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Proteins ,carbohydrates and fats as sources of energy

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Introduction

- **Carbohydrates** –These are naturally occurring organic compounds with a general formulae $\mathbf{C_x(H_2O)_y}$, . Carbohydrates are vital to the existence of all living things since they are a source of energy

- **Proteins** -Proteins are large molecules made up of nitrogenous organic compounds with a long chain Amino acid . Proteins play pivotal roles in the human body. They are vital component and are required for the optimum function of body tissue and organs.

- **fats-** Also known as 'fatty acids' or 'lipids.' Fats in our bodies are made up of three molecules linked together. Apart from being an energy source, dietary fats also serve as body building blocks .

How nutrients end up as ATP

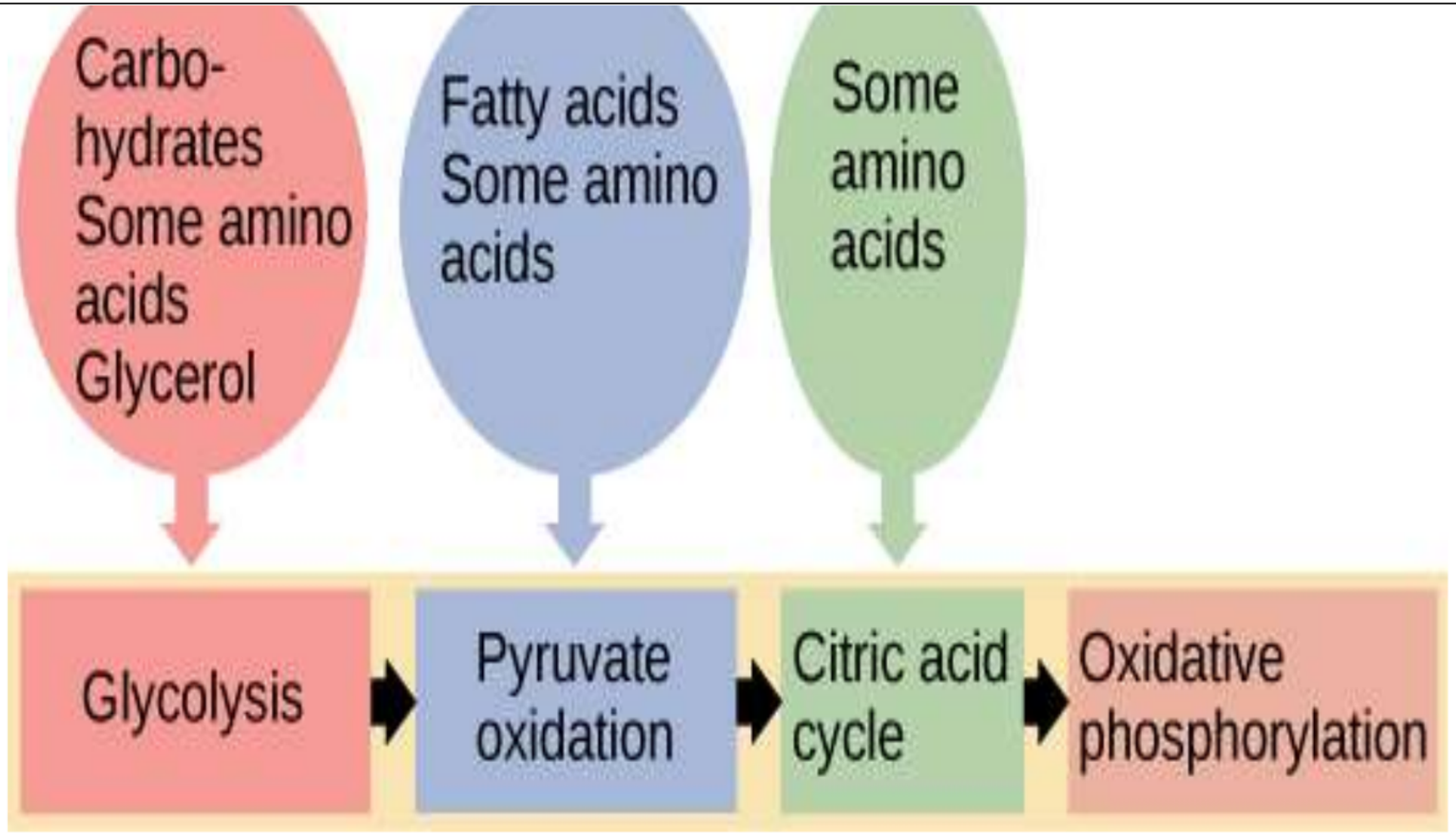
Adenosine 5’-triphosphate (ATP) is a molecule that is responsible for the storage and transfer of energy in body cells. This molecules contain a base known as adenine that is attached to a ribose sugar that are further attached to three phosphate groups.

