Ministry of Higher Education and Scientific Research
AL-Mustaqbal University College of Science
Department of medical systems

Biochemistry

Lecture 2

Amino Acid and Peptides

By
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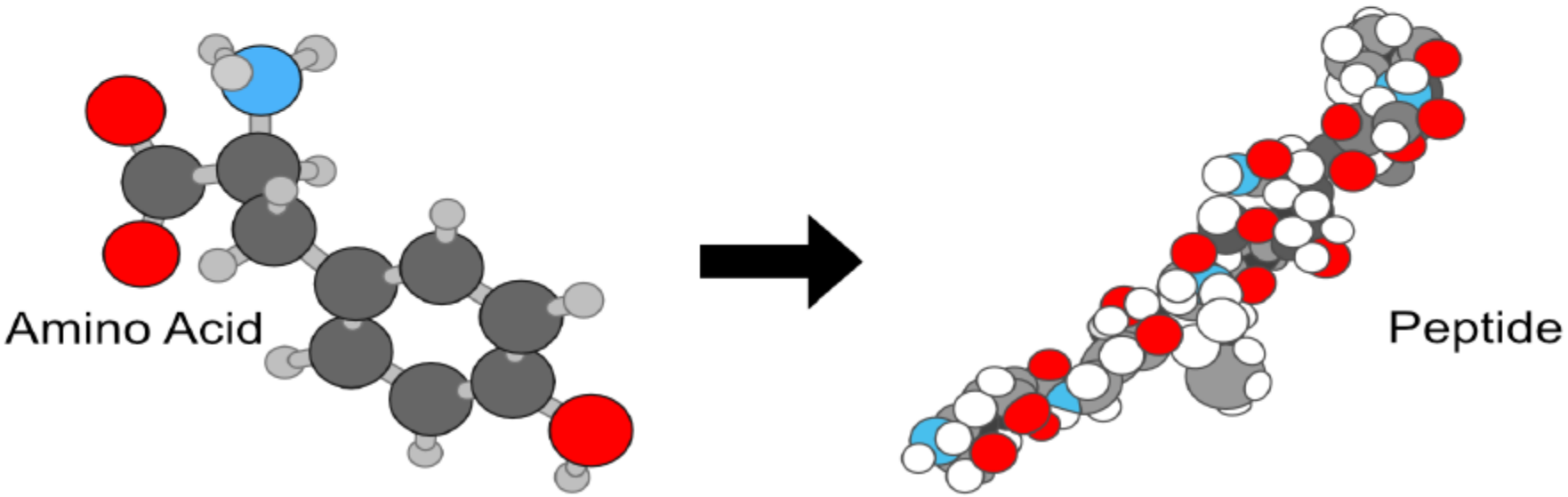
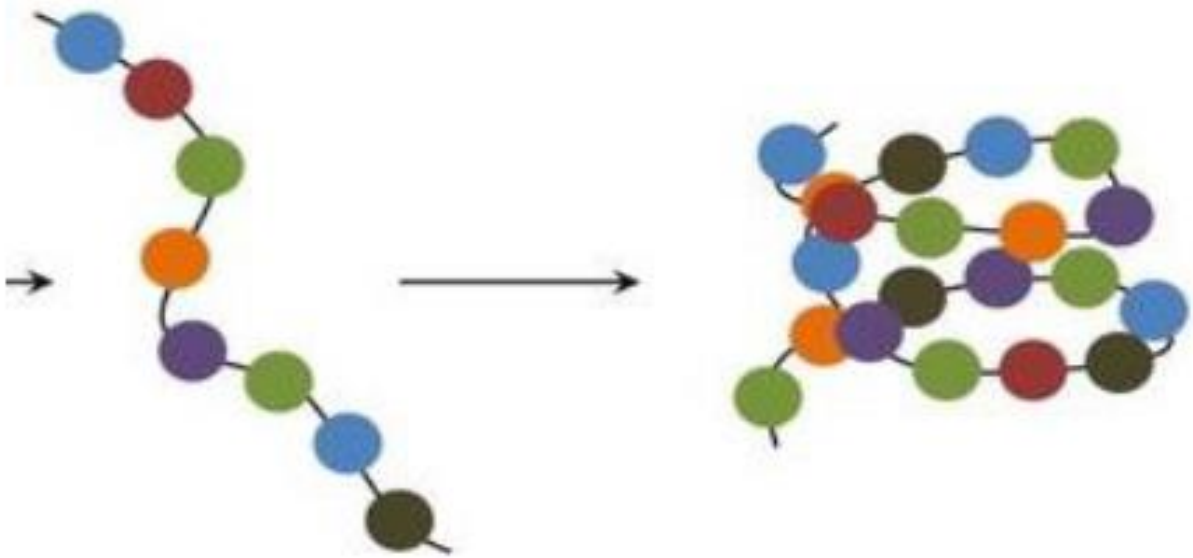
Amino acids, peptides And polypeptides



