

Proteins: Chemistry And Identification

7

Living things are made up of many different chemical molecules. One important group of chemical molecules is proteins. Proteins make up the bulk of all solid material within your body and the bodies of other animals. Your muscle, skin, hair, and inside organs are largely protein. Proteins are essential for body growth and repair. They also make up some hormones which function in chemical control in the body.

In this investigation, you will

- learn how to recognize molecular formulas for small molecules called amino acids.
- use models of different amino acids to construct a protein molecule.
- use chemical tests to determine if protein is or is not present in different substances.

Materials

paper models
scissors
dropper
glass marking pencil or labels
test tubes
test tube rack (or tin can)
nitric acid
fingernail clippings
egg white (hard-boiled)
absorbent cotton
dog hair (white)
cream cheese

Procedure

Part A. Models of Protein

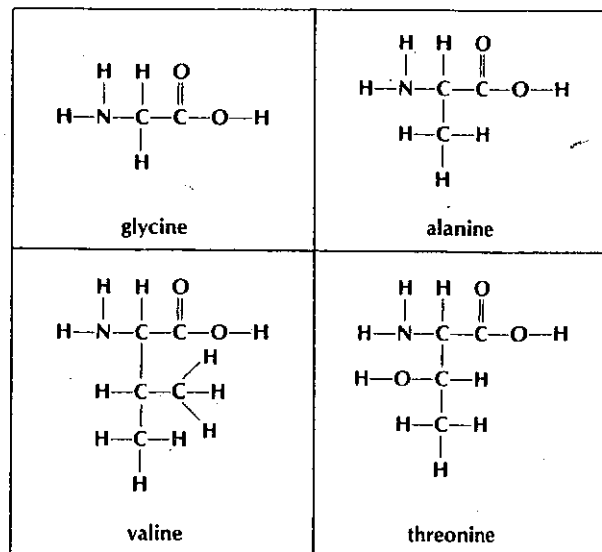
I. Amino Acids, Building Blocks of Protein

Proteins are complex molecules made up of smaller molecules called amino acids. There are about twenty different amino acids found in nature. The element nitrogen (N) is present in all amino acids.

Examine the structural formulas of the four representative amino acids shown in Figure 7-1.

- Name the four elements present in these amino acids. _____

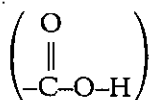
FIGURE 7-1



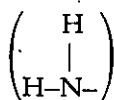
2. What is the molecular formula for the amino acid (a) glycine? C—H—O—N—
 (b) alanine? C—H—O—N—
 (c) valine? C—H—O—N—
 (d) threonine? C—H—O—N—

3. How do the molecular formulas for all the amino acids differ? _____

Note the upper right corner of each amino acid. These ends have a special arrangement of carbon, oxygen, and hydrogen atoms. This end arrangement is called a carboxyl group and looks like this:



4. Circle the carboxyl group on each structural formula in Figure 7-1. Note the upper left corner of each amino acid. These ends have a special arrangement of nitrogen and hydrogen atoms. The end arrangement is called an amino group and looks like this:



5. Use dashed lines to circle the amino groups on the structural formulas in Figure 7-1.
 6. In lab 6, you studied carbohydrates.
 (a) Do carbohydrates have carboxyl groups?

(b) Do carbohydrates have amino groups?

7. How does the number of hydrogen atoms compare to the number of oxygen atoms in each amino acid? _____

II. Combining Amino Acids to Form Protein

Amino acids are not protein molecules. They are only the "building blocks" of protein. Several amino acids must be chemically joined in a chain to form a protein molecule. We can show how amino acids join by using models.

Use the paper models given to you by your teacher to complete this section.

- Cut out the four amino acid models. **CAUTION:** Always be extremely careful with scissors. Cut along the solid lines only. Attempt to join the amino acids.

8. Can the amino acid models easily join to form a protein molecule? _____

- Join the molecules by removing as many —OH groups and —H groups as needed from the amino acids. All four amino acid molecules can be joined in this manner to form a protein. Join them in the order valine—threonine—alanine—glycine.

- Join the leftover —OH and —H ends.

9. What chemical substance is formed when the —OH's and —H's are joined? _____

10. How many molecules of water are formed when four amino acids join? _____

11. What chemical compound is formed when the four amino acids are joined? _____

12. Describe the difference between an amino acid molecule and a protein molecule.

There are thousands of different proteins in living organisms. What makes each protein different is the order, number, kind, and arrangement in space of amino acids joined. You only assembled four amino acids into a protein using a specific order.

