

# Medical Biochemistry Tutorial

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By, Biochemistry Team 428

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**Course:** MBC 141

**Topic:** Protein.

**Title:** Structure Of Protein.

## Primary Structure Of Protein

### **1. What is the important of knowing the Primary Structure of a protein ?!**

If we know the normal and the abnormal ( mutated ) primary structure of a protein it can help in the diagnosis or the study of a disease.

### **2. How can you break the peptide bond ?!**

By using strong acid or base + high temperature level.

### **3. What is the effect of high concentration of urea or heating to the protein ?!**

It denature the protein but doesn't break the peptide bond.

### **4. What is the characteristic of peptide bond ?!**

Has a **Partial** double bond character .. 1. Shorter than a single bond. 2. Rigid and planar. 3. It's Trans bond in large part. 4. Covalent Bond. 5. Polar but Uncharged 6. Involved in hydrogen bond.

### **5. What make the peptide bond Rigid and planner ?!**

The Partial double bond character and because it is shorter than a single bond.

### **6. Explain the Rotation in the peptide bond or around it ?!**

Because the peptide bond is short, rigid, and planner there is no free rotation between the carbonyl carbon and the nitrogen of the peptide bond. But there is a free rotation between the  $\alpha$ -carbon and  $\alpha$ -amino or  $\alpha$ -carboxyl, however this free rotation is limited by the size and the character of R-group.

### **7. Why it is better to the R-group in the amino acid to be Trans than Cis ?!**

Because if the R groups are in the same side steric interference ( تدخل ومضايقه ) will occur. Which is not good to the bond.

Good Luck.

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## Secondary Structure of Protein:

### **1. How many polypeptide bonds are there in the $\alpha$ -helix ?!**

Only one peptide chain.

### **2. Explain the $\alpha$ -helix ?!**

- Spiral structure.
- tightly packed coiled polypeptide backbone core.
- the R groups face the outward.
- It is a right handed curl.

### **3. Why the R groups face the outward ?!**

To avoid steric interfering.

### **4. Give an examples of an $\alpha$ -helix ?!**

Keratins = structurally nearly entirely  $\alpha$ -helical. Their rigidity is determined by the number of disulfide bonds. ( In hair and skin )

Myoglobin= highly  $\alpha$ -helical, globular, and flexible molecule.

### **5. What stabilized the $\alpha$ -helix ?**

The Hydrogen bond. ( between the carbonyl oxygens and amid hydrogens )

### **6. Talk about the Hydrogen bond in $\alpha$ -helix ?!**

- Parallel to the spiral.
- linkage 4 residues .
- H-bond is a weak bond.

### **7. How many amino acid there are in each turn of $\alpha$ -helix ?**

about 3.6 amino acid.

### **8. What disrupt the $\alpha$ -helix ?**

1. Proline = because it cause a kink .
2. Large amount of charge Amino Acids ( Glutamate, Aspartate, Histidine, Lysine, and Arginine ) = it form an ionic bond or electrostatically repelling each other.
3. Amino acid with bulky side chain ( Tryptophan )
4. Amino acid that branch at the  $\beta$ -carbon.

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## 9. How does the $\beta$ -Sheets surface appear ?

As " Pleated " So it's often called the  $\beta$ -Pleated Sheets. ( زي كسرات التتوره )

## 10. Comparison of a $\beta$ -Sheets and $\alpha$ -helix ?

$\beta$ -Sheets	$\alpha$ -helix
Two Or more Peptide bond.	Only 1 peptide bond.
H-bond Perpendicular	H-Bond Parallel

## 11. When does the $\beta$ -Sheets appear Parallel, AND when does it appear Antiparallel ?!

Antiparallel = N-terminal and C-terminal ends of the  $\beta$ -Strands alternating.

Parallel = N-termini of the  $\beta$ -Strands are all together in one side while the C-termini are all together in the other side.

## 12. Talk about the H-bond in $\beta$ -Sheets ?

When formed between polypeptide backbone of separated polypeptide chains = Interchain Bond.

When  $\beta$ -Sheet formed by a single polypeptide chain folding back on itself = Intrachain Bond.

## 13. What is the relation between Globular Protein and $\beta$ -Sheets?

In globular protein  $\beta$ -Sheets are right handed curl or twist. Twisted  $\beta$ -Sheets form the core of globular protein.

## 14. Why does the $\beta$ -Bends named like this ?

Because they reverse the direction of a polypeptide chain, helping it form a compact, globular shape.

## 15. Where can you find the $\beta$ -Bends?!

Found on the surface of the protein.

## 16. How many Amino Acid there are in $\beta$ -Bends?

Composed of 4 amino acids.

## 17. What are the kinds of Amino Acid you can find in $\beta$ -Bends?

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1. Proline = cause a kink.
2. Glycine = يسد الفراغات التي تصير لأنه صغير

## 18. What stabilize the $\beta$ -Bends?

H-Bond and Ionic Bond.

## 19. What are the repetitive secondary structure ?!

$\alpha$ -helix and  $\beta$ -Sheets.

## 20. What non-repetitive secondary structure ?

The loops or coil conformation. They are not random but they are less regular than the repetitive.

## 21. What is the Supsecondary structure ?

They also called the "motifs". They are globular protein constructed by combining secondary structure (  $\alpha$ -helix,  $\beta$ -Sheets, non-repetitive ). They are connected by loops.

## Tertiary Structure of Protein:

### 1. What determines the tertiary structure of protein ?!

The primary structure.

### 2. The formation of domains pathway ...

2nd protein ---> Super 2nd protein "motifs" ---> Domains.

## Important notes about Tertiary:

1. 3D shape.
2. Refer to folding of domains and final arrangement of domains in polypeptide.

### 3. Why does the Tertiary structure become a compact in aqueous solution ?!

**Mainly** because of the hydrogen bond. AND you may say + because of the hydrophobic side chains are buried in the interior while the hydrophilic found in the surface of molecule.

### 4. How many domain are there in a 200 Amino Acid polypeptide chain ?!

2 OR more domains.

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Important notes about Domains:

1. Folding of one domains is different from folding of another.
2. The core of domains is built from the supersecondary structural.

## **5. What are the bonds that stabilized the Tertiary ?**

Disulfide Bond= Covalent.

Hydrophobic interaction= Not covalent.

Hydrogen Bond = Weak and not covalent.

Ionic Bond = Not covalent.

## **6. Does the peptide bond stabilized the Tertiary ?**

No it doesn't.

## **7. what determine the time of folding of a polypeptide ?!**

Interactions between the side chain.

## **8. What are the denaturation agents ?!**

Heat, organic solvents, mechanical mixing, strong acid or base, detergents, ions of heavy metals like lead and mercury.

Important notes about denaturation:

It may be reversible.

Denatured proteins are often insoluble and therefore precipitate from solution.

## **9. Talk about Chaperones ( المراقبين الدوليين )**

It is required for the proper folding of protein. Some of them important in keeping the protein from folding before it synthesis is finished. Other, protect protein as they fold. Also it stop the folding processes if there wasn't enough Amino.

Quaternary Structure of Protein:

### **1. What is monomeric ?**

It is a protein with a single polypeptide.

### **2. What are the bond that held the subunit of the quaternary structure ?**

The non covalent bonds ( H-bond, ionic bond, hydrophobic bond ).

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### **3. Example of a quaternary protein ?**

Hemoglobin.

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