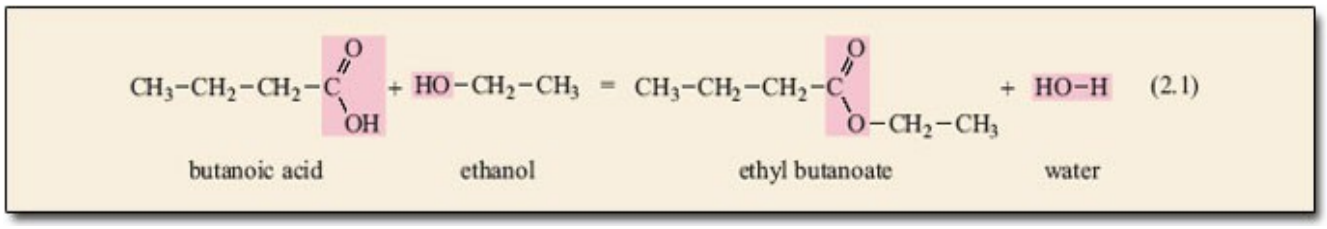
ARTIFICIAL FLAVORING - Esters

Many foods such as ice cream, candy, syrup, and others contain artificial flavors. Many of these flavoring additives are esters. An ester is an organic compound that is produced when an organic acid reacts with an alcohol. Esters are named by combining the names of the alcohol and the acid from which they are synthesized. For example, ethyl alcohol and benzoic acid produce the ester, ethyl benzoate. Ethyl alcohol and decanoic acid produce ethyl decanoate. The following reaction shows the formation of an ester, ethyl butanoate.



The equilibrium constant for the reaction between primary alcohols and unhindered carboxylic acids is approximately four. If equal quantities of acid and alcohol are used the reaction gives a product yield of only 67%. In order to make esters in high yields the equilibrium must be shifted using LaChatelier's principle. In this experiment you will synthesize a series of low molecular weight esters from their corresponding acids and alcohols. In order to generate the esters efficiently, you will use an excess of alcohol and in some cases you will remover the water as a low boiling azeotrope. You will then attempt to identify the characteristic odor of each of the esters you have made. Not all esters have an odor and some may be colorless too. An example of an odorless ester is vegetable oil.

Beginning Question: How do you prepare esters? What do they smell like?

Procedure:

1. Fill a large beaker about ¾ of the way full. Bring the water to a boil.
2. Place 6 TT in a rack. Number the tubes with a wax pencil or on masking tape.
3. Place 1 mL of each reagent into the appropriate tube, as indicated in the chart below. Note the odor of each as you add it. Write your observations.
4. Carefully add 0.5 mL of sulfuric acid to each tube.
5. Stir each mixture slightly by tapping the bottom of the tube with your finger.
6. Place tubes 1 and 2 into the beaker of boiling water.
7. After a few minutes, removes the tubes from the water bath. Check each tube for the presence of an odor. Record your observations.
8. If no odor, cover with aluminum foil and put in the drying oven overnight.
9. Repeat with the remaining tubes.

Data

Make observations for each alcohol and acid before experiment.

TT	Alcohol (Initial OBS)	Carboxylic Acid (Initial OBS)
1	methyl	butyric
2	Isoamyl	salicylic
3	Amyl	Glacial acetic
4	Ethyl	butyric
5	Methyl	Salicylic
6	Ethyl	Benzoic

Then, make your final observations.

TT	Observations (final)
1	
2	
3	
4	
5	
6	

Discussion:

1. What kind of organic reaction is this? (hint: It has to do with 2 molecules linking up by the elimination of a smaller molecule between them—water)

2. Why do you put the ester in the oven?

3. What is the purpose of the sulfuric acid?

4. Use structural formulas, write the reaction for the preparation of:
   amyl acetate
   ethyl benzoate

5. Name the esters you have produced.

Resources:

Conclusion: