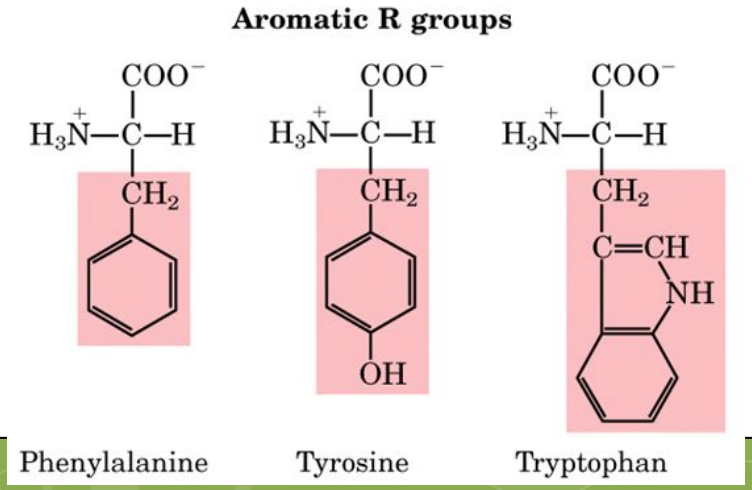
These can be synthesized within the body

- Alanine
- Aspartic acid
- Glycine
- Asparagine
- Serine
- Proline
- Glutamic acid
- Arginine
- Glutamine
- Cysteine
- Tyrosine

All amino acids are required for body growth.
Since "essential amino acids" cannot be synthesized within the body, they have to be consumed in the form of food.

AROMATIC AMINO ACID

- Aromatic amino acid contains aromatic ring. They are:
  - Phenylalanine(Benzene ring or phenyl).
  - Tyrosine(phenol).
  - Tryptophan(indole).
- Phenylalanine and Tryptophan are essential amino acids.
- Tyrosine can synthesis from Phenylalanine.



Polar, charged (R group) Amino acids

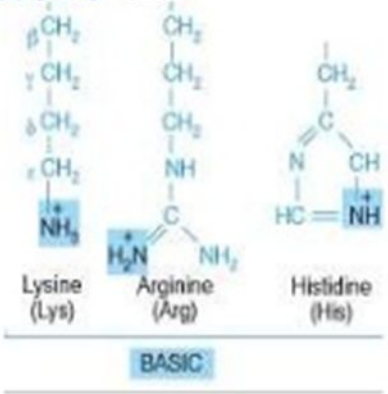
Polar **positively** charged amino acids

- More **hydrophobic** as compared to non-polar amino acids and polar uncharged amino acids.
- These are **basic** in nature.

Lysine

Arginine

Histidine

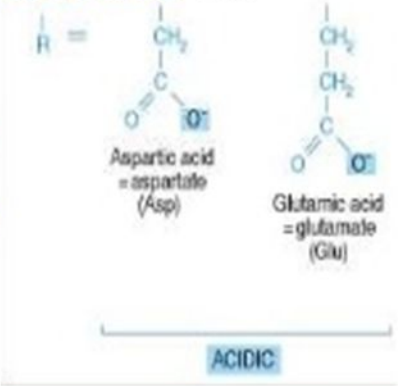


Polar **negatively** charged Amino acids

- More **hydrophilic** as compared to non-polar amino acids and polar uncharged amino acids.
- These are **acidic** in nature.

Aspartate

glutamate



SOURCES OF PROTEIN

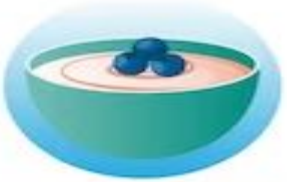

FISH


NUTS


MILK


EGGS


ALMONDS


GREEK YOGURT


CHICKEN


LENTILS


BROCCOLI


SPROUTS


OATS


SEEDS

Physical properties of amino acids

- **Solubility :** most of the amino acids are ***soluble in water but insoluble in organic solvents.***
- **Melting point:** Amino acids generally melt at high temperature , often **above 200° c.**
- **Taste:** Amino acids may be sweet(Gly , Ala, Val); tasteless (Arg, Ile);

Monosodium glutamate(MSG ; *ajinamoto)* is used as flavoring agent in food industry. In some individuals intolerant to MSG **Chinese restaurant syndrome** (flu like) is observed.

Function of Amino acid

1. **Protein Synthesis:** **Amino acids are the building blocks of proteins. During protein synthesis, amino acids are linked together in a specific sequence to form *polypeptide chains*, which then fold into functional proteins.**

2. **Enzyme Activity:** **Many enzymes, which are specialized proteins, are *catalysts* that facilitate biochemical reactions in cells.**

3. **Structural Proteins:** **Amino acids like *collagen* and *keratin* provide structural support to various tissues and organs in the body. For example, collagen is a protein found in skin, tendons, and cartilage, providing strength and elasticity.**

4. **Transport Proteins:** **Some amino acids are involved in the transport of molecules across cell membranes.**

5. **Antibodies: Immunoglobulins, which are antibodies produced by the immune system, are made up of amino acids. These antibodies help the body recognize and *defend against foreign invaders such as bacteria and viruses*.**

Function of Amino acid

6. Hormones: Some hormones, like *insulin* and *glucagon*, are proteins composed of specific sequences of amino acids. These hormones regulate blood sugar levels.

7. Neurotransmitters: Amino acids such as glutamate, *gamma-aminobutyric acid (GABA),* and *serotonin* act as neurotransmitters in the nervous system. They transmit signals between nerve cells and play a crucial role in communication within the brain.

8. pH Regulation: Amino acids can act as *buffers to help maintain the pH balance* in bodily fluids, ensuring that physiological processes occur within the appropriate pH range.

9. Detoxification: Amino acids like *glutathione* play a role in detoxifying harmful substances, including drugs and toxins, by binding to them and facilitating their removal from the body.

Essential Amino Acids:

- Histidine - new blood / tissue repair
- Isoleucine - wound healing
- Leucine - muscle/bone growth
- Lysine - bone/muscle strength
- Methionine - healthy skin/hair/nails
- Phenylalanine - brain function
- Threonine - healthy skin/teeth
- Tryptophan - regulates sleep/mood
- Valine - mental focus/coordination

THANK YOU