Tishk International University
Faculty of Applied Science
Department of Nutrition and Dietetics

Nutritional Biochemistry I/ NUT 207

TOPIC: Nutrition of carbohydrates, fats and proteins

2nd Grade- Fall Semester 2025-2026

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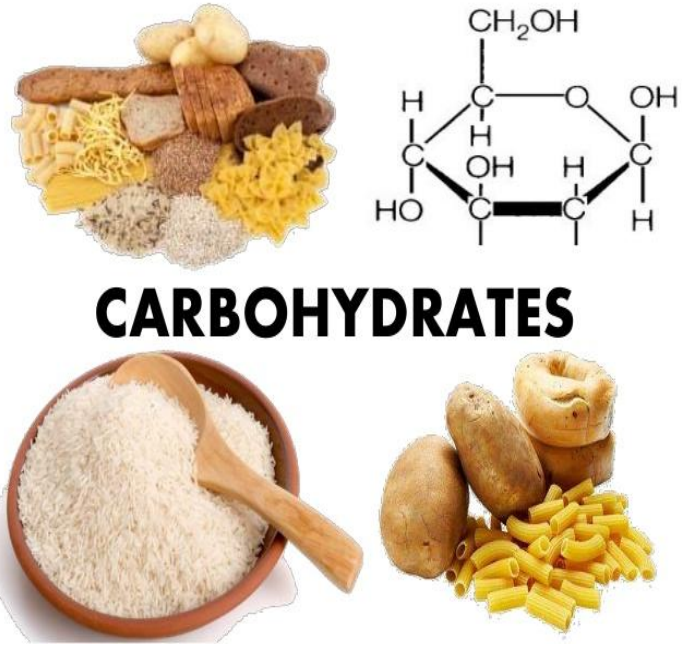
Physiology and nutrition of carbohydrates:

- (CH2O)n , one of the macronutrients.
- A major energy source to the body.
- Provides 4kcal/g.
- Carbohydrates in food are present in the form of sugars and starch (polymers of sugar) and cellulose (non-starch polysaccharide).
- The simplest component of carbohydrate is glucose.



Classification:

- Carbohydrates are classified into *Simple* and *Complex*.
- Simple carbohydrates are subdivided into (*mono*, *di*, *oligo* and *polysaccharides*).
- There are six naturally occurring carbohydrates of interest in foods.

- Glucose
- Fructose
- Maltose
- Sucrose
- Lactose
- Polysaccharides (starch, glycogen)

Metabolism:

- The digestion of carbohydrates starts in the mouth by the action of saliva.
- It’s finally broken down to the simplest unit which is absorbed in the small intestine.

- Carbohydrate digestion involves hydrolysis of disaccharide and polysaccharide to simple sugars.

- Ribose, xylose and arabinose are not required in diet as these can be synthesized by all animals.

- The non-digestible carbohydrates in plant foods are called ‘dietary fiber’.

Normal glucose value

A normal value for glucose is 80-120 mg/dL.

The glycemic Index (GI) is the blood glucose response after having a carbohydrate meal, and it's affected by number of factors.

Glycemic Index

Low GI (<55), Medium GI (56-69) and High GI (70>)

Grains / Starchs		Vegetables		Fruits		Dairy		Proteins	
Rice Bran	27	Asparagus	15	Grapefruit	25	Low-Fat Yogurt	14	Peanuts	21
Bran Cereal	42	Broccoli	15	Apple	38	Plain Yogurt	14	Beans, Dried	40
Spaghetti	42	Celery	15	Peach	42	Whole Milk	27	Lentils	41
Corn, sweet	54	Cucumber	15	Orange	44	Soy Milk	30	Kidney Beans	41
Wild Rice	57	Lettuce	15	Grape	46	Fat-Free Milk	32	Split Peas	45
Sweet Potatoes	61	Peppers	15	Banana	54	Skim Milk	32	Lima Beans	46
White Rice	64	Spinach	15	Mango	56	Chocolate Milk	35	Chickpeas	47
Cous Cous	65	Tomatoes	15	Pineapple	66	Fruit Yogurt	36	Pinto Beans	55
Whole Wheat Bread	71	Chickpeas	33	Watermelon	72	Ice Cream	61	Black-Eyed Beans	59
Muesli	80	Cooked Carrots	39						
Baked Potatoes	85								
Oatmeal	87								
Taco Shells	97								
White Bread	100								
Bagel, White	103								

Glycemic Index calculation formula

$$\text{Glycemic index} = \frac{\text{Glucose response to test food}}{\text{Glucose response to standard food}} \times 100$$

Amount of food is standardized to 50 grams of carbohydrates

Glucose response is area under the curve of blood glucose measurements taken for 3 hours after the meal

Functions

- Major energy providing nutrient in the diet.
- The non-digestible carbohydrate help in various ways.
- Different starches are used as thickening agents.
- Helps in growth of desirable bacteria.
- Pentoses are components of DNA and RNA.

