

# Functional properties of proteins-

- Protein functionality is defined as those physical and chemical properties which affect the behavior of protein in food systems during processing, storage, preparation and consumption.
- Physicochemical properties that enable proteins to contribute to the desirable characteristic of food.
- Functional properties of proteins depends on-
  - a. size
  - b. shape
  - c. amino acid composition and sequence
  - d. net charge and distribution of charges

# Some important functions of proteins-

TYPE OF PROTEINS	FUNCTIONAL PROPERTIES
a) Biocatalysts	Work as enzyme
b) Collagen ,keretin,elastin	Structural components of cells and organs
c) Actin, myosin	Contractile proteins
d) Insuline, growth factors	Hormones
e)Serum albumin, transferrin, hemoglobin	Work as transport proteins
f) Phosvitin ,ferritin	They are metaloproteins
g) Immunoglobulins	Act as antibodies
h)Seed proteins casein micelles,egg albumin	They are work as protective proteins

➤ The main functional quality of protein is

## **Gel Formation-**

myofibrillar proteins mainly responsible for it.

- Myosin and actin contribute most of the development of desirable gel characteristics in processed meat products. The heat-induced gelation of myosin results in the formation of a 3-dimensional network structure that holds water in a less mobile state .
- During network formation fat and water retention are enhanced and these influence the yield, texture.

# Factors affecting the gel formation

- Types of muscles-White muscle generally forms stronger gels than red muscle.
- Source of muscles-Gel forming ability of muscles from different species is complex, and is influenced by different processing conditions.
- pH- Gelation properties of myofibrillar protein are strongly pH-dependent. At the isoelectric point of myofibrillar protein (pH 5.3), either only poor gels are formed or gel formation is inhibited.
- Temperature-The optimal temperature for the heat-induced gelation of myosin at pH 6 is 60 to 70 °C.

# Solubility-

- Solubility of muscle protein is a function of protein structure, structure of myofibril, pH and ionic concentration.
- Solubility can be defined as the amount of total protein that goes into solution under specified condition.
- The solubility of proteins in aqueous buffers depends on the distribution of hydrophilic and hydrophobic amino acid residues on the protein's surface.
- It is used as method of separating proteins.
- The salt concentration needed for the protein to precipitate out of the solution differs from protein to protein

# Viscosity-

- The resistance of fluid to flow is measured by their viscosity.
- Viscosity provides information on physico- chemical interaction among proteins by indicating structural changes that may occurs in the proteins molecules.
- Viscosity has been used to determine the degree of protein denaturation and aggregation during frozen storage.
- It is considered a more reliable index of fish protein quality than protein solubility or emulsifying capacity.

# Emulsification Properties-

- An emulsion is defined as heterogeneous systems consisting of two immiscible liquid phases one of which is dispersed and the other is droplet.
- The formation of emulsion requires the application of energy, when energy is applied to water and oil, the phases may be dispersed.
- Proteins by virtue of their structure and conformation act as excellent emulsifiers and reduce their interfacial energy at the oil-water interface. Myosin and actomyosin molecules are good emulsifiers by virtue of their having hydrophobic and hydrophilic residues.

# Factors responsible for change in the quality of proteins-

➤ There are various factors which are responsible for the change in the quality of proteins-

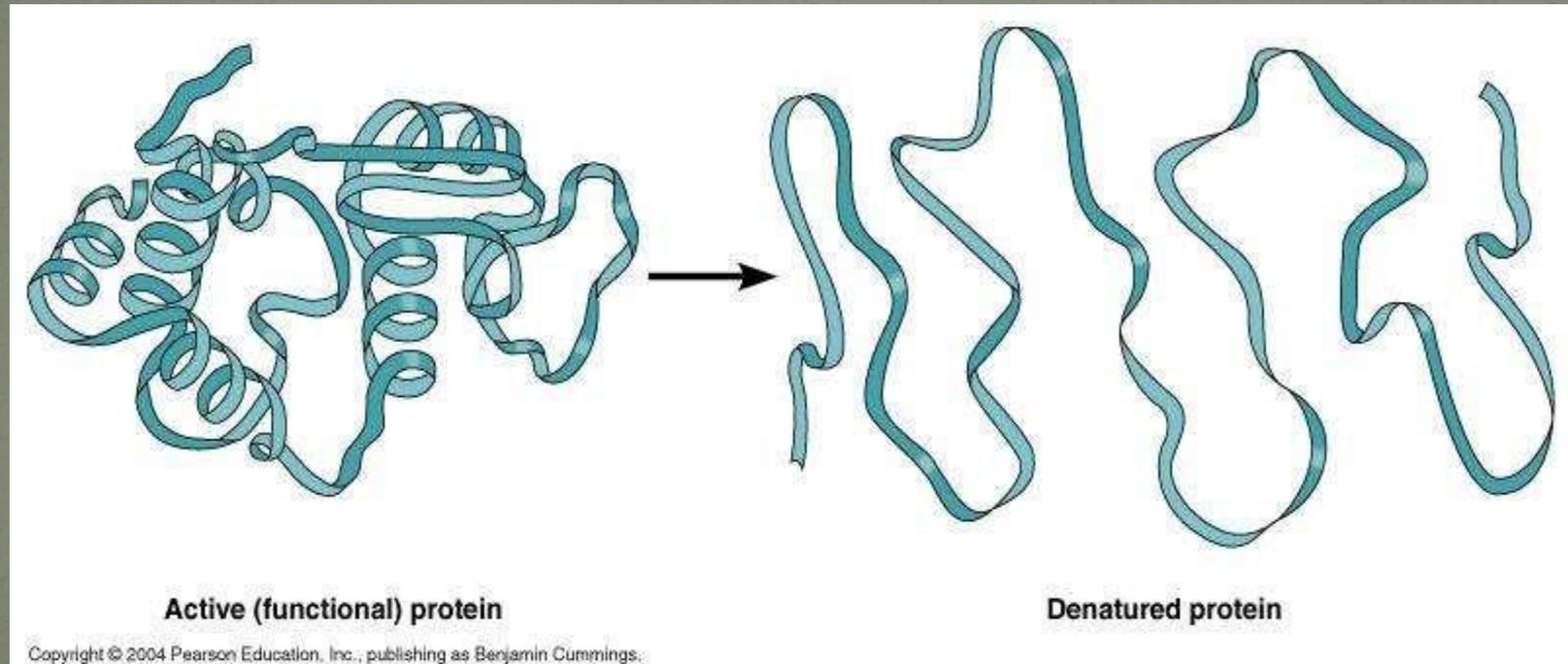
- a. Temperature
- b. pH
- c. Salt concentration
- d. Acids ,bases ratio
- e. Pressure.



# Denaturation of proteins-

- **Denaturation** -is a process in which proteins or nucleic acids lose the quaternary structure, tertiary structure and secondary structure.
- Which is present in their native state, by application of some external stress or compound such as a strong acid or base, a concentrated inorganic salt, an organic solvent (e.g., alcohol or chloroform), radiation or heat.
- If proteins in a living cell are denatured, this results in disruption of cell activity and possibly cell death.
- Denatured proteins can exhibit a wide range of characteristics, from conformational change and loss of solubility to aggregation due to the exposure of hydrophobic groups.

- Denaturation of fish proteins during different processing methods (freezing, drying) due to change in temperature, pH, and acid or base concentration etc.



## Change in the quality of after cooking-protein



- Protein goes through certain chemical changes when it is heated and cooked. When the proteins in food are heated, they coagulate, which means they become firm.
- When exposed to hot temperatures, the protein shrinks and loses moisture. This usually occurs at temperatures between 160 and 185°F.
- When meat sources of protein are cooked slowly, any connective tissues are likely to dissolve. Heat does not destroy the protein in food, though it might reduce the overall content slightly.

## Effect of pH and salt on protein quality-

- During post mortem changes, there is formation of acids, so at low pH most of the main muscle proteins are at their isoelectric point and the meat fails to attract and hold water, so it releases drip. This phenomenon is known as “drip loss”.
- Salt (NaCl) is highly water soluble. The functions that salt provides in meat mixtures are mainly determined by the dissociated ions  $\text{Na}^+$  and  $\text{Cl}^-$ . When salt is mixed with comminuted meat the  $\text{Cl}^-$  ion increases the negative charge of the proteins. The adsorption of  $\text{Cl}^-$  ions onto the positively charged groups of myosin results in a shift in its isoelectric point to a lower pH, also causing a weakening of the interaction between oppositely charged groups at a pH greater than the isoelectric point.

- In the presence of salt, part of the insoluble myosin passes into the liquid phase and dissolves, increasing meat swelling and water holding capacity in its dissociated ionized form ( $H^+$   $OH^-$ ).
- Salt-solubilized myofibrillar proteins form a sticky exudate on the surface of the meat pieces, which binds them together after cooking. This layer forms a matrix of heat-coagulated protein which entraps free water. The increased water-holding capacity of salt-treated meat gives it a higher cooking yield, and greater tenderness and juiciness when the product is consumed

# Protein shape determines function

- Amino acid order determines the shape (conformation) of a protein
- Conformation determines function
- Function depends on its ability to recognize and bind a molecule

Amino acids → conformation → function → binding

# Protein binding examples

- **Antibodies** bind to particular foreign substances that fit their binding sites.
- **Enzymes** recognize and bind to specific substrates, facilitating a chemical reaction.
- **Neurotransmitters** pass signals from one cell to another by binding to receptor sites on proteins in the receiving cell.