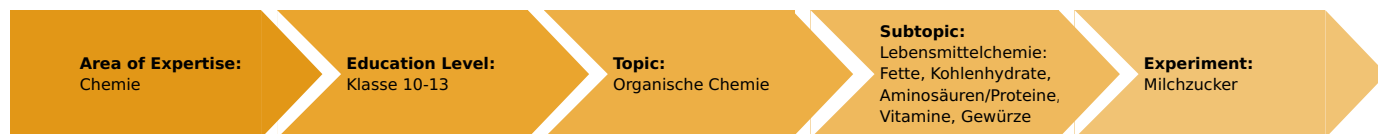


Lactose (Item No.: P7187100)

Curricular Relevance



Difficulty



Intermediate

Preparation Time



10 Minutes

Execution Time



10 Minutes

Recommended Group Size



2 Students

Additional Requirements:

Experiment Variations:

Keywords:

carbohydrates, lactose

Task and equipment

Information for teachers

Additional Information

Lactose is known from advertising as a regulator of digestion. Baby foods contain lactose.

Notes on content and learning objectives

- Milk contains lactose (milk sugar), which can be extracted from the filtrate after precipitating out proteins.
- Lactose is a disaccharide of glucose and galactose.
- Lactose can be detected by the red colour it gives with ammonia in alkaline solution.
- Lactose is added to baby foods.

Notes on the method

The separate steps in the production of cheese should be gone into more deeply in a classroom discussion, and, when possible, intensified by a visit to a dairy or cheese-factory.

A basic knowledge of the reaction with Fehling's solution is necessary to answer question 2.

Fundamentals and Remarks

Casein flocculates out from milk on acidification or fermentation. It is used to make quark and cheese. The milk proteins dissolved in the whey can be precipitated out by heat. The filtrate then obtained contains mainly lactose. The major carbohydrate in milk is lactose (4-7 %). Small amounts of glucose, amino sugars and oligosaccharides are also present.

Industrially, lactose is won from whey concentrates.

Lactose is predominately used in the production of baby foods, confectionery and as base substance for tablets.

Hints on going deeper

- Role of lactose in the production of baby foods
- Preparation of cheese as a student experiment, processing of whey and detection with caustic soda/ammonia solution.

Hints on set-up and procedure

Preparation:

Use fresh milk and not UHT milk for the experiment if at all possible, as the proteins which were exposed to high temperature in UHT milk do not coagulate as well.

Notes on the students experiment:

Should a hot plate be available, use this for the experiment, as the heating and evaporating off must be carefully carried out, otherwise the solution tends to boil over or spurt out.



Hazard and Precautionary statements

Ammonia solution:

- H314: Causes severe skin burns and eye damage.
- H335: May cause respiratory irritation.
- H400: Very toxic to aquatic life.
- P273: Avoid release to the environment.
- P280: Wear protective gloves/protective clothing/eye protection/face protection.
- P301 + P330 + P331: IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.
- P304 + P340: IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
- P305 + P351 + P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do - continue rinsing.
- P309 + P310: IF exposed or you feel unwell: Call a POISON CENTER or doctor/physician.

Acetic acid:

- H226: Flammable liquid and vapour.
- H314: Causes severe skin burns and eye damage.
- P280: Wear protective gloves/protective clothing/eye protection/face protection.
- P301 + P330 + P331: IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.
- P307 + P310: IF exposed: Call a POISON CENTER or doctor/physician.
- P305 + P351 + P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do - continue rinsing.

Sodium hydroxide:

- H314: Causes severe skin burns and eye damage.
- H290: May be corrosive to metals.
- P280: Wear protective gloves/protective clothing/eye protection/face protection.
- P301 + P330 + P331: IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.
- P309 + P310: IF exposed or you feel unwell: Call a POISON CENTER or doctor/physician.
- P305 + P351 + P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do - continue rinsing.

Hazards

- Ammonia solution irritates respiratory organs, eyes and skin. Acetic acid and sodium hydroxide solution are caustic.
- Avoid skin-contact with the liquids.
- Wear protective gloves and protective glasses.

Waste disposal

Pour the solutions to drain after diluting them with water.

Lactose (Item No.: P7187100)

Task and equipment

Task

How can lactose be produced?

Detect lactose in milk.



