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SYNTHESIS AND EVALUATION OF ASPIRIN DERIVATIVE BY MICROWAVE OVEN

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ABSTRACT

In our lab, we employ specially designed synthetic microwave technology. Chemical or organic chemistry is the process that creates all of these materials. A temperature of 55<°C must be maintained for 30 minutes during the aspirin derivative production procedure. Microwave treatment yielded production that was comparable, if not better, over a short period of time (7 min at 175 W). The synthesis times for aspirin are reduced to 7 minutes, while the Claisen condensation time is decreased to 4.5 minutes. Compared to a typical effect of 72.08%, aspirin has an 85.88% influence on microwave technology.
Microwave-assisted synthesis has several advantages over conventional heating methods, including shorter reaction times, higher yields, and improved product purity. The synthetic para-amino salicylic acid was subjected to a number of spectroscopic and analytical techniques to confirm its purity and molecular structure. The developed synthesis methodology is a helpful tool for the rapid synthesis of 4 Acetamido Salicylic Acid derivatives with potential therapeutic applications.

Keywords: *Aspirin derivative, ammonium acetyl salicylate derivative, acetylation, microwave oven, drug discovery, acetylation, salicylic acid, esterification, Catalyst, Reflux, crystallization, purification.*

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INTRODUCTION

Microwave chemistry is a useful tool in organic chemistry labs for undergraduate students. It allows students to run multiple reactions in the same amount of time it takes to complete one, saving time and teaching them about optimization.[1] Normally, many organic chemistry syntheses require hours of heating. However, microwave chemistry greatly accelerates these sorts of operations and provides greater yields.[2] Polar molecules rotate in unison with the magnetic field due to the oscillation of magnetic fields generated by microwaves. This molecule mobility leads to an increase in molecular interactions. These reactions are valuable because microwave reactions have been shown to occur much more quickly.[3]

Aspirin derivative is prescribed to people who are more likely to have a heart attack in addition to being used as a pain reliever aspirin derivative lowers the chance of blood clots in arteries, which lowers the risk of heart attacks aspirin derivative is a blood thinner that functions as an analgesic to lessen edema.[4] Acetylation is the organic process that yields aspirin derivative. The reaction is started when one of the carbonyl groups of acetic anhydrides is attacked by the alcohol group of salicylic acid. The current method's increased environmental friendliness makes it a crucial step toward green chemistry.[5]

Currently underutilized in the laboratory, this approach has the potential to have a big impact on drug development, screening, combinatorial chemistry, and medicinal chemistry.[6] Because traditional methods of organic synthesis use large amounts of reagents and solvents that harm the environment, they typically require lengthy heating times, complex apparatus setups, and higher process costs.[7] Significant opportunities exist for reducing waste output, byproducts, and energy costs through the development of green chemistry. Microwave irradiation has been useful for many chemical syntheses because it can couple directly with the reaction molecule and prevent thermal conductivity, which raises the temperature quickly.[8]

MATERIAL AND METHODOLOGY:

The microwave is one of the home appliances that is used the most. Microwave ovens are found in most homes and convenience stores. Its extraordinary cooking speed explains why it's so popular.[9]

OPERATING PRINCIPLE:

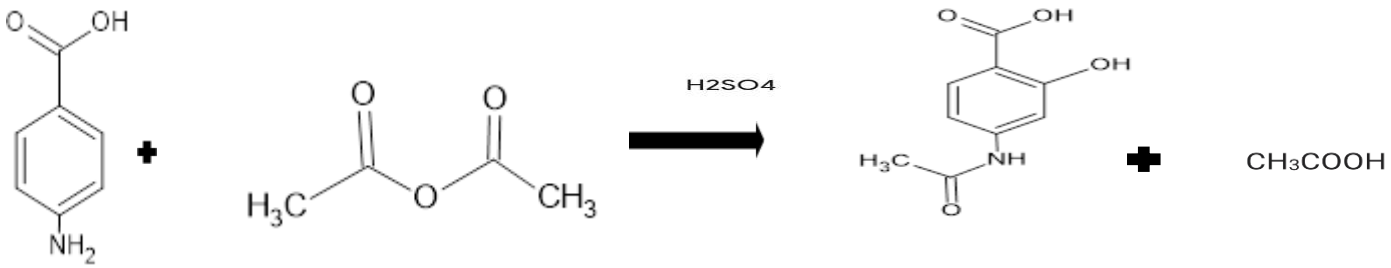
Waves of radio frequencies make up microwaves. Microwave ovens typically use a radio frequency of about 2500 megahertz.[10] This frequency of radio waves has an intriguing characteristic: they absorb instantly, transform into atomic motion, and ultimately transform into heat.[11] An additional intriguing characteristic of this particular microwave spectrum is that it doesn't absorb well in most metals, glass, ceramics, or plastics, which can lead to sparks in microwave ovens. Because conductor conductivity is infinite, or because conductors do not contain any electronic waves, as we learned in our course, metal reflects microwave radiation. Water resonates at a frequency of 2500 megahertz, making the property stated in this paragraph achievable. [12]

Dipoles, which have both positive and negative charges, are the fundamental units of all food molecules.[13] When an electromagnetic field is present, the molecules are arranged so that the +ve charge is at the -ve pole and the -ve charge is at the positive pole. Molecular heat is produced by this process fractionally.[14] As previously observed, a microwave oven operates at a frequency of 2500 megahertz. Then, a microwave operating at this frequency reroutes the electromagnetic field 2,500,000,000 times in a second. A microwave oven has a very high heat efficiency as a result.[15]

Figure No.1: Raga's Microwave System

Reaction-Principle:

Aspirin derivative synthesis with microwave assistance for the organic chemistry lab. In organic chemistry, several syntheses require an hour of room temperature heating. This kind of reaction could happen more quickly and with a higher yield thanks to microwave chemistry.[16] More molecular interaction is encouraged by a microwave's fluctuating magnetic field. It's been demonstrated that microwave reactions occur faster.[17] thus, rendering these responses meaningful. Microwave chemistry is one application for which undergraduate students are given in the organic lab. In the organic lab, students can learn optimization by using a microwave.[18]



P Amino Salicylic Acid Acetic Anhydride 4Acetamidosalicyclic Acid

SYNTHESIS OF ASPIRIN DERIVATIVE (PRODUCT) [MICROWAVE OVEN] PROCEDURE:

Gradually mix 10 grams of para-amino salicylic acid (0.07 mol) with 18 milliliters of acetic anhydride (0.90 mol) in a 250 milliliter Erlenmeyer flask.

Carefully add 10 to 20 drops of 85% phosphoric acid to the liquid, mixing well after each addition.

Microwave the mixture for one minute, or just long enough to dissolve all of the para-amino salicylic acid.

Gently stir in 20 milliliters of distilled water after the reaction is complete. After that, set the chilled mixture over an ice bath and watch for the crystallization of ammonium acetyl salicylate.[19]

After filtering the crystals with a Buchner filter, extract with cold water.

Weigh the solid after it has dried completely in the oven for 30 minutes to obtain a 85% product yield with a melting point range of 128 to 132 degrees Celsius.[20]

CALCULATION:

THEORETICAL YIELD:

Molecular weight of Para Amino Salicylic acid (reactant) = Molecular weight of 4 Acetamide Salicylic Acid (Product)

$$X = \frac{195 \times 4}{153}$$

Theoretical yield = **5.09 g/mol**

Practical yield = 3.5 gm

$$\textbf{Percentage (\%) yield} = \frac{\text{Practical yield}}{\text{Theoretical yield}} \times 100$$

$$= \frac{3.5}{5.09} \times 100$$

Percentage (%) yield =68.76 %

RESULT:

EVALUATION TEST

Parameter	Observation
Colour	Black
Appearance	Crystalline- powder
Odour	Odourless
State	Solid
Flame Test	Positive – 4 Acetamido salicylic Acid is aromatic in nature
Solubility	Sample + ethanol - Soluble
Melting Point	131°C
PH Determination	3.2

Table No.1: Evaluation Test

IDENTIFICATION TEST:

Sr. No.	Test	Observation	Inference
1	a boil approximately 0.5g After adding 10 milliliters of the NaOH solution for three minutes, let it cool, then add 10 milliliters of the sulfuric acid solution. After filtering and dissolving the white crystalline ppt in roughly 2 milliliters of water and ferric chloride test solution,	Dark violet colour is observed.	Test is positive
2	In test A add 3ml ethanol (95%) add 3ml sulphuric acid and heat.	Odour of ethyl acetate observed	Test is positive

Table No.2: -Identification Test

LIMIT TEST:

Sr. No	Limit Test	Inference
1	**Chloride test:** Boil 1.75 g in 75 ml of water for 5 minutes, let cool, then add enough water to cover the contents and filter.25 milliliters of the filtrate pass the chloride limit test.	Test is Positive
2	**Sulphate Test**: - 10 ml of the filtrate obtained in the test for chloride complies with limit test for the sulphate	Test is Positive
3	**Arsenic Test**: - Combine 5.0 g with 3 g of anhydrous sodium carbonate, then fully mix in 10 ml of bromine solution. The cooled residue was dissolved in 16 milliliters of brominated hydrochloride acid and 45 milliliters of water after being allowed to dry out on a water bath and gently ignited. Using 2 ml of stannous chloride as T, remove the excess bromine. The resultant solution passes the arsenic limit test.	Test is Positive

Table No.3: - Limit Test

ASSAY OF ASPIRIN DERIVATIVE:

Sr. No.	Titration	Burette reading		End point
		Initial	Final	
1	Sample:1.5g Aspirin Derivative +15ml ethanol +50ml 0.5N NAOH boil for 10 min. Titrate with 0.5 N HCL with phenol red indicator	0.0 ml	16.5 ml	Orange colour
2	Blank:15ml ethanol +50ml 0.5N NaOH boil for 10 min Titrate with 0.5N HCL with phenol red indicator	0.0 ml	22.2 ml	Pink colour

Table No.4: Assay of Aspirin Derivative

UV SPECTROSCOPY OF 4ACETAMIDO SALICYCLIC ACID:

Sr.No.	Concentration µg/ml	Wavelength (nm)	Absorbance (A1% cm)
1	2 µg/ml	356 Nm	0.919
2	4µg/ml	241 Nm	0.811
3	6µg/ml	356 Nm	0.783
4	8µg/ml	222 Nm	0.751

Table No.5: UV Spectroscopy of 4acetamidoSalicyclic Acid

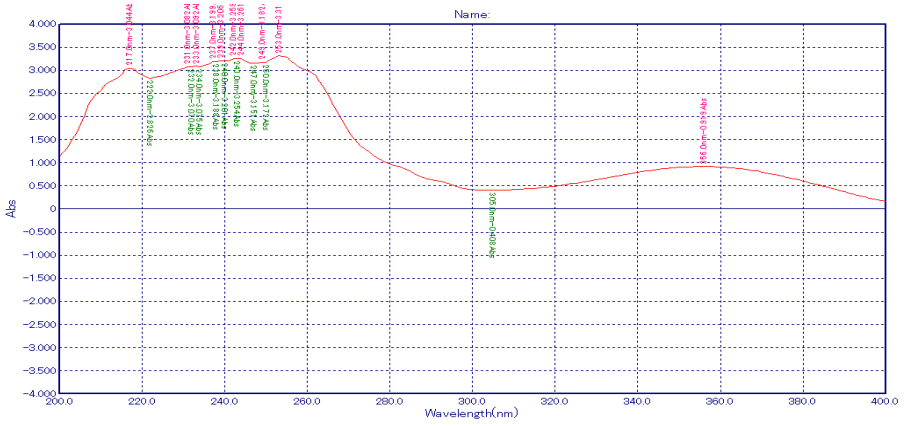


Figure No.2: Graph of 2 *µg/ml* conc. of sample

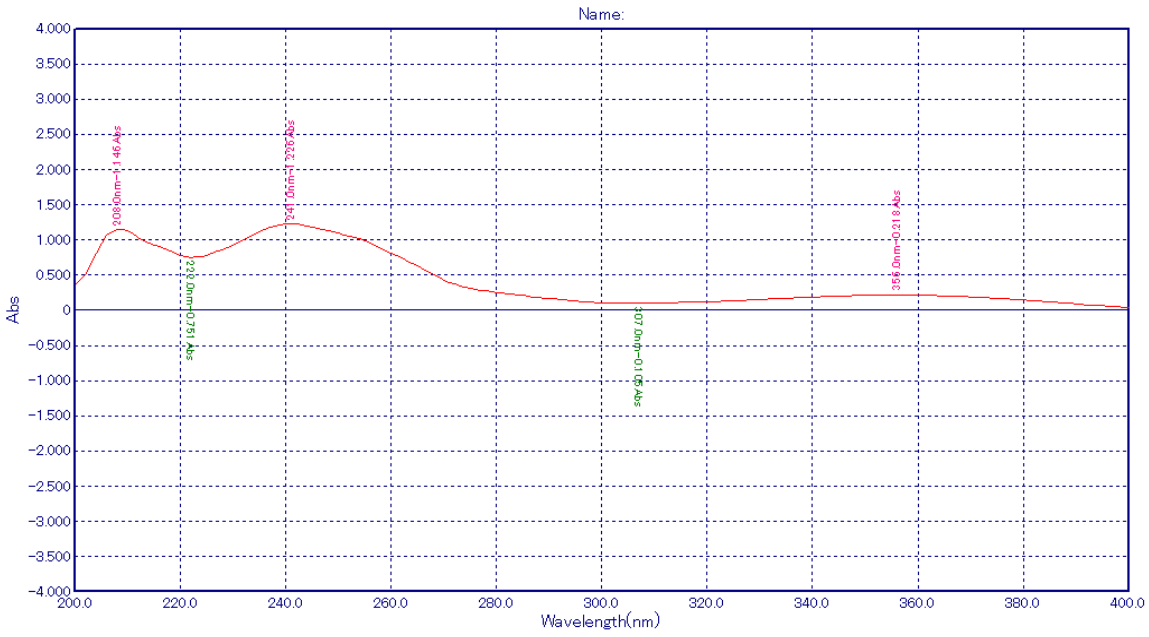


Figure No.3: Graph of *4µg/ml conc. of sample*

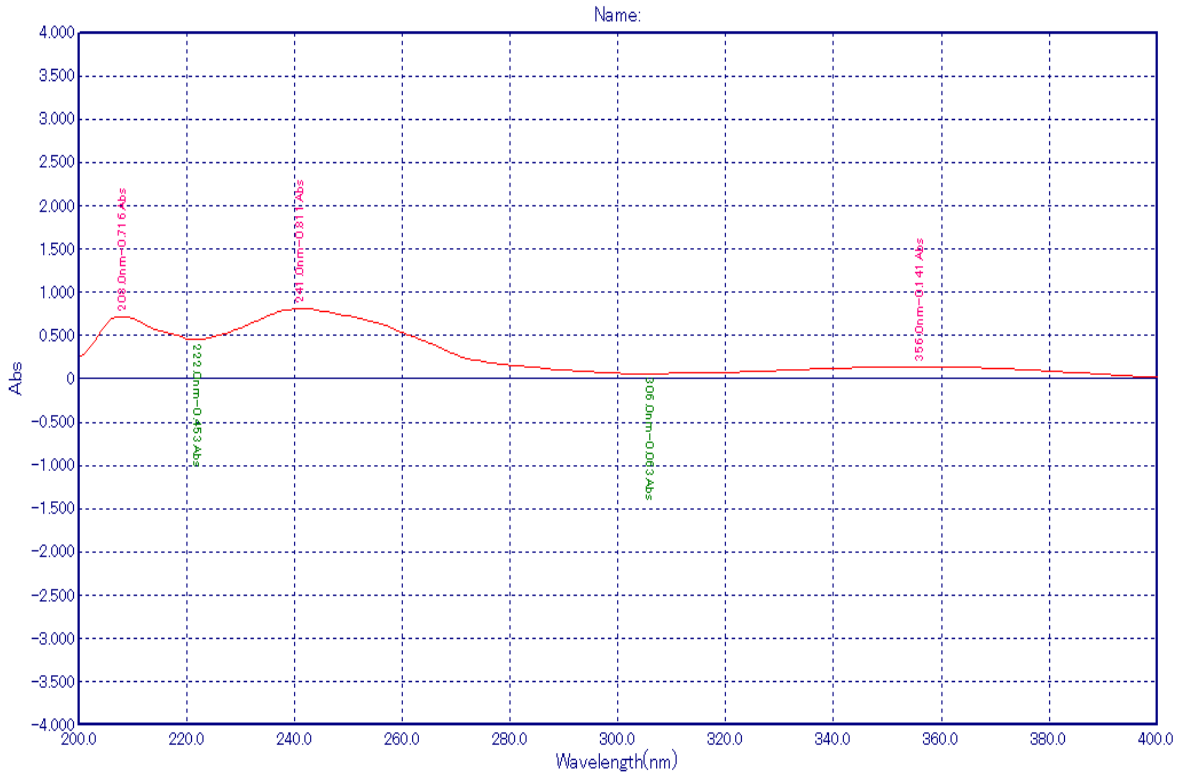


Figure No.4 :Graph of 6 *µg/ml* conc. of sample

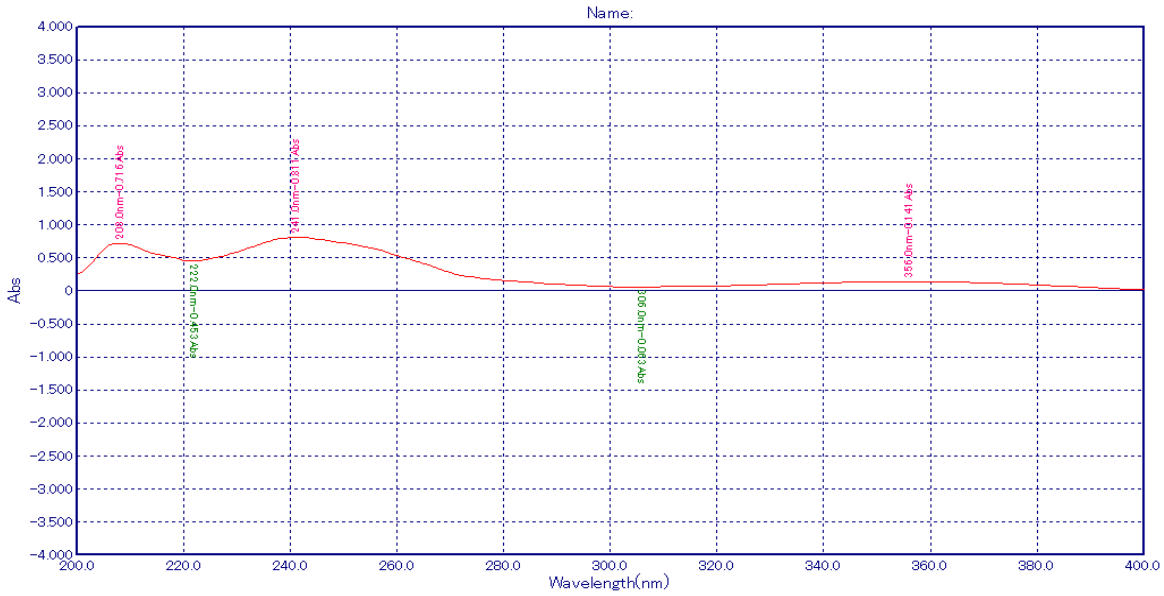


Figure No.5: Graph of 8 *µg/ml* conc. of sample

DISCUSSION:

Microwave-assisted synthesis utilizes microwave radiation to heat the reaction mixture directly, rather than relying on heat transfer through conduction or convection. Microwaves penetrate the reactants and cause rapid molecular motion, leading to faster heating and potentially shorter reaction times compared to conventional methods. In microwave-assisted synthesis of aspirin derivative, the reaction conditions such as temperature and time can be precisely controlled. This can lead to improved reaction efficiency and higher yields compared to traditional methods. The reaction typically takes only a few minutes under microwave irradiation, significantly reducing the overall reaction time. Microwave-assisted synthesis offers several advantages in terms of safety and efficiency. The reaction vessel is usually sealed, minimizing the risk of exposure to hazardous reagents or byproducts. Additionally, the shorter reaction times reduce energy consumption and increase productivity, making the process more environmentally friendly.

CONCLUSION:

In conclusion, the synthesis of aspirin derivative involves a targeted acetylation process of 4-acetoamide salicylic acid, typically using acetic anhydride or acetyl chloride as acetylating agents. This synthetic pathway effectively introduces the acetoamide group at the 4-position of the salicylic acid core, yielding a compound with promising potential in pharmaceutical and biomedical applications. The resulting 4-acetoamide salicylic acid combines the therapeutic properties of salicylic acid derivatives, such as anti-inflammatory and analgesic effects, with the potential for improved efficacy and safety profiles through further structural modifications and optimization.

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