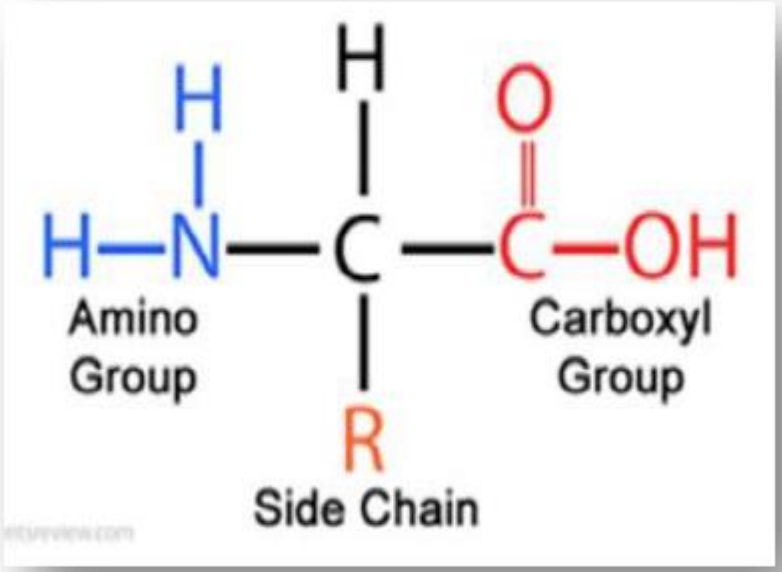


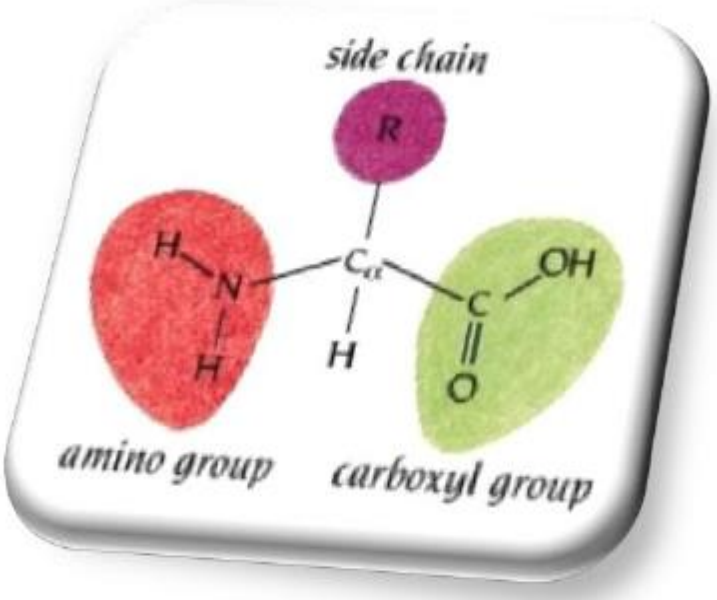
peptide protein

Amino acids:

- ✓ Amino acids are organic molecules that, when linked together with other amino acids, form a protein.
- ✓ Amino acids are essential to life because the proteins they form are involved in virtually all cell functions. General structural formula for α-amino acids.
- ✓ There are 20 different R groups in the commonly occurring amino acids.
- ✓ Generally, amino acids have the following structural properties:

1. A carbon (the alpha carbon).
2. A hydrogen atom (H).
3. A Carboxyl group (-COOH).
4. An Amin group (-NH2).
5. A "variable" group or "R" group.





❖ Amino acids differ from each other according to the specific chemical group, the **R** group.

Amino Acid Groups:

- ✓ Amino acids can be classified into four general groups based on the properties of the "R" group in each amino acid .
- ✓ Amino acids can be polar, nonpolar, positively charged, or negatively charged. Polar amino acids have "R" groups that are hydrophilic, meaning that they seek contact with aqueous solutions .
- ✓ Nonpolar amino acids are the opposite (hydrophobic) in that they avoid contact with liquid. These interactions play a major role in protein folding and give proteins their 3-D structure.
- ✓ Below is a listing of the 20 amino acids grouped by their "R" group properties .
- ✓ The nonpolar amino acids are hydrophobic, while the remaining groups are hydrophilic.

