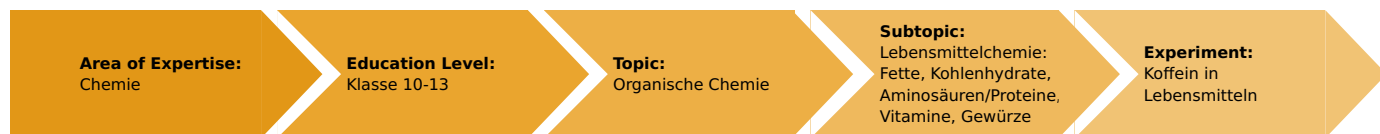


Caffeine in beverages (Item No.: P7186400)

Curricular Relevance



Difficulty



Intermediate

Preparation Time



10 Minutes

Execution Time



20 Minutes

Recommended Group Size



2 Students

Additional Requirements:

Experiment Variations:

Keywords:

food chemistry, beverages, caffeine

Task and equipment

Information for teachers

Additional Information

The consumption of caffeine in soft drinks, tea or coffee has become a natural part of our habits. Caffeine is a drug which is harmful to health.

Notes on content and learning objectives

- Tea and coffee contain caffeine, an alkaloid which acts as a stimulant.
- Solid caffeine is converted directly to the gaseous state on heating, without any intermediate liquid state. It sublimes.
- Caffeine is harmful to health when consumed in larger quantities.

Notes on the method

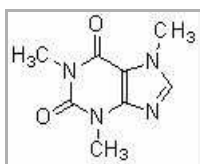
The sublimation of a substance can be particularly well demonstrated by heating elementary iodine in a test tube. Caffeine crystals can be irradiated with UV light. They fluoresce blue-violet.

The dangers of other alkaloids, such as cocaine and morphine, can be pointed out in a classroom discussion.

Fundamentals and remarks

A cup of coffee contains between 60 mg and 100 mg caffeine per 100 ml. A cup of tea contains between 10 mg and 40 mg caffeine per 100 ml. The caffeine in tea used to be called theine.

Caffeine (1,3,7-Trimethylxanthine) is a purine alkaloid with the following structural formula:



Caffeine has a slightly bitter taste and sublimes at 178 °C. It is very soluble in water, benzene and chloroform. Solvents used to be used to extract caffeine from coffee, but nowadays decaffeinated coffee is produced by extracting it with super-critical carbon dioxide.

High pressure liquid chromatography with UV detection is generally used for the quantitative determination of caffeine.

Hints on going deeper

- One can critically ask, if the high consumption of caffeine makes sense.
- The extraction of caffeine with chloroform and detection under UV light is a task for a workgroup.

Notes on the set-up and procedure

Preparation:

Decaffeinated coffee can be used in place of barley coffee.

Notes on the students experiment:

The heating of the ground sample can also be carried out with two watch glasses.

The deposit can also be examined under the microscope.

Waste disposal

Put the solid remains in the normal waste container when they have cooled down.

Caffeine in beverages (Item No.: P7186400)

Task and equipment

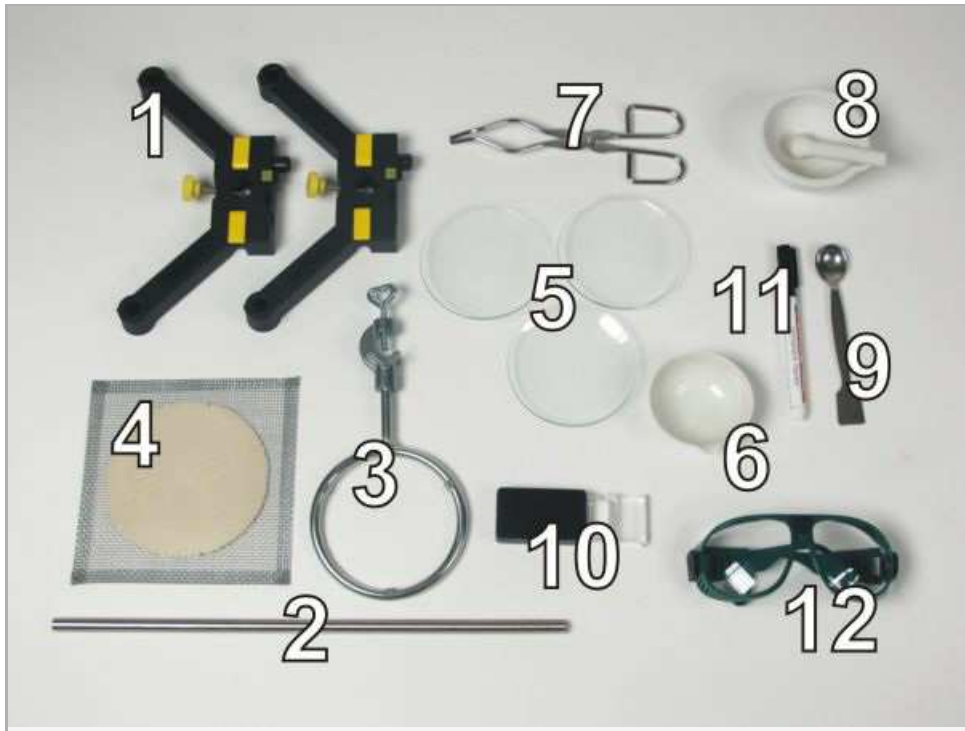
Task

Which ingredients of tea and coffee have a stimulating effect?

