

# PLANTS VERSUS ANIMALS IN THE DINING HALL

**CHEM-643 Intermediary Metabolism  
Case Study in Amino Acid Metabolism  
Written by Harold B. White**

## **Summary and Comments:**

Amino acid metabolism involves an incredible number of pathways that few people need to know in detail. However, there are some important concepts that every student of biochemistry should know. Human nutrition and the implications of a vegetarian diet provided the context here for a conceptual overview of amino acid and protein metabolism. Most students are or have friends who are vegetarian. Page 1 provides a forum for students to discuss their experiences and question what they know and don't know about human nutrition as it relates to protein and amino acids.

Through a comparison of two sets of experimental data, Page 2 sets the stage for an in depth study of the meaning of essential and non-essential amino acids. One set of data comes from whole animal experiments involving the flow of carbon from sucrose into various non-essential (and some essential) amino acids and the other shows how deficiencies of various amino acids affects cell growth in culture. While broadly in agreement, discrepancies are apparent between the two sets of data and with the classification of essential and non-essential amino acids found in textbooks (Arginine, Methionine, Cystiene, and Tyrosine, for example). The point of the exercise was to analyze the data, identify the discrepancies, and explain them from known biochemical pathways. An appreciation for the biosynthesis of amino acids in mammals should emerge from this exercise.

Page 3 moves to the flow of nitrogen in amino acid metabolism through an analysis of the redistribution of labeled nitrogen from one amino acid into the other amino acids. The large table that accompanies this Page contains many patterns that reflect the underlying roles of various amino acids and the specificity of particular enzymes such as transaminases. Again, the patterns can be explained by pathways found in textbooks and related to the nutritional classification of amino acids. While Page 2 focuses on amino acid biosynthesis, Page 3 adds the issue of amino acid catabolism and the urea cycle.

Page 4 moves to broad issues of plant and animal amino acid metabolism. It uses the concept of natural selection in evolution to interpret the need for plants

to synthesize secondary metabolites as a way of delaying their entry into the food chain. Evolutionary concepts also provide a rationale for which amino acids are essential and which are not. ["Doby" was the nick name used by Theodosius Dobzhanski.]

Page 5 continues the reflections of the previous page with a consideration of amino acid metabolism in obligate carnivores or in humans in during pregnancy.

This PBL Problem with teaching notes was published in *Biochemistry and Molecular Biology Education*, [30, 315 \(2002\)](#).

### List of issues students should address in this problem:

- Essential and non essential amino acids
- Metabolic differences in amino acid metabolism in animals and plants
- Secondary metabolites derived from amino acids in plants
- Amino acid composition of protein-rich vegetables
- Complete and incomplete proteins, balanced proteins
- Evolutionary perspective on the nutritional properties of plants and the nutritional needs of animals
- (Essential fatty acids, vitamin B<sub>12</sub> deficiency)
- Risks associated with eating or not eating meat
- Some animal proteins are incomplete
- The cat as an obligate carnivore
- Nutritional needs during pregnancy

### Pedagogical attributes of the problem:

- Real world, cogent, situation that students will recognize.
- Open-ended decision-making elements.
- Requires pursuit of learning issues beyond textbooks.
- Requires integration of multiple pathways, broad view with multiple details.

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