- **Carbohydrates :** carbohydrates are broken down into glucose which is further converted into energy in the mitochondria cells . The process of converting glucose into energy is referred to as glycolysis. During this process, a molecule with six atoms of carbon is converted into two molecules of pyruvate. Each of this pyruvate molecules contains three carbon atoms. The ATP is then hydralised into energy.

How nutrients end up as ATP cont…

- **Proteins -**Proteins are initially broken down forming singular amino acids before being utilized in the cellular respiration pathway. Each amino acid's amino group is removed (deaminated) and transformed into ammonia. At various points along the Citric Acid Cycle, these intermediates enter cellular respiration**.**
- **Fats -**Triglycerides (fats) are obtained from animal products since Triglycerides are long term energy stored in animals. Compared to carbohydrates Triglycerides have roughly approximately twice as much energy. Fats are comprised of there fatty acids and glycerol. The glycerol is able to enter the process of glycolysis process where the fatty acids are synthesized into energy by being broken into two carbon units.

This processes can be summarized by the images on the slides below(figure 1) and (figure 2)


Carbo-
hydrates
Some amino
acids
Glycerol
Fatty acids
Some amino
acids
Some
amino
acids
Glycolysis
Pyruvate
oxidation
Citric acid
cycle
Oxidative
phosphorylation

