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PHYSICAL CHARACTERISTICS OF FOOD



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Colloidal Systems

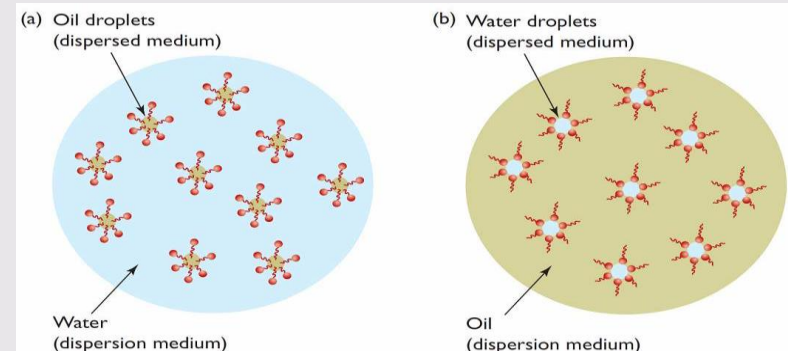
- Colloids - some foods contain one or more discontinuous phases in a continuous phase
- Contains substances whose molecular aggregates have a diameter of $1\mu\text{m}$ and less than $100\mu\text{m}$
- Colloidal dispersions are classified as:
 - Lyophilic colloids
 - Lyophobic colloids



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Food Dispersions

- Food dispersions classified:
 - Solids in liquid (Sol) – gelatin in water
 - Liquid in insoluble liquid (emulsion) – water in oil emulsion
 - Gas in liquid (foam)
 - Gas in solid (solid foam) – foam candy
 - Solid in gas (aerosol) – smoking of meat and fish
- Colloidal dispersions of polysaccharides:
 - Sols – free flowing liquids at room temperature
 - Gels – relatively firm, do not flow
 - Food sols – have a diameter of $1\mu\text{m}$ and less than $100\mu\text{m}$ (dilute solution of gelatin in water)





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Food Dispersions

- Sols possessing continuous aqueous phase have particles that are electrically charged on surface
 - Ionized groups are the source of these charges
 - Electrical double layer may exist around each particle
- Food gels consist of continuous phase of interconnected macromolecules intermingled with a continuous liquid phase such as water (jelly, gelatin)
 - Varying degree of elasticity and rigidity
 - Sol can be transformed into gel under low temperature, change in pH, alteration of gelling agent



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Emulsions

- Colloidal dispersion of one liquid in another immiscible liquid
- Dispersed droplets in food emulsions have diameters between 10 – 100 microns
- Two types of food emulsions:
 - Oil in water (O/W) – lipid droplets dispersed in water (milk, cream, ice cream) – milk, cream
 - Water in oil (W/O) – water droplets dispersed in a continuous oil phase - butter



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Emulsifying Agent

- An emulsifier holds the dispersed phase within the continuous phase
- Consists of two parts:
 - Hydrophilic
 - Hydrophobic
- Function is to stabilize the emulsion



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Emulsions

- The opacity of an emulsion is determined by droplet size, droplet concentration
- An emulsion is transparent when the droplet diameter is $\leq 0.05 \mu\text{m}$
- Droplet size distribution – emulsions change their size distribution over time with droplet size shifting to larger values
- Emulsifying agent (emulsifier) holds the disperse phase within the continuous phase
 - Mayonnaise – stable emulsion of oil and vinegar has egg yolk (lecithin) as emulsifier
 - Stabilizers are often added to increase viscosity, shelf life



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Mechanism of action of Emulsifier

- Emulsifiers are grouped into three based on their mechanism of action in forming stable emulsions
 - Emulsifier at the oil water interface
 - Finely divided particles absorbed at the interface
 - Water dispersible hydrocolloids that increase viscosity of the continuous phase
- Stability of emulsion is reduced by the following process:
 - Flocculation –agglomeration of droplets to form loose or irregular clusters (first step)
 - Creaming – involves floatation or sedimentation of dispersed emulsified droplets into emulsion layers
 - Coalescence – irreversible union of small droplets to form large droplets



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Foam

- Is a dispersion of gas bubbles in a liquid or semisolid phase
- Bubbles are separated from each other by liquid or semisolid wall (lamellae)
- Based on thickness of bubble size foam can be very dense as continuous liquid phase or light as the dispersed gaseous phase
- Features of foam:
 - Large amount of entrapped gas
 - Extensive surface area – rigid, elastic walls



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Foam Formation

- Foam formation depends on the presence of a foaming agent in the continuous phase prior to dispersion of gas
- Foaming agent is absorbed to reduce surface tension and resist the coalescence of bubbles (ice-cream)
- Foam is formed either by :
 - Condensation – gas under pressure is passed into solution
 - Dispersion – gas is injected into the solution through orifice
- Foaming agent can be classified as:
 - Surface active lipids (phospho-lipids)
 - saponins
 - albumins



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Foam Stability

- Stability is related to the resistance of the foam wall to bursting stresses
- Loss of liquids in wall is caused by gravitational force and deformation forces brought by gas movement
- Stability is increased by increasing the viscosity of the solution and by producing particulate matter



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Foam Destruction

- Excessive foaming may lead to wastage of material – coffee extract, fruit juices
- Wastage is prevented by addition of antifoaming agents – silicone oils
- Antifoaming agents collapse the foam