Nonpolar Amino Acids:

Ala: Alanine	Gly: Glycine	Ile: Isoleucine
Leu: Leucine	Met: Methionine	Trp: Tryptophan
Phe: Phenylalanine	Pro: Proline	Val: Valine

Polar Amino Acids:

Cys: Cysteine	Ser: Serine	Thr: Threonine
Tyr: Tyrosine	Asn: Asparagine	Gln: Glutamine

1. Polar Basic Amino Acids (Positively Charged)

His: Histidine Lys: Lysine Arg: Arginine

2. Polar Acidic Amino Acids (Negatively Charged)

Asp: Aspartate Glu: Glutamate

Classification of amino acids:

While amino acids are necessary for life, not all of them can be produced naturally in the body These:

1. Nonessential amino acids:

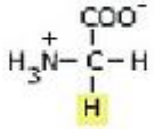
- ✓ (11 amino acids can be produced naturally) are alanine, arginine, asparagine, aspartate, cysteine, glutamate, glutamine, glycine, proline, serine, and tyrosine.
- ✓ With the exception of tyrosine, nonessential amino acids are synthesized from products or intermediates of crucial metabolic pathways. For example: alanine and aspartate are derived from substances produced during cellular respiration.
- ✓ Alanine is synthesized from pyruvate, a product of glycolysis. Aspartate is synthesized from oxaloacetate, an intermediate of the citric acid cycle.
- ✓ Six of the nonessential amino acids (arginine, cysteine, glutamine, glycine, proline, and tyrosine) are considered conditionally essential as dietary supplementation may be required during the course of an illness or in children.

2.Essential amino acids :

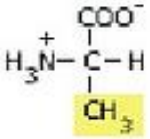
- ✓ Amino acids that cannot be produced naturally.
- ✓ They are histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine.
- ✓ Essential amino acids must be acquired through diet .
- ✓ Common food sources for these amino acids include eggs, soy protein, and whitefish.

Unlike humans, plants are capable of synthesizing all 20 amino acids.

