Salahaddin University- Erbil

College of Agricultural Engineering Sciences

Department of Animal Resources

2nd Stage/ 2nd Semester

“Dairy Science and Technology”

Physicochemical properties of milk –part2

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What are the examples of Physiochemical properties of milk?

- Physical state
- Acidity and pH
- Density
- Colour & appearance
- Flavour
- Taste
- Viscosity
- Surface tension
- Smell
- Foaming and cream
- Refractive index
- Specific heat
- Specific gravity
- Electrical conductivity
- Oxidation-reduction potential
- Boiling point
- Freezing point

Freezing Point (F.P.) of milk

- F.P. of milk is in an average of about -0.522 C.
- F.P. It depends on the concentration of soluble constituent, mainly lactose and chloride.
- Factors affecting F.P. of milk are: may vary daily, seasonally and according to breed, feed, and other factors.

- Q/ Why Freezing points measurement is important?
  A/ for detection of amount of added water to milk, since each 1% added water made the freezing point about 0.01 degree closer to zero point.

- Q/Why F.P. of milk is lower than the F.P. of water?
  A/ because of the dissolved components in milk.

Q/ Factors affecting Freezing point in milk

- **1-Acidity of the milk: Q/Why** increase in the acidity of milk results in a lower freezing point? A/ because the colloidal minerals dissolved by the acid and this increase the solutes in the milk.

- **2-Preservatives:** Preservatives added to milk will increase the materials held in solution which tends to lower F.P.
- **3-Species of animal:** The F.P. of milk differs between species of animal and this depends upon the amount of lactose and ash in the milk of each species.

Boiling point

- Milk is slightly heavier than water, and since the boiling point of a liquid is influenced by factors responsible for its specific gravity, milk boils at a temperature slightly above that of water.
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- Water boils at 100ºC and average milk boils at **100.17ºC.**

Surface tension

- **Surface tension:** At the surface of liquids there is a force which tends to contract that surface. The force is seen in falling drops which assume a spherical shape thus bringing the ratio of surface to volume to a mininum value.

- The surface tension is measured in terms of the force per unit length and generally is reported in dynes per centimeter.

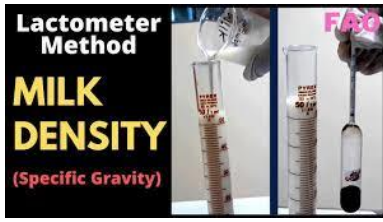
- Surface tension of milk is about 52 dyne/cm.
- The addition of substances to water may cause an increase or a decrease in surface tension.

Specific gravity

- **The specific gravity of milk** is the ratio of its weight to the weight of an equal volume of water.
- The specific gravity of normal whole milk (cow) is usually with an average of about 1.032 at 16 C,
- Q/ Why Milk is heavier than water? A/ Because all the solid constituents except the fat have a greater specific gravity than water.
- The specific gravity varies with temperature, (lower at higher temperature and vice versa),
- The specific gravity of water (1), fat (0.93), protein (1.35), lactose (1.66), and ash (5.5)

Specific gravity (Sp.gr)

- specific gravity (Sp.gr)= density of substance/ density of water



- A milk low in fat (sim milk) will have the higher sp.gr. and conversely milk rich in fat (cream) will have the lower sp.gr.
- The sp gr. of milk is lowered by addition *of water & cream* and increased by addition of skim milk or removal of fat.
- Q/ For what reason the sp.gr. is used?
- A/ Sp.gr is used for the estimate the solids and solids non-fat contents of milk

Refractive index (RI) of milk

- RI is normally determined at 20 C with the D line of the sodium spectrum. The RI of milk is 1.3440 to 1.3485 and can be RI is used to estimate total solids.

Type of milk	Refractive index
Camel	1.3423±0.001
Cow	1.3459±0.000
Buffalo	1.3464±0.000
SEM	0.0056
CD (0.05%)	0.00167
CV %	0.1195

SEM: Standard error of mean; CD: Critical difference (5% level significant); CV: Coefficient of variance.

Viscosity

- **Viscosity:** is the quantity that describes a fluid's resistance to flow.
- **Q/Why Viscosity of milk and milk products is important? Answer:** 1- to determine the rate of creaming, 2-to determine rates of mass & heat transfer 3- to determine the flow condition in dairy process.

- **The viscosity of milk and milk products depends on the: 1-temperature and 2- pH.**

- The increase in viscosity is due to the fat and the protein primarily the casein.
- Viscosity of whole milk is higher than water which arrange of (1.6 – 2), while it is (1.002) for water.

Electrical conductivity

- is mainly due to its soluble salt fraction.
- Lactose does not conduct current, and fat decreases conductivity.

- The contribution of proteins and peptides is of minor importance.

- Thus, addition of lactic acid to a phosphate buffer solution (pH 6.5) decreases conductivity.
- Fermentation of lactose to lactic acid sharply increases conductivity.

Heat stability of milk

- **Heat stability** is defined as the length of time required to induce coagulation at a given temperature or the temperature required to induce coagulation in a given time.
- The stability of milk system at the high processing temperatures to which milk is exposed for the manufacture of certain products is very important.
- Added citrates, phosphates and calcium have a great impact on the heat stability.

Physico-Chemical Changes during processing & storage of Milk and Milk Products

- Heating milk at near boiling point causes a film or skin to form on the surface. This skin is mainly due to calcium caseinate.

- Pasteurization temperatures slightly lowers the viscosity through breaking the clumps of fat globules, but when subjected to high heat, or high pressure, the viscosity is increased due to the denaturation of proteins.
- Freezing alters the physical condition of milk to the extent that it never returns to its original state.
- Freezing causes the fat globules to lose their complete emulsion structure, become irregular in shape and size.