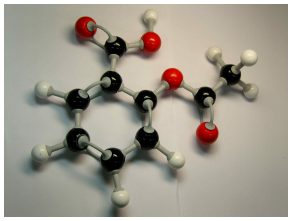
EXPT 19. Synthesis of Aspirin



[Key Contents]

- organic compound, synthetic compound, drug
- melting point, purity

[References]

Standard General Chemistry Laboratory Manual
(6th edition, Korean Chemical Society)
EXPT 35 "The Story of Aspirin"
Principles of Modern Chemistry, 6th Ed. (Oxtoby et al.)
Ch 7. Bonding in Organic Molecules
Chemistry for Life, Chemistry for Better Life (Kim et al.)
Ch 11. Chemistry for Life
Ch 12. Chemistry for Better Life

[Goal]

- to experience organic synthesis
- to appreciate the role of organic chemistry in drug industry

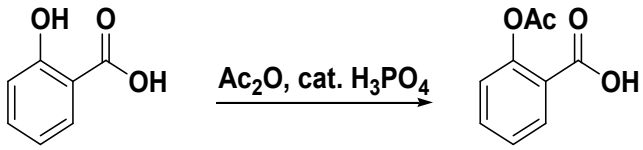
[Background]

Organic compounds from aspirin to asphalt abound around us. Organic compounds are found in automobile parts, home and office appliances, clothing, construction materials, etc. Organic compounds were believed to arise only from living organisms. Organic compounds are carbon compounds whether or not derived from life.

Human life span increased dramatically as clean water became available and our body and the environment were maintained clean all thanks to chemistry. Chemistry played particularly important role in the discovery and synthesis of organic compounds with medicinal applications.

Aspirin is one of the most widely used compounds as a drug. Today about 100 million tablets are taken a day worldwide. Aspirin is acetylsalicylic acid with several functional groups commonly

encountered in organic chemistry bonded to a benzene ring. It can be easily synthesized in the laboratory according to the following reaction scheme. The reaction proceeds with high efficiency under an acidic condition.



Like any product in chemical synthesis, aspirin synthesized in the laboratory is not pure and need to be purified. Pure compounds have well-defined melting point. The melting point of aspirin is 135°C. You will learn to purify your aspirin and test purity based on the melting point.

[Apparatus and Chemicals]

hot plate, water bath, thermometer (0~150°C), 50 mL Erlenmeyer flask, beaker, balance, Buchner funnel, Buchner flask, cylinder, filter paper, melting point apparatus

salicylic acid, acetic anhydride, 85% phosphoric acid, petroleum ether, ice

[Procedure]

1) Prepare a boiling water bath.

2) Add 2.5 g salicylic acid and 3 mL acetic anhydride to a dry 50 mL Erlenmeyer flask. Wash down all salicylic acid with acetic anhydride so that no solid remains on the wall of the flask. Heat in the water bath.

3) Add 3-4 drops of 85% phosphoric acid as catalyst and maintain 70-80°C for about 15 minutes until the solution becomes clear.

4) Slowly add 2 ml distilled water to hydrolyze residual acetic anhydride.

5) When no more acetic acid vapor appears, take the flask out of the bath, add 20 mL distilled water, and let cool.

6) If no precipitate appears, cool the flask in an ice bath and rub

the inner wall of the flask with a glass rod. Filter the precipitate using Buchner funnel and aspirator and wash with 5 mL of cold water.

7) Dry on hot plate and weigh the solid material on the filter paper.

8) Take 1.0 g of the solid material and dissolve in a minimal volume (about 5 ml) of diethyl ether in a test tube in a water bath. Filter off any insoluble material.

9) Add 15 mL petroleum ether and leave the test tube in ice bath. Avoid agitation.

10) Collect the white needle shape crystal on a filter paper, wash with a small volume of petroleum ether and dry.

11) Weigh the purified aspirin.

12) Determine melting point.

[Data Analysis]

1) Calculate the overall yield of the synthesis.

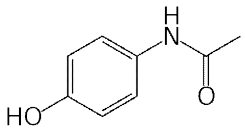
2) Report melting point. How sharp is it?

[Additional Material]

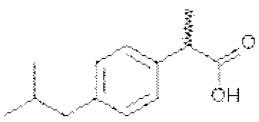
Alternative Pain Killers

1956 : acetaminophen (Tylenol)

1969 : ibuprofen



acetamnophen



ibuprofen