Modification of Wheat Proteins
Osborne’s Solubility Fractions of Wheat Protein

Metabolic proteins
   Albumins - Water soluble
   Globulins - Soluble in dilute salt solution

Storage proteins (mainly gluten proteins)
   Gliadin  - Soluble in aqueous alcohol
             - Generic name of prolamin
   Glutenin - Soluble in dilute acid or alkali
             - Generic name of glutelin
Gliadin and Glutenin

• Essentially comprise gluten, being present in approximately equal amounts
• Elasticity is associated with Glutenin
• Extensibility is associated with Gliadin
• Gliadins comprise monomeric proteins with molecular weight ranging from 30,000 to 50,000 daltons
• Glutenins are polymeric proteins stabilized by inter-chain disulfide bonds and with molecular weight exceeding $1 \times 10^6$ daltons
Major Amino Acids in Wheat Protein

Schematic diagram of the structure of some amino acids common in wheat, showing linkage with peptide bonds.
Why Modify Proteins?

Mainly, to improve functional properties

• To increase solubility (e.g., beverages)
• To decrease solubility (e.g., cheese)
• To provide emulsifying capacities (e.g., mayonnaise)
• To provide foaming capacities (e.g., whipping agents)
• To impart texture (e.g., textured vegetable proteins)
Types of Modified Proteins

- Acid modified (hydrolyzed vegetable proteins, deamidated)
- Bleached
- Oxidized (2 cysteine to cystine) - potassium bromate, glucose oxidase, reduced (cystine to 2 cysteine) - sodium metabisulfite
- Cross-linked (phosphorus oxychloride, sodium trimetaphosphate, transglutaminase)
- Substituted or stabilized (acetic anhydride, succinic anhydride)
- Cross-linked and substituted
- Enzyme-modified (proteases, transglutaminase)
- Combined modification (proteases + metabisulfites)
Relevant Methods of Protein Modification

1. Partial protease hydrolysis
   - Increases water solubility
   - Improves moisture sorption and water binding
   - Improves emulsifying properties
   - Increases foam stability
2. Progressive protease hydrolysis

- Bitter peptides formation
- Exposure of the hydrophobic amino acid residues near the C-terminal in the polypeptide increases bitterness
3. Acid-modification

- Complete acid hydrolysis of proteins to amino acids (high temperature and high hydrochloric acid concentration)

- Deamidation using high temperature and low hydrochloric acid concentration (converts glutamine and asparagine to glutamic acid and aspartic acid)
4. Cross-linking

- The transglutaminase enzyme catalyzes the cross-linking of polypeptide chains using the glutamine and lysine residues
- Cross-linking can occur intra- or inter-molecularly
5. Oxidation/reduction

• Oxidation of sulfhydryl groups to disulfides leads to dough strengthening
  
  (Example: potassium bromate, glucose oxidase)

• Reduction of disulfide bonds to sulfhydryl groups leads to increased dough extensibility
  
  (Example: L-cysteine-HCl, sodium metabisulfite)
6. Physical modification

- Complex formation (sugar ester)
- Heat treatment (jet cooking)
- Texturization (extrusion)
Functions of Protein In Foods

Solubility
- Water absorption and binding

Viscosity

Gelation

Cohesion-adhesion

Elasticity

Emulsification

Fat absorption

Flavor binding

Foaming

Beverages

Meats, sausages, breads, cakes

Soups, gravies

Meats, curds, cheese

Meats, sausages, baked goods, pasta products

Meats, bakery

Sausages, bologna, soups, cakes

Meats, sausages, donuts

Simulated meats, bakery

Whipped toppings, chiffon desserts, angel cakes

Creating Better Solutions...Naturally