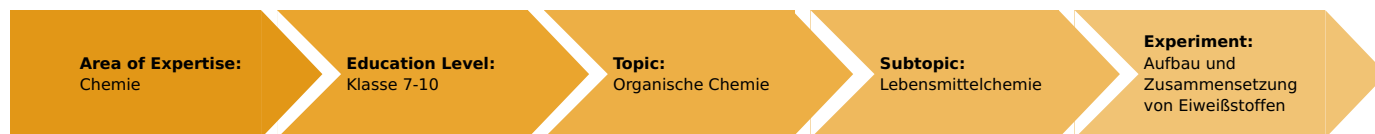


The structure and composition of proteins (Item No.: P7185000)

Curricular Relevance



Difficulty



Intermediate

Preparation Time



10 Minutes

Execution Time



20 Minutes

Recommended Group Size



2 Students

Additional Requirements:

Experiment Variations:

Keywords:

food chemistry, proteins, material properties of proteins

Task and equipment

Information for teachers

Additional Information

Foods containing proteins decompose when they are too strongly heated. In doing so, they give off an unpleasant smell and leave a black residue. The boiling over of milk can be used as an example.

Notes on content and learning objectives

- When protein is heated, carbon, water and ammonia are formed.
- The black residue on combustion is identifiable as carbon.
- Ammonia colours universal indicator paper blue and has a pungent smell. Water changes the colour of water indicator paper to blue.
- Protein is composed of the four basic elements carbon, hydrogen, oxygen and nitrogen.

Notes on the method

This experiment is a good introduction to the chemistry of proteins.

A basic knowledge of organic chemistry, or appropriate references, are required in order that the questions can be answered. The molecular structures of amino acids can be illustrated by means of molecular model kits.

Fundamentals and remarks

Proteins, more exactly "simple proteins" are made up from L configured amino acids.

"Conjugated proteins", also called proteides, however, are made up from amino acids together with non protein-like components such as lipids and carbohydrates. Proteins and proteides have very complex molecular structures. The examination of their structures is therefore particularly complicated and lengthy.

Hints on going deeper

- The importance of proteins for healthy nutrition.
- The manufacture and processing of products containing proteins.
- Keeping and preserving foods containing proteins.

Notes on set-up and procedure

Preparation:

Hair or finger nails can be burned to demonstrate the smell of horn.

The use of solid material, egg white, in the test tube is recommended to avoid boiling over. Milk powder or protein preparations can also be used.

Notes on the students experiment:

Take care that the students only hold the indicator paper with tweezers.

The detection of ammonia can be hindered by the formation of other decomposition products. A more reliable way to form ammonia from proteins is to add a sodium hydroxide pellet and heat them in a water bath. The ammonia vapour can also be demonstrated by smoke formation with hydrochloric acid (possibly as teacher experiment).



Hazards

- Carry out the experiment in a fume cupboard whenever possible! Gases with an unpleasant smell are evolved on heating.
- Wear protective glasses!

Waste disposal

Dispose of the decomposition products and the indicator paper in the normal waste bin.

The structure and composition of proteins (Item No.: P7185000)

Task and equipment

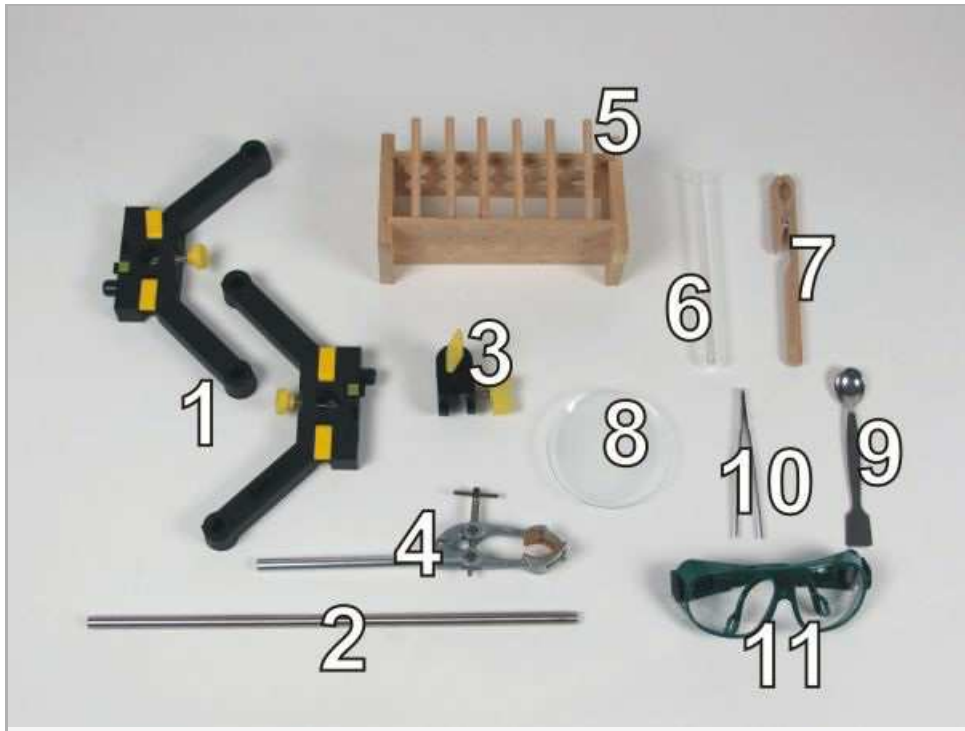
Task

Which chemical elements are proteins composed of?

