UNIVERSITY OF NAIROBI

SCHOOL OF PUBLIC HEALTH

Course: Public Health Nutrition

MBCHB Level 2

Jan 2018

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Proteins

- The basic material for all living cells

- Essential for Growth & development
- Made up of ~20 amino acids (A.A.)

- 9 of the 20 A.As are essential – the body cannot function without them, & can't synthesize them, - MUST come from Diet,

- The balance of these 9 E.A.A in the protein of any given food is what determines its quality

Essential Amino Acids (E.A.A)

1. Histidine
2. Isoleucine
3. Leucine
4. Lysine
5. Methionine
6. Phenylalanine
7. Threonine
8. Tryptophan
9. Valine

Non- Essential Amino Acids (E.A.A)

1. Alanine
2. Arginine
3. Asparagine
4. Aspatic acid
5. Cystein
6. Tyrosine
7. Glutamic acid
8. Glutamine
9. Glycine
10. Proline
11. Serine

Functions of proteins in the body

- **Mainly 2 broad functions:**
- 1. Structural
- 2. Physiological (regulatory)

Structural functions:- Protein provide

- body structure for individual **cells** (membrane, cytoplasm and cellular organelles);

- overall structure that characterizes the appearance of our body (**skin, hair and muscles**)- in a protein deficient diet, muscles shrink, skin loses its elasticity and hair becomes thin an can be easily pulled out).

Physiological functions of proteins

- 1**. Chemical reactions**: Amino acids are important in formation of most *hormones and enzymes* that speed up the metabolic reactions in the body. E.g Insulin hormone is a protein. Other hormones are also made up of lipids.

- 2**. Transportation** – Transport proteins in the body carry substances from one organ to another e.g. hemoglobin in transportation of oxygen from lungs. Vitamin A also need protein for its transportation. Hence protein deficiency can cause poor oxygen circulation and vit. A deficiency

Physiological functions of proteins(2)

3. **Defense proteins (immunity):**
   1. The skin as the first barrier to infections is made up of proteins;
   2. For synthesis of antibodies to fight off infections.
4. **Movement:** Contractile or motile proteins give cells and organisms the ability to move , contract and change shape. These proteins are the ***actin and myosin,*** which cause the muscles to contract, allowing for movement, contraction in heart muscles, digestive tract, blood vessels, etc.

Physiological functions of proteins

5. **Fluid Balance**: Proteins help regulate fluid balance by transporting particles from one side of the cell membrane to another, and by preventing the fluid being forced into the tissues and by attracting the fluid in the tissues back into the blood.

6. **Acid-Base balance:** Chemical reactions of metabolism in the body requires specific level of acidity or *pH* to function well. Protein serves as buffers to maintain the *pH* level by:

- When blood is too acidic – protein picks up excess hydrogen ion to increase *pH* of blood, and if blood is too alkaline, protein donates hydrogen to decrease the *pH*

7. **Glucose formation:** Incase of inadequate carbohydrate intake to supply glucose, the liver makes glucose from amino acids, e.g. when you skip breakfast and have not eaten for the last 24 hours. In extreme cases such as starvation, this leads to muscle wasting and edema.
8. **Energy source:** Not a main function of protein, but occurs e.g during prolonged exercise. – is costly for the body

