

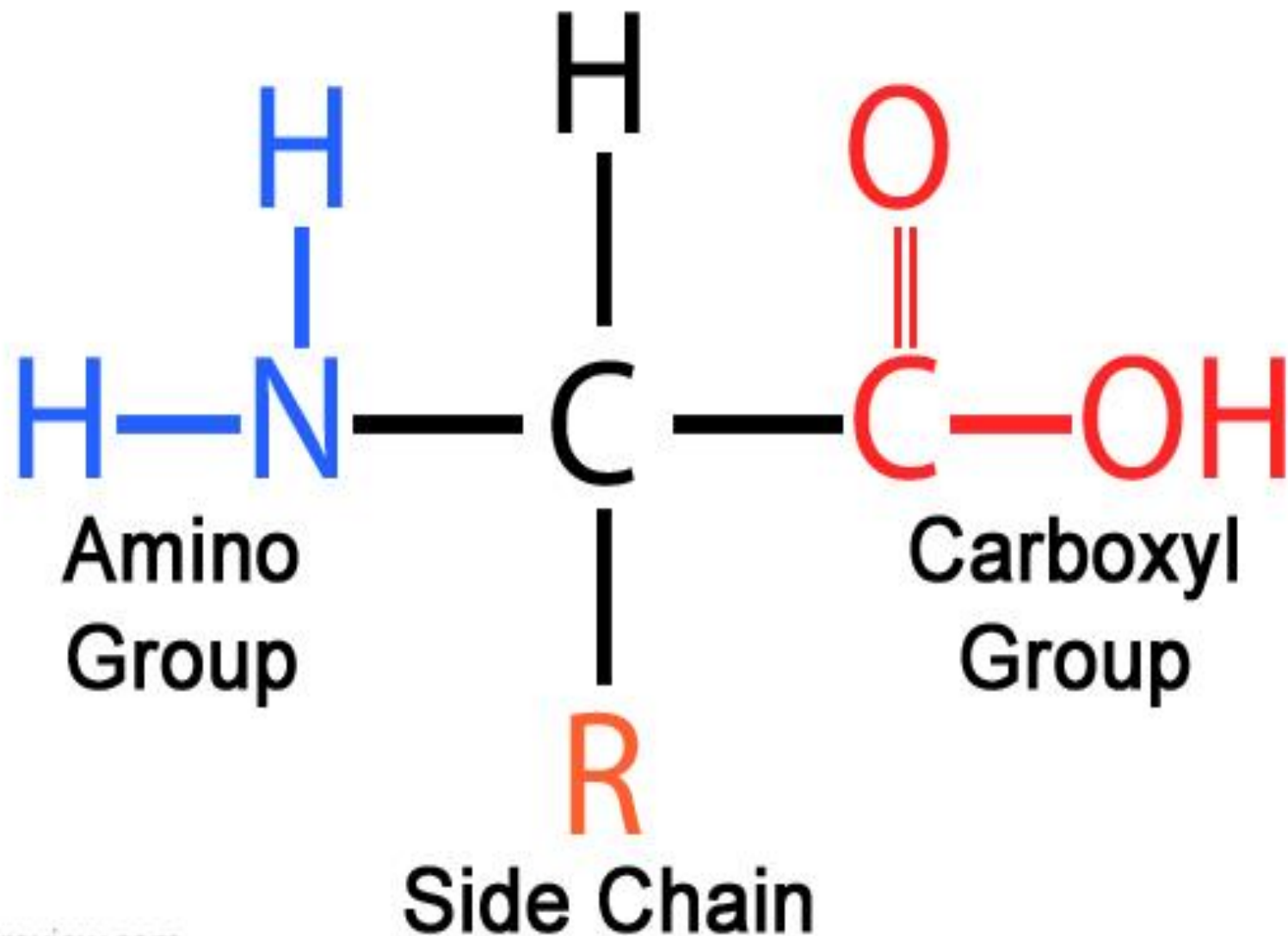
# Chapter 3 : Proteins

In Greek : “to take first place”

# Amino Acids

- The basic building blocks of all proteins
- The end product of protein digestion
- There are **20** common amino acids:
  - **9** are **essential** or indispensable : body cannot make them so they must be supplied through the diet
  - **11** are **nonessential** or dispensable because cells can make them as needed

# Amino Acid Structure



# Functions of Protein

- Except for bile and urine, every tissue and fluid in the body contains some protein

## *1. Body structure and framework*

- Skeletal muscle, skin, blood, Form tendons, membranes, organs, and bones.

## *2. Enzymes*

## *3. Other body secretions and fluids*

- Neurotransmitters, antibodies, and some hormones are made from amino acids

# Functions of Protein

## 4. *Fluid balance*

- Because they attract water, which creates osmotic pressure.