Decompose proteins by strongly heating them and use indicator paper to determine the decomposition products which result.



Equipment



Position No.	Material	Order No.	Quantity
1	Support base, variable	02001-00	1
2	Support rod, stainless steel, l=370 mm, d=10 mm	02059-00	1
3	Boss head	02043-00	1
4	Universal clamp	37715-00	1
5	Test tube rack for 12 tubes, holes d= 22 mm, wood	37686-10	1
6	Test tube,180x20 mm,DURAN, PN19	36293-00	1
7	Test tube holder, up to d 22mm	38823-00	1
8	Watch glass, dia.100 mm	34574-00	1
9	Spoon, special steel	33398-00	1
10	Tweezers, l = 130 mm, straight, blunt	64610-00	1
11	Protecting glasses, clear glass	39316-00	1
	Butane burner f.cartridge 270+470	47536-00	1
	Butane cartridge CV 300 Plus, 240 g	47538-01	1
	Indicator paper, pH1-14, roll	47004-02	1
	Indicator paper f.water roll 5m	47015-00	1
Additional material			
	Egg		
	Feather		

Set-up and procedure

Set-up

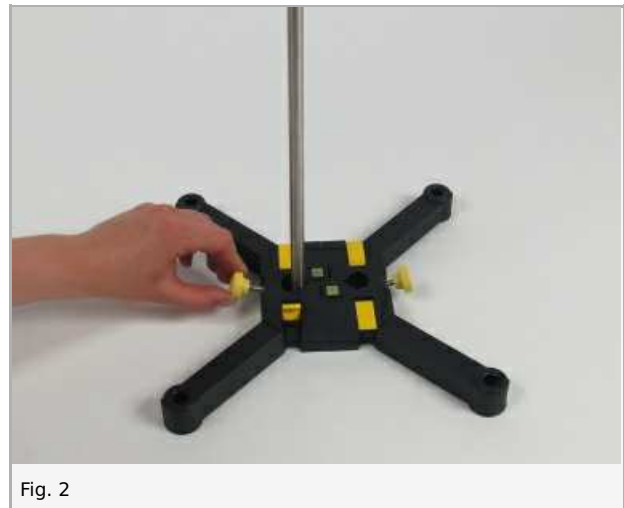
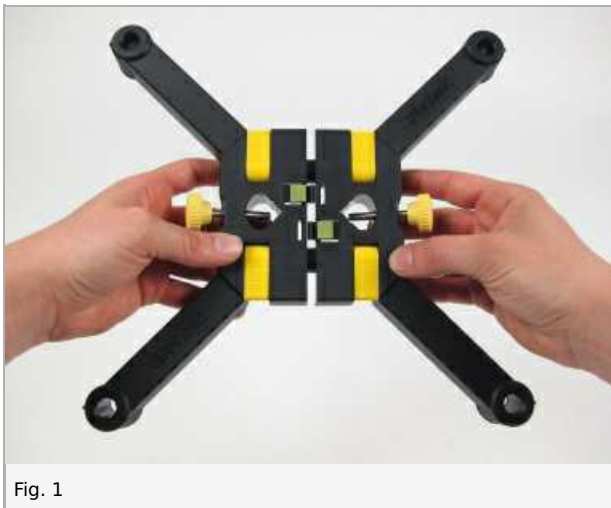
Hazards

- Carry out the experiment in a fume cupboard whenever possible! Gases with an unpleasant smell are evolved on heating.
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Setup

Prepare a stand and a bunsen burner as shown in figures 1 to 5.





Procedure

Wedge the feather in the test tube holder (Fig. 6), burn the tip of it in the flame of the bunsen burner and test the smell of the tip when it has cooled.



Put two spatula tips of protein in a test tube. Fit the test tube almost horizontally in the clamp (Fig. 7).



Fig. 7

Heat the test tube with a small flame until drops of liquid condense on the walls of the test tube. Extinguish the flame of the bunsen burner.

Use tweezers to hold a strip of indicator paper for water against the drops formed in the test tube. Place the strip of indicator paper on a watch glass and evaluate it.

Now strongly heat the residue in the test tube with the bunsen burner until light-coloured fumes are given off. Hold a wetted piece of indicator paper in these fumes.



Fig. 8

Waste disposal

Dispose the decomposition products and the indicator paper in the normal waste bin.

Report: The structure and composition of proteins

Result - Observations

Note your observations.

- a) Smell of the burnt feather.
- b) Colour of the residue in the test tube.
- c) Colour of the indicator paper for water.
- d) Colour of the indicator paper.

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Evaluation - Question 1

Draw conclusions from your observations.

1. The residue in the test tube is an indication of the element
2. Indicator paper for water detects the formation of, which is composed of the chemical elements and
3. The colour of the indicator paper is an indication of the formation of the volatile base, which is composed of the elements and

Evaluation - Question 2

Complete the following statements.

Proteins are therefore composed of the four basic elements and

Evaluation - Question 3

The term "amino acids" is used for proteins. Attempt to explain what this indicates.

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Evaluation - Question 4

Express the structural formula of the simplest amino acid.

Evaluation - Question 5

Make a list of foods which are fundamentally built up of "amino acids".

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