Deficiency:

Malnutrition occurs.

Recommended Dietary Allowance

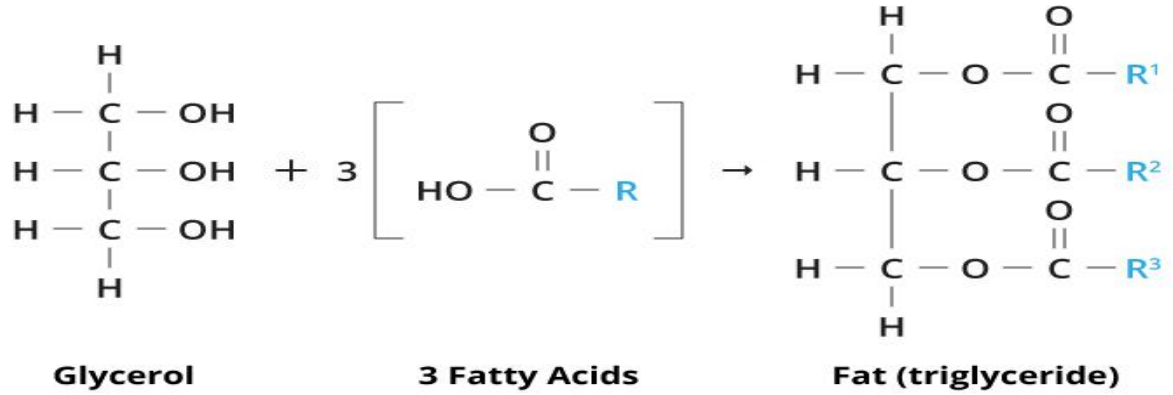
- Carbohydrate in the diet = 55 – 65 % of total energy.
- 130 grams
- 40gm of dietary fiber in the daily adult diet is recommended. (FAO/WHO, 1998).

Dietary Sources

It is present in variable amount in nearly all foods except fats and oils.

Fats

- Fats are triglycerides of fatty acids and glycerol.



- Fatty acids have a fundamental structure of

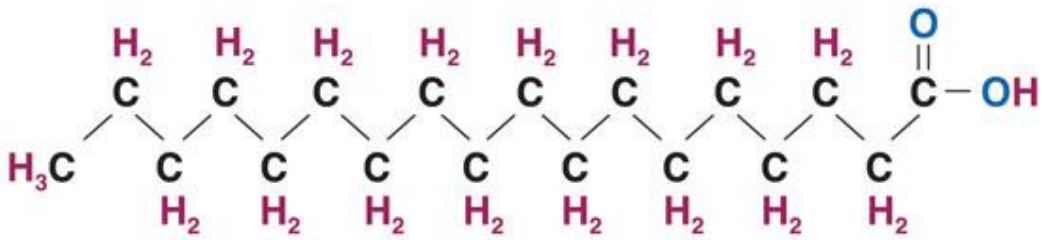
$$CH_3\text{-}(CH_2)_n\text{-}COOH$$

- Fat is a concentrated source of energy providing 9kcal/g.

Classification:

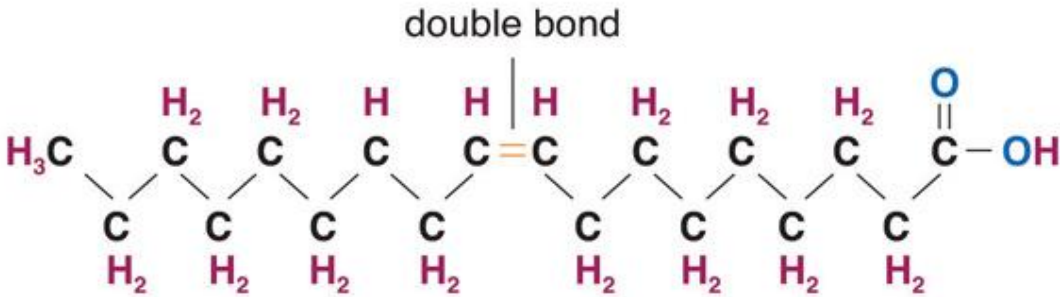
- Saturated

Stearic acid
$C_{18}H_{36}O_2$
A saturated fat



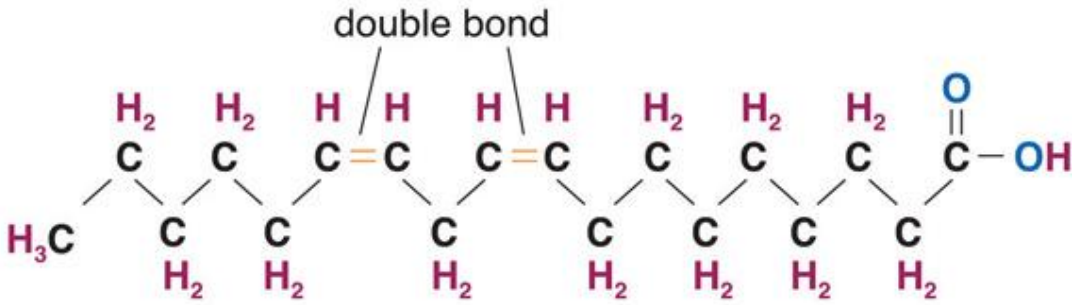
- Monounsaturated

Oleic acid
$C_{18}H_{34}O_2$
A monounsaturated fat



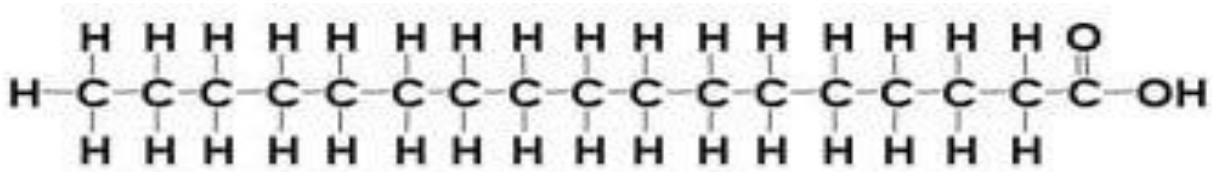
- Polyunsaturated

Linoleic acid
$C_{18}H_{32}O_2$
A polyunsaturated fat

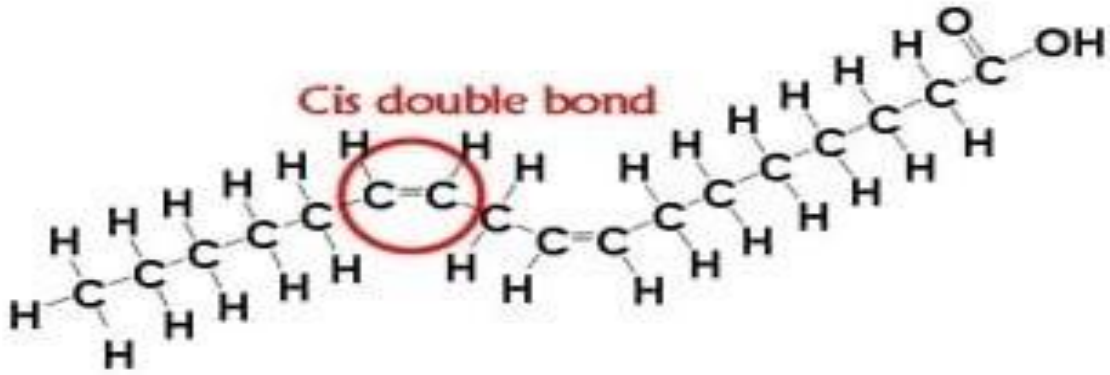


Classification:

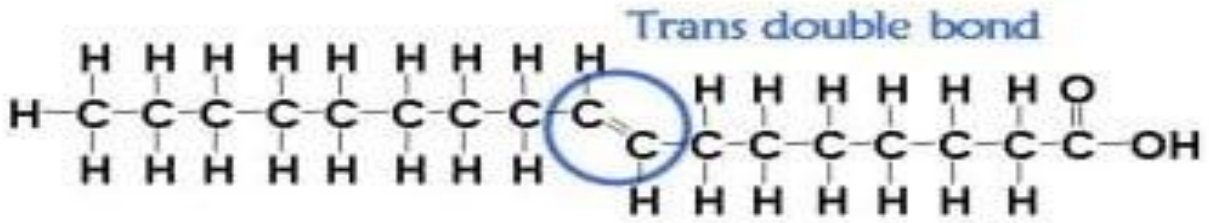
SATURATED
Stearic acid
(found in butter)