Detect caffeine in coffee, coffee substitute and tea.



Equipment

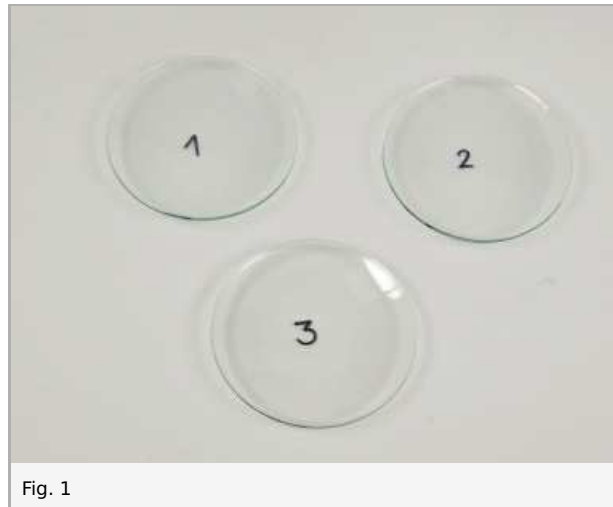


Position No.	Material	Order No.	Quantity
1	Support base, variable	02001-00	1
2	Support rod, stainless steel, l=370 mm, d=10 mm	02059-00	1
3	Ring with boss head, i. d. = 10 cm	37701-01	1
4	Wire gauze with ceramic, 160 x 160 mm	33287-01	1
5	Watch glass, dia.100 mm	34574-00	3
6	Porcelain dish, 75ml, d = 80 mm	32516-00	1
7	Crucible tongs,200mm,stainl.steel	33600-00	1
8	Mortar w. pestle, 70ml, porcelain	32603-00	1
9	Spoon, special steel	33398-00	1
10	Magnifier, 3x and 6x	64601-00	1
11	Labor pencil, waterproof	38711-00	1
12	Protecting glasses, clear glass	39316-00	1
	Butane burner f.cartridge 270+470	47536-00	1
	Butane catridge CV 300 Plus, 240 g	47538-01	1
Additional material			
	Coffee substitute produced from malted barley (Karo)		
	Coffee		
	Tea (black tea)		

Set-up and procedure

Set-up

Number three watch glasses from 1 to 3 (Fig. 1) and stand them to one side.



Assemble the stand as shown in figures 2 to 6. Fasten the support ring to the support rod and place the wire gauze on it. Adjust the height of the support ring so that the flame of the burner just reaches the wire gauze.



Fig. 2



Fig. 3



Fig. 4



Fig. 5



Fig. 6

Procedure

Put three spoonful of coffee in the mortar (Fig. 7). Frind it with the pestle until it is powdery. Transfer the powdered coffee to the

evaporating dish.



Fig. 7

Place the evaporating dish on the wire gauze and cover it with watch glass 1 (Fig. 8). Heat the evaporating dish with a small flame until a deposit forms on the underside of the watch glass.



Fig. 8

Examine the deposit with a magnifying glass.

Clean the mortar and the evaporating dish. Grind three spoonful of tea in the mortar. Transfer the ground tea to the evaporating dish. Cover the evaporating dish with watch glass 2 and heat it as previously.



Fig. 9

Carry out the same procedure with ground barley coffee, covering the evaporating dish with watch glass 3.

Waste disposal

Put the solid remains in the normal waste container when they have cooled down.

Report: Caffeine in beverages

Result - Observations

Describe your observations.

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Evaluation - Question 1

Draw conclusions from your observations.

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Evaluation - Question 2

Name soft drinks which contain caffeine.

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Evaluation - Question 3

Why should only small quantities of drinks containing caffeine be consumed?

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Evaluation - Question 4

Complete the following statements:

1. Coffe and tea contain, which on heating to needles.
2. In small amounts, caffeine acts and
3. Larger amounts of caffeine lead to, and

Evaluation - Question 5

Calculate the amount of tea and coffee consumed at home by your family.

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Evaluation - Question 6

From these amounts, calculate the amount of caffeine which is consumed, assuming that coffee contains a maximum of 100 mg caffeine per 100 ml and tea a maximum of 40 mg per 100 ml.

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