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CERTIFICATION COURSES

Dairy and Food Process and Products Technology

PROF. TRIDIB KUMAR GOSWAMI
AGRICULTURAL AND FOOD ENGINEERING DEPARTMENT
IIT KHARAGPUR

Lecture 21

Fatty acids:- A fatty acid is a long chain carboxylic acid, $CH_3(CH_2)_nCOOH$, many varieties are available in nature. Even numbered fatty acids are more in nature than those for odd numbered ones.

Saturated Fatty acids :- Fatty acids containing from 2 – 80 carbon atoms per molecules are known. In most animal and vegetable fats C_2 to C_{20}, particularly C_{16} and C_{18} are found. Saturated fatty acids with more than 24 carbon atoms

Seldom occur in food triglycerides, but do so in waxes. C_4 – C_{10} occur mainly in milk fat such as butyric ($CH_3(CH_2)_2COOH$), Caproic ($CH_3(CH_2)_4COOH$), Caprylic ($CH_3(CH_2)_6COOH$), Capric ($CH_3(CH_2)_8COOH$). C_{12} – C_{24} are found mostly in most vegetable and animal fats. Fatty acids with odd numbered carbon atoms are found in animal and vegetable fats but they seldom exceed 1-2% of the total fat. Common saturated acids are lauric ($CH_3(CH_2)_{10}COOH$), myristic ($CH_3(CH_2)_{12}COOH$), palmitic ($CH_3(CH_2)_{14}COOH$), and stearic ($CH_3(CH_2)_{16}COOH$).

Unsaturated fatty acids:- Both no. of carbon atoms and double bond (DB) characteristics differ. DB may vary between 1 to 6.

Trivial name	Structure
Myristoleic	$CH_3(CH_2)_3CH=CH(CH_2)_7COOH$
Palmitic	$CH_3(CH_2)_5CH=CH(CH_2)_7COOH$
Oleic	$CH_3(CH_2)_7CH=CH(CH_2)_7COOH$
Linoleic	$CH_3(CH_2)_4CH=CHCH_2CH=CH(CH_2)_7COOH$
Linolenic	$CH_3(CH_2CH=CH)_3(CH_2)_7COOH$
Arachidonic	$CH_3(CH_2)_3(CH_2CH=CH)_4(CH_2)_3COOH$

Oleic acid – Olive oil (75%); Linolenic – 60-80% Safflowerseed oil

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Lecture 22

Essential fatty acids:- Those which man or animals can not synthesize. e.g. poly unsaturated fatty acids (PUFA) such as linoleic acid.

Triglycerides:- acyl derivatives of glycerol.

H_2C^1OH
HOC^2H
H_2C^3OH

$H_2C^1OCOR_1$
HOC^2H
H_2C^3OH

$H_2C^1OCOR_1$
R_2COOC^2H
H_2C^3OH

$H_2C^1OOCR_1$
R_2COOC^2H
$H_2C^3OOCR_3$

–Fat :-

– commonly known as butter fat –> 2.5 – 6.0.

–Protected by a membrane (FGM)

– Made up of approx. 98% triglycerides, 0.2 to 1% phospholipids, 0.2 to 0.4% sterols.

– Phospholipids and proteins are mostly associated the FGM

– Table, or light, or coffee, or single cream –> 18 – 25%.

– Light whipping -> not less than 30%,

– Heavy whipping -> not less than 36%,

– plastic or extra heavy cream -> 65 to 80%,

- **butter** -> 82.5%,
- butter oil or dry butter -> 98 – 99.5%,
- **cheddar cheese** -> 30 to 40%,
- ice cream -> 8 – 20%,
- **Evaporated milk** -> 8%,
- whole milk -> 26%.

- **Exists in milk in the form of minute globules**
  - in a true emulsion of oil-in – water in the dispersed phase.
- **Each globule of fat is surrounded by a very thin film of protein, or the serum of milk, concentrated on the surface and held in place by surface attraction or adsorption.**
- The concentrated layer surrounding the fat globule is composed of certain protein and fat-like substances, especially lecithin.