Protein sources

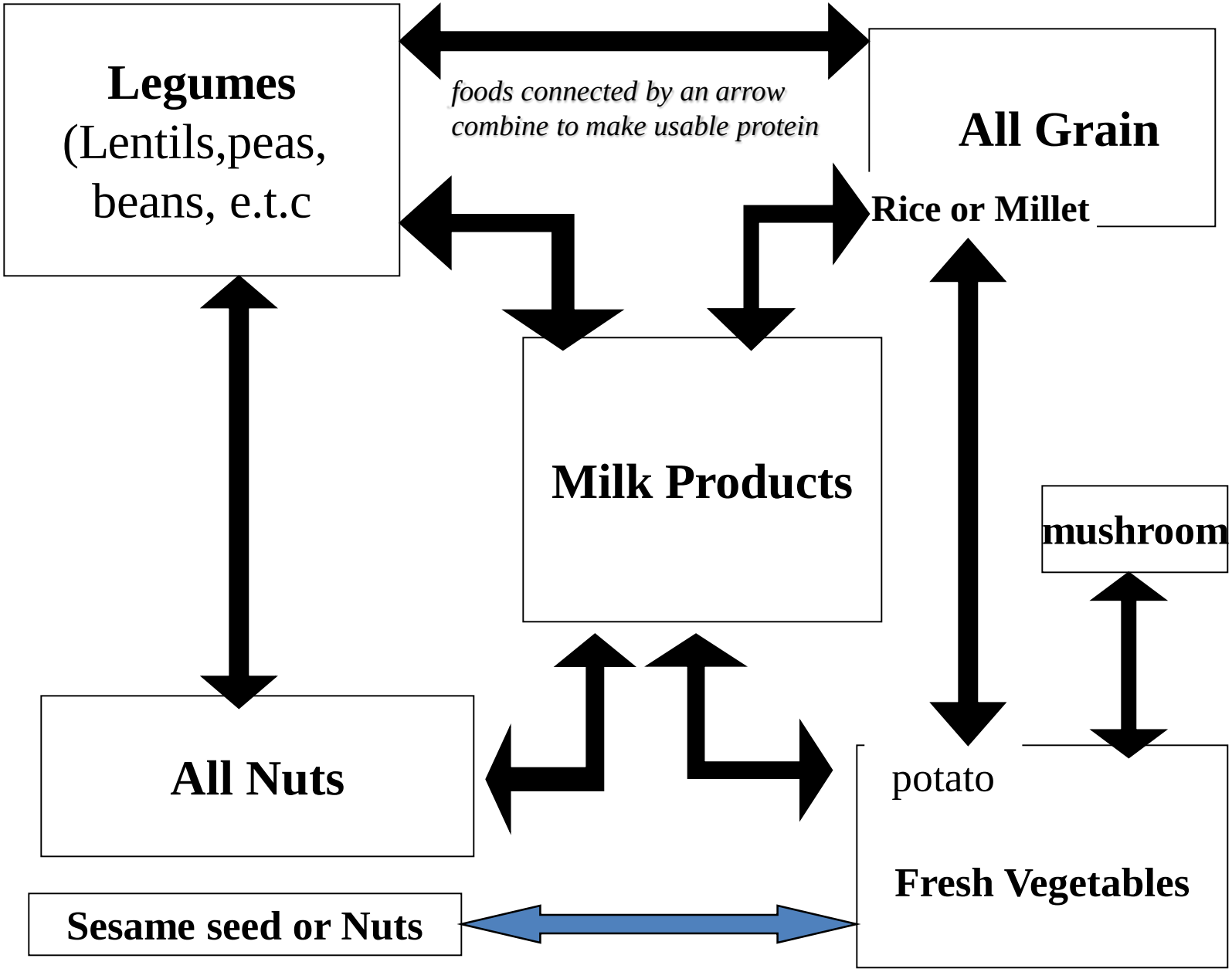
Two Types of Protein Food Sources:

1. **Animal Protein Foods/Complete proteins:**
   - Contain all E.A.As, & have higher protein quality
   - E.g. Milk,Eggs, meat, fish, poultry.

2. **Plant Protein Foods/Incomplete protein**
   - Do not contain all E.A.As
   - E.g. Legumes/beans, grains, nuts, seeds
   - Combination of foods gives complete proteins

- Example 1: beans with: Maize, rice, Wheat, Nuts or Seeds

- Example 2:Rice with: Beans, nuts, seeds, green grams, or wheat,



COMBINING FOODS FOR MORE COMPLETE PROTEIN

Protein Needs

- Minimum Daily Protein requirements for healthy adults is ~ 50g-65g/day.
- For pregnant & lactating mothers=65-70g

- **High protein intake…..**
  - common among adults- not healthy to the body
  - High protein intake has been linked to:
    - High Calcium loss in adults, causing osteoporosis
    - Renal dysfunction in old age
    - Production of toxic effects in premature infants

Is Meat good for you?

- Meat eaters have a low health rating
- Most meats, except from local breeds, have received hormone treatment of one kind or another.
- Meat has been linked to chronic diseases – heart diseases, cancers (stomach & colon cancer) and digestive diseases e.g. appendicitis

Micronutrients (Vitamins & Minerals)

	Vitamins	Minerals
Definition	Are essential organic compounds in diet needed by the body in small amounts to promote & regulate body functions & processes for growth, reproduction & maintenance of health.	Naturally occurring inorganic elements that function in the body as structural components and regulators of body processes.
Traditional Classification / Grouping	Based on their solubility in water or fat. This determines their absorption, transportation, excretion & storage in the body: Water soluble vitsB & C ; Fat soluble vits: A, D, E & K	Based on the amounts needed in the diet or present in the body: **Major minerals** and **Trace minerals**

Type I and Type II Micronutrients

1. Classifications of micronutrients is based on the body's response to a nutrient deficiency: **Type I and Type II**
   (Ref: Golden, M 1995. Specific deficiencies versus growth failure: type I and type II nutrients. SCN News, 12, 10–14.);

2. This classification emphasises that poor growth is not caused solely by protein-energy malnutrition but can result from other nutrient deficiencies that may not be recognised & so appropriately treated.

3. It also shows the importance of a wide range of nutrients in causing poor growth or weight loss, & therefore the need for a nutritionally balanced diet.

Type I and Type II Micronutrients

Type I micronutrients: response to deficiencies is characterised by specific physical signs of deficiency due to reduced tissue concentration of the nutrient

Type I micronutrients do not affect growth or weight; but cause major illnesses & impaired immunity (Iron, Iodine, Vit.A & C); have specific signs of clinical deficiency;

Type II micronutrients: essential for growth & tissue repairs.