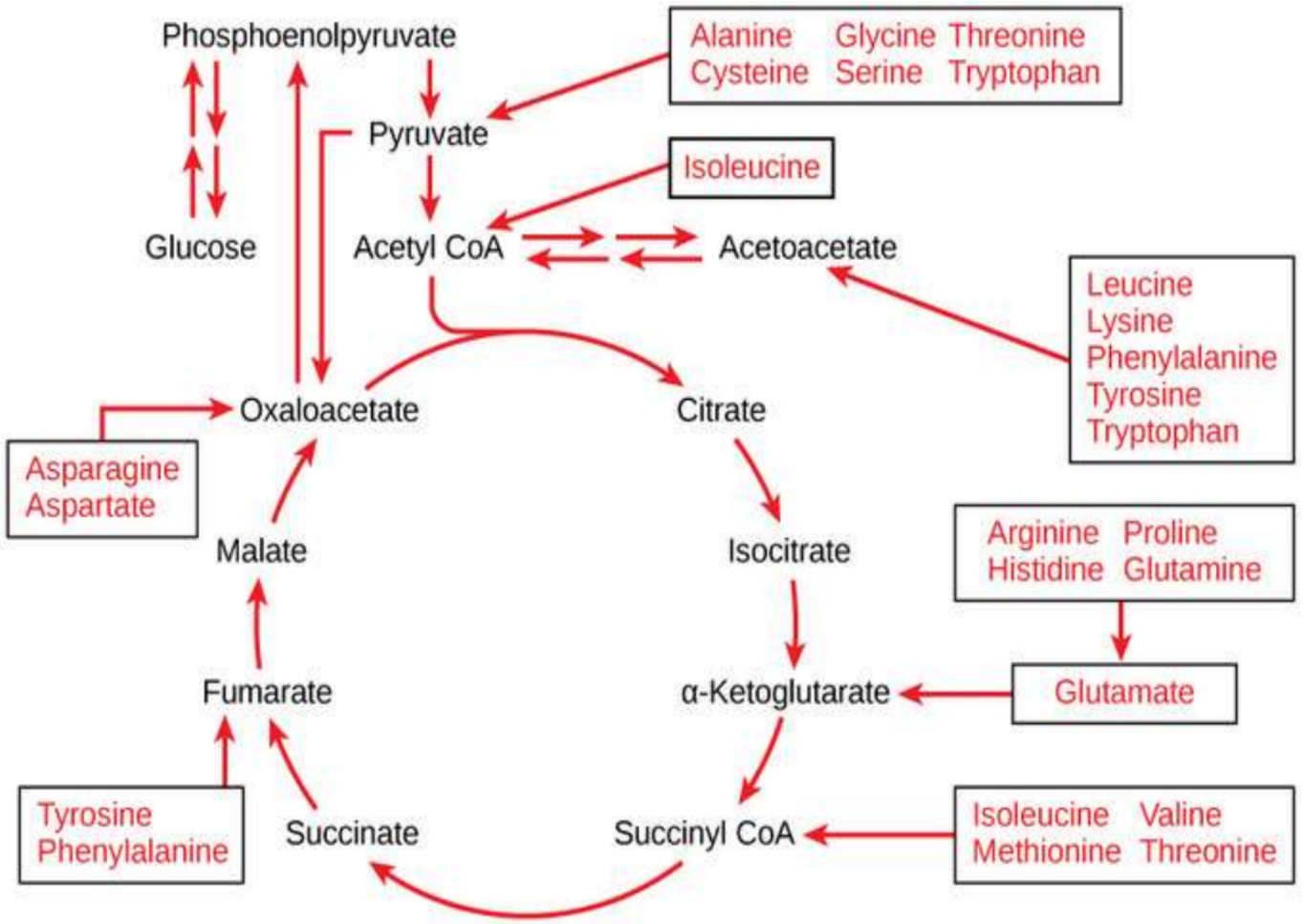

Phosphoenolpyruvate
Alanine Glycine Threonine
Cysteine Serine Tryptophan
Pyruvate
Isoleucine
Glucose
Acetyl CoA
Acetoacetate
Leucine
Lysine
Phenylalanine
Tyrosine
Tryptophan
Oxaloacetate
Citrate
Asparagine
Aspartate
Malate
Isocitrate
Arginine Proline
Histidine Glutamine
Fumarate
α-Ketoglutarate
Glutamate
Tyrosine
Phenylalanine
Succinate
Succinyl CoA
Isoleucine Valine
Methionine Threonine

Image links.

Figure 1: retrieved on 8/10/2021 from: https://textimgs.s3.amazonaws.com/boundless-biology/zvdmx1njstdt6ol0ikk8.jpe#fixme

Figure 2: retrieved on 8/10/2021 from: https://s3-us-west-2.amazonaws.com/courses-images/wp-content/uploads/sites/1842/2017/05/26154645/figure-07-06-01.jpeg

Disease that disrupts conversion of carbohydrates to ATP

- **Diabetic ketoacidosis (DKA)**
- The disease is characterized by total or partial insulin deficiency and is exacerbated by conditions that cause hyperglycemic acidosis, dehydration, and poor metabolism. The most common causes of primary infection are poor insulin management and the development of diabetes. (Kitabchi,1995).
- Insulin deficiency leads to unrestricted lipolysis and oxidation of the fatty acids, leading in ketone body formation and raised anion gap metabolic acidosis.

Disease that disrupts conversion of proteins to ATP

- **Phenylketonuria**
- Deficiency of phenylalanine hydroxylase results in phenylketonuria (PKU), which is an inborn mistake of phenylalanine metabolism (Blau, 2010).
- PKU patients develop a buildup of Phe and its metabolites in their tissues and bodily fluids as a result of this deficit.
- Metabolic changes implicated in the pathogenesis of the brain injury reported in phenylketonuria patients are being investigated.
- Because phenylalanine and its metabolites cause an increase in ROS generation while simultaneously reducing antioxidant defenses, they cause the oxidation of lipids, proteins, and DNA.

Disease that disrupts conversion of fats to ATP

- **Dyslipidemia**
- Dyslipidemia is defined as a high amount of lipids (cholesterol, triglycerides, or both) or a low level of high-density lipoprotein (HDL) cholesterol**.**
- Gene mutations result to the body increasing production of LDL cholesterol or triglycerides, or to fail to remove those substances from the system . Some factors include low HDL cholesterol production or elimination. Primary reasons are usually hereditary and thus they can be passed on from parent to child (Kopin, 2017).
- Cholesterol levels and triglyceride l tend to be elevated in patients with primary dyslipidemias, which interfere with the body's lipid metabolism and disposal.
- Hyperlipidemia is related with increased basal lipolysis in adipose tissue as well as raised levels of free fatty acids in the blood. Basal lipolysis is stimulated by acute-phase serum amyloid A (SAA), a lipolytic adipokine in humans that is released during the acute phase (Kopin, 2017).

References

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