

Passage IV

Proteases catalyze the breakdown of proteins. Two experiments were performed by 30 students to investigate the breakdown of casein, a milk protein.

Experiment I

A 300 mL solution of casein was prepared in a flask. The flask was shaken vigorously to evenly distribute the contents of the solution. The solution was immediately divided evenly into 30 test tubes. Each student received 1 test tube. Each student then added a 2 mL solution containing proteases to her or his test tube. Each test tube was then incubated for a set period of time in 1 of 3 water baths. Each water bath was maintained at a specific temperature. Immediately following the incubation period, the amount of protein in each test tube was determined. The following ratio, which represents the proportion of protein remaining, was then calculated for each test tube:

amount of protein after incubation period / amount of protein before incubation period. The results appear in Figure 1.

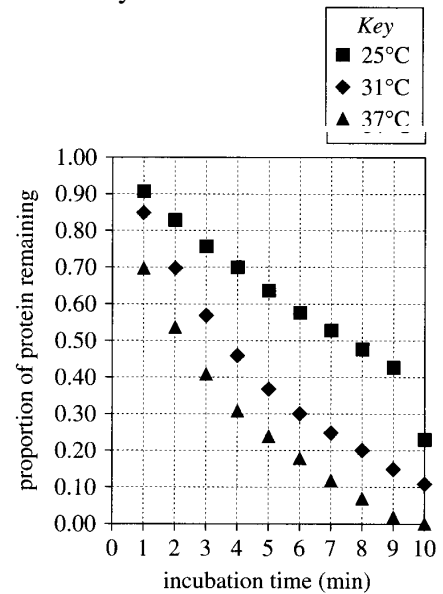


Figure 1

Experiment 2

Experiment 1 was repeated with the following modifications:

- Immediately after adding the 2 mL protease solution to a test tube, each student added either 1 mL of an acidic solution, 1 mL of a basic solution, or 1 mL of H₂O
- The initial pH of each solution was then determined to the nearest 0.5 pH.
- The 30 test tubes were then incubated for 6 min in a water bath that was maintained at 31 °C.

The results appear in Figure 2.

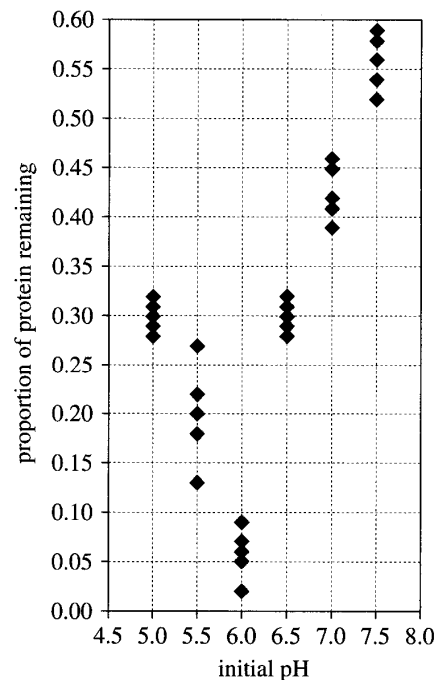


Figure 2

17. In Experiment 1, at an incubation temperature of 31 °C, which of the following incubation times resulted in the least amount of protein remaining in solution?

- A. 1 min B. 4 min C. 7 min D. 10 min

18. Based on the results of Experiment 2, the average proportion of protein remaining in the 5 test tubes that had an initial pH of 5.5 was closest to which of the following?

- F. 0.10 G. 0.20 H. 0.30 J. 0.40

19. In which of the following ways did Experiments 1 and 2 differ?

- A. A protease solution was used in Experiment 1, but not in Experiment 2.
 B. A protease solution was used in Experiment 2, but not in Experiment 1.
 C. The initial pH of the solutions was intentionally varied in Experiment 1, but not in Experiment 2.
 D. The initial pH of the solutions was intentionally varied in Experiment 2, but not in Experiment 1.

20. Which of the following phrases best explains why the flask containing the 300 mL solution of casein was shaken in Experiment 1 ?

F. So that each of the test tubes would contain the same amount of casein

G. So that each of the test tubes would not contain any of the casein

H. So that all of the casein would be located at the top of the flask

J. So that all of the casein would be located at the bottom of the flask

21. Suppose an additional test tube had been included in Experiment 2 and that the initial pH of the solution in this test tube was 6.75. The proportion of protein remaining would most likely have been closest to which of the following?

A. 0.175 B. 0.375 C. 0.575 D. 0.775

22. Based on the information provided, proteases are most likely:

F. fats. G. antibodies. H. enzymes. J. carbohydrates.

23. An error was made during Experiment 1. One test tube was incubated in a water bath for 3 min longer than had been intended and than is indicated in Figure 1. Based on the results, this test tube was supposed to be incubated for:

A. 5 min at 25°C. B. 10 min at 25° C. C. 5 min at 310° C. D. 10 min at 31 ° C.