UNSATURATED
Linoleic acid
(found in vegetable oil)

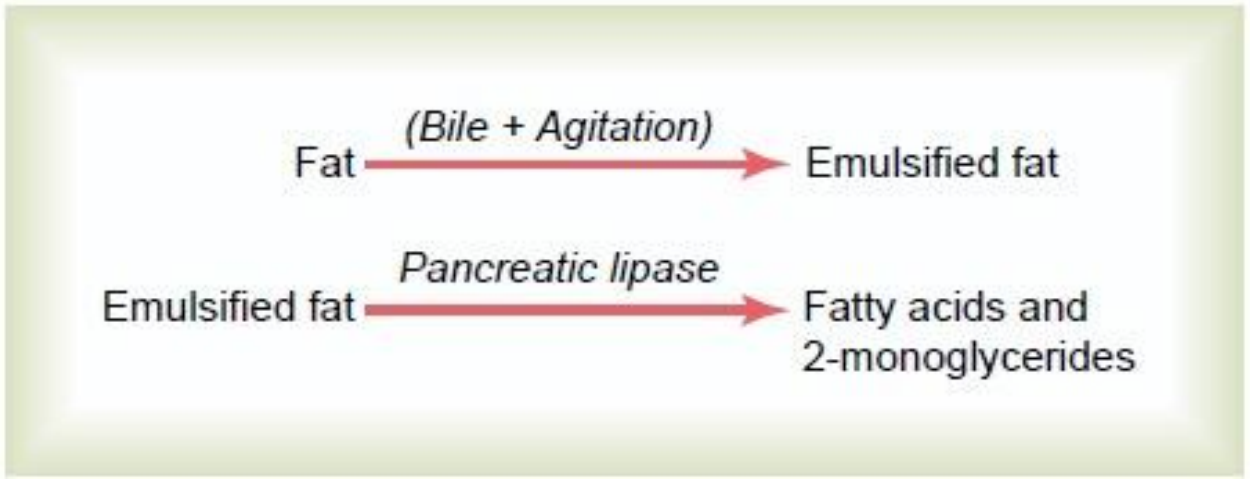


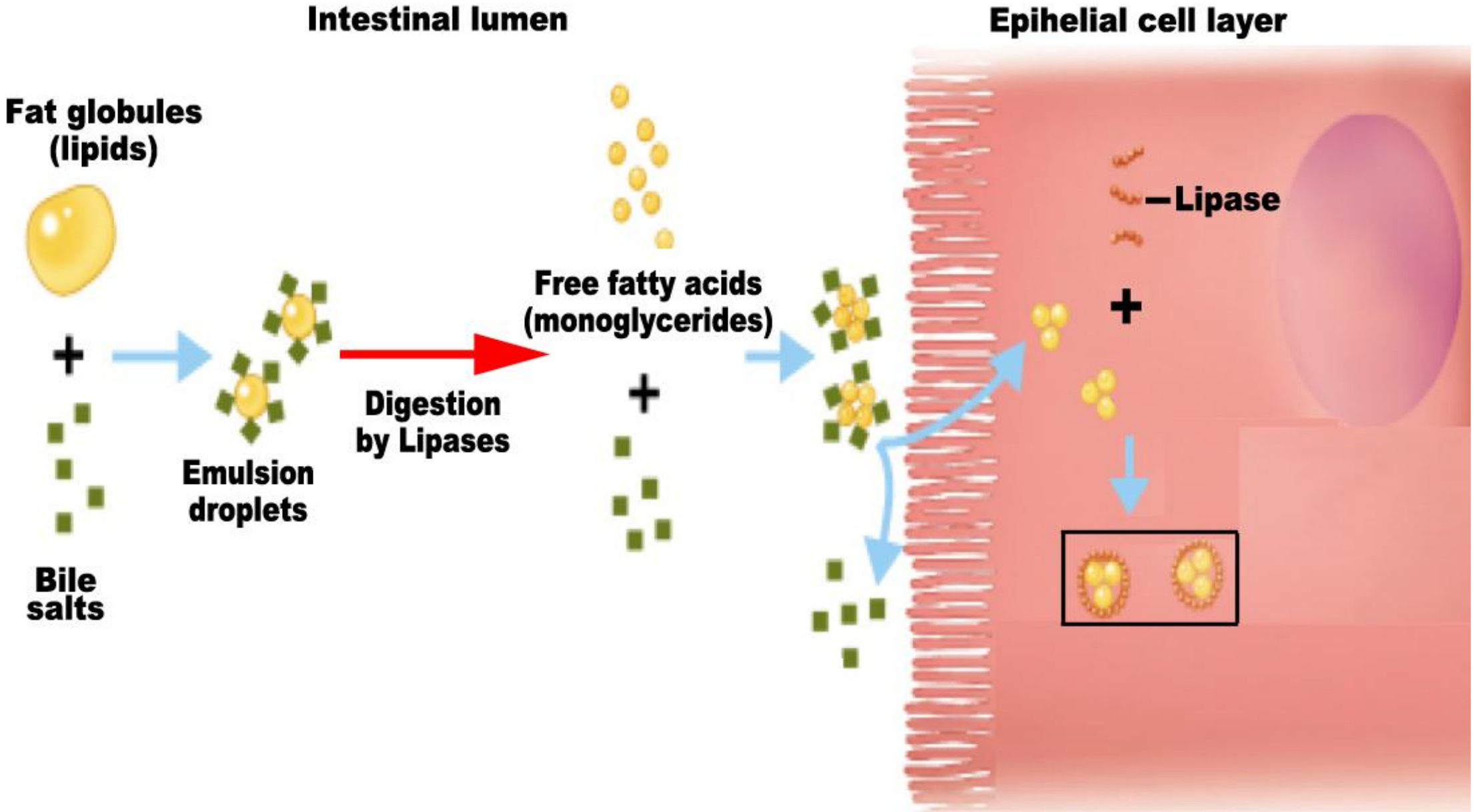
TRANS
***trans*-Linoleic acid**
(found in some margarine)



