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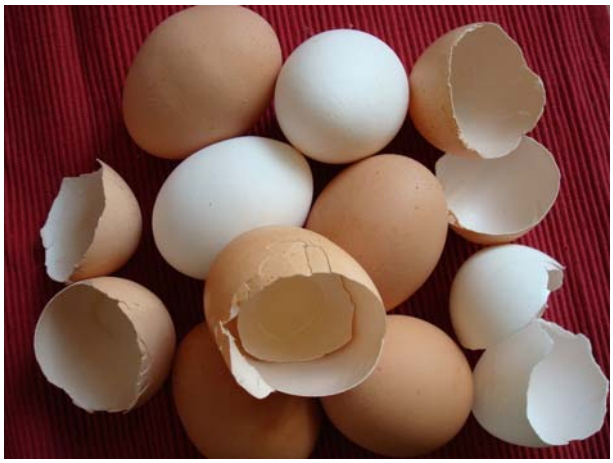
Cooperating Institutions and Universities within the PARSEL-Project:

For Students

Chemistry in a Class of Its Own: Building Blocks of Life – "To become fit and strong eat eggs all day long" – The Truth about Proteins in My Body

A Module for Science Instruction – especially Chemistry – for Grades 10 to 13



Outline

Everything we eat lived once or comes from a living organism – animals or plants – and everything that lives is made up of the same basic biochemical building blocks. These are mainly carbohydrates, fats, proteins and nucleic acids. Hence, it seems to be essential to know more about these bio-molecules, which are, in all their different designs, a part of our nutrition and which belong to our menu. In the PARSEL module **"The building blocks of life – "To become fit and strong eat eggs all day long" – The truth about proteins in my body",** you will have the opportunity to experiment with the "building blocks of life" to get to the bottom of important questions such as "How does the protein in chicken get into my muscles?" You will investigate the digestion of proteins in an experiment and then apply those results to the processes actually happening in the human body. The following worksheets will help you to find answers to those important questions and will help you in conducting the experiments.

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Chemistry in a Class of Its Own: Building Blocks of Life – "To become fit and strong eat eggs all day long" – The Truth about Proteins in My Body

These worksheets belong to: . . . . . .

1. Qualitative Test for Proteins in Milk and Potatoes

Please note: Working in a groups of two, one person carries out experiment a) and the other person experiments b) and c).

Equipment

3 x 150 ml beakers (wide), magnetic stirrer and hotplate, stir bar, small glass funnel, 2 folded filters, plate stand, support ring, 4 test tubes, test tube rack, small spatula, glass rod, pasteur pipette, hot water bath (100°C)

Chemicals

Some ninhydrin crystals, nitric acid (65%), 100 ml of whole milk, approx. 0.5 ml of citric acid (20 %)

Only for b): precision balance, drying oven

a) Test for Proteins in Milk

Procedure

Label a beaker and pour 100 ml of milk into it (I). Add citric acid and stir until no more precipitate forms. Attach the support ring to the plate stand, put the glass funnel into the support ring and filter the mixture through a folded filter into a second beaker (II) (keep residue I!). Heat the residue in beaker II on the magnetic stirrer and hotplate until no more precipitate is formed. Filter out this precipitate, too (residue II).
Transfer small amounts of residues I and II **into two separate test tubes.** Only once, add one drop of nitric acid and some ninhydrin crystals. Add some distilled water and then heat (takes some time, hot water bath has to boil!)

Observations

_____

_____

_____

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Interpretation

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b) Quantitative Determination of Proteins in Milk

Procedure

Weigh both folded filters before carrying out the experiment. Procedure is the same as in a) up to the filtration of the second residue. Completely dry both residues, including the filter paper, at 50°C in the drying oven and then determine the mass again.

Observations

Residue I = ___ g amounts to ____ g of protein per 100 ml milk

Residue II = ___ g amounts to ____ g of protein per 100 ml milk

Interpretation

_____

_____

_____

c) Where Does the White Foam Come From When Boiling Potatoes?

Additional equipment

600 ml beaker, 2 medium sized potatoes, lab spoon, 2 test tubes

Procedure

Peel the two medium sized potatoes and boil them in a large beaker until foam floats on the water. Skim off the foam and divide it equally between two labelled test tubes. Use ninhydrin to test for proteins (see a)). In the second test tube add nitric acid to the foam, heat it and cool it down a little after the colour has changed. Now add some drops of 2 N NaOH.

Observations

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_____

_____

Interpretation

2. Calorimetric Method for Quantitative Protein Test

Task: Determine the protein content of bananas and egg white.

