Modification of Wheat Proteins

Osborne's Solubility Fractions of Wheat Protein

Metabolic proteins

Albumins	-	Water soluble
Globulins	-	Soluble in dilute salt solution

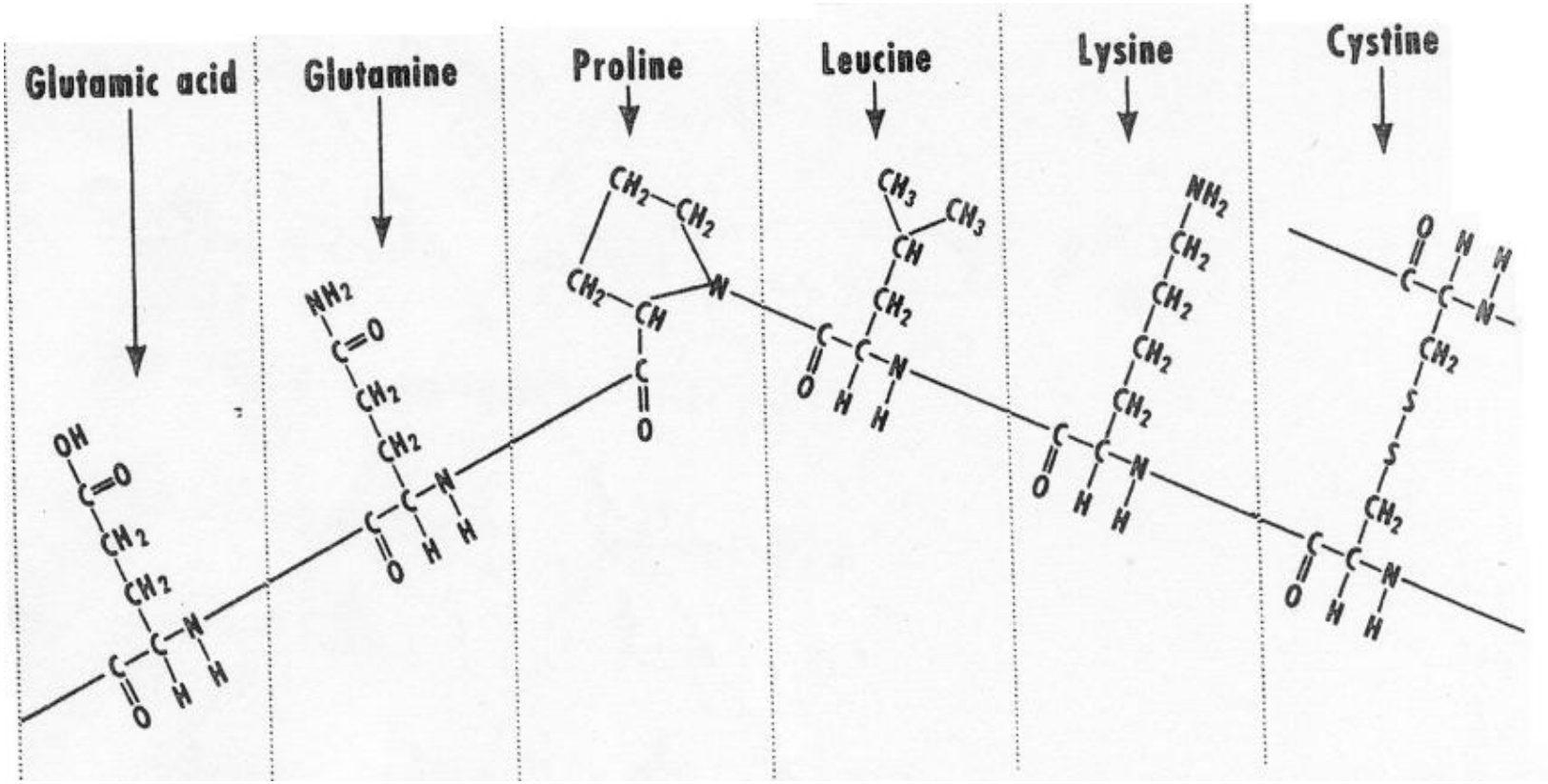
Storage proteins (mainly gluten proteins)

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 x 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

Relevant Methods of Protein Modification

2. Progressive protease hydrolysis

   - Bitter peptides formation

   - Exposure of the hydrophobic amino acid residues near the C - terminal in the polypeptide increases bitterness

Relevant Methods of Protein Modification

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)

Relevant Methods of Protein Modification

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

Relevant Methods of Protein Modification

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)

Relevant Methods of Protein Modification

6. Physical modification
    - Complex formation (sugar ester)
    - Heat treatment (jet cooking)
    - Texturization (extrusion)

Functions of Protein In Foods

Solubility	Beverages
Water absorption and binding	Meats, sausages, breads, cakes
Viscosity	Soups, gravies
Gelation	Meats, curds, cheese
Cohesion-adhesion	Meats, sausages, baked goods, pasta products
Elasticity	Meats, bakery
Emulsification	Sausages, bologna, soups, cakes
Fat absorption	Meats, sausages, donuts
Flavor binding	Simulated meats, bakery
Foaming	Whipped toppings, chiffon desserts, angel cakes