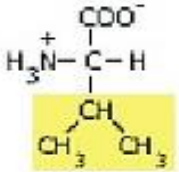
Nonpolar, alphabetical R groups



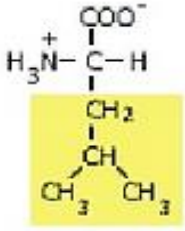
Glycine



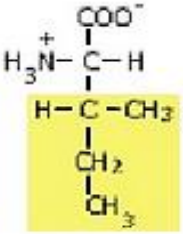
Aladine



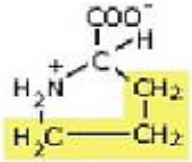
Valine



Leucine

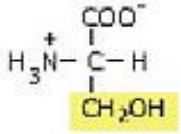


Isoleucine

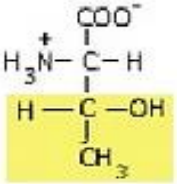


Proline

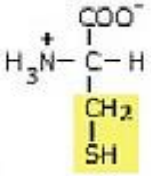
Polar, uncharged R groups



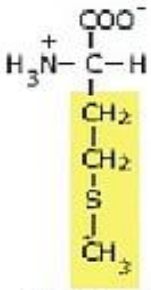
Serine



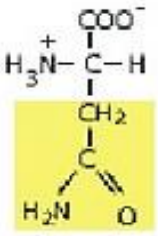
Threonine



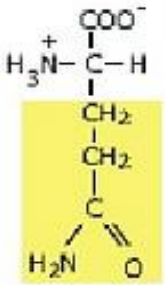
Cysteine



Methionine

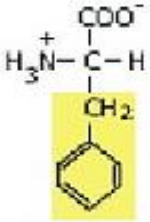


Aspargine

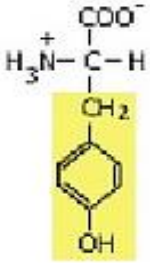


Glutamine

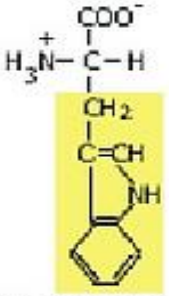
Aromatic R-groups



Phenylalanine

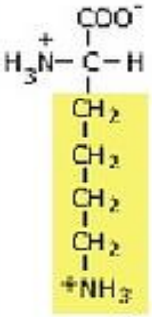


Tyrosine

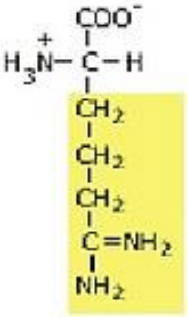


Tryptophan

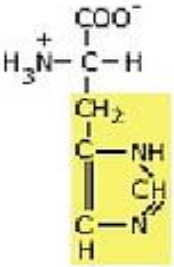
Positively charged R groups



Lysine

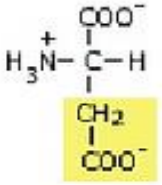


Arginine

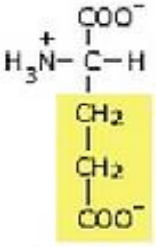


Histidine

Negatively charged R groups

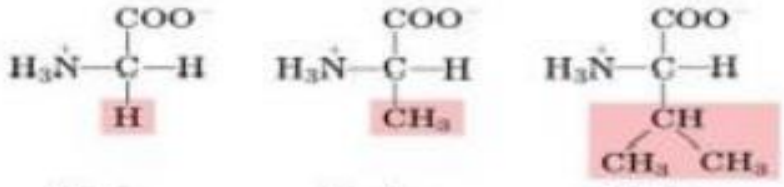


Aspartate

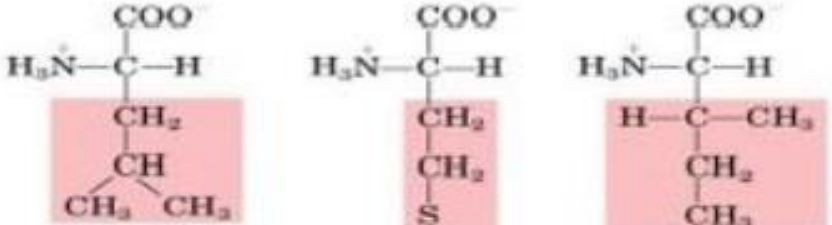


Glutamate

Nonpolar, aliphatic R groups

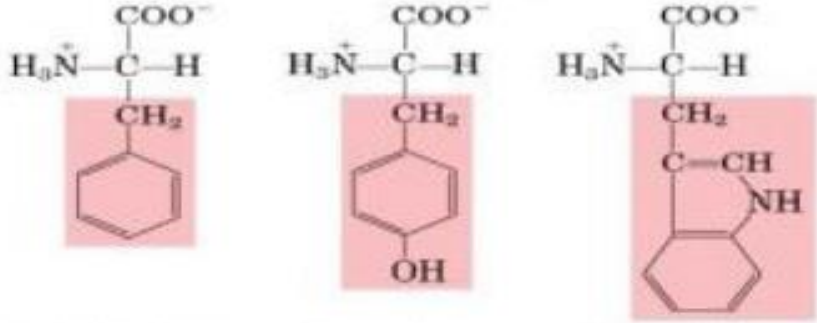


Glycine Alanine Valine



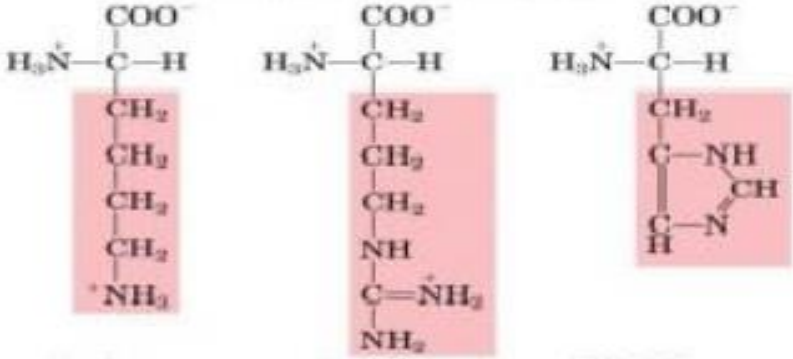
Leucine Methionine Isoleucine

Aromatic R groups



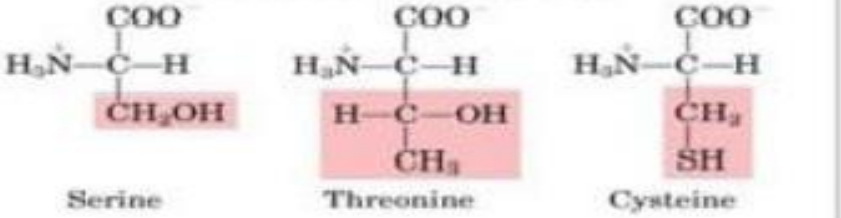
Phenylalanine Tyrosine Tryptophan

Positively charged R groups

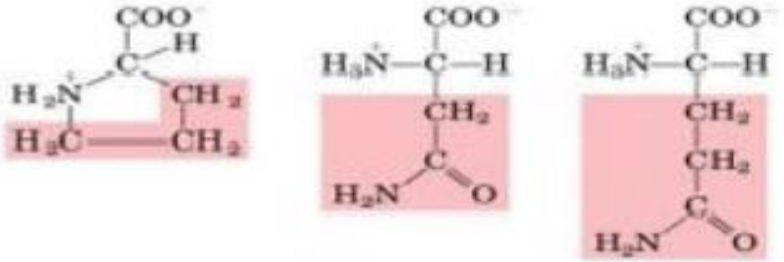


