25.2: Amino Acid Metabolism - An Overview

Learning Objectives

- Objective 1
- Objective 2

Once the proteins in the diet have been hydrolyzed, the free amino acids join the non-essential amino acid synthesized in the liver and the amino acids recycled from the body's own proteins, constituting the **amino acid pool** now available for metabolic processes. Most of the amino acid pool is used for the synthesis of protein and other nitrogen-containing compounds such as DNA bases, neurotransmitters, hormones, etc. Under certain metabolic situations, amino acids can also be used as a source of energy by the body. It is worth mentioning that the *human body cannot store amino acids*. If the amino acids in the amino acid pool are not used for biological processes, they are degraded and the nitrogen excreted in the urine as urea.

Protein turnover

A balance between protein synthesis and protein degradation is required for good health and normal protein metabolism. Not all the amino acids needed for the biological function of the body need to be incorporated through the diet. When the proteins already present in the metabolism have complete their lifespan, they are also recycled. **Protein turnover** refers to the replacement of older proteins as they are broken down within the cell. Different types of proteins have very different turnover rates, depending on their particular function. Structural proteins such as college tend to have long half-life periods (in the range of years), while enzymatic protein have a shorter life span to adapt to the metabolic requirements of the body.

Example protein half-lives

Name	Half-Life
Collagen	117 years
Eye lens crystallin	>70 years
Replication factor C subunit 1	9 hours
40S ribosomal protein S8	3 hours
Ornithine decarboxylase	11 minutes

Once the protein have been hydrolyzed and amino acids recycled, these amino acids are added to the amino acid pool for further utilization.

Note To Your Health: Complete and Incomplete Proteins

Amino acids are classified into three groups namely: essential amino acids and nonessential amino acids

ESSENTIAL AMINO ACIDS

- Essential amino acids cannot be made by the body. As a result, they must come from food.
- The 9 essential amino acids are: histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine.

NONESSENTIAL AMINO ACIDS

Nonessential means that our bodies produce an amino acid, even if we do not get it from the food we eat. Nonessential amino acids include: alanine, arginine, asparagine, aspartic acid, cysteine, glutamic acid, glutamine, glycine, proline, serine, and tyrosine.

Based on this classification of amino acids, proteins can also be classified as either complete or incomplete. **Complete proteins** provide adequate amounts of all nine essential amino acids. Animal proteins such as meat, fish, milk, and eggs are good examples of complete proteins. **Incomplete proteins** do not contain adequate amounts of one or more of the essential amino acids. For example, if a protein doesn't provide enough of the essential amino acid leucine it would be considered

incomplete. Leucine would be referred to as the limiting amino acid, because there is not enough of it for the protein to be complete. Most plant foods are incomplete proteins, with a few exceptions such as soy. Table 25.2.1 shows the limiting amino acids in some plant foods.

Food	Amino Acid(s)
Beans and Most Legumes	Methionine, Tryptophan
Tree Nuts and Seeds	Methionine, Lysine
Grains	Lysine
Vegetables	Methionine, Lysine

***Table* 25.2.1** *Limiting Amino Acids in Some Common Plant Foods.*

Even though most plant foods do not contain complete proteins, it does not mean that they should be sworn off as protein sources. It is possible to pair foods containing incomplete proteins with different limiting amino acids to provide adequate amounts of the essential amino acids. These two proteins are called **complementary proteins**, because they supply the amino acid(s) missing in the other protein. A simple analogy would be that of a 4 piece puzzle. If one person has 2 pieces of a puzzle, and another person has 2 remaining pieces, neither of them have a complete puzzle. But when they are combined, the two individuals create a complete puzzle.

Two examples of complementary proteins are shown below.

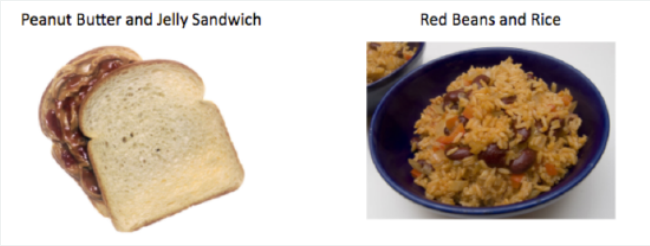

***Figure* 25.2.1** *.Two complementary protein examples*

It should be noted that complementary proteins do not need to be consumed at the same time or meal. It is currently recommended that essential amino acids be met on a daily basis, meaning that if a grain is consumed at one meal, a legume could be consumed at a later meal, and the proteins would still complement one another.

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