

CHAPTER 6 - PROTEINS

- **Animal** proteins = meat, **eggs**, **dairy** products
 - High in **B** vitamins, iron, zinc, calcium
 - High in saturated **fat**, cholesterol
- **Plant** proteins = grains, nuts, **legumes**
 - **Low** in saturated fat and cholesterol
 - High in **fiber**, phytochemicals, monounsaturated, PUFAs
- Proteins = contain **nitrogen**
 - 20 side chains = 20 amino acids
 - Peptide bonds = A-A
 - Carbon bound to amino group, hydrogen, acid group and side chain
- **Amino acid pool** = **AAs available** for use in the body
 - AAs come from **dietary** proteins or breakdown of **body** protein
 - Deamination > Broken down to make energy (ATP)
 - Deamination > Make glucose + liver converts to fatty acid (triglyceride)
stored as fatty acid in adipose (WE DON'T 'STORE' PROTEIN)
 - Build **other proteins** + other nitrogen-containing molecules (DNA, RNA)
- **Limiting amino acid** = shortage of one AA that **stops** protein synthesis
 - **If limiting AA is a nonessential** = **transamination** = amine group is transferred from one AA to another, creating a new AA
 - **If limiting AA is essential** = body breaks down existing protein (because it must be consumed from diet otherwise)
- **Essential** = indispensable
 - **Cannot** be made in the body; must **EAT**
 - Missing? Body protein is broken down
 - Histidine
 - Isoleucine
 - Leucine
 - Lysine
 - Methionine
 - Phenylalanine
 - Threonine
 - Tryptophan
 - Valine
- **Non-essential** = **dispensable (DON'T EAT)**
 - Made in the **body via transamination**
 - Alanine

- Arginine*
 - Asparagine
 - Aspartic acid
 - Cysteine *
 - Glutamic acid
 - Glutamine*
 - Glycine*
 - Proline*
 - Serine
 - Tyrosine*
- **Essential** (eat) used to **make** non-essential (transamination)
 - But **sometimes (certain conditions) body can't convert = non-essential becomes *conditionally essential***
 - **PKU = phenylketonuria**; genetic
 - Phenylalanine **cannot** be converted to tyrosine
 - **High phenylalanine** leads to **high phenylketones** in blood
 - diet soda containing aspartame = phenylketones
- **Mechanical** digestion of protein = mouth
 - **Chemical** digestion of protein = stomach (HCL, pepsin)
 - Absorption = SMALL (mucosal cells)
 - Dipeptides and tripeptides break into single AAs
 - AAs moved **from** mucosal cells > **blood** > **liver**
 - AA **supplements** can **reduce** the **absorption** of some dietary AAs (shared transport protein)
- **Protein Function**
 - Structure (**connective tissue**)
 - Catalyzing reactions (**enzymes**)
 - Chemical signaling (**hormones**)
 - Transport (**Hb**)
 - Movement (**muscles**)
 - Immunity (**antibodies**)
 - Blood clotting, fluid balance, pH
- **Deamination** = removes **amino** group (NH₂) = produces **urea** as by-product > **urine**
 - 3 options after deamination:
 1. *Excess calories* (energy) = converted to fatty acid by LIVER = **stored as triglycerides in adipose tissue**
 2. *Insufficient calories* (energy) = broken down = **ATP**
 3. Can also be used to make glucose

- **Protein-energy malnutrition** = loss of fat **and** muscle, and decreased immunity from long-term **protein and calorie** deficiencies
 - Two types:
 1. **Kwashiorkor** = **pure protein** deficiency (**ONLY PROTEIN IS DEFICIENT**)
 - a. Characterized by **swollen** belly
 - b. **Fluid** accumulates in abdomen
 - c. **Fat** accumulates in **liver**
 - d. **Growth is impaired**; but do **not** appear thin
 - e. Poor immune function, hair color change, low nutrient absorption
 2. Marasmus = overall protein-energy deficiency (**DEFICIENT IN ENERGY AND PROTEIN**) = **body/muscle wasting**
 - a. **Depletion** of fat stores
 - b. **Wasting** of muscle
 - c. Decrease in intelligence and learning ability = **lifelong** effect

