

Chapter 5
Proteins: More Than Just Meat and Muscle

Hewlings/Medeiros

PowerPoint presentation created by
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Chemical Structure of an Amino Acid

Amino acid structure

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R Groups are Unique

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Essential Amino Acids	Non-Essential Amino Acids
<ul style="list-style-type: none"> • Histidine • Isoleucine • Leucine • Lysine • Methionine • Phenylalanine • Threonine • Tryptophan • Valine 	<ul style="list-style-type: none"> • Alanine • Arginine • Asparagine • Aspartic Acid • Cysteine • Glutamic Acid • Glutamine • Glycine • Proline • Serine • Tyrosine

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Making of a Non-Essential Amino Acid

Phenylalanine → Tyrosine

(essential AA) phenylalanine hydroxylase (non-essential AA)

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Phenylketonuria

Phenylalanine ↑ Tyrosine

(essential AA) phenylalanine hydroxylase (non-essential AA)

MISSING, LACKING

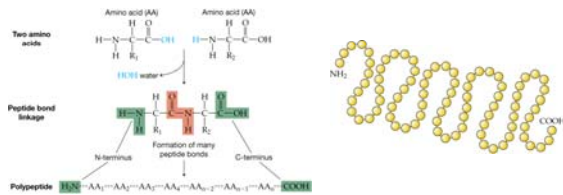
Control intake Becomes essential

- Some amino acids may become essential in certain disease conditions.
- They are **conditionally essential**.

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Protein Bonds

Amino acids are joined to form proteins by strong bonds: "peptide bonds"



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Protein Organization

- Primary structure
 - Sequence of amino acid (determines protein shape)
- Secondary structure
 - Bends and folds held together by bonds
- Tertiary structure
 - 3D shape (dictates function)
- Quaternary structure
 - Two or more proteins interacting together
 - Important when protein needs to be active only at certain times and can turn off by separating

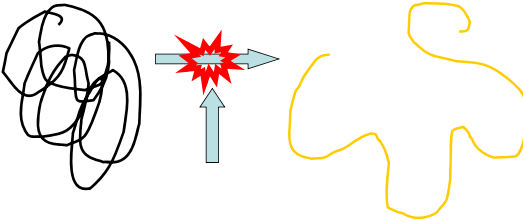
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Sickle Cell Anemia



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Denaturation of Proteins



Heat/acid/alkaline/enzymes

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Functions of Proteins

- Growth, maintenance, and repair
- Body structure and blood
- Fluid balance
- Acid/base balance
- Immune function
- Enzymes
- Hormones
- Transport
- Energy yielding (4 kcal/g)

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Protein Turnover

- A connection between synthesis and breakdown
- Important for muscular growth and maintenance

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Protein Synthesis

- DNA tells body in what order to join the amino acids to make specific proteins
- Mistake in specific order = health consequences
- Protein synthesis occurs in the cytosol of the cell
- DNA is in nucleus
- So the code for synthesis must be carried into the cytosol
- mRNA carries instructions and protein is made (costs energy)

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Limiting Amino Acid

C is the limiting essential amino acid.

It limits the amount of protein that can be synthesized.


CCCCC
AAAAAAAA
RRRRRR

➔

CAR CAR CAR
CAR CAR
R
A A A

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Food Sources of Protein



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Quality of Protein

- High-quality, or complete protein
 - Contains ample amount of all nine essential amino acids
 - Easy to digest and absorb
- Low-quality protein (incomplete)
 - Deficient or low in one or more essential amino acids

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Plant Protein

- Somewhat less efficient (than animal protein)
- Low in cholesterol and saturated fat
- High in dietary fiber, phytochemicals
- Lacking in one or more essential amino acids

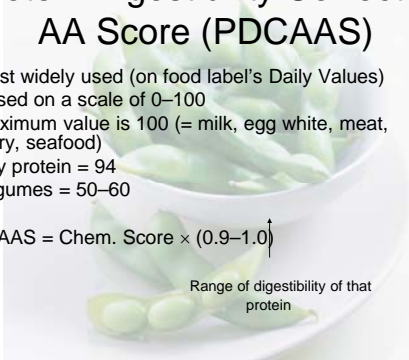
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Protein Digestibility Corrected AA Score (PDCAAS)