Milk fat contains traces of fatty acids, vitamins A, D, E, and K and enzymes

More than 400 different fatty acids of which predominant are

- Myristic acid (C14 : 0)
- Palmitic acid (C16 : 0)
- Stearic acid (C18 : 0)
- Oleic acid (C18 : 1)

Lipids, proteins, cerebrosides, nucleic acids, enzymes, trace elements (minerals), and some bound water stabilize and prevent fat globules from coalescence during milk processing and handling.

FGM prevents attack from lipases (lipolysis) or increase amount of diglycerides, monoglycerides, and free fatty acids in milk.

Free fatty acids are fairly soluble in water and are situated in milk plasma and fat.

Short chain free fatty acids, situated in the milk plasma, are ionized and are more water soluble than long chain free fatty acids (C > 14).

Minerals associated with the fat globule membrane are copper (5 – 25%) and iron (30 – 60%).

Other minerals include cobalt, calcium, sodium, potassium, magnesium, manganese, molybdenum, and zinc.

Compound lipids also occur in milk such as phospholipids and phosphatides that are situated mainly in the fat globule membranes but also in milk plasma, lipoproteins, and milk microsomes.

Phospholipids and phosphatides are highly surface active and polar, and dissolve poorly in both water and oil.

Lipids can be crystallized, which affects fat structure, melting range, rheological properties of milk

Autoxidation of the double bond containing fatty acids or fatty acid residues can occur leading to off flavours.

Whole milk contains about 10 to 20 mg / 100 g cholesterol (3.3 % fat). Amount of cholesterol is positively correlated with the amount of fat in the product. Cholesterol is located in the fat globule membrane, and approx. 10% of the cholesterol is esterified.

- **Size of fat globule:-**
  - **generally 2 – 30 μm.**
  - **A single drop of milk contain about 100,000,000 fat globules.**

Composition of milk fat:-

- **Not a single chemical compd. – mixture of several different glycerides.**
- **Organic acids contained in milk fat and fats from other sources other than milk fat are commonly known as "fatty acids",**
- **animal fats are relatively simple as compared with milk fat.**

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Lecture 23

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- **Organic acids contained in milk fat and fats from other sources other than milk fat are commonly known as "fatty acids",**
- **animal fats are relatively simple as compared with milk fat.**

– e.g., beef fat consists of the glycerides of palmitic, stearic, and oleic acids. Mutton tallow – glyceride of stearic acid.

– Lard – glyceride of oleic acid. Milk fat – butyric,caproic, caprilic, capric, lauric, myristic, palmitic, stearic, and oleic acids.

– Soluble and volatile acids – Butyric (C3), caproic(C5), caprylic (C7), capric (C9). Insoluble and non volatile acids – lauric (C11), Myristic acid (C13), palmitic acid (C15), stearic acid (C17), oleic acid (C17).

– Hardness or softness of milk fat and their relation to the texture of butter depend on the

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– Hardness or softness of milk fat and their relation to the texture of butter depend on the

– Stage of lactation (butyric acid content declines from the beginning to the end of lactation period),

– **Feed**

- **increase in olein content produces soft fat with low m.p**.
- for cottonseed meal, increase in olein is counteracted by the decrease in butyrin.

– **Feeds result in higher olein content – rich in vegetable oils such as linseed meal, soybean meal.**

- **Grass pasture increases olein content**.
- **Feeds with low vegetable oil but rich in carbohydrates produce less olein content – firmer fat)**.
- Nutrition (decline in the volatile acids and increase in the olein content).