## 5. *Acid–base balance*

- They can act as either **acids** or **bases** depending on the pH of the surrounding fluid.
- Ability to buffer or neutralize excess acids and bases enables proteins to maintain normal blood pH, which protects body proteins from being **denatured**

# Functions of Protein

## *6. Transport molecules*

- transport other substances through the blood.
  - **lipoproteins** transport fats ,cholesterol, and fat-soluble vitamins
  - **Hemoglobin** transports oxygen
  - **Albumin** transports free fatty acids and many drugs.

## *7. Component of other compounds*

- **Opsin**, the light-sensitive visual pigment in the eye
- **Thrombin**, a protein necessary for normal blood clotting.

# Functions of Protein

## 8. *Some amino acids have specific functions*

- **Tryptophan** : is a precursor of the vitamin niacin and is also a component of serotonin.
- **Tyrosine** : is the precursor of melanin, the pigment that colors hair and skin and is incorporated into thyroid hormone.

## 9. *Fueling the body.*

- Provides 4 cal/g.
- Protein is a source of energy when it is consumed in **excess** or when calorie intake from carbohydrates and fat is inadequate.

# Protein Catabolism for Energy

- If insufficient carbohydrate and fat are available for energy use → dietary and body proteins are sacrificed to provide amino acids that can be burned for **energy**.
- Over time → loss of lean body tissue occurs



# Sources of Protein

- Meat ( 7 g)
- Milk (8 g)
- Grains (3 g)
- Vegetables (2 g)

# Protein Quality

- Based on their **content of essential amino acids**
- For most people now, **protein quality is not important** because the amounts of protein and calories consumed are more than adequate.
- when protein needs are increased or protein intake is marginal ... ?????!!!

# Protein Quality

## Complete

- provide all 9 essential amino acids in adequate amounts and proportions needed by the body for protein synthesis
- **animal sources**
- **Soy protein (the only plant source)**

## incomplete (limiting)

- also provide all the essential amino acids
- But one or more are present in insufficient quantities to support protein synthesis
- **Grains , legumes**

# Complementary proteins

- Incomplete + Incomplete proteins that have different limiting amino acids = complementary proteins
- Small amounts of a complete protein + any incomplete protein = complementary.
- Not necessary in the same meal, instead over the day

# complementary proteins



## QUICK BITE

Examples of two complementary plant proteins

Black beans and rice

Bean tacos

Pea soup with toast

Lentil and rice curry

Falafel sandwich (ground chickpea patties  
on pita bread)

Peanut butter sandwich

Pasta e fagioli (pasta and white bean stew)

# Protein Requirements

- 0.8 g/kg
- Minimum requirement needed to:
  - Maintain nitrogen balance
  - Additional factor to account for individual variations and the mixed quality of protein typically consumed.
- 10% to 35% of total calories

# Protein Requirements

- Protein restriction :
  - People with severe liver disease (because the liver metabolizes amino acids)
  - Those who are unable to adequately excrete nitrogenous wastes from protein metabolism due to impaired renal function.

# Protein Requirements

Increase the need for protein

## BOX 3.3

### CONDITIONS THAT INCREASE THE NEED FOR PROTEIN

*When calorie intake is inadequate and so protein is being used for energy*

- Very low calorie weight loss diets
- Starvation
- Protein–energy malnutrition

*When the body needs to heal itself*

- Hypermetabolic conditions such as burns, sepsis, major infection, and major trauma
- Skin breakdown
- Multiple fractures
- Hepatitis

*To replace excessive protein losses*

- Peritoneal dialysis
- Protein-losing renal diseases
- Malabsorption syndromes, such as protein-losing enteropathy and short bowel syndrome