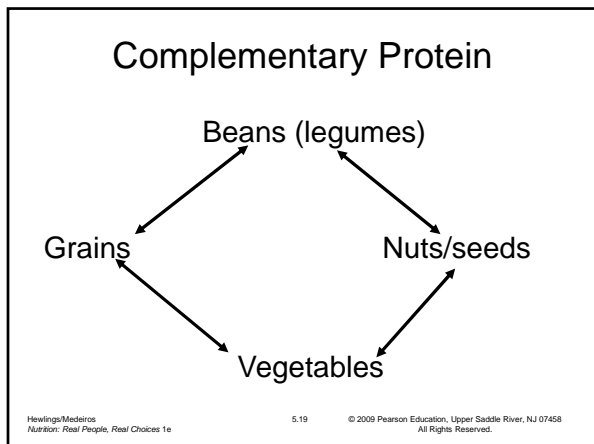
- Most widely used (on food label's Daily Values)
- Based on a scale of 0–100
- Maximum value is 100 (= milk, egg white, meat, dairy, seafood)
- Soy protein = 94
- Legumes = 50–60

PDCAAS = Chem. Score × (0.9–1.0)

Range of digestibility of that protein



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Protein Supplementation

- **Key for skeletal muscle growth = protein synthesis must exceed breakdown**
- **Major stimulus for muscle hypertrophy is the nature and frequency of the weight training combined with normal meal consumption.**
- **Increased protein intake does not increase net protein balance, so increasing intake to maximize growth has been discounted.**

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DRI for Protein

0.8 gm of protein / kg of healthy body weight
154 lb./2.2 kg/lb. = 70 kg

70 kg × 0.8 g protein/kg healthy body wt = 56 g protein

Do athletes need more?

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DRI for Protein

- Increased by ~10–15 g/day for pregnancy
- Endurance athletes **may** need 1.5–2 g/kg healthy weight
- About 8–10 percent (or more) of total kcal
- Most of us eat more than the RDA for protein
- Excess protein cannot be stored as protein
- New DRI for protein coming

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Types of Vegetarians

- **Vegans** omit all animal products from their diets, including dairy and eggs.
- **Lacto-vegetarians** include dairy products but no other animal foods.
- **Lacto-ovo vegetarians** eat both dairy products and eggs, but no meat.
- **Macrobiotic vegetarians** consume mostly whole grains, especially brown rice, in their diets and include vegetables, soy, legumes, fruits, and sometimes white-meat fish, but avoid meat, poultry, eggs, and dairy
- **Semivegetarians** occasionally eat meat and seafood, yet predominantly subsist on a vegetarian diet.

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Reasons for Being a Vegetarian

- Some people believe that killing animals for food is unethical.
- Trappist and Hindu monks are vegetarians for religious reasons.
- Seventh Day Adventists believe that a vegetarian diet is more healthy and base their beliefs on Biblical texts.

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The Top Five Perceived Benefits for Eating a Vegetarian Diet (Lea 2002)

- Eat more fruit and vegetables
- Decreased saturated fat intake
- Weight control
- Prevent disease in general
- Better health by decreasing intake of chemicals, steroids, and antibiotics that are found in meat

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Health Benefits

- Preventing hypertension
- Avoiding Type 2 diabetes
- Lower incidence of certain cancers (colon)
- Lower Body Mass Index
- Decreased mortality due to ischemic heart disease
- Vegetarians on average live 7 years longer.
- Vegans live on average 15 years longer.

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Are vegetarian diets adequate?

- Vegan diets can supply all that people need, but require extra planning and consideration.
 - Especially for protein B₁₂, iron, zinc, vitamin D, calcium
- Vegan diets are healthier than the typical western diet, but you don't have to go to extremes to achieve health benefit.

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Complementary Foods

- Beans and rice
- Beans and corn or wheat tortillas
- Rice and lentils
- Pea soup with bread or crackers
- Garbanzo beans (chickpeas) with sesame paste
- Pasta with beans
- Peanut butter on bread

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Food Guide for Vegetarians



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Is eating meat animal abuse?



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Benefits of Soy



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Malnutrition

- Protein-energy malnutrition
- Marasmus
 - Seen in hospitalized patients
- Kwashiorkor



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Kwashiorkor



- Low-protein-density diet
- Energy needs are marginally met
- Signs and symptoms:
 - Apathy, listlessness, failure to grow, poor weight gain, change in hair color, nutrient deficiency, flaky skin, fatty infiltration in the liver, massive edema in the abdomen and legs

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Marasmus



- Starving to death
- Insufficient protein, energy, nutrients
- "Skin and bones" appearance
- Little or no subcutaneous fat
- Reduced brain growth

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Is a high-protein diet harmful?

- Low in plant foods (fiber), vitamins, phytochemicals
- Intake of animal protein increases risk for heart disease (high in saturated fat).
- Excessive intake of red meat is linked with colon cancer.
- Burden on the kidneys
- Increases calcium loss
- National Academy of Sciences recommends no more than two times the RDA for protein.

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