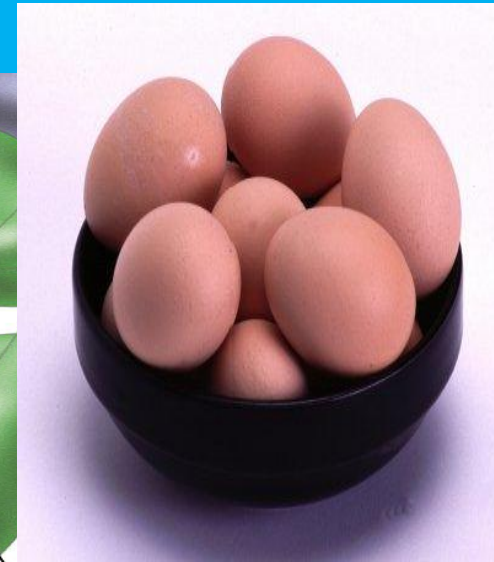
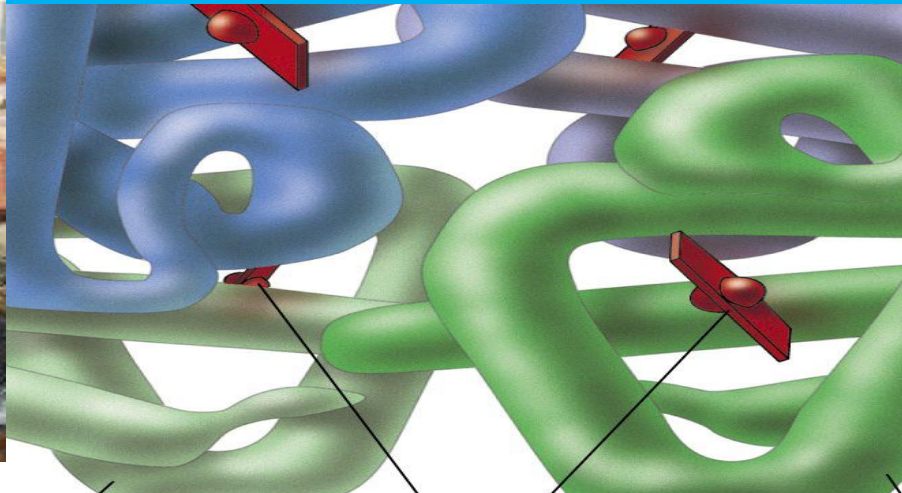


# AMINO ACIDS & PROTEINS

## 211 Chem



By

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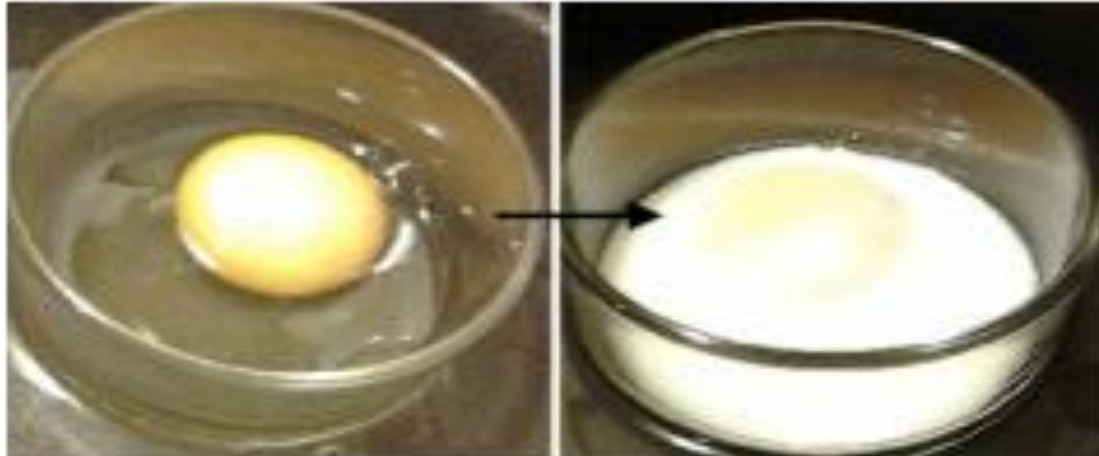
## *Denaturation of proteins (Loss of protein conformations)*

- It is the disruption of secondary, tertiary and quaternary protein structure (the protein native conformations).
- Denaturation is due to breaking of bonds responsible for the secondary, tertiary and quaternary protein structure **but not due to the breaking of peptide bonds** responsible for primary structure.
- We need denaturation as without it meats and other protein high products would stay chewy and hard to eat and swallow.

## *Denaturation of proteins (Loss of protein conformations)*

- Reversible or irreversible
- Acid, alkaline, heat, alcohol, agitation and other factors can disrupt the chemical forces that stabilize proteins and can cause them to lose their shape (denature)
- Denaturation of proteins happens during food preparation (cooking, whipping, adding acids) or digestion (in the stomach with hydrochloric acid)

# *Protein Denaturation*



Normal protein  
(Native protein)

Denaturation →



Denatured protein  
(Denatured protein)

## Denaturation factors include the following:

### 1- Strong acids or bases

They break **hydrogen bonds** between polar R groups and **ionic bonds**

### 2- Organic solvents

They disrupt the **hydrophobic interactions**.

### 3- Detergents

These amphipathic molecules (contain both hydrophobic and hydrophilic components) disrupt **many weak chemical interactions**.

Denaturation factors include the following:

#### 4- Reducing agents

They **convert disulfide bonds into sulfhydryl groups.**

#### 5- Salts of heavy metals

Heavy metals like  $\text{Hg}_2^+$  and  $\text{Pb}_2^+$  disrupt **all salt bridges** by forming ionic bonds with negatively charged ions and also **unite with  $-\text{SH}$  groups.**

Denaturation factors include the following:

## 6 -Temperature

As the temperature increases, weak interactions such as **hydrogen bonds** are disrupted.

## 7- Mechanical stress

Stirring and grinding actions disrupt the **delicate forces** required to maintain protein structures.

Denaturation factors include the following:

## 8- Repeated freezing and thawing

They cause disruption of the **weak chemical interactions.**

## 9- Agitation

It **stretches chains** until bonds break.



# *Changes due to protein denaturation*

**1- Decreased solubility** due to exposure of the internal nonpolar groups.

**2- Increased viscosity** due to unfolding of the peptide chains and increase of molecular size.

**3- Partial or complete Loss of biological activity** as in the case of enzymes and hormones

**4- Improved digestibility** due to unfolding of the peptide chains.