Lysine Arginine Histidine

Polar, uncharged R groups

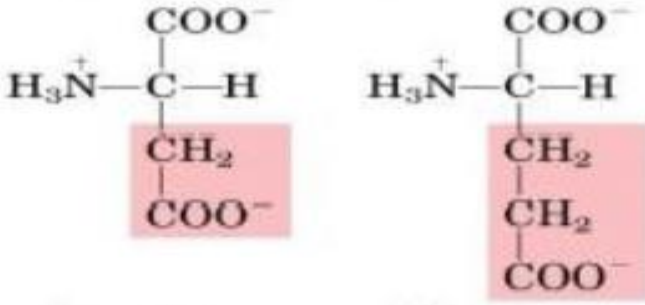


Serine Threonine Cysteine



Proline Asparagine Glutamine

Negatively charged R groups



Aspartate Glutamate

Amino acid pool:

Free amino acids are present throughout the body, for example, in cells, blood, and the extracellular fluids. This pool is supplied by three sources :

1. Amino acids provided by the degradation of body proteins.
2. Amino acids derived from dietary protein.
3. Synthesis of nonessential amino acids from simple intermediates of metabolism.

Conversely, the amino pool is depleted by three routes :

1. Synthesis of body protein .
2. Amino acids consumed as precursors of essential nitrogen-containing small molecules.
3. Conversion of amino acids to glucose, glycogen, fatty acids or CO_2.

Which groups on amino acids react to form a peptide bond?

- ✓ When the carboxyl group of one amino acid reacts with the amino group of another to give an amide linkage
- ✓ Water is eliminated in the process, and the linked amino acid residues remain after water is eliminated.
- ✓ A bond formed in this way is called a peptide bond.
- ✓ Peptides are compounds formed by linking small numbers of amino acids, ranging from two to several dozen .
- ✓ In a protein, many amino acids (usually more than a hundred) are linked by peptide bonds to form a polypeptide chain .

Types of Peptides:

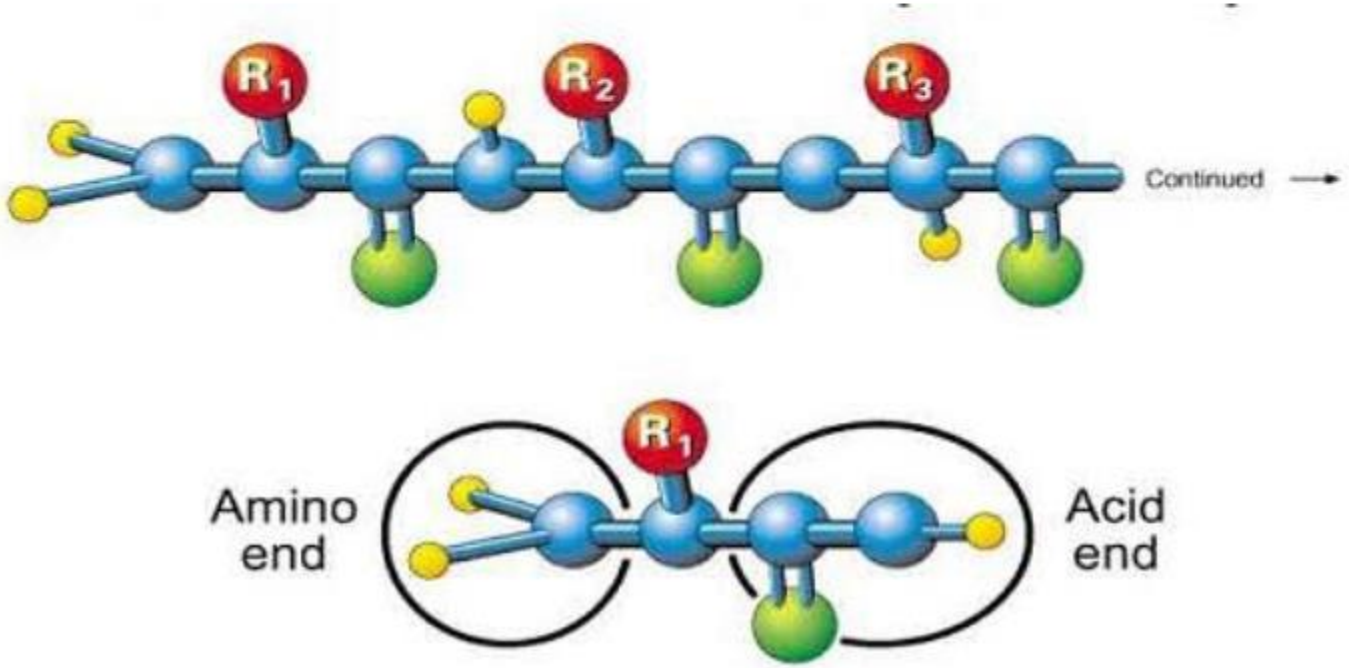
A peptide is a short-chain made up of amino acid which, together with other peptides, types of peptide:

1. Dipeptide: two amino acids
2. Oligopeptide: 5-10 amino acids
3. Polypeptide: molecular mass below5000g/mol

Protein: Molecular mass between 6000 -40,000,000g. in a protein, upward of a hundred amino acids are so joined to form a polypeptide chain.

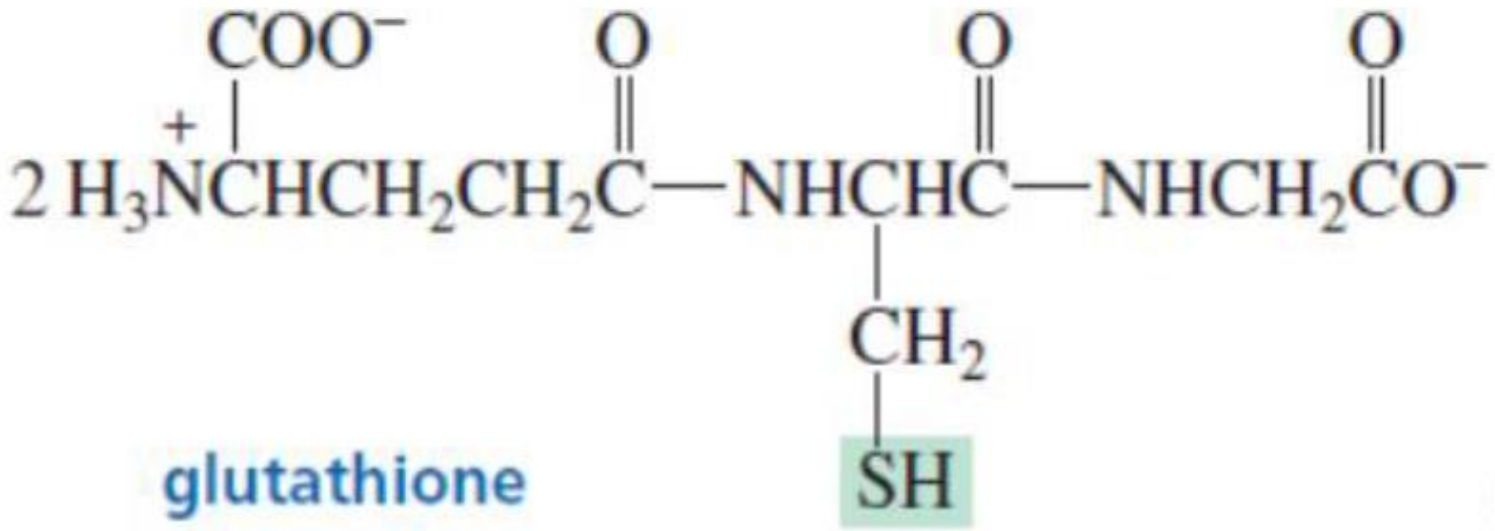
Polypeptides:

- ✓ Polypeptides are chains of amino acids .
- ✓ Proteins are made up of one or more polypeptide molecules.
- ✓ The amino acids are linked covalently by peptide bonds .
- ✓ One end of every polypeptide, called the amino terminal or N-terminal, has a free amino group. The other end, with its free carboxyl group, is called the carboxyl terminal or C-terminal.