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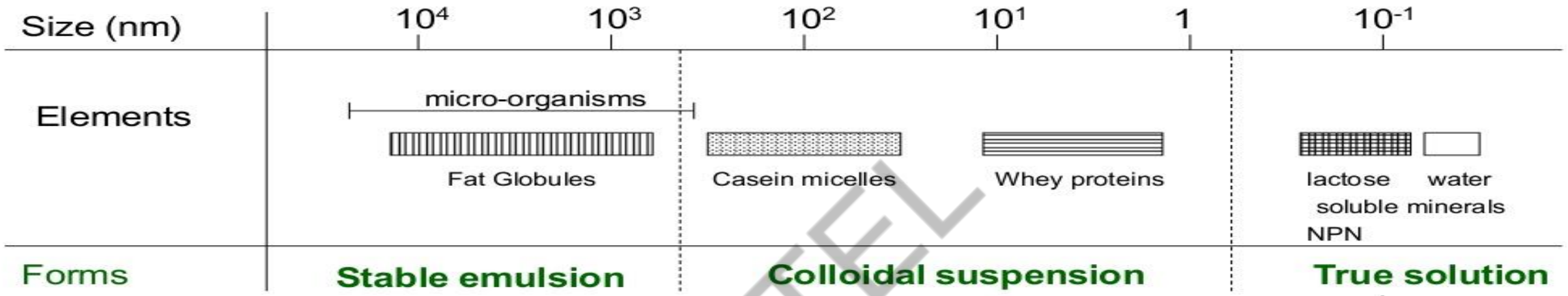
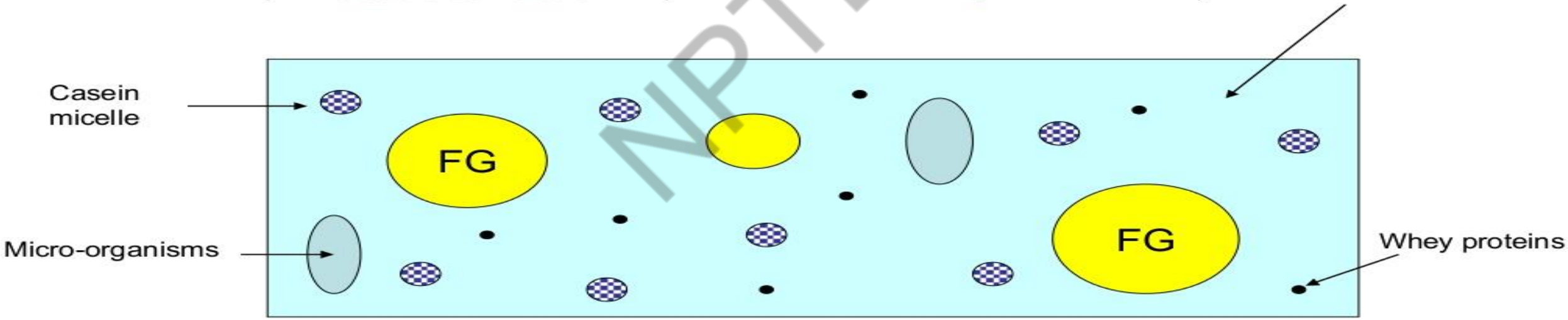
Lecture 24

Different milk phases





Relative sizes of particles in milk.

Size (mm)	Type of particles
10^{-2} to 10^{-3}	Fat globules
10^{-4} to 10^{-5}	Casein-calcium phosphates
10^{-5} to 10^{-6}	Whey proteins
10^{-6} to 10^{-7}	Lactose, salts and other substances in true solutions

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Lecture 25

What is protein?

Protein is a macronutrient that is essential to building muscle mass. It is commonly found in animal products, though is also present in other sources, such as nuts and legumes.

There are three macronutrients: protein, fats and carbohydrates. Macronutrients provide calories, or energy. The body requires large amounts of macronutrients to sustain life

Meat, seafood, poultry, grains, beans and dairy products are good sources of protein.

Each gram of protein contains 4 calories. Protein makes up about 15 percent of a person's body weight.

Chemically, protein is composed of amino acids, which are organic compounds made of carbon, hydrogen, nitrogen, oxygen or sulfur. Amino acids are the building blocks of proteins, and proteins are the building blocks of muscle mass.

When protein is broken down in the body it helps to fuel muscle mass, which helps metabolism.

It also helps the immune system stay strong. It helps you stay full, satiety effects

How much protein in take?: - A safe level of protein ranges from 0.8 grams of protein per kilogram of body weight, up to 2 grams of protein per kilogram for very active athletes.

Structure of protein:-

Most proteins **fold** into unique 3-dimensional structures. The shape into which a protein naturally folds is known as its **native conformation.**

Protein folding is the **physical process** by which a protein chain acquires its **native 3-dimensional** structure, a **conformation** that is usually **biologically functional**, in an **expeditious and reproducible** manner.

Thank You!!