Name of the
project:Digitization of chemistry experiments to improve the quality and
support chemistry teaching in secondary schoolsAcronym:ChemIQSocProject2021-1-SK01-KA220-VET-000027995number:ChemIQSOC



Tittle: Preparation of eugenol

Work instructions

Task: Isolate crude eugenol (4-allyl-2-methoxyphenol) from cloves.

Theory

Steam distillation of dried clove buds (*Syzygium aromaticum*) provides a hydrodistillate from which crude natural eugenol is isolated by extraction.



Equipment: laboratory stands, distillation flasks, adapters, thermometer, condenser, cooling water inlet and outlet hoses, allonge, separating funnel, Erlenmayer flasks with stopper, funnel, filter paper, rotary vacuum evaporator (rotavap)

Chemicals: dichloromethane, hydrochloric acid (35%), sodium hydroxide

Procedures:

1. All work is carried out with safety goggles!

Isolation of eugenol by steam distillation

- 1. Set up the apparatus for steam distillation, put crushed cloves (5 g) in the distillation flask, turn on the water heating and cooling in the condenser. Collect the hydrodistillate in a collecting vessel until it is clear.
- 2. Transfer the hydrodistillate to an extraction funnel and extract with 3 × 30 ml of dichloromethane (CH₂Cl₂). Wash the combined organic layers with 2 × 30 ml of 10% aqueous NaOH, acidify the combined aqueous layers with 35% HCl and re-extract with 2 × 30 ml of CH₂Cl₂. Dry the combined organic layers with anhydrous sodium sulfate (Na₂SO₄), filter off the drying agent and evaporate the filtrate under vacuum on a rotary evaporator to isolate crude natural eugenol as a pale-yellow oil.

Name of the	Digitization of chemistry experiments to improve the quality and
project:	support chemistry teaching in secondary schools
Acronym:	ChemIQSoc
Project	2021-1-SK01-KA220-VET-000027995
number:	



Management of chemical substances

Chemicals	Form	H-statements	P-statements
Dichloromethane	Liquid, 97%	H315, H319, H351,	P261, P281, P305 +
		H335, H336, H373	P351 + P338
HC1	Liquid, 35%	H290, H314	P260, P280, P303 +
			P361 + P353, P304 +
			P340 + P310, P305 +
			P351 + P338
NaOH	Solid	H314, H290	P280, P305 + P351 +
			P338, P310

Sources of risk and assessment of risk severity

There is no risk when following all the principles for working with chemicals and using personal protective equipment (gloves, goggles, lab coat).

Waste management method

Dispose of waste materials in a marked container. Do not return unconsumed residues to storage bottles. Dispose of broken glass in a marked container.

Risk reduction measures

Avoid direct exposure, use protective equipment. Do not expose to prolonged or repeated exposure. In the event of an accident or if you feel unwell, inform the teacher immediately. These substances or their containers must be disposed of as hazardous waste. Do not eat, drink, smoke. Wash your hands with warm water and soap or treat them with a reparative cream after work or when interrupting work.



Worksheet

Observation

- 1. Describe the appearance and smell of eugenol.
- 2. Search for the basic physicochemical properties of eugenol.

Feature	Eugenol
Solubility in water	
Solubility in other solvents	
Boiling point	
Density	
Refractive index	

Yield

1. Record the volume of eugenol prepared.

 $V(C_{10}H_{12}O_2) = \dots ml$

Questions

- 1. Draw the structural formula of eugenol.
- 2. Describe the principle of obtaining eugenol from cloves.
- 3. Write what is the specific isolation procedure of eugenol compared to other essential oils, e.g. methanol, limonene.



- 4. Explain why it is necessary to perform multiple extractions with dichloromethane.
- 5. Explain why a NaOH solution is used to wash the product.
- 6. Write what causes acidification of eugenol with HCl.
- 7. Suggest at least 2 ways how you would increase the yield of eugenol from cloves.
- 8. Explain the importance of the following operations in the preparation of eugenol:
 - a. Extraction:
 - b. Application of sodium sulfate:
 - c. Steam distillation:
 - d. Evaporation on a vacuum rotary evaporator:
- 9. Describe the uses of eugenol.

Name of the	Digitization of chemistry experiments to improve the quality and
project:	support chemistry teaching in secondary schools
Acronym:	ChemIQSoc
Project	2021-1-SK01-KA220-VET-000027995
number:	



Conclusion

Briefly summarize the objective of the experiment, the main results and compare them with the expected values.

Disclaimer

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or Slovak Academic Association for International Cooperation, National Agency for the Erasmus+ Programme for Education and Training Sectors. Neither the European Union nor the granting authority can be held responsible for them.