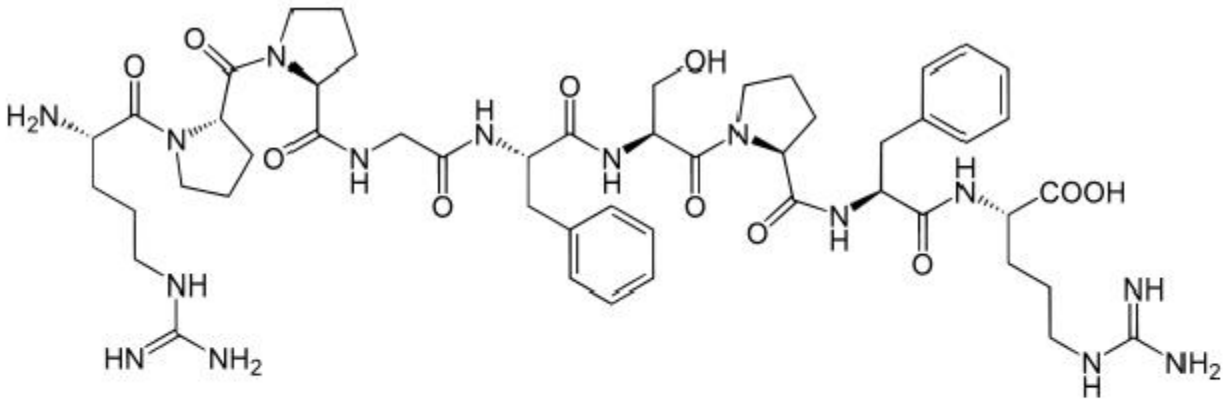
Some Biologically important peptides:

1. **Glutathione:** is a substance made from the amino acids glycine, cysteine, and glutamic acid .It is produced by the liver and involved in many body processes.



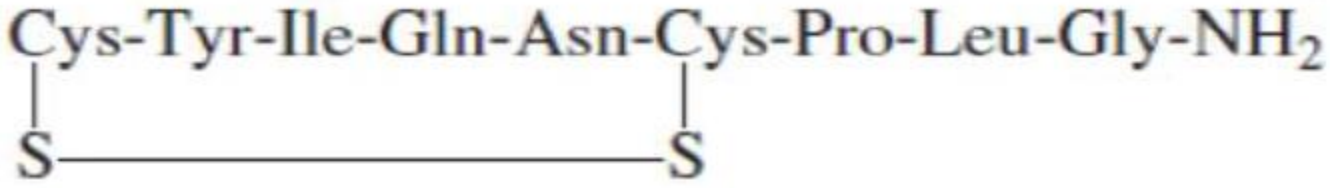
glutathione

1. **Bradykinin:** is a peptide that promote inflammation.

