Physical Properties of Foods

Content

Food colloidal systems

- Colloidal sol
- Jel

Food colloidal systems

- Colloidal systems give structure, texture and mouthfeel to many different products, for example:

Jam

Ice cream

Mayonnaise

Katchup

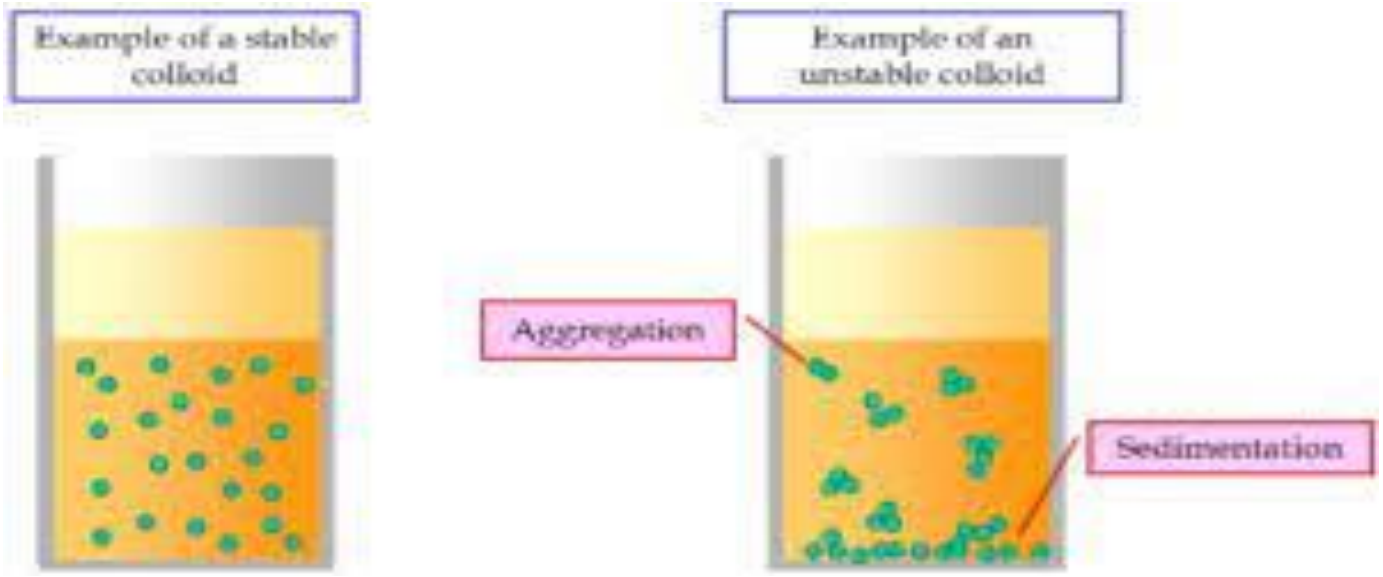
The function of colloidal systems can be used in a variety of ways in order to produce food products.

Colloidal system in foods

- All colloidal systems have two phases: a continuous phase and a discontinuous or dispersed phase.
- Particles in the dispersed phase in colloidal are between 1 and 1000 nm in diameter.
- For this reason, most manufactured foods can be considered as food colloids and many contain hydrocolloids that are added to control stability and rheological properties.
- Food hydrocolloids are high molecular weight hydrophilic biopolymers used in food products to control their texture, flavor, and shelf-life.

What are coloidal systems?

- Colloids are formed when one substance is dispersed through another, but does not combine to form a solution.



Colloidal systems in foods can be categorized into four groups:

- sols,
- gels,
- emulsions, and
- foams

System	Dispersed phase	Continuous phase	Product
Sol	Solid	Liquid	Uncooked custard, unset jelly
Gel	Liquid	Solid	Jelly and jam
Emulsion	Liquid	Liquid	Mayonnaise, milk, butter, margarine
Foam	Gas	Liquid	Whipped cream, whisked egg white
Solid foam	Gas	Solid	Meringue, bread, cake, ice cream

Class	Technical Name	Example
S/S	Solid dispersion	Chocolate
L/S	Solid emulsion or gel	Jelly
G/S	Solid foam	Meringue
S/L	Sol or suspension	Fruit juice
L/L	Emulsion	Milk
G/L	Foam	Whipped cream
S/G	Powder	Flour
L/G	Aerosol	—