Deficiency is characterized by reduced growth rate (stunting) or weight loss (wasting) with no specific deficiency signs (Zinc, Selenium, Magnesium, -most trace minerals); have no specific clinical signs

Vitamin C (ascorbic acid)

	Food Sources	Functions
	Citrus fruits, cabbages, tomatoes, potatoes, dark green veges, peppers, lettuce, strawberries, mangos, papayas.	-Collagen formation for (wound healing), - Maintains bone & teeth, - Anti-oxidant (against chronic diseases); -strengthens resistance to infection; - Absorb of iron from plant-based food.

Vitamin B-Complex (Water Soluble)

Vitamin	Food Sources	Function
B1 (Thiamine)	Animal protein food, whole-grain, cereals, pasta, nuts, legumes, wheat germ, oats.	Facilitates release of energy from carbohydrate; supports normal appetite & nervous system function.
B2 (Riboflavin)	Milk & Milk products, dark green veges, liver, meat, whole-grain & cereals.	Facilitates release of energy from energy nutrients; promotes healthy skin and normal vision.
B3 (Niacin)	All Protein Foods	Facilitates release of energy from energy nutrients; promotes health of skin, nerves, & digestive system.

Vitamin	Food Sources	Function
B6 (Pyridoxine)	Animal protein food, whole-grain, Green vegetables, bananas	-Essential for all Protein utilization -Formation of anti-bodies & red blood cells Converts tryptophan to niacin
Folate(Folic Acid)	Green vegetables, liver, legumes, seeds.	Red blood cells; protein metabolism; new cell division. In pregnancy, helps regulate embryonic & fetal nerve cell formation
B12 (Cobalamin)	All Protein Foods	Helps maintain nerve cells; red blood cell formation; synthesis of genetic material.

- Vit B5 is also a co-enzyme in energy production (anti-stress vitamin) & is found in most foods

- Biotin (also B-Complex), is found in most foods & also facilitate release of energy from energy rich nutrients

Fat Soluble Vitamins

Vitamin	Food Sources	Function
Vit. A	*Retinal:* milk/ margarine, cream, cheese, butter, eggs, liver. *Beta-carotene: dark leafy* veges carrots, sweet potatoes, pumpkin.	Vision; growth & repair of body tissues; reproduction, bone & teeth formation; immunity; hormone *synthesis; antioxidant.*
Vit. D	sunlight; fortified milk, margarine, eggs, liver, fish.	Calcium & phosphorus metabolism for bones & teeth; absorption of calcium.
Vit. E	Veg.oils, green veges, whole-grains, butter, liver, egg yolk, milk fat, nuts, seeds.	Protects red blood cells; antioxidant (protects fat-soluble vitamins); stabilization of cell membranes.

Vitamin K:

Food Sources: liver, green leafy and cabbage-type vegetables, Milk

Functions: Synthesis of blood-clotting proteins & a blood protein that regulates blood calcium.

Minerals

Their **bioavailability depends on many factors**, esp. interaction with:

- Other minerals e.g. too much dietary zinc reduces copper absorption
- Fibre, phytate & oxalic acid in some foods- e.g. high oxalic acid in spinach binds the available calcium, making it a poor dietary source.
- Vitamins Vit. D is important in calcium, Phosphorus and magnesium absorption

Minerals

A: Major Minerals (*See Ms. Word handout):*

The required amount in the body is more than 100 mg /day or present in the body in amounts more than 0.01% of total body weight; (Ca, P, Mg, Na, K, S)

1. The bone Builders:
   - Calcium (Vit. D improves its absorption)
   - Phosphorus – also part of every cell
   - Magnesium :
     - Works with Ca to strengthen bones & teeth
     - Works with Vt B1 & B6 to regulate nerves & muscles

2. Control Water balance in the body:

- **Sodium –** helps maintain normal fluid balance in the body
- **Potassium-** Facilitates many reactions in the body, protein synthesis, nerve transmission
- **Sulfur**- Part of some amino acids & insulin

Trace minerals

Amount needed in the body is less than 100 mg/day or present in the body in amounts of 0.01% of body weight or less (I, Fe, Zn, Se, Cu, flouride, manganese, chromium)

- Iodine- for normal physical growth
- Iron – for red blood cells and transport of oxygen
- Zinc- Part of many enzymes
- Selenium – as an anti-oxidant
- Copper – absorption of iron,
- Flouride- Bone and teeth

CONCLUSION

- **Adequate Nutrition: is** the means by which people thrive, maintain growth, resist and recover from illnesses, and perform daily tasks.

- **Your Nutritional Status** determines, to a substantial extent, your capacity to adapt and maintain health.

Summary on Micronutrients

- *Summary Sheet on types, sources, physiological functions & daily requirements (Ms word doc)*