Metabolism:

- The digestion of fat takes place in small intestine with the help of bile and lipase enzyme into fatty acids and glycerol.
- These are again resynthesized into triglyceride in the intestinal cell.




Intestinal lumen
Epihelial cell layer
Fat globules
(lipids)
+
Bile
salts
Emulsion
droplets
Digestion
by Lipases
Free fatty acids
(monoglycerides)
+
Lipase
+

Functions

- Fats are concentrated source of energy.
- Provide palatability to diet.
- Help in absorption of fat- soluble vitamins.
- Essential fatty acids (EFA) are important for the function and structure of body cell membranes.
- Fats as adipose tissue act as an insulator and padding for vital organs.

Deficiency:

- The essential fatty acid deficiency known as phrynoderma is seen along with malnutrition.

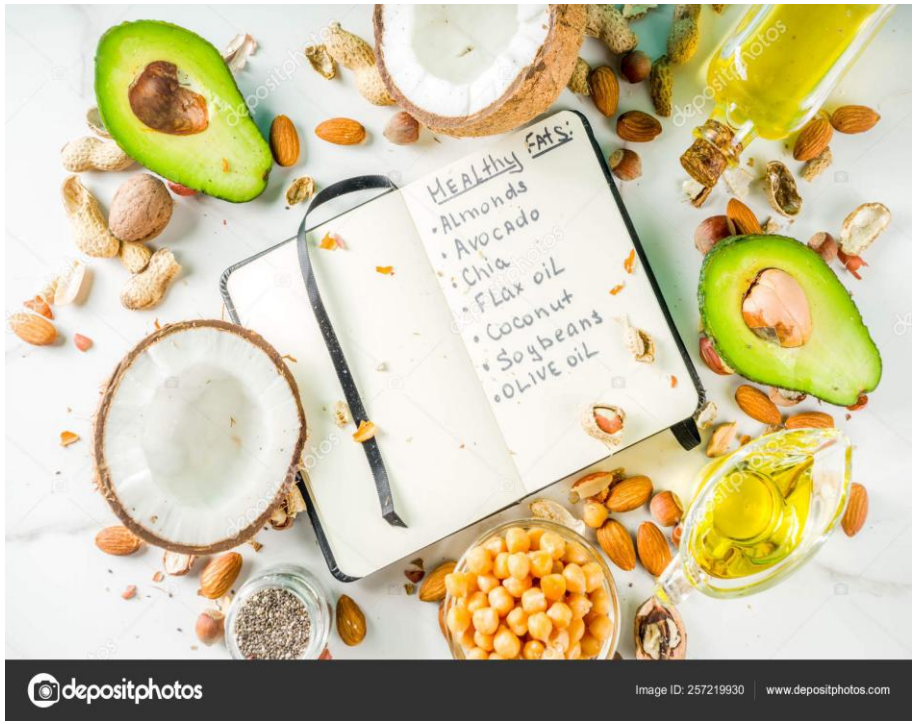
Recommended Dietary Allowance:

A minimum amount of fat is required to meet the requirement of essential fatty acids.