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	Ring with boss head, i. d. = 10 cm	37701-01	1
6	Wire gauze with ceramic, 160 x 160 mm	33287-01	1
7	Glass beaker DURAN®, short, 250 ml	36013-00	1
8	Glass beaker DURAN®, short, 400 ml	36014-00	1
9	Beaker, 250 ml, low form, stackable, plastic	36082-00	1
10	Graduated cylinder 100 ml, PP transparent	36629-01	1
11	Test tube rack for 12 tubes, holes d= 22 mm, wood	37686-10	1
12	Test tube, 180x18 mm,100pcs	37658-10	(1)
13	Test tube brush w. wool tip,d25mm	38762-00	1
14	Filter funnel, d = 75 mm, PP	46895-00	2
15	Students thermometer,-10...+110°C, l = 180 mm	38005-02	1
16	Pipette with rubber bulb	64701-00	2
17	Glass rod, boro 3.3, l=200mm, d=6mm	40485-04	1
18	Protecting glasses, clear glass	39316-00	1
19	Rubber gloves, size S (7)	39325-00	1
	Butane burner f.cartridge 270+470	47536-00	1
	Butane cartridge CV 300 Plus, 240 g	47538-01	1
	Caustic soda sol. 32% 1000 ml	30266-70	1
	Ammonia solution, 25% 1000 ml	30933-70	1
	Water, distilled 5 l	31246-81	1
	Acetic acid 99...100%, pure 1 l	31301-70	1
	Boiling beads, 200 g	36937-20	1
	Indicator paper, pH1-14, roll	47004-02	1
	folded filter,qual.,150 mm,100pcs	47580-04	2
Additional material			
	Pasteurized milk (not UHT milk!)		

Set-up and procedure

Set-up

Hazards

- Ammonia solution irritates respiratory organs, eyes and skin. Acetic acid and sodium hydroxide solution are caustic.
- Avoid skin-contact with the liquids.
- Wear protective gloves and protective glasses.



Setup

Assemble the stand and the Bunsen burner as shown in figures 1 to 4.



Fig. 1



Fig. 2



Fig. 3



Fig. 4

Attach the funnel so, that it hangs vertically above the 250 ml glass beaker (Fig. 5).



Fig. 5

Procedure

Pour 100 ml of milk in a 250 ml lab beaker.

Add acetic acid dropwise under stirring until the milk has a pH of between 4.5 and 5.0 (Fig. 6). Test the pH with universal indicator paper.

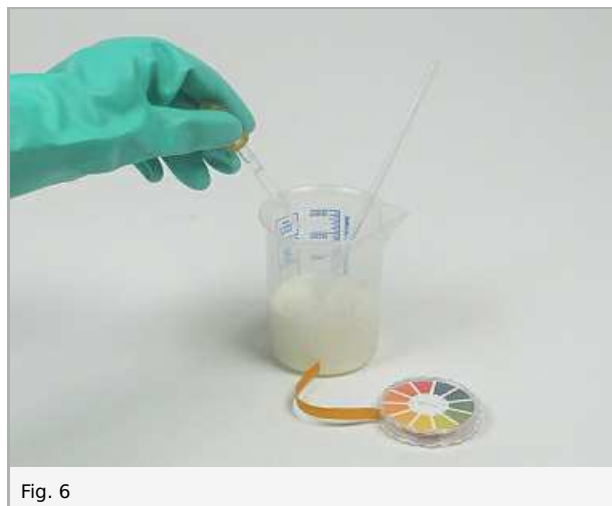


Fig. 6

Filter the solution through a fluted filter in a 250 ml glass beaker as shown in figure 7.



Fig. 7

Add a few boiling stones to the filtrate in the glass beaker. Carefully heat the solution to boiling (Fig. 8). Allow the solution in the beaker to cool. Then filter the mixture through a fluted filter in the well rinsed 250 ml lab beaker.



Fig. 8

Fill the filtrate in the well rinsed 250 ml glass beaker and add a few boiling stones. Carefully evaporate the slightly turbid filtrate in beaker 3 down to approx. 20 ml and then allow the concentrate to cool.

Transfer concentrated filtrate to the test tube to fill it to a height of 2 cm. Add 4 drops of caustic soda. Pipette ammonia solution into the test tube to a height of 4 cm (Fig. 9).



Fig. 9

Half-fill a 400 ml beaker with water and add a few boiling stones. Heat it to boiling, then put it aside. Extinguish the bunsen burner flame!

Place the test tube in the hot water bath until the solution has become intensely coloured.

Waste disposal

Pour the solutions to drain after diluting them with water.

Report: Lactose

Result - Observations

Note your observations in the following succession:

- a) Addition of acetic acid
- b) Heating
- c) Concentrating the filtrate
- d) Reaction of the alkaline filtrate with ammonia solution

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Evaluation - Question 1

Draw conclusions from your observations.

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Evaluation - Question 2

Lactose is a disaccharide of galactose and glucose. The two monosaccharides are connected by a 1,4-glycosidic linkage. How will lactose react with Fehling's solution?

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Evaluation - Question 3

Complete the following statements.

1. When milk is heated, then (predominately casein) and deposit out.
2. When heated, precipitates out from the filtrate or whey.
3. The filtrate contains or, which is composed of the components and glucose.
4. With ammonia solution, galactose forms a

Evaluation - Question 4

Consider why lactose is obtained as a by-product in the production of cheese?

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