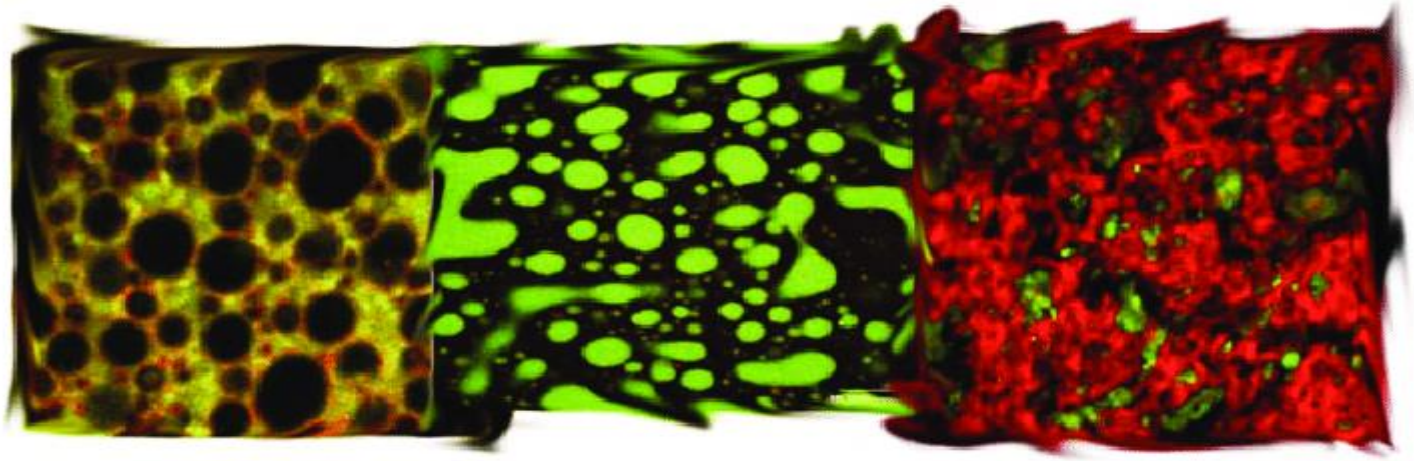


Fig. 1 Examples of food structures, from left to right: ice cream, yogurt and cheese. Pictures were obtained by CSLM, with fluorescent dyes coloring fats (green) and proteins (red). Courtesy of Friesland Foods

What are colloidal systems?

- Colloidal systems give structure, texture and mouthfeel to many different products.

Jam

Icecream

Mayonnaise

- The functions of colloidal systems can be used in a variety of ways in order to produce food products.

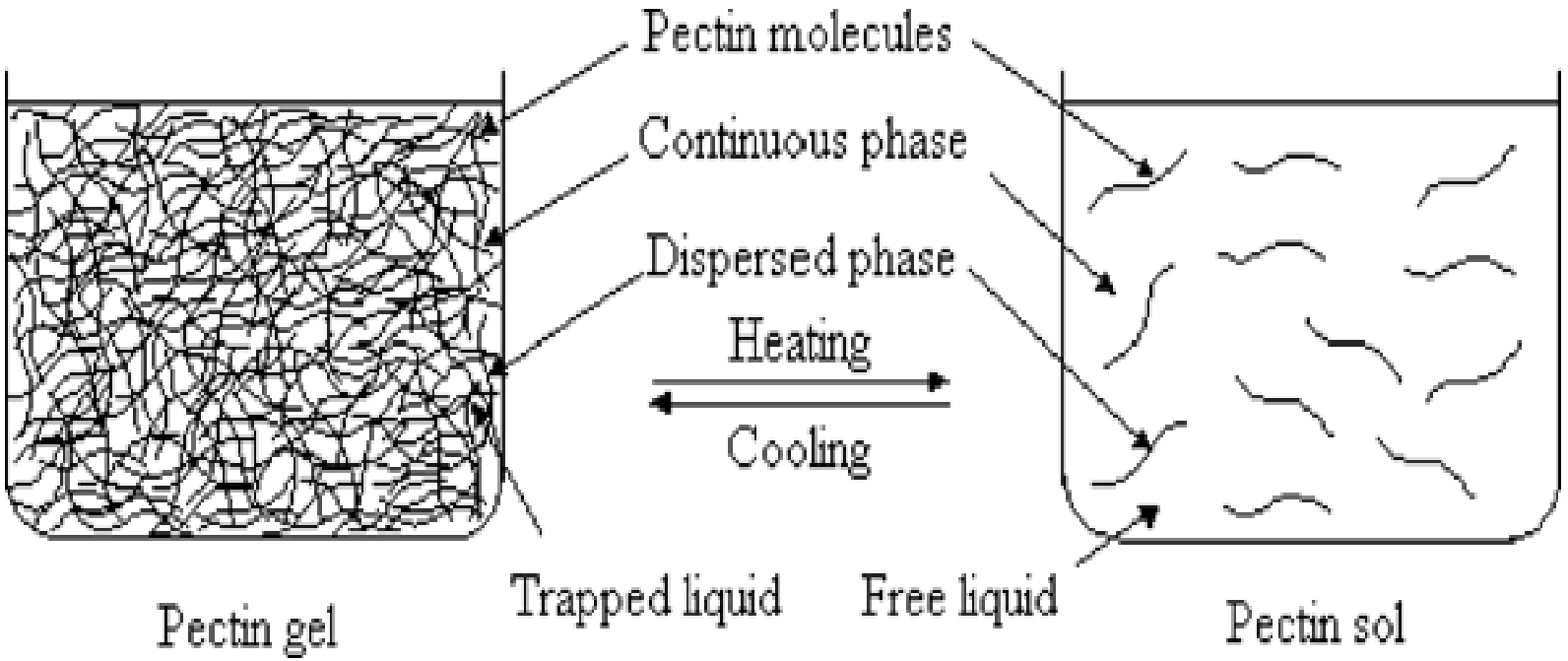
Sols

- A sol can be defined as a colloidal dispersion in which solid particles are dispersed in a liquid phase. The dispersed phase is attracted to molecules of the continuous phase.

Example:

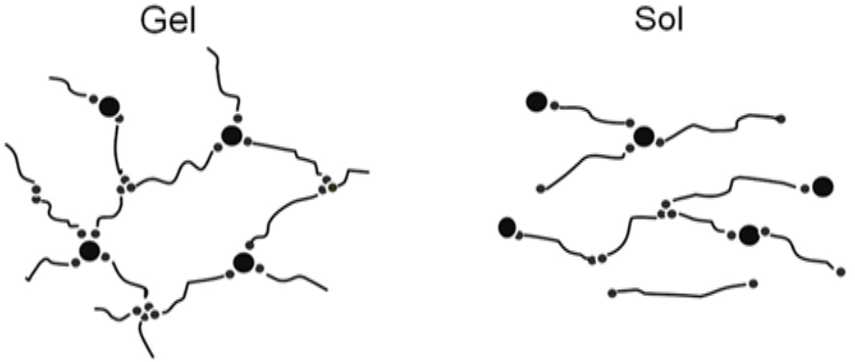
Gravy, stirred custard, and other thick sauces

- The proper ratio of the ingredients is necessary to achieve the desired viscosity of the sols at a certain temperature. If they are unacceptably thick, they can either be heated or more water can be added to reduce their viscosity.
- If the mixture is heated and stirred and when this solution cools, the sol changes into a gel, which resembles a solid rather than a liquid. Both protein and starch can be used in the formation of a sol or gel.


Pectin molecules
Continuous phase
Dispersed phase
Heating
Cooling
Pectin gel
Trapped liquid
Free liquid
Pectin sol

Gels

Gels



- A gel is the reverse of a sol:
  a solid matrix is the continuous phase and
  a liquid is the discontinuous phase.
- The solid in the gel is sufficiently concentrated to provide the structure needed to prevent flow of the colloidal system.
- Some of the free liquid may be released if the gel structure is cut. This phenomenon is known as syneresis.
- The type of solid and its concentration in the gel are important in determining the amount of syneresis.
- Syneresis may be undesired in some products such as jelly but may be useful in cheese production.

Hydrocolloids

- Compounds that have the ability to form gels are called **hydrocolloids**.
- Some are water soluble and form colloidal solutions others are onl able to swell in water and can be dispersed by means of shear forces.

Functions-

- tickening or gelation
- Emulsifying
- Whipping
- Suspending
- Encapsulating

Hydrocolloids-not real emulsifiers because do not have the characteristics linkage of lipophilic and hydrophilic groups in the molecular structure.

Hydrocolloid types

- Based on their origin and way of manufacturing,

1) hydrocolloids purely isolated from plants (without chemical modification)
2) hydrocolloids obtained by fermentation
3) Plant-derived hydrocolloids that are chemically modified
4) Hydrocolloids from animals

Properties of hydrocolloids

- Viscosity enhancing or thickening properties
- Gelling properties
- Surface activity and emulsifying properties
- Hydrocolloids as edible films and coatings
- Hydrocolloids as fat replacers

Hydrocolloids in food industry

- ✓ Thickener
- ✓ Stabilizer
- ✓ Emulsifier

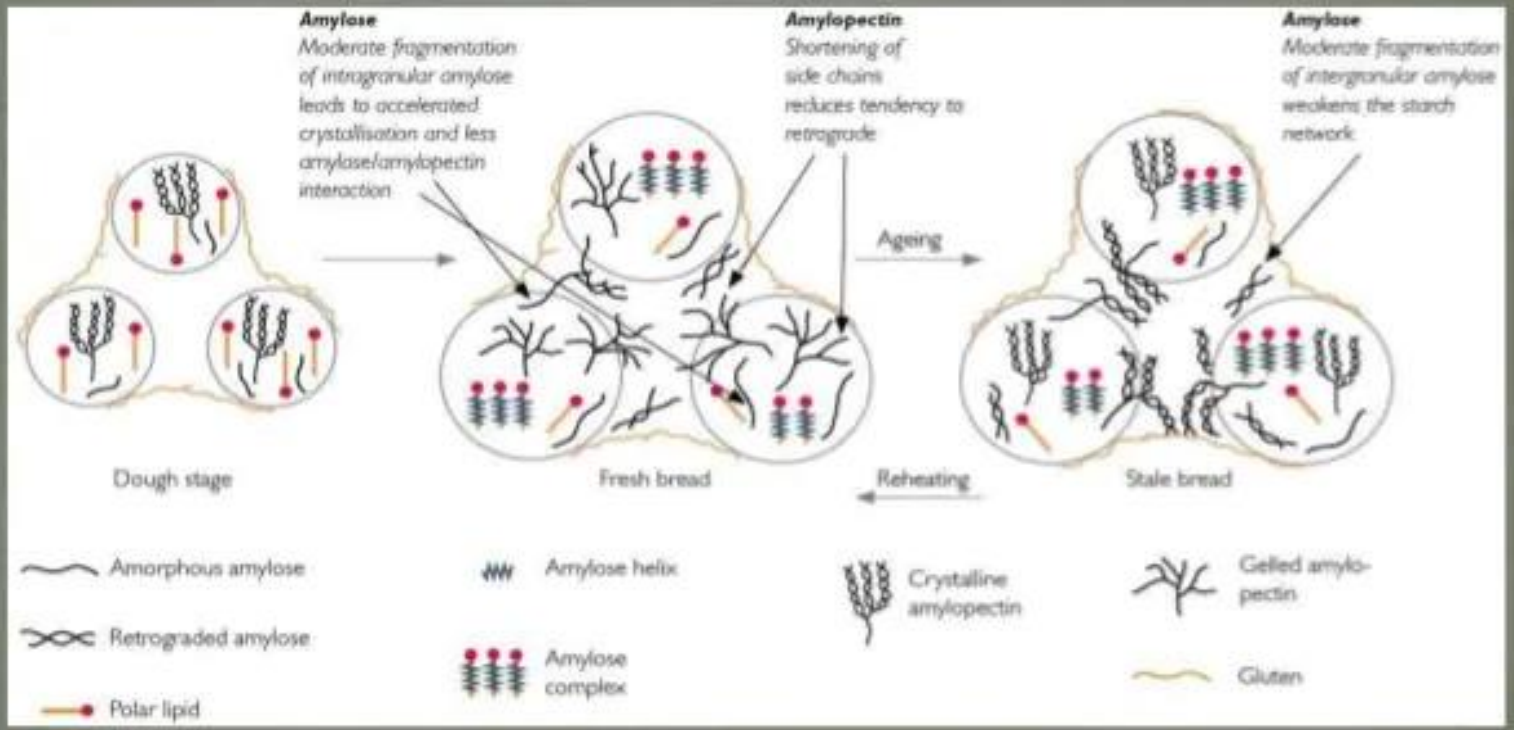
Jams and jellies

- Hydrocolloid: Pectin
- Source: Fruits
- Mode of gelation:Interaction between the pectin molecules through hydrogen bonding

Hydrocolloids as a baking improver

- Retards staling of bread
- Increases shelf life
- Dough conditioning
- Maintains the texture of final product

Staling???


Amylose
Moderate fragmentation of intragranular amylose leads to accelerated crystallisation and less amylose/amylopectin interaction
Amylopectin
Shortening of side chains reduces tendency to retrograde
Amylose
Moderate fragmentation of intergranular amylose weakens the starch network
Ageing
Reheating
Dough stage
Fresh bread
Stale bread
Amorphous amylose
Retrograded amylose
Polar lipid
Amylose helix
Amylose complex
Crystalline amylopectin
Gelled amylopectin
Gluten

Gel-forming ability of proteins are affected by;

1) pH
2) Ionic strength of the medium
3) Other substances

Gel-forming ability of hydrocolloids are affected by

1) Presence of electrolytes,
2) Temperature
3) Additives

Gelling agent

- food additives as a thickener and stabilizer in various foods such as jelly, desserts and candies.
- Typical gel-forming agents; natural gums, starches, pectins, agar-agar and gelatin.
- They are generally polysaccharide or protein in nature. Examples;
- Alginic acid (E400), sodium alginate (E401), potassium alginate (E402), ammonium alginate (E403), calcium alginate (E404) are gelling agents in polysaccharide structure.
- Agar (E406) is a polysaccharide derived from red seaweed.
- Carrageenan (E407) is a polysaccharide derived from seaweed.
- Gelatin (E441) is a protein obtained by partial hydrolysis of animal collagen.