Equipment

24 large test tubes, permanent marker, adjustable microlitre pipettes (100 µl, 200 µl and 1 ml) with corresponding disposable tips, vortex, 100 ml beaker, fork, electrical pump with vacuum hose, filtering flask with Büchner funnel and suction ring, round filters, 10 ml glass pipette with Peleus ball, stopwatch, photometer, graph paper, pencil, ruler, 1 egg white, 1 banana

Chemicals

Albumin solution (20 mg/ml) (3.6 ml will be required per experimental series), Biuret reagent: Dissolve 1.5 g $CuSO_4$ x 5 H_2O und 6 g K-Na-tartrate in 500 ml dist. water; whilst stirring add 300 ml of 10% NaOH solution and fill up to 1 l with dist. water (50 ml reagent solution will be required per experiment)

Procedure

1. Making the albumin calibration solution

Mark 14 test tubes (see table) and prepare two watery solutions each of the following amounts of albumin (double determination):

Test tube no.	0/0a	1/1a	2/2a	3/3a	4/4a	5/5a	6/6a
Albumin concentration [µl albumin]	0 0	1 50	2 100	3 150	4 200	5 250	6 300

Then fill all test tubes with dist. water up to the maximum volume of 500 µl and then vortex.

2. Making the test solutions

- Egg white: dilute egg white 1:10 with water (1 ml egg white and 9 ml dist. water) and mix well. Then place 100 µl, 250 µl and 500 µl each in a test tube and fill the amounts up to 500 µl with dist. water and vortex them. (Two test tubes for each amount, i.e. 6 test tubes. Mark them accordingly!)

- Banana: Weigh approx. ½ banana and mash it with a fork in the beaker. Add 10 ml dist. water; homogenise the mixture and filter through a Büchner funnel using vacuum; Take 100 µl, 250 µl und 500 µl from the residue and fill each amount up to 500 µl with distilled water in a test tube; vortex. (Two test tubes for each amount, i.e. 6 test tubes. Mark them accordingly!)

3. Determining concentration

Using a pipette, place 2.5 ml Biuret reagent into a test tube, vortex the solution and leave it to rest for 20-30 mins at room temperature. Determine the absorption at 540 nm against the empty value (0 mg Albumin/ml) and enter the absorption values in the table below.

Observations

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_____

Sample	1st determination	2nd determination
0 mg albumin		
1 mg albumin		
2 mg albumin		
3 mg albumin		
4 mg albumin		
5 mg albumin		
6 mg albumin		
100 µl egg white (1:10)		
250 µl egg white (1:10)		
500 µl egg white (1:10)		
100 µl banana (1:)		
250 µl banana (1:)		
500 µl banana (1:)		

Interpretation

Plot the amount of protein in the calibration solution against the absorption at 540 nm (you can use the computer programme Excel or graph paper for this) and from the graph read off the protein concentration found in egg white and banana. (Then stick the graph to the back of this page.)

- Egg white contains _____ mg proteins per 100 g egg white.

- Banana contains _____ mg proteins per 100 g banana.

3. Test for the Structure of Proteins in Egg White Using Low Molecular Weight Components Obtained through Enzyme Splitting

Equipment

Egg white from one chicken egg, 2 small beakers (10 ml), adjustable microlitre pipette with fitting disposable tips 1 ml, pair of scissors , disposable gloves, 3 x 100 ml beakers, 250 ml beaker, dialysis tube, magnetic stirrer and stir bar, UV spectrometer

Chemicals

10 ml protease solution (0.45 mg/ml in phosphate buffer), 0.1 M phosphate buffer pH 7.5 (180 ml are required per experiment; 6 parts 0.1 M K_2HPO_4 and 1 part 0.1 M KH_2PO_4)

Procedure:

The following experiments a), b) and c) must be started simultaneously!

Soak enough dialysis tube in water (in 250 ml beaker) for 10 mins and tie a knot in one end.

a) Put 3 ml egg white (highly viscous; cut off tip of pipette) and 1 ml protease solution into the dialysis tube and mix well ("knead the tube")
Now tie a knot in the other end of the tube or close it with a peg or similar and place the dialysis tube into a beaker with 60 ml phosphate buffer.
Stand the beaker onto the magnetic stirrer and let it stir rapidly. After 0, 15, 30, 45 and 60 mins take 3 ml of the outer solution and determine the absorbance at 280 nm.

b) As in a) but without the egg white. Instead, place 3 ml buffer solution into the dialysis tube (1st comparison).

c) As in a) but without the protease solution. Instead, place 1 ml phosphate buffer into the dialysis tube (2nd comparison).

Observations

Time	Absorbance a)	Absorbance b)	Absorbance c)
0 min			
15 min			
30 min			
45 min			
60 min			

Interpretation

Plot the absorbance against the time and stick the resulting graph to the back of this page.

Explanation of the results

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