

Organic & Pharmaceutical Chemistry Laboratory

Experiment 9: Extraction and Hydrolysis of Trimyristin from Nutmeg Seed

Student
Name:

Date:

Student ID:

Score:

/ 10

1. Why is isolating trimyristin from nutmeg seeds considered unusually facile compared to isolating organic compounds from most other natural sources?

A) Water-soluble via simple aqueous filtration

B) High content in nutmeg (typically 25% to 40%)

C) Nutmeg contains no other organic compounds

D) Precipitates as pure crystals without solvent

2. What chemical structural feature distinguishes trimyristin from most typical triglycerides found in other natural fats and oils?

A) Three different unsaturated long-chain fatty acids

B) Glycerol backbone with 3 identical saturated chains

C) Aromatic ring backbone with carbohydrate side chains

D) Monoglyceride with single ester linkage

3. What primary procedure is employed immediately following solid-liquid extraction to eliminate impurities from the crude trimyristin product?

A) Recrystallization in a heated solvent

B) High-temperature vacuum distillation

C) Acid-base titration with hydrochloric acid

D) Silica gel column chromatography

4. How does the melting point profile of an impure sample of trimyristin compare to that of a pure trimyristin sample?

A) Melts higher with a sharp, narrow range

B) Melts lower over a broader temperature range

C) Melts at identical temperature without variation

D) Exhibits no melting point and decomposes

5. What intermediate compound is formed immediately following the alkaline hydrolysis (saponification) of trimyristin with sodium hydroxide (NaOH) prior to acidification?

A) Free Myristic Acid

B) Sodium Myristate (soap)

C) Methyl Myristate

D) Glycidyl Myristate

6. What reagent is added in the final step of the reaction sequence to convert sodium myristate into pure myristic acid?

A) Sodium Hydroxide (NaOH)

B) Hydrochloric Acid ($\text{HCl} / \text{H}_3\text{O}^+$)

C) Ethanol ($\text{CH}_3\text{CH}_2\text{OH}$)

D) Sodium Bicarbonate (NaHCO_3)

7. How can the potential side reaction (elimination reaction) be minimized or avoided during the experiment?

A) Increasing reaction temperature during distillation

B) Maintaining low temperature and avoiding overheating

C) Adding excess strong base during final filtration

D) Performing reaction under pure oxygen pressure

8. What is the correct theoretical molar ratio of trimyristin to sodium hydroxide (NaOH) required for complete saponification?

A) 1 : 1

B) 1 : 2

C) 1 : 3

D) 3 : 1

9. Plant-derived triglycerides generally differ from animal-derived triglycerides because plant lipids are richer in:

A) Saturated fatty acids

B) Unsaturated fatty acids

C) Short-chain amino acids

D) Inorganic phosphate esters

10. What are the key chemical formulas for trimyristin and myristic acid respectively?

A) Trimyristin: $\text{C}_{45}\text{H}_{86}\text{O}_6$; Myristic Acid: $\text{C}_{14}\text{H}_{28}\text{O}_2$

B) Trimyristin: $\text{C}_{14}\text{H}_{28}\text{O}_2$; Myristic Acid: $\text{C}_{45}\text{H}_{86}\text{O}_6$

C) Trimyristin: $\text{C}_{12}\text{H}_{24}\text{O}_2$; Myristic Acid: $\text{C}_{36}\text{H}_{72}\text{O}_6$

D) Trimyristin: $\text{C}_{18}\text{H}_{36}\text{O}_2$; Myristic Acid: $\text{C}_{57}\text{H}_{110}\text{O}_6$

Answer Key & Explanations

Q#	Answer	Explanation & Reference
1	B	25% to 40% yield in nutmeg Unlike most natural sources where isolating a compound is hindered by complex mixtures, trimyristin constitutes over 25% (and up to 40%) of nutmeg's weight, facilitating straightforward solid-liquid extraction.
2	B	Identical saturated acyl chains Trimyristin is a triester with a glycerol backbone connected to three identical saturated carboxylic acid chains (myristic acid/tetradecanoic acid), whereas most natural fats contain mixed acyl chains.
3	A	Recrystallization To ensure purity, the crude product from extraction is recrystallized by dissolving it in a heated solvent and allowing fine pure crystals to form upon cooling.
4	B	Lower and broader range According to melting point theory, an impure or adulterated sample melts at a lower temperature and over a broader range compared to the sharp, higher melting point of a pure sample.
5	B	Sodium Myristate Alkaline hydrolysis (saponification) of trimyristin using NaOH yields glycerol and the sodium salt of myristic acid (sodium myristate, which acts as soap).
6	B	Hydrochloric Acid (HCl / H₃O⁺) Acidification with hydrochloric acid protonates the carboxylate anion of sodium myristate, yielding free myristic acid and sodium chloride (NaCl).
7	B	Low reaction temperature To avoid undesired elimination side reactions, the reaction mixture must be kept at a low temperature, avoiding excessive heating during distillation.
8	C	1 : 3 Ratio Each mole of trimyristin contains 3 ester linkages, thus requiring 3 moles of NaOH for complete saponification to yield 1 mole of glycerol and 3 moles of sodium myristate.
9	B	Unsaturated fatty acids Fatty acids derived from plants are generally richer in unsaturated fatty acids compared to animal lipids. Nutmeg is unusual because its lipid fraction consists almost exclusively of saturated trimyristin.
10	A	C₄₅H₈₆O₆ & C₁₄H₂₈O₂ Trimyristin (glycerol trimyristate) has the chemical formula C ₄₅ H ₈₆ O ₆ , and free myristic acid has the molecular formula C ₁₄ H ₂₈ O ₂ .