Gelatin
Gelatin source

- Collagen (hides, bones, tendons)
- In mammals, collagen comprises one-third of total body protein
  - In the US, principally from pigskins
- Sub-unit is called tropocollagen (Type III collagen)
  - 2800Å x 15Å, it is a rigid rod.
  - MW approximately 300,000 daltons.
Gelatin structure

Three left-handed helices combine into a right-handed super triple helix (each of these is a gelatin molecule)
False colored SEM of connective tissue-individual collagen fibers can be seen.

London Research Institute
Amino acids in gelatin

- Gelatin contains some 18 distinct amino acids
- Of these 1/4 are basic or acidic  
  - Lys, arg, his, asp, glu
- 1/3 is glycine or (occasionally) alanine
- 1/4 is proline or hydroxyproline
- Not a nutritionally complete protein.
Amino acids in gelatin

Image courtesy of www.gelatin.com/structure.htm
Basic repeat unit in gelatin

- **Gly-pro—X or Gly-X-Hyp**

- where X is acidic or basic; often hydroxyproline (Hyp)
  - Gelatin is the only protein, except for elastin, known to contain hydroxyproline.
  - Generally, low in S-containing amino acids
Role of proline and hydroxyproline

- These cyclic imino acids cause kinks or breaks in what would otherwise be a helical structure.

This promotes collagen helix stability
Gelatin manufacture

- Acid extracted (type A) gelatin, or
- Alkaline extracted (type B) gelatin
  - In US, mostly alkaline extracted
- The extracted gelatin is gelled in thin layers
- Dried
- Ground into gelatin powder (MW about 100,000)
Gelatin gelation

- Gelatin is dispersed in water that is not too warm (35-40° C, to prevent lumping)
- Then cooled slowly and allowed to form a gel
Gelatin gelation

- One part gelatin can trap 99 parts of water
- Gel texture is related to gel structure and can be measured in a variety of ways.
Gel structure

Denaturation

Heat
Gel structure

Association and formation of junction zones

This is a gel!
Gel structure

- Note that forming gels is something only LARGE (macromolecules) molecules can do!
- Anything that reduces molecular size, reduces the ability of that molecule to form a gel.
Conditions for gelation

- **Concentration**
  - 0.6-0.7% minimum
  - Typically, gelatin with desirable textural properties has 1.0-1.5% gelatin
Conditions for gelation

- **Temperature**
  - Must get to 35° C for dispersion
  - Usually, pure gelatin is dispersed in cold water, then boiling water is added
  - Need to cool to 35° C for gelation
Conditions for gelation

- **Effect of rate of cooling**
  - Faster rate, thermally less stable gel
    - Weaker junction zones in gel
  - Slower rate, thermally more stable gel
    - Stronger junction zones in gel
Conditions for gelation

- **Gelatin molecular weight (MW)**
  - The lower the MW, the less strong the gel will be. This is true for virtually any gel forming polymer.

- **pH**
  - Little effect of pH on gel strength in the range 4-8 (typical food range)
  - Will gel best at isoelectric point (pH 4.8-5.0 for Type B, alkaline extracted gelatin)
Conditions for gelation -
Effect of other ingredients

- **Sugar**
  - Increasing concentration of sugar (sucrose) will generally decrease gel strength
  - This is believed to be due to competition of the sugar for available water as well as a general plasticizing effect of sugar on food gels
Conditions for gelation -
Effect of other ingredients

- Certain proteolytic enzymes will hydrolyze gelatin and **destroy** the gel structure
- Some of the enzymes and their sources are
  - Papain--papaya
  - Ficin--figs
  - Bromelin--pineapple
Proteolytic enzyme action

Enzyme

Enzyme

Enzyme

Enzyme

Enzyme

High molecular weight
~100,000 daltons
Proteolytic enzyme action

A collection of low molecular weight pieces - no good for a gel

Avg MW 2000-5000 daltons