PHY 3102 Exam Revision

Theme 1: Nutrition, digestion and absorption

Describe the different nutrients

Carbohydrates

- Into Glucose
    - Most digestive carbohydrates can be converted into this
    - Body's main fuel
    - Only source of energy for brain, red blood cells and part of kidney
    - Adequate levels spares protein and prevents ketosis meaning there can be complete fat breakdown
- Excess is stored liver + muscle glycogen stores where glycogen is the primary energy reserve in a nonfed state
- Carry micronutrients

Fats into fatty acids

- For body fat stores
- Most sources are saturated, unsaturated and polyunsaturated fatty acids
- All types have the same energy value
- When discussing good or bad fats, this is in reference to the physiological responses
- Double bonds change physical characteristics about how tightly packed it can be affecting fluidity and shape
- Polyunsaturated are more bendy where they are considered to be good fats that refers to cellular signalling and such example would be omega-6
- Absorbed dietary fats are lipids which are important for cellular functions, carrying proteins and overall physiology
- They undergo hydrolysis by lipase where emulsification then occurs
- Most fat digestion occurs in the small intestine
- Bile helps with fat digestion by breaking large fat globules into small globules
- Chylomicrons circulate in the lymph to the blood

- Carry micronutrients
- Contains essential fatty acids
- For cell structure

Proteins into amino acids

- For body proteins where they carry minerals, vitamins and signalling molecules
- Are functional proteins which include collagen, enzymes and transporters
- Loss of nitrogen through urea
- Best sources are considered to be “complete” or “high quality”
    - Examples include eggs, fish, meat, poultry, milk/milk products and soy
    - Have all the essential amino acids at the right amounts
    - 90-99% digestible
- Other sources are said to be “incomplete” or “low quality”
    - Examples include nuts, legumes, seeds, cereals, grain foods
    - They do not contain all the essential amino acids and are 70-90% digestible
- For cell structures

Alcohol

- Not a core energy source
- Quickly absorbed in the stomach
- Needs no digestion
- Broken down in the liver as an energy source by alcohol dehydrogenase
- Can lead to fatty liver
- Prevents the absorption of vitamin B where thiamine and niacin are coenzymes which are important for converting pyruvate for the TCA cycle
- Sedates inhibitory nerves where it acts as a CNS depressant
- Blood alcohol levels increase
- Affects brain responses
- Leads to death of liver and brain cells
- Depression of ADH thus loss of body water and important minerals

Describe nutrient assimilation

There are **five pathways** to nutrient assimilation

1. **No diffusion** required for example glucose which can diffuse straight through
2. **Luminal hydrolysis**
    - It can occur in the lumen or cytosol
    - Polymers are broken down into monomers for example proteins to amino acids which is probably done by pancreatic peptidases where amino acids are transported through the epithelium by amino acid transporters
3. **Brush border hydrolysis**
    - Enzymes are present at the brush border
    - Carbohydrate oligomers are converted into monomers for example sucrose to glucose and fructose by pancreatic amylase where fructose moves by transporter
4. **Intracellular hydrolysis**
    - Occurs inside the cell
    - For example peptides to amino acids where peptides of 2-3 amino acids can be transported by amino acid transporters into the epithelium
5. **Luminal hydrolysis + intracellular resynthesis** where largely triglycerides go through this being converted into free fatty acids and then into new triglycerides
    - Amino acids, sugars and peptides enter the portal blood vessel and then to the liver where it receives 75% of blood flow from this source
    - The blood from the portal vein drains from the stomach, intestine, pancreas and spleen
    - Glucagon (from alpha-cells) and insulin (from beta-cells) from the pancreas are released into the portal blood which is important for regulating glucose levels and are released based on nutrient status
    - 25% of the blood flow to the liver on the other hand comes from the hepatic artery
    - All blood of the liver then leaves the hepatic vein

- Fatty acids and triglycerides enter the lymphatic system where efferent lymphatics go to the intestinal lymph trunks and then to the thoracic duct
- Lymphatics receive chyle which is a milky fluid rich in emulsified fat

Describe glycaemic and non-glycaemic carbohydrates and the factors that affect the GI of foods

- Rate of glucose uptakes in the gut is determined by the rate of hydrolysis of oligo- and polysaccharides
- **Glycaemic carbohydrates** are mono- and disaccharides and starch
- **Non-glycaemic carbohydrates** are certain oligosaccharides and non-starch polysaccharides that are not absorbed/digested in the small intestine and enter the large intestine
- The **glycaemic index (GI)** is a method of ranking carbohydrates based on their immediate effect on blood glucose levels where glucose= 100 is high GI is equal to or more than 70 and low is equal to or less than 55
- One must also consider **glycaemic load**
    - Considers the effect of GI and the amount of carbohydrates have on postprandial blood glucose levels
    - Incorporates both the quantity and quality of the dietary carbohydrate consumed
    - GL = (CHO in food portion (g)*GI)/100 considered bad such as fruit as they have a high GI but when one considers the quantity of carbohydrates per portion, the GL is slow
    - GL of 10 is low
- **Factors that affect GI** of foods include:
    - Seed coat present where it protects against digestion by amylase
    - Size of food particles where smaller particles are digested faster
    - Structure of starch granules where starch granules that have burst open have a higher GI
    - Ratio of amylose to amylopectin where amylopectin is branched thus easier to break down
    - Acidity where it protects against digestion by amylase

- Fat content where fats are slowly digested
- Presence of lectins and phytates where they contain amylase inhibitors
- Type of sugar present where only glucose causes increase in blood glucose

Explain the physiological significance of glycaemic index

High GI foods break down quickly during digestion and cause a rapid increase in plasma glucose

- Helps refuel carbohydrates stores after exercise
- Increases insulin production
- Decreases HDL cholesterol
- Increases LDL and TG levels
- Increases appetite
- Are not highly satiating thus can lead to excess intake leading to T2D:
  - Fat insulin resistance=Release of FFA where fat is burned rather than glucose
  - Muscle insulin resistance=decrease in glucose uptake
  - Liver insulin resistance=Continuous glucose production

Low GI foods break down slowly during digestion and cause a slow rise of plasma glucose

- Helps control diabetes
- Help people lose weight
- Lower blood cholesterol but one must consider fat content of foods as high fat means low GI
- Improve sensitivity to insulin
- Increases satiety due to longer digestion
- Decreases hunger
- Decreases voluntary food intake
- Decreases blood glucose levels
- Decreases heart rate risk
- Decreases type 2 diabetes risk