

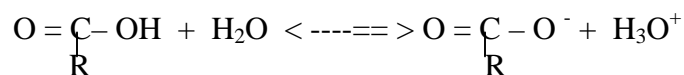
ESTERS AS FOOD FLAVORINGS

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Background

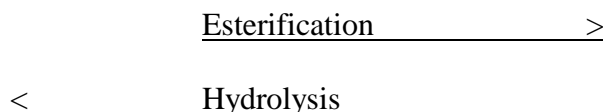
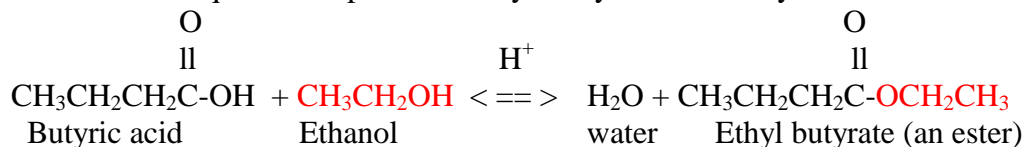
Carboxylic acids are structurally like aldehydes ($\text{H}-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}$) and ketones ($\text{C}-\overset{\text{O}}{\parallel}{\text{C}}-\text{C}$) in that they contain the carbonyl group ($\text{C}=\text{O}$). However, an important structural difference is that carboxylic acids contain a hydroxyl group ($-\text{OH}$) attached to the carbonyl carbon. In turn this functional group is called the carboxyl group ($\text{HO}-\overset{\text{O}}{\parallel}{\text{C}}$). This combination gives the group an important characteristic; it behaves as an acid.

As a family, carboxylic acids are weak acids, which ionize only slightly in water. As aqueous solutions typical carboxylic acids ionize to the extent of only one percent or less.



The reaction of a carboxylic acid and an alcohol yields an ester and water is eliminated. The functional group of an ester is $\text{O}=\text{C}-\text{O}$.

Ester formation is an equilibrium process catalyzed by an acid catalyst.



A distinct difference between carboxylic acids and esters is in their odors. Carboxylic acids are noted for their sour, disagreeable odors. On the other hand, esters have sweet pleasant odors often associated with fruits; these compounds are used in the food industry as flavoring agents. For example, while butyric acid gives rancid butter its putrid odor, the ester, ethyl butyrate, is used as the artificial flavoring agent of pineapple and be found in other flavorings.

Procedure

1. Prepare a 60°C water bath.
2. Prepare and label clean small dry test tubes. Following the table below add 10 drops of liquid carboxylic acid or 0.1 g of solid carboxylic acid. Then add 10 drops of the corresponding alcohol. Note the odor of each reactant by fanning (wafting) the vapors toward your nose.

3. Add 2 drops of concentrated sulfuric acid (catalyst) to each test tube and gently mix the contents. **WARNING: Strong acid, take precautions.**
4. Place the test tubes in the warm water bath for 15 minutes without getting water into the tube. Remove the test tubes and cool. Pour contents into a watch glass and note the odor of the ester formed. Odors should be raspberry, banana, and oil of wintergreen.
5. Record results on report sheet.

<u>Carboxylic acid</u>	<u>Alcohol</u>
Formic	Isobutyl
Acetic	Isopentyl
Salicylic	Methyl

Report sheet

<u>Test tube #</u>	<u>Acid</u>	<u>Alcohol</u>	<u>Name of ester formed</u>	<u>Odor</u>
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Application Exercise

Locate five different grocery items that contain esters. Form a table listing the food item, the ester(s) found within, and then name the carboxylic acid and alcohol that would be derived from hydrolyzing each ester.

KEY

<u>Alcohol</u>	<u>Carboxylic Acid</u>	<u>Ester</u>	<u>Odor of Ester</u>
Isoamyl (isopentyl)	acetic	isoamyl acetate	banana
Octyl	acetic	octyl acetate	citrus, orange
Isobutyl	formic	isobutyl formate	raspberry
Methyl	salicylic	methyl salicylate	oil of wintergreen
n-propyl	acetic	propyl acetate	pear
methyl	butyric	methyl butyrate	apple
Ethyl	butyric	ethyl butyrate	pineapple