

## PW N° 4: Synthesis of Banana Flavor (Isoamyl Acetate)



### 1. Introduction

Functional analysis is a key step in understanding the behavior, reactivity, and transformation of organic molecules.

It involves identifying the **functional groups**, predicting their **chemical reactivity**, and relating structure to function.

Flavor molecules offer a simple yet illustrative example of how functional groups determine both **chemical properties** and **sensory characteristics**.

Isoamyl acetate, a naturally occurring ester, is the major compound responsible for the characteristic “**banana aroma**.”

Although present in banana fruit, it can be synthesized in the laboratory through a classical **esterification reaction** between an alcohol and a carboxylic acid.

In contrast to natural flavors, which contain complex mixtures of many molecules, synthetic flavors often contain only one compound.

Isoamyl acetate is widely used in pharmaceutical formulations (syrups, pediatric medicines) and in the food industry.

### 2. Objectives of the Practical Work

At the end of this practical work, the student should be able to:

#### 2.1. Functional Analysis

- Identify the functional groups present in the reactants (alcohol and carboxylic acid) and in the ester produced.
- Predict the reactivity of these functions based on their chemical properties.

#### 2.2. Synthesis

- Perform an organic synthesis using a **Fischer esterification**.
- Assemble and operate a **reflux apparatus** safely.

- Carry out **liquid–liquid extraction**, washing, and drying of an organic product.

### 3. Experimental Procedure

#### 3.1. Synthesis of Isoamyl Acetate (Esterification Reaction)

1. In a round-bottom flask, introduce:
  - **10 mL of isoamyl alcohol**
  - **10 mL of acetic acid**
2. Add a catalyst:
  - A small spatula of **p-toluenesulfonic acid (PTSA)**, *or*
  - **5–9 drops of concentrated sulfuric acid**
3. Add a few **boiling stones**.
4. Assemble a **reflux apparatus** and heat the reaction mixture under gentle boiling for **30 minutes**.
5. After heating, allow the mixture to cool to room temperature.

#### 2. Extraction and Purification of the Ester

1. Pour the reaction mixture into a beaker containing **ice-cold saturated sodium chloride solution**.

Two immiscible layers should form:

- **Aqueous layer**
  - **Organic layer** (containing isoamyl acetate)
2. Transfer the mixture into a **separatory funnel**.  
Shake gently, vent often, and allow the phases to separate.  
Drain and discard the **aqueous phase**.
  3. Wash the **organic layer** with **50 mL of cold water**.
  4. Collect the washed organic phase in an Erlenmeyer flask.
  5. Dry the organic layer by adding **anhydrous magnesium sulfate**.  
Filter to obtain the purified isoamyl acetate.

#### Functional Analysis Questions

1. **To which type of reaction does this synthesis belong?**  
(*Hint: identify the functional groups before and after the reaction.*)
2. **Identify the functional groups present in the reactants and in the final product.**

- Isoamyl alcohol:.....
  - Acetic acid:.....
  - Isoamyl acetate: .....
3. **Give the IUPAC names of the reactants and of the ester formed.**
  4. **Explain the role of the separatory funnel** during purification.
  5. **Justify the solubility or insolubility** of the following compounds in water:
    - acetic acid
    - isoamyl alcohol
    - isoamyl acetate
  6. **What is the purpose of adding sodium chloride?**  
Name the purification technique involved.