13. Construct two proteins different from the one you made above. List the order of amino acids here:

(a) _____

(b) _____

Part B. Identification of Proteins

- Number five clean test tubes 1 to 5. Place them in a test tube rack. Using Figure 7-2 as a guide, add the following substances to each test tube:

tube 1—fingernail clippings
 tube 2—egg white, hard-boiled
 tube 3—absorbent cotton
 tube 4—dog hair, white
 tube 5—cream cheese

- Add 5 drops of nitric acid to each test tube.

CAUTION: Nitric acid is harmful to skin and clothing. Rinse with water if spillage occurs. Call your teacher.

The test used to identify protein is technically called the xanthoproteic test. A substance containing protein will turn yellow when nitric acid is added to it. No color change to yellow indicates that the substance being tested has no protein.

- Wait several minutes. Then record the color of the items placed in each tube in Table 7-1.
- On the basis of the xanthoproteic test, indicate in the last column of the table if the substances tested do or do not contain protein.

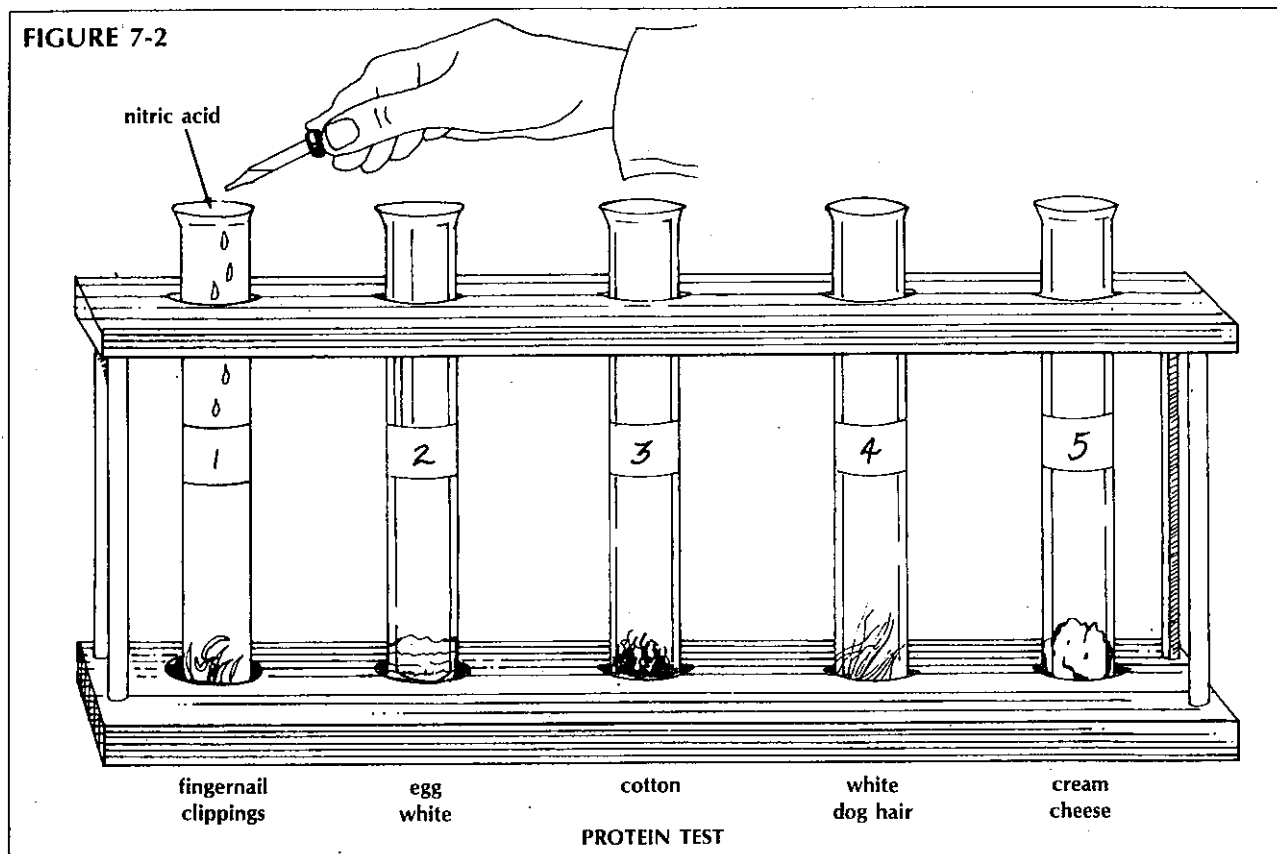


TABLE 7-1. TESTING SUBSTANCES TO DETERMINE IF PROTEINS ARE PRESENT

SUBSTANCE	COLOR CHANGE DUE TO NITRIC ACID	SUBSTANCE TESTED IS A PROTEIN (ANSWER YES OR NO)
Fingernail		
Egg white		
Cotton		
Dog hair		
Cream cheese		

Analysis

Use your results from Part A to answer questions 1-8.