- Fats from varied sources is preferred than from any single kind.

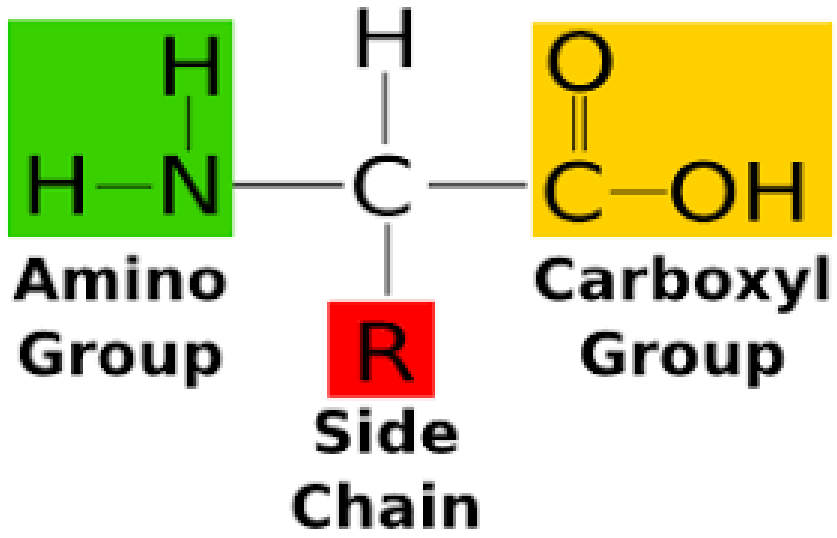
Dietary sources

- It is present in small amounts in cereals and legumes.
- Animal sources (Butter).
- Vegetable sources (coconut, safflower).



Proteins:

- One of the major macronutrients.
- The basic structure is amino acid.