*During periods of normal tissue growth*

- Pregnancy
- Lactation
- Infancy through adolescence



# Protein Deficiency

**Protein–energy malnutrition (PEM):** occurs when protein, calories, or both are deficient in the diet.

# Protein Deficiency

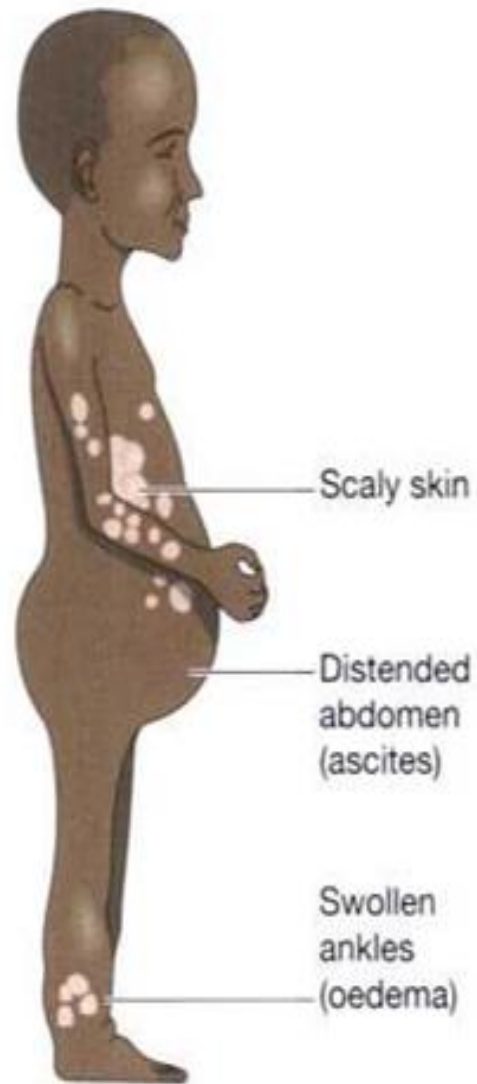
- **Kwashiorkor:** caused by a deficiency of protein or from infections.
- **Marasmus:** caused from severe deficiency or impaired absorption of calories, protein, vitamins, and minerals.

# kwashiorkor

- results mainly from acute critical illnesses such as trauma, sepsis, and other illnesses seen in intensive care units
- Aggressive nutritional support is used to restore metabolic balance as quickly as possible.

# Marasmus

- Occurs among homeless people, elderly people living alone, fad dieters, adults who are addicted to drugs or alcohol, and people with eating disorders
- Nutritional therapy is **started slowly** and **advanced gradually** to avoid life threatening metabolic imbalances.



**A Kwashiorkor**



**B Marasmus**

# Protein Excess

- No proven risks from eating an excess of protein
- Data are conflicting as to whether high-protein diets increase the risk of osteoporosis or renal stones
  - Calcium phosphate ( as a buffer) : from bones → osteoporosis
  - Renal stones:

# PROTEIN IN HEALTH PROMOTION

Not addressed in the *Dietary Guidelines for Americans*

# Vegetarian Diets

- Semi vegetarians
- Lacto ovo vegetarians
- Vegan
- Macrobiotic



# Advantages of vegetarianism

- Vegetarians have lower incidences of
  - Obesity
  - Cardiovascular disease
  - Hypertension
  - Type 2 Diabetes
  - Cancer
  - Dementia
  - Renal disease
  - Gallstones
  - Diverticular disease

# Disadvantages of vegetarianism

1. Poorly planned vegetarian diets may lack certain essential nutrients, which endangers health.
2. Can be excessive in fat and cholesterol if whole milk, whole-milk cheeses, eggs, and high-fat desserts are used extensively.

# Nutrients of Concern

- Most vegetarian diets, even vegan ones, meet or exceed the **RDA for protein** despite containing less total protein and more lower-quality protein than nonvegetarian diets.

# Iron

- Because of lower bioavailability of iron from plants
- Should have 1.8 times the normal iron intake
- Sources :
  - Iron fortified bread and cereals
  - Baked potato with skin
  - Beans , lentils
  - Soybean ( tofu, veggie meats)
  - Dried apricots, prunes, and raisins

# Vit C and plant iron ??

- Consume a rich source of vitamin C at every meal → helps to maximize iron absorption from plants.
- Try orange and citrus fruits, tomatoes, kiwi, red and green peppers, broccoli, Brussels sprouts, cantaloupe, and strawberries.

# Zinc

- Plant sources of zinc are less absorbed than animal ones
- Sources :
  - Whole grains (esp. the bran and germ)
  - White beans , chickpeas
  - Zinc fortified cereals
  - Soybean products
  - Pumpkin seeds
  - Nuts

# Calcium

- Spinach, beet greens ... are also rich in Ca
- But they have oxalate which interferes with Ca absorption
- Ca supplements are recommended when not meeting the requirements

# Calcium

- Sources :
  - Chinese cabbage
  - Broccoli
  - Okra
  - Turnip greens
  - Calcium fortified orange juice
  - Tofu , soy milk
  - Calcium fortified breakfast cereals



# Vitamin D

- Depending on the sunlight exposure and adequacy of food choices
- Sources :
  - Sunlight
  - Fortified milk , soy milk
  - Fortified ready-to-eat cereals

# Omega 3

- Because they excluded fish, eggs, and sea vegetables
- Sources :
  - Fortified foods
  - Flaxseeds , flaxseeds oil
  - Walnut , walnut oil
  - Canola oil
  - Soybean oil

# Vitamin B12

- No plant sources for B12
- Supplements is recommended for all people over 50
- Sources :
  - Fortified soy milk
  - Breakfast cereals
  - Veggie burgers