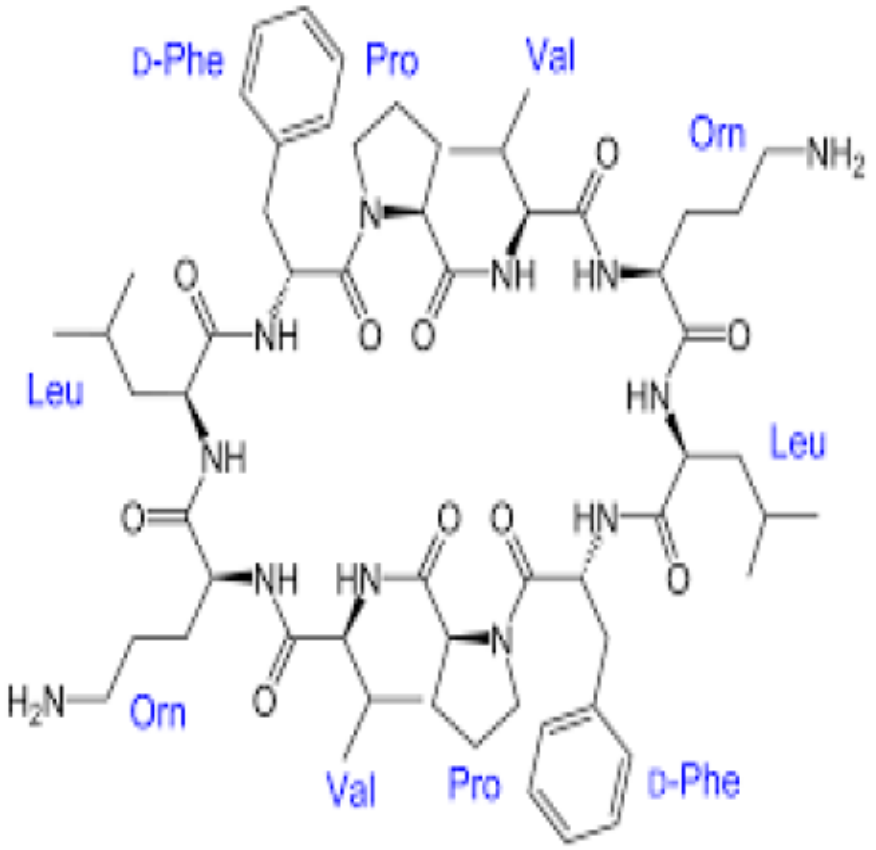


Arg-Pro-Pro-Gly-Phe-Ser-Pro-Phe-Arg

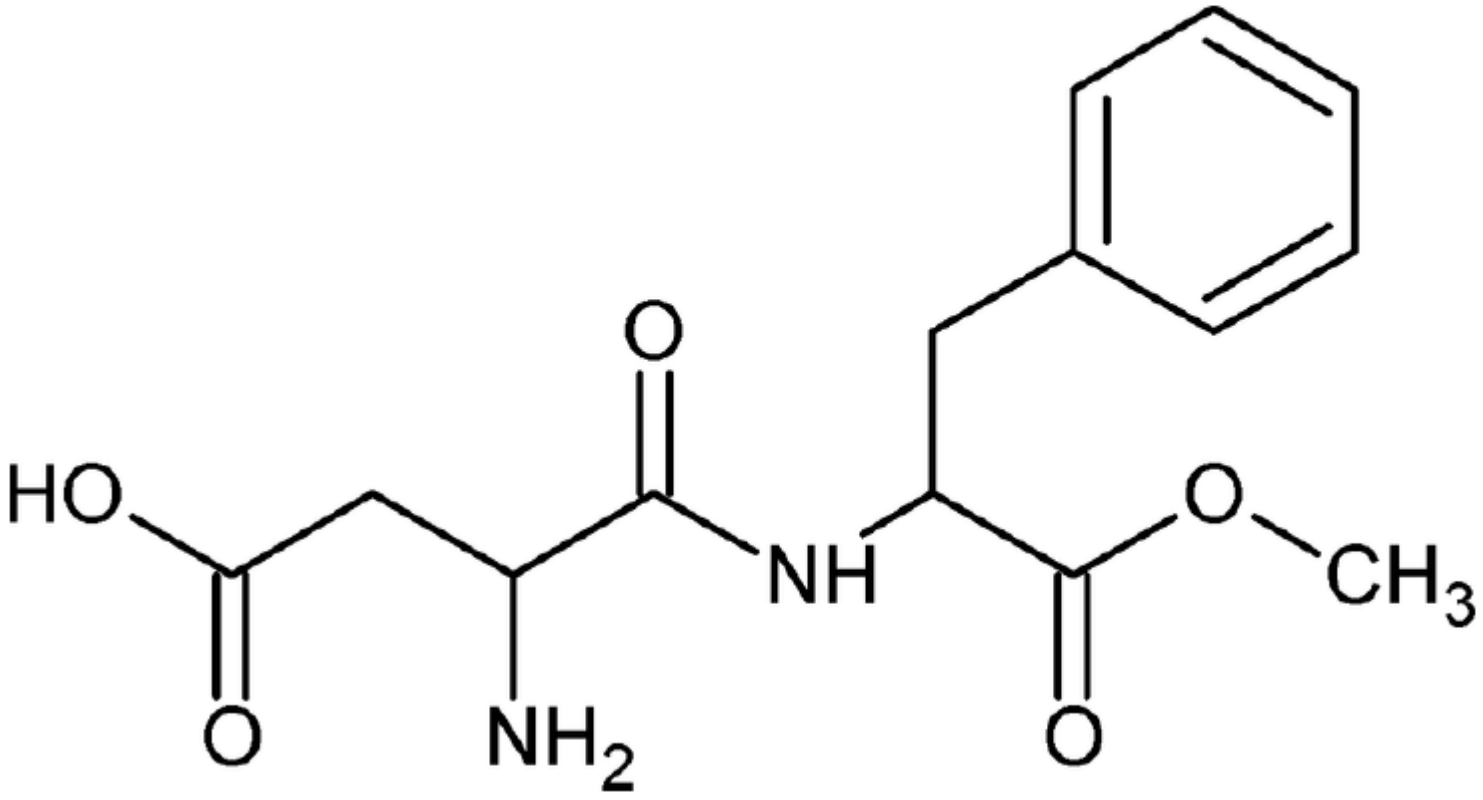
2. **Vasopressin:** A cyclic hormone consisting of nine amino acids, secreted by the posterior lobe of the pituitary glad. controls blood pressure by regulating the contraction of smooth muscle. It is also an antidiuretic..



3.<u>Gramicidin S</u>: A cyclic peptide consisting of ten amino acids. Produced by fungi ,it acts as an antibiotics it acts as an antibiotics.



4. <u>Aspartame</u>: it is the methyl ester of a dipeptide of L-aspartate and L-phenylalanine. and is commonly used as a sugar substitute in foods and beverages.



Thank you