Preparation of an Ester

Chemists use esterification reactions to make artificial esters. Artificial esters are used in many food products as artificial flavourings. In this investigation, you will synthesize an ester. Examples of the carboxylic acid and alcohols that are used to make different esters are shown below.

<table>
<thead>
<tr>
<th>Alcohol</th>
<th>Carboxylic Acid</th>
<th>Ester</th>
</tr>
</thead>
<tbody>
<tr>
<td>methanol</td>
<td>salicylic acid</td>
<td>methyl salicylate</td>
</tr>
<tr>
<td>octan-1-ol</td>
<td>ethanoic acid</td>
<td>octyl ethanoate</td>
</tr>
<tr>
<td>3-methylbutan-1-ol</td>
<td>ethanoic   acid</td>
<td>3-methylbutyl ethanoate</td>
</tr>
</tbody>
</table>

Pre-Lab Questions

1. Draw the ester functional group.
2. What are the names of the functional groups of alcohols and of carboxylic acids?
3. What is a common physical property used to identify an ester?

Question

What observable properties do esters have?

Procedure

1. Your teacher will assign the ester you will be making. Use one of the following procedures based on the ester that is assigned to you.

   **Methyl salicylate ester:**
   - Add 1 g of salicylic acid to a test tube.
   - Add 10 drops of methanol to the same test tube.

   **Octyl ethanoate ester:**
   - Add 10 drops of 3-methylbutan-1-ol to a test tube.
   - Add 10 drops of ethanoic acid to the same test tube.

   **3-Methylbutyl ethanoate ester:**
   - Add 10 drops of 3-methylbutan-1-ol to a test tube.
   - Add 10 drops of ethanoic acid to the same test tube.

   **Note:** The procedure after this point is the same for everyone, no matter what ester you are making.

2. Using a hot plate, heat 100 mL of water in a 250 mL beaker until the temperature is about 60°C. Turn the hot plate off to avoid boiling the water. Use the thermometer to monitor the temperature of the hot water. The temperature should stay between 50°C and 60°C.

3. Add 3 mL of distilled water to a test tube. Place this test tube on ice to cool the water.
4. Your teacher will carefully add five drops of sulfuric acid to the alcohol/acid mixture in your test tube.

5. Cover the tube with plastic wrap.

6. Use a retort stand and clamp to secure the test tube in the hot-water bath you prepared in Step 2.

7. Leave the test tube in the hot water for about 5 min.

8. After 5 min, add 3 mL of ice-cold water to the test tube, which you prepared in Step 3. The ester should float on top of the water.

9. Separate the ester from the water using a medicine dropper. Place the ester on a watch glass and record the physical properties of the ester. To smell the odour of the compound, use your hand to waft the aroma toward your nose. Do not inhale the solution directly.

10. Dispose of all materials as instructed by your teacher.

**Analyze and Interpret**

1. Describe the physical properties of the ester you made.

2. Using structural formulas, write the chemical equation for the reaction you performed.

3. Collect the data for the other esters that were made by the class. Organize the data on a table.

**Conclude and Communicate**

4. How do you know that a new product was formed in each of the reactions performed by the class? Explain.

5. Compare the odour of the esters with familiar odours (such as the odours of plants, flowers, and fruits). What did they remind you of?

---

Esters that mimic the scent of wintergreen, bananas, and pineapples can be made in the lab.