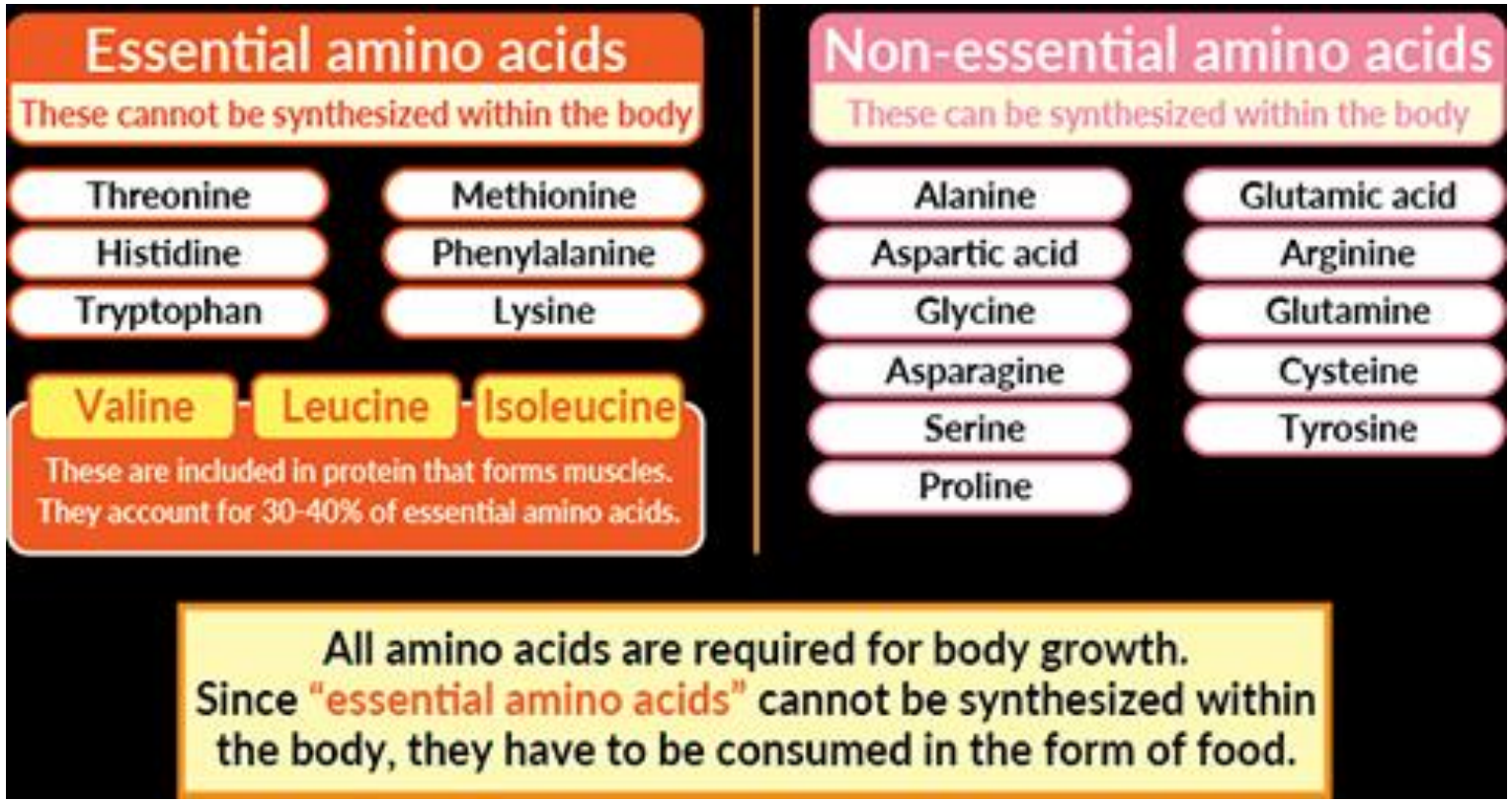


- Amino acids are water soluble,

Crystalline, and insoluble in organic solvents.

Classification:

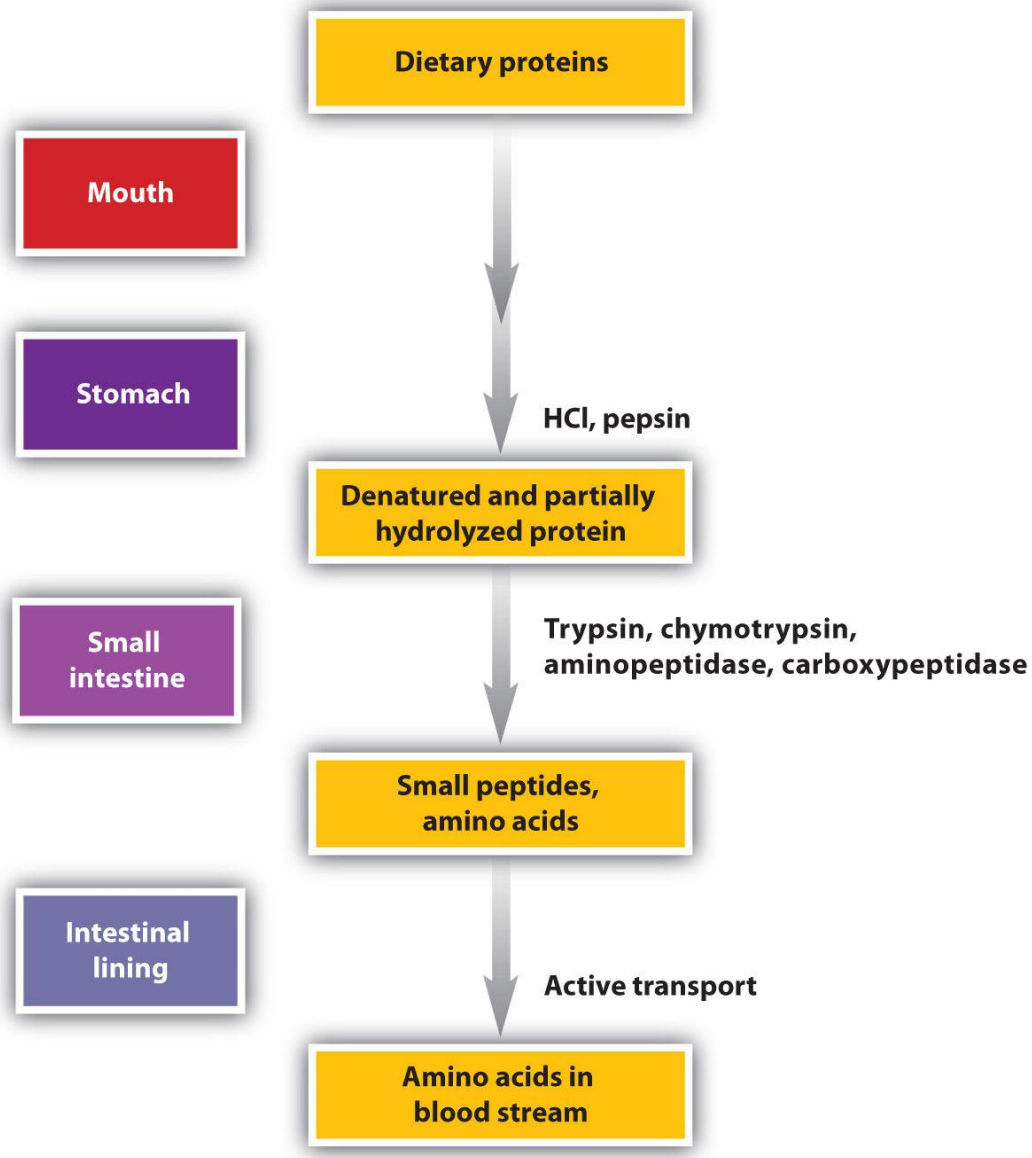
- There are 20 amino acids present in the body.
- Infants require two more essential amino acids (arginine and histidine).