- **High-protein diets** = MORE **urea** (more deamination)
 - Increased kidney function (waste excretion)
 - Increased loss of water (**dehydration**)
 - Increased loss of calcium in urine (**kidney stones**)
 - **High protein diet associated with...**
 1. High in **animal** protein = **high** in saturated **fat**, **cholesterol**; **low** in fiber
 2. **Low** in grains, fruits, vegetables
 3. **High** in calories and fat
 4. Increased **risk** of heart **disease**, cancer, obesity, **diverticulosis**, diabetes

- Protein **allergies** = adverse **immune** response to a specific food product (**make Ab**)
 - Major allergens = milk, eggs, peanuts, tree nuts, fish, shellfish, soy, wheat
- Food **intolerance/sensitivity** = an adverse reaction to food, but **NO** production of antibodies (**not immune**)
 - MSG symptom complex/Chinese restaurant syndrome

- **Nitrogen balance?** *Protein intake recommendations are based on nitrogen balance*
 - Nitrogen balance: the amount of **nitrogen consumed** versus **nitrogen excreted**
 1. **In nitrogen balance** = nitrogen intake **equals** nitrogen loss
 - Body protein and weight stays the **SAME**
 2. **Negative nitrogen balance** = **more** nitrogen **lost** than consumed
 - Due to illness, injury, decreased consumption of protein
 - **LOSE** body protein
 3. **Positive nitrogen balance** = **more** nitrogen **consumed** than lost
 - Growth, pregnancy, weight training (increase muscle mass)
 - **GAIN** body protein

AMDR for protein = Acceptable Macronutrient Distribution Range = **10% - 35%** of **calories**

Protein quality: measure **content** of **essential AA** compared to body needs (how good a protein is at providing the **essential AAs**)

- **PDCAAS** = Protein Digestibility Corrected Amino Acid Score = **most** commonly used for determining **protein quality**

RDA (recommended dietary allowances) for protein **per day**= **0.8 g/kg** of body weight for **adults**

- **More WEIGHT** = **more** protein for maintenance and repair
- Typical Canadian adult consumes less than 80g protein/day
- **Higher needs** = infants, children, pregnancy, lactation (breast feeding), after an injury, **athletes**
 - Lactating women = **add 25 g protein / day**
 - **Athletes >**
 1. **Endurance** athletes (triathlete) = need more protein because some protein is used for **energy + maintain blood glucose** during endurance events
 - **1.2 - 1.4 g protein / kg of body weight / day**
 2. **Strength** athletes (weightlifter) = need more protein for **muscle** growth
 - **1.2 - 1.7 g protein / kg of body weight / day**

Protein Denaturation = **change in a protein's 3D shape**

- Heat from cooking
- Acidity (stomach acid)
- Mechanical agitation
- **Cooking egg: raw** egg protein = **transparent**
 - **Cooked** egg protein = **opaque** / firm
 - **Irreversible** denaturation

High-quality **COMPLETE** dietary **protein**

- Contain **all essential AAs**
- **High PDCAAS**
- More **easily** digested
- **Animal** proteins (except for SOY = high quality **plant** protein)

Low-quality **INCOMPLETE** dietary protein

- **Low** in one or more **essential AA**
- **PLANT** protein
- Combine complementary proteins (2 incompletes = complete)
 - **Protein complementation** = combining proteins from **different sources** to ensure presence of *ALL essential AAs*
 1. **Legumes with grains (beans + rice)**

- **AAs most often limited in PLANT** = Lysine, Methionine, Cysteine
 1. **Legumes** are **deficient** in methionine and cysteine but **high** in **lysine**
 2. **Grains** (rice), nuts, seeds are **deficient** in lysine but **high** in **methionine** and cysteine
- **Complementary proteins do not need to be consumed in the same meal;** can eat an assortment of plant foods *throughout the day*
 - Lentils, rice, chickpeas, peanuts

Vegetarian diet = plant-based diet that eliminates some **or** all animal foods

- Vegan diet = eliminate **all** animal products (subtype)
- healthy choice when carefully planned to meet nutrient needs > a poorly planned vegetarian diet will be no healthier than any other poorly planned diet
- Meatless diets CAN be low in iron and zinc
- **Vegans** may be at risk for B12 deficiency + inadequate calcium/vitamin D
- **Healthier, cheaper, better for environment**

CHAPTER 7 WATER

Water

- 60% of body **weight**
 - 75% of **muscle** = water
 - 25% of **bone** = water
 - $\frac{2}{3}$ = **intracellular** (inside cells)
 - $\frac{1}{3}$ = extracellular (outside cells)
- **Water is NOT stored > maintain water balance > intake** (drink, food, metabolism) = **output** (urine, evaporation, feces)

Regulate BP + BV = three main **mechanisms**:

1. **Thirst**: induced by **dehydration**, **signals need** to consume water
 2. **Water reabsorption**: regulated by **kidneys**
 3. **Vasoconstriction**: SM contraction in **blood vessels**
- 3 MAIN HORMONES
 - ADH
 - Angiotensin 2
 - Aldosterone

Functions of water

1. **Solvent**: solutes dissolve in water
2. **Participates** in chemical **reactions**
3. **Transports nutrients**, O₂, hormones, waste
4. Protects/**cushions** body structures
5. Regulates **pH** and **temperature**

Fluid guidelines

- **Before exercise (2 hours before)** = 16 oz
- **During exercise** = 5-10 oz **every** 15-20 minutes
- **After exercise** = 24 oz per **pound** of lost **weight**
- **Before next practice:** replace at least 80% of weight lost

Dehydration = water **loss is greater** than water **intake**

- Reduces **BV** and **BP**
- **Urine color** reflects level of hydration
- **Diuretics** (coffee, tea, cola) **inhibit** ADH secretion = **pee a lot**

Overhydration = water **intake is greater** than water **loss**

- **Sodium in blood** is diluted = **hyponatremia**

Water AI

- **MEN = 3.7 L/ DAY**
- **WOMEN = 2.7L/ DAY**
 - More water:
 - Increased **activity**
 - Increased **temperature**
 - **Decreased** humidity
 - **Low-calorie** diet
 - High-**salt** diet
 - High-**fiber** diet
 - **Alcohol** intake

Minerals = maintain structure and regulate chemical reactions + body processes

- **20 minerals needed** by the body in **SMALL amounts**
 - MAJOR mineral = need **more** than **100** milligram/day = Na, K, Cl, Ca, P, Mg, S
 - TRACE mineral = need **less** than **100** milligram/day = Fe, Cu, Zn, Se, I, Cr, F, Mn, molybdenum...others
- Just like eating from **variety of food groups** = more vitamins = **more minerals**
"chart"
 - **Vegetables + Fruit** = Fe, Ca, K, Mg, Molybdenum
 - **Grains** = Fe, Zn, Se, Cu, Mg, Cr, S, Mn, Na, K, P
 - **Milk + alternatives** = Ca, Zn, P, K, I, Molybdenum
 - **Meat + alternatives** = Fe, Zn, Mg, K, Cr, S, I, Se, P, Cu, Mn, F

Minerals > BOTH **plant** AND **animal** sources

- BUT **amount of mineral** affected by:
 1. Amount of mineral in **soil**

2. Degree of **processing**: **added** minerals > fortification or **removed** minerals > skins, bran germ [refined grains]
3. **Absorption and bioavailability**: inhibited by...
 1. Substances in **plants** make it **harder** to **absorb** minerals
 - a. **Oxalates** (spinach, rhubarb, beet greens, chocolate) interfere with **Ca** and **Fe** absorption
 - b. **Tannins** (tea, red wine, grains) interfere with **Fe** absorption
 - c. **Phytates** (whole grains, bran, soy) limit absorption of **Ca, Zn, Fe, Mg**. But **phytates** can be **broken** by **yeast**, so foods **high in yeast** and phytates prevents this (breads)
 2. Other minerals (like **ions**) can **inhibit** absorption **too**
 3. How much **already** in the **body** can also **inhibit/promote** absorption

