



Quantitative estimation of aspirin in various drugs: UV- Vis absorption spectroscopy and colorimetric studies

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ABSTRACT

Aspirin (acetylsalicylic acid) is an important drug used for its analgesic, antipyretic and anti-inflammatory properties. Various analytical techniques such as HPLC, Mass spectroscopy etc are available for the determination of aspirin content in drugs but these methods are expensive and laborious in nature. Therefore, these methods are neither suitable nor accessible for undergraduate students. In this background, we have used a very simple analytical technique to teach students how to determine aspirin contents in various drugs. Using this method the students have successfully determined the aspirin content in commercially available drugs like ASA, Aspesol, Colsprin, Ecosprin and Disprin. The results obtained in the present study were found comparable to data reported elsewhere. Therefore, this study can be used by other research and/or educational institutes to train undergraduate students in drug assay.

Keywords: Aspirin, ASA, Aspesol, Colsprin, Ecosprin, Disprin.

INTRODUCTION

Aspirin very well known as acetylsalicylic acid (ASA), is a salicylate drug, often used as a pharmaceutical agent for over 100 years [1] such as an analgesic to relieve minor aches and pains, as an antipyretic to reduce fever, and as an anti-inflammatory medication. Aspirin is also used in low doses as a blood thinner to prevent blood clots. It is effective in reducing the risk of stroke and offers a protective effect against heart attacks in men with chest pain. It is unique among Cox-inhibitors (cyclooxygenase) because it covalently modifies the proton of enzymes and irreversibly inhibits them [2]. Aspirin was first isolated by Felix Hoffmann, a chemist

with the German company Bayer in 1897. The name ‘aspirin’ comes from the ‘a’ in acetyl chloride, the ‘spir’ from the old botanical name for meadowsweet, *Spiraea ulmaria* (known to contain salicylic acid) and ‘in’, which was a then familiar name ending for medicines. It is one of the most widely used medications as a pain reliever. It is a white, crystalline, weakly acidic substance which melts at 135°C. In the laboratory, it is prepared as follows:

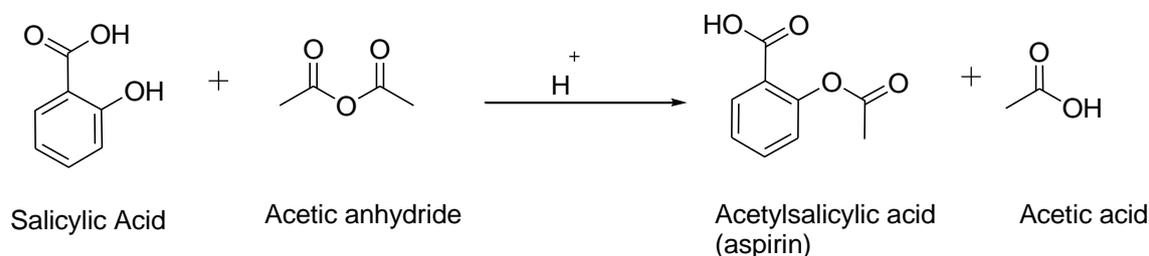


Figure I: Preparation of Aspirin from Salicylic Acid

There are many methods [3-6] available for the estimation of aspirin in drugs such as volumetric method, colorimetric method, chromatographic method etc.

The aim of this project is to determine and compare the amount of aspirin present in different brands of drugs using spectrometric and colorimetric method. Salicylic acid and iron (III) chloride form an intensely coloured complex which enables us to determine the specific amount of acetylsalicylic acid present in a tablet spectrometrically and colorimetrically. The experimental work for this project was done by student authors Bidushi Sarkar, Milanpreet Kaur, Mansi Sharma, Lovely Jain and Nikanshi Yadav as part of their summer internship during the months of May to July at DS Kothari Centre for Research and Innovation in Science Education at Miranda House under the guidance of Malti Sharma, Mallika Pathak and Bani Roy.

METHODOLOGY

Sodium hydroxide (NaOH) and acetic anhydride were purchased from Thomas Baker (chemicals) Pvt. Ltd. Ferric chloride was purchased from LOBA Chemie Pvt. Ltd. Salicylic acid was purchased from Thermo Fisher Scientific India Pvt. Ltd. Concentrated hydrochloric acid was purchased from Thomas Baker (chemicals) Pvt. Ltd. . Drugs ASA, Dispirin, Ecospirin, Colsprin and Aspesol were purchased of brand Zydus Healthcare, Reckitt Benckiser, USV Ltd. and Shreya Life Sciences from the market.

Equipment: All absorption and colorimetric measurements were performed using UV Vis spectrophotometer (USB650, Vernier Red Tide) and Digital Photoelectric Colorimeter (Model : photic-10).

Preparation of Aspirin

To 8.0 g of salicylic acid, 10 ml of acetic anhydride and 10 drops of concentrated sulfuric acid were added in a conical flask. The flask was placed in a hot water bath for about 15 minutes. The resulting reaction mixture was transferred slowly with

shaking to a flask containing ice cold water. The white compound obtained was filtered, dried and weighed. The dried product was recrystallized with absolute alcohol and white crystals were obtained. Formation of aspirin was confirmed by performing ferric chloride test.

Preparation of standard aspirin solution

To 400 mg of prepared acetylsalicylic acid, 10 mL of 1M NaOH solution was added and the solution heated to boiling. The solution was cooled, transferred quantitatively to a 250 mL volumetric flask and diluted to the mark with deionised water. This solution was labelled as "Standard Aspirin Solution". Using this solution, a series of solutions were prepared by taking different volumes of "Standard Aspirin Solution" and diluting to 100 mL by adding 0.02M FeCl₃ solution.

Preparation of Tablet Solution

Each tablet was tested for the presence of free salicylic acid before preparation of tablet solution and found the absence of free salicylic acid in drugs. One tablet of Disprin was weighed and 10 mL of 1M NaOH solution was added to it. The solution was heated until the tablet dissolved. The solution was transferred quantitatively to a 250 mL volumetric flask and diluted to the mark with distilled water. Using graduated pipette, 3.5 mL of the above solution was transferred to a 100 mL volumetric flask and was diluted with 0.02 M FeCl₃ solution. This solution was labelled as "disprin". Using similar procedures, solutions were prepared using the other tablets.

RESULTS & DISCUSSION

Colorimeter and UV-visible spectrometer are the best and fastest methods for the determination of aspirin content in drugs. Aspirin is hydrolysed to give salicylic acid, which gives a violet coloured complex with FeCl₃ which was used for the determination of aspirin content in drugs. Using different volumes of "Standard Aspirin Solution", a series of solutions was prepared, which were diluted to 100 ml by adding 0.02M FeCl₃ solution. Using 5ml of standard aspirin solution, a λ_{max} of 519 nm (Fig. II) was determined using UV-visible spectrometer. The absorbance of the other solutions was determined at 519 nm. Using the absorbance readings, a calibration graph (Fig. III) was plotted between absorbance and concentration using the computer interface. In case of the colorimeter, absorbance readings were taken with filter no. 51 and the absorbance versus concentration graph was plotted manually.

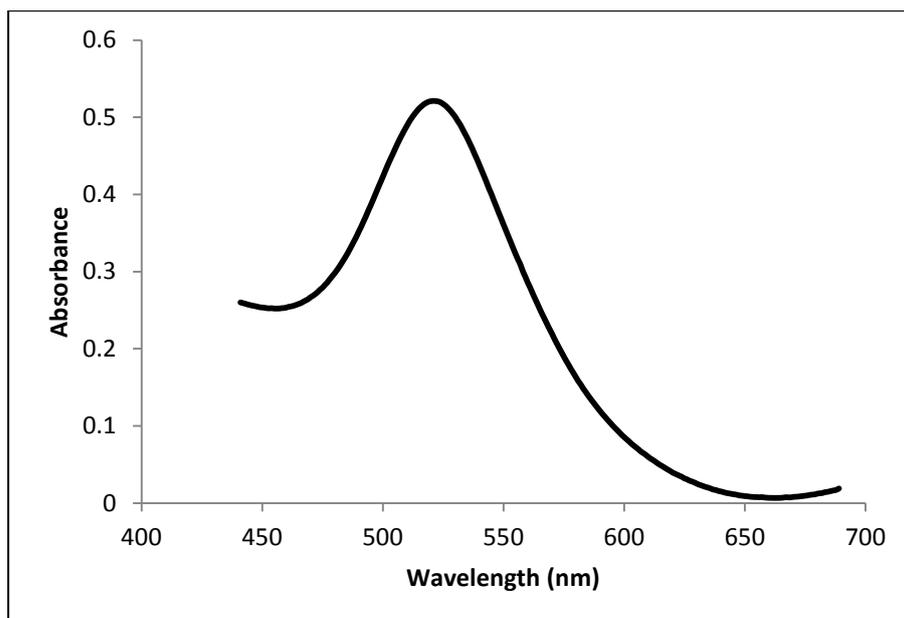


Figure II.: Absorption spectrum of synthesized aspirin using UV Vis spectroscopy

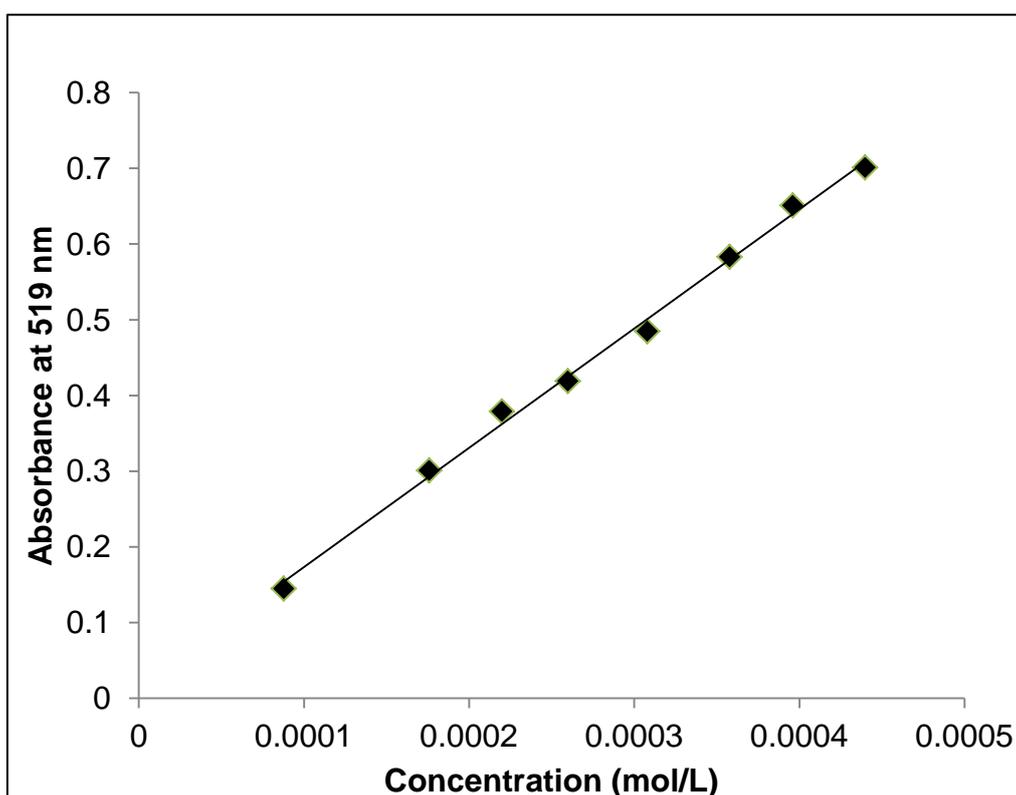


Figure III: Calibration graph of standard Aspirin solution using UV- Vis spectroscopy

Concentration of aspirin in each tablet (Table II) was determined from the calibration graph after determining the absorbance (Table I) of each tablet solution by both spectrometer (Table II) and colorimeter (Table III).

Table I: Absorbance values of different drugs using UV-Vis spectroscopy**Table II.** Estimated concentration of Aspirin in drugs (mol/L) using UV-Vis

S. No.	Name of the Tablet	Number of Tablets taken	Absorbance
1.	ASA	6	0.392
2.	Aspisol	4	0.350
3.	Colsprin	3	0.362
4.	Disprin	1	0.234
5.	Ecosprin	4	0.435

spectroscopy.

S.No.	Name of the Tablet	Concentration of Aspirin(mol/L)
1.	ASA	0.000241
2.	Aspisol	0.000215
3.	Colsprin	0.000223
4.	Disprin	0.000268
5.	Ecosprin	0.000229

Table III. Concentration values of different drugs using colorimeter

S.No.	Name of the Tablet	Number of Tablets taken	Absorbance	Concentration (from graph)
1.	ASA	6	0.42	0.000222
2.	Aspisol	4	0.44	0.000202
3.	Colsprin	3	0.51	0.000202
4.	Disprin	1	0.40	0.000260
5.	Ecosprin	4	0.40	0.000212

The mass (mg) of aspirin found out in different tablets (per tablet) using the two methods was compared (Table 4) with the mass in mg of aspirin per tablet mentioned on the packing by the company:

Table IV: Comparison of Aspirin content in drugs determined using UV-Vis spectrophotometer and colorimeter with company reported values

S.No.	Name of the Tablet	Mass of aspirin per tablet (mg)		
		By visible spectrometer	By colorimeter	Mentioned by company
1.	ASA	51.81	47.73	50
2.	Aspisol	69.33	64.14	75
3.	Colsprin	95.89	86.86	100
4.	Disprin	345.72	335.40	350
5.	Ecosprin	73.85	68.34	75

CONCLUSION

The Aspirin content determined by students using UV-Vis Spectroscopy and Colorimetry are in agreement with the reported values in drugs by the pharma companies. Results obtained with UV-Vis spectrometer were better than that obtained with colorimeter. This is because colorimeter determines absorbance over a band of wavelengths while spectrometer determines absorbance at a particular wavelength.

ACKNOWLEDGMENTS

Authors would like to acknowledge the support given to the project by the DS Kothari Centre for Research and Innovation in Science Education (DSKC) at Miranda House.

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