1. Name four amino acids. _____
2. (a) How many amino acids are there? _____
(b) How are amino acids used by living things? _____
3. List several of your body parts that are protein. _____

4. Name the four chemical elements present in the amino acids studied (and in all amino acids).

5. Name the two special end groups present in amino acids. _____
6. What element is present in protein (amino acids) that was not present in carbohydrates (Laboratory Investigation 6)? _____
7. Explain how a protein molecule is formed in living organisms. _____

8. Explain how one protein differs from another protein. _____

Use your results from Part B to answer questions 9-13.

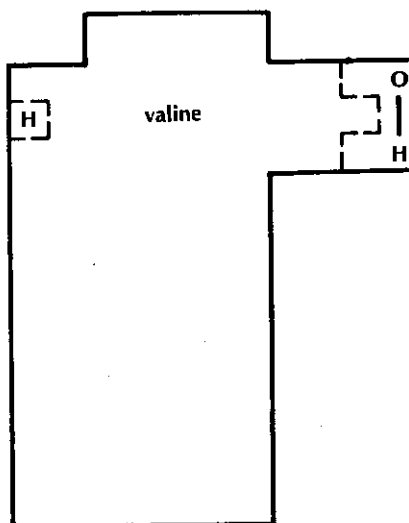
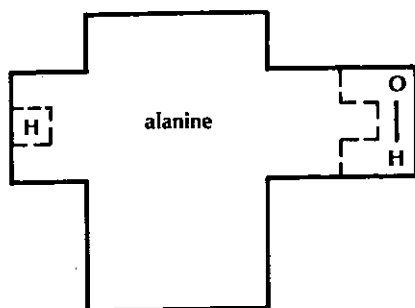
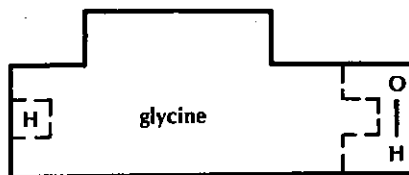
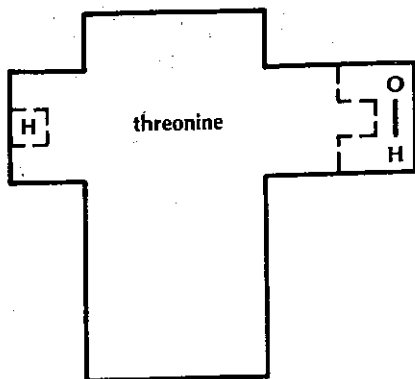
9. Describe how to tell if a substance is a protein by using the xanthoproteic test. _____

10. (a) List those substances tested that were protein. _____

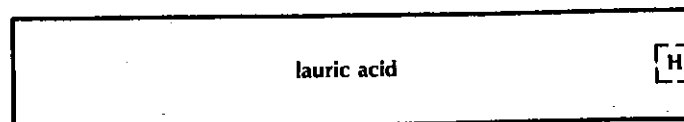
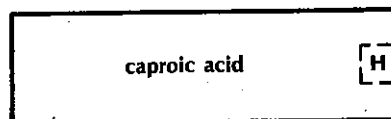
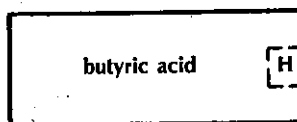
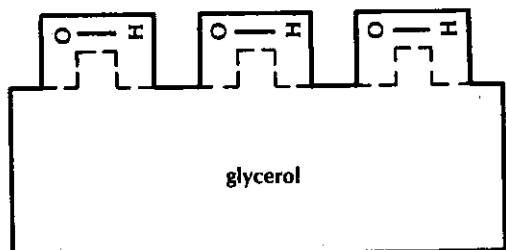
(b) List those substances tested that were not protein. _____
11. Using what you have learned about proteins, decide which of the following substances are protein. Place a checkmark on the line next to each substance that is protein.

(a) hamburger _____	(e) liver _____
(b) chicken _____	(f) human hair _____
(c) peanut oil _____	(g) stomach _____
(d) maple syrup _____	(h) 207 amino acids joined _____
12. In Latin, the word "xantho" means yellow, and "proteic" means protein. Why is "xanthoproteic" a meaningful word to use when describing the chemical test used for identifying a protein?

MODELS FOR INVESTIGATION 7, "PROTEINS: CHEMISTRY AND IDENTIFICATION"



MODELS FOR INVESTIGATION 8, "FATS: CHEMISTRY AND IDENTIFICATION"



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