Metabolism

- Digestion of protein starts from stomach and finally completes in small intestine.

- The amount as well as the type of protein taken in diet is equally important as the digestibility and absorbability vary between different proteins.



Biological value (BV)

‘‘ The percentage of absorbed protein nitrogen that is retained in the body’’.

A high BV indicates a high degree of utilization of the amino acids of the protein.

Net Protein Utilization (NPU)

‘’The percentage of protein eaten that is retained’’.

Functions:

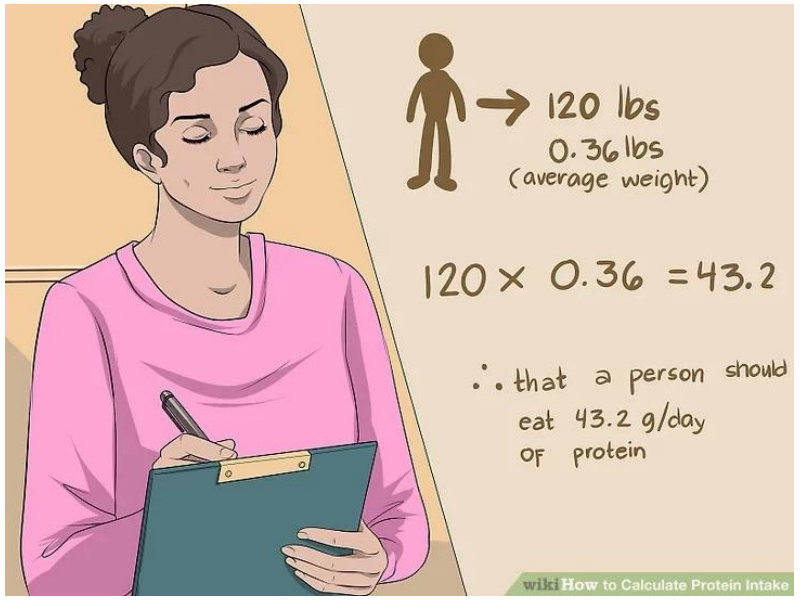
1. Required for general growth, maintenance & repair of body tissues.
2. Secondary role as energy source.
3. Essential for synthesis of protoplasm, enzymes.
4. For production and maintenance of body proteins.
5. Required for the supply of the essential amino acids which cannot be synthesized in the body.

Deficiency

- Low protein diets cause anemia , hypoalbuminemia and edema.
- Infants fed on low protein diets suffer from physical and mental retardation.
- Protein deficiency is generally observed with calorie deficiency and this condition is called ‘Protein Calorie Malnutrition’.

Recommended Dietary Allowance

- ✓ The minimum protein requirement is 0.51-0.66g (av. 0.57g)/kg body weight.
- ✓ The requirement for infants and children is 1.5 – 2.0g/Kg.
- ✓ Also it's recommended that the diet should have at least 1/3 to ½ of total proteins from animal sources.



Dietary Sources

- Protein rich foods are widely present in nature, from animal and vegetable sources.
- *Animal sources* are;
  - Liver
  - Meat
  - Egg
  - Milk
- *Vegetable sources* include;
  - Legumes
  - Soybean
  - Nuts