MINERALS function

1. **Fluid balance** = Na, K, Cl
2. **Blood + immunity** = Fe, Cu, Ca, Zn, Se, Mg
3. **Bones + teeth** = Ca, P, Mg, F
4. **Energy for physical activity and metabolism** = Fe, Mg, Zn, Cr, Se, I, P, Ca
5. **Antioxidants** = defend against **oxidative** damage (cancer, CVD, aging) = Se, S, Zn, Cu, Mn
6. **Cofactors** = **promote enzymatic activity**
7. **Growth and Development** = Zinc, iodine, calcium
8. **Nerve impulses and muscle contraction** = Ca, Na, K, Chloride

Electrolyte balance

- *Electrolytes = ions = Na, K, Cl*
- [electrolytes] is regulated by **kidneys = primary regulator for body's Na+, K+, Cl- concentrations**
 - *Deficiency in electrolytes*
 - Results = **acid-base imbalance**, poor **appetite**, muscle **cramps**, confusion, apathy, constipation, irregular heartbeat, **death**
 - Cause = heavy **sweating**, chronic diarrhea, **vomiting**, kidney disorder, medication
 - *Excess in electrolytes*
 - Excess K from **supplements** can cause **heart to stop**
 - **Excess Na from consumption** (salt) or **dehydration** (lose water)

Prehypertension = BP between 120/80 and 139/89 mmHg

Hypertension = BP consistently at or above 140/90 mmHg

- Hypertension

- **Caused** by = **increased** blood **volume** / **constricted** blood **vessels** > **high BP**
- Results in = **atherosclerosis**, heart **attack**, strokes, **death**
- **Treated** = *diet, exercise, medication*
- **Increased risks** = genetic, race, age, obesity, **diet**, lack of activity
 - Diet **high** in Na and low in K, Mg, Ca, and Fiber = **increase** risk
 - To lower BP = **eat fruits**, vegetables, fish, nuts, seeds, **decrease salt**

Hypertension...DASH Diet (Dietary Approaches to **Stop Hypertension**) = DIET

- Abundant in *fruits, vegetables*, **low-fat** dairy products, whole grains, legumes, nuts, **moderate amount of meat**
- **High** - K, Mg, Ca, fiber
- **Low** - salt, saturated **fat**, total **fat**, cholesterol
 - These recommendations are similar to the Eating Well with Canada food guide
 1. Increase fruit
 2. Increase vegetables
 3. Decrease fat
 4. Decrease sugar

Electrolyte - How much?

- Canadian adults between 14-50
 1. **Sodium**
 - **no less** than 1500 mg/day - **no more** than 2300 mg/day
 - **Young** children + **older** adults = **lower** intake
 - **Typical** consumption = 3400 mg/day
 2. **Potassium**
 - **No less than** 3500 mg/day (minimum)
 - **NO UL**
 - DRI = 4700+ mg/day for adults
 - **Typical** consumption = 3400 mg/day

Most common sources of sodium in diet? (for men and women)

1. Rice
2. Poultry
3. Bread
4. Fish

Most common sources of sodium for children (2-18)

1. SALT
2. Yeast breads and rolls
3. Cheese

Processed foods - SODIUM

- **MOST** (Over $\frac{3}{4}$) of our **sodium** intake comes from **processed** foods (**restaurant, fast foods**)

- Only **12%** of our sodium intake comes from **whole, unprocessed, unseasoned food**

Potassium (K)

- Foods high in K =
 1. dried figs/**apricots**, molasses
 2. dates, prunes, nuts, avocado
 3. Vegetables, fruits, meat