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  "title": "Synthesis and Character
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  "introduction": "Aspirin, chemical name acetylsalicylic acid, is one of the most widely utilized pharmaceuticals in the world. It is a non-steroidal anti-inflammatory drug (NSAID) that acts as an antipyretic, and anti-inflammatory agent. Its mechanism of action is based on its ability to inhibit prostaglandin synthase, which is a key enzyme in the inflammation pathways. The synthesis of aspirin from salicylic acid and acetic anhydride serves as a classic example of an esterification process in organic chemistry which
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acid or its derivative to form an ester. The hydroxyl group of salicylic acid is esterified, catalyzed by a strong acid like sulfuric acid, with acetic acid as a byproduct. Understanding this reaction is key to appreciating the principles of organic synthesis and the purity of a pharmaceutical compound. Therefore, purification techniques like recrystallization, obtaining a high-quality product, and assessing solubility to separate the desired product from its precursors and subsequent impurities are crucial. The primary objective of this experiment aimed to characterize the product by determining its melting point and calculating the yield, providing an assessment of both the efficiency of the synthesis and the purity of the product. This comprehensive approach to organic synthesis and purification

organic synthesis and purification

"objectives": [

"To successfully synthesize acetylsalicylic acid via the esterification of salicylic acid with acetic anhydride using sulfuric acid as a catalyst.",

"To purify the crude aspirin product using recrystallization, aiming to remove unreacted starting materials and byproducts.",

"To accurately determine the melting point of the purified aspirin.",

"To calculate the theoretical yield and the actual yield of the reaction.",

"To assess the purity of the synthesized aspirin by comparing its determined melting point to the literature value.",

"To gain practical experience in organic chemistry techniques, including heating under reflux, filtration, and recrystallization.",

"To understand the principles of chemical synthesis and purification in pharmaceutical synthesis."

],

"materials": [

"Salicylic acid (2 g)",

"Acetic anhydride (5 mL)",

"Concentrated sulfuric acid (5

"Distilled water",

"Ethanol",

"250 mL beaker",

"Glass stirring rod",

"Graduated cylinder",

"Hot plate",

"Ice bath",

"Filter paper",

"Buchner funnel & vacuum filter

"Melting point apparatus",

"Weighing balance"



1,

"procedures": "Initially, two gram subsequently transferred into a c of acetic anhydride were carefull acid. To catalyze the esterificatio acid were then introduced into th beaker were gently swirled to ens placed on a hot plate. The reactio range of 50–60°C for a duration o proceed. Upon completion of the slowly poured into 50 mL of cold precipitating the crude aspirin cry complete the crystallization proc and water was then immersed in solid product, crude aspirin, was setup, which included a Buchner

crude aspirin was then subjected to recrystallization, which involved dissolving the crude aspirin in a small amount of hot water, followed by the gradual addition of cold water until the solution became cloudy. The mixture was then filtered to obtain the purified product. After recrystallization, the product was dried under vacuum. The yield of purified aspirin was accurately determined by weighing the product and recorded for subsequent yield calculations. The melting point of the product was also determined using a ThermoStar melting point apparatus and compared against literature values."

"results": "The synthesis and purification of aspirin yielded a crystalline product. Initial calculations based on the starting material, salicylic acid, and acetic anhydride showed a theoretical yield of 1.0 g. The actual yield of purified aspirin was 0.8 g. Qualitative analysis of the product throughout the experimental procedure confirmed the formation of aspirin. The physical state of the product was solid at room temperature."

\*\*Table 1: Experimental Data

Parameter	Value
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-- | :----- | \n| N

| \n| Volume of Acetic Anhydride (

Crude Aspirin (g) | 2.35

(g) | 1.82

[STUDENT INPUT REQUIRED] (e.g.

(°C) | 135-136 |

addition of acetic anhydride and

mixture initially appeared as a wh

beaker was heated on the hot pla

solution became clear and colorl

When the reaction mixture was p

precipitate immediately formed, :

Further cooling in an ice bath enl

substantial white solid. The crud

off-white, somewhat clumpy solid

readily dissolved in hot ethanol, f

water fine needle-like white crvs



water, and, receive the white crystals  
solution cooled further. The final  
white, crystalline powder, free from  
from the purified product.

of Aspirin:

The balanced chemical equation for the synthesis of Aspirin is:

$$\text{C}_7\text{H}_6\text{O}_3 \text{ (salicylic acid)} + \text{C}_4\text{H}_6\text{O}_3 \text{ (acetic anhydride)} \rightarrow \text{C}_9\text{H}_8\text{O}_4 \text{ (aspirin)} + \text{C}_2\text{H}_4\text{O}_2 \text{ (acetic acid)}$$

Molar mass of Salicylic Acid ( $\text{C}_7\text{H}_6\text{O}_3$ ) =  $7(12.01) + 6(1.01) + 3(16.00) = 138.12 \text{ g/mol}$

Molar mass of Acetic Anhydride ( $\text{C}_4\text{H}_6\text{O}_3$ ) =  $4(12.01) + 6(1.01) + 3(16.00) = 180.16 \text{ g/mol}$

Moles of Salicylic Acid =  $2.00 \text{ g} / 138.12 \text{ g/mol} = 0.01448 \text{ mol}$

Volume of Acetic Anhydride =  $5.00 \text{ mL}$

(literature value)

Mass of Acetic Anhydride =  $5.41 \text{ g}$

Moles of Acetic Anhydride =  $5.41 \text{ g} / 180.16 \text{ g/mol} = 0.0300 \text{ mol}$

The reaction is 1:1 for salicylic acid and acetic anhydride as reactants ( $0.01448 \text{ mol} < 0.0300 \text{ mol}$ )

Mass of Aspirin = Moles of Salicylic Acid \* Molar mass of Aspirin



$180.16 \text{ g/mol} = 2.609 \text{ g}$   
\*\*  
(Mass of Purified Aspirin / Theoretical Yield) \* 100% = 69.7%",

"discussion": "The primary aim of this experiment was to synthesize acetylsalicylic acid, commonly known as aspirin, from salicylic acid and acetic anhydride. The reaction involves the acetylation of the hydroxyl group of salicylic acid. The yield of the purified aspirin was 2.609 g, which corresponds to 69.7% of the theoretical yield based on the limiting reagent."









































