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A Review on Assay of Paracetamol

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ABSTRACT: Paracetamol, also known as acetaminophen, is a widely utilized analgesic and antipyretic, making accurate content determination in pharmaceutical formulations crucial for quality and efficacy. Assays typically use techniques like UV–Visible spectrophotometry, HPLC, and titrimetric methods, with UV spectrophotometry favoured for its simplicity and cost-effectiveness. The assay measures maximum absorbance in the UV region, quantifying concentration according to Beer–Lambert's law and expressing results as a percentage of the labelled claim. Ensuring accurate assay results is vital for quality control, dosage uniformity, and compliance with pharmacopoeial standards.

KEYWORDS: Paracetamol tablet, UV-Visible spectrometry

I. INTRODUCTION

Paracetamol, also known as acetaminophen, is an over-the-counter (OTC) drug with analgesic and antipyretic properties. It is a member of the non-steroidal anti-inflammatory drug (NSAID) subclass of the non-opioid analgesic class.[1]

For more than 30 years, Indians have used paracetamol as a home remedy for analgesic. It is also well known for being a very effective treatment for pain and fever in both children and adults. It has become the most popular analgesic and antipyretic in the world due to its reasonable safety at approved dosages. Overdoses and persistent paracetamol usage, however, may cause serious liver damage. One of the main causes of poisoning worldwide is hepatotoxicity from paracetamol overdose, which causes liver damage and kidney toxicity. Furthermore, paracetamol enhances genotoxicity and carcinogenicity by inhibiting DNA synthesis.[2]

Since it is ineffective at blocking CycloOxygenase (COX) at high peroxide concentrations, it has limited anti-inflammatory benefits. Children should take 10–15 mg/kg of paracetamol every 4–6 hours, while adults should take 0.5–1 g daily (up to 4 g). Currently available dosage forms include tablets, capsules, liquid suspensions or solutions, drops, extended-release (long-acting) pills, oral disintegrating tablets, suppositories, intravenous, and intramuscular injections.[3]

1.1CHEMISTRY

IUPAC NOMENCLATURE:

N-(4-hydroxyphenyl)acetamide

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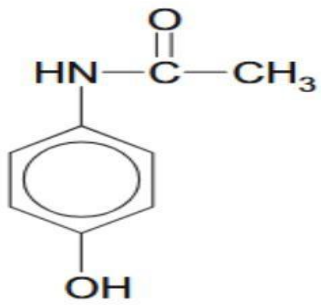

Fig no: 1 Structure of Paracetamol[4]

1.2 INTRODUCTION TO UV SPECTROMETER

In order to create different absorption or emission profiles for spectroscopic activities, electromagnetic radiation must be able to interact discretely with atoms and molecules. The wavelength of electromagnetic radiation is the characteristic that affects the perceived color spectrum. The portion of the electromagnetic spectrum that is visible to the human eye is known as the visible component. These visible wavelengths range between 400 and 800 nm.[5]

II. PRINCIPLE

UV Absorption spectroscopy is demonstrated by visible spectroscopy. The basis for absorbance spectroscopy is the Beer-Lambert Law. The measurement of monochromatic photon absorption by chemical substance solutions in the 185–380 nm and 380–780 nm ranges of the spectrum is known as ultraviolet and visible absorption spectrophotometry, respectively. The absorbance A, which is the logarithm to the base of 10 of the reciprocal of transmittance (T) for monochromatic photons, is used to express the magnitude of a solution's absorption.

$$A=Log_{10}(I_0/I)$$

Where,

I_0= the intensity of incident radiation

I= the intensity of the transmitted radiation

The thickness of the absorbing layer used for measurement and the concentration of the absorbing material in the solution determine the absorbance. The pharmacopoeia for a number of compounds use the specific absorbance of a 1%w/v solution, which is the absorbance of a 1%w/v in a 1 cm cell measured at a specified wavelength that can be determined using the equation,

$$A(1\%,1cm) = A/cl$$

Where,

C is the concentration of the absorbing substance expressed as percentage w/v

L is the thickness of the absorbing layer in cm

The value of $A_{1\%1cm}$ at a particular wavelength in a given solvent is a property of the absorbing substance. [6]

BEER LAMBERTS LAW

The Beer-Lamberts Law relates the attention of light to the properties of the material through which the light is travelling.

If the intensity of the light passing through the sample, I is less than I_0 then the sample has absorbed some of the light.

Beers law states that the absorbance is directly proportional to the concentration (c) of the solution of the sample used in the experiment.

$$i.e.;\quad A \alpha C$$

The absorbance (A) is defined via the incident intensity I_0 and transmitted intensity I by

$$A = \log_{10}(I_0/I)$$

Lamberts law states that the absorbance is directly proportional to the length of the light path (I), which is equal to the width of the cuvette.

$$i.e.;\quad A\alpha\, l$$

therefore $A \alpha cl$

$$A = €cl$$

The constant € is called Molar Extinction Coefficient and is a measure of the probability of the electronic transition. [7,8]

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III. ASSAY PROCEDURE

Paracetamol tablets were assayed spectrophotometrically by using the following methods

1.Using standard absorptivity value (IP Method)

20 Tablets of Paracetamol were weighed and finely powdered by using a mortar and pestle. An accurately weighed quantity of powder equivalent to 75mg of Paracetamol was transferred to a 100ml volumetric flask, 25ml of 0.1M NaOH and 50ml of distilled water were added and mechanically shaken for 15 minutes, then diluted with a sufficient amount of distilled water to produce 100ml. The resulting solution was then filtered by passing through Whatman filter paper No. 41. 10ml of the filtrate was transferred to a 100ml volumetric flask and further diluted to 100ml with distilled water. Again 10ml of the resulting solution, 10ml of 0.1M NaOH was added and diluted to 100ml with distilled water and mixed thoroughly. The UV Spectrophotometer was put at zero by running a baseline (between 400-200nm) using 0.1M NaOH solution as blank. The absorbance of each sample was determined at 257 nm. The percentage content of Paracetamol was calculated taking 715 as the specific absorbance at 259.6nm λmax of Paracetamol.[9,10]

2. Calibration curve method :

Preparation of standard stock solution :

Standard stock solution of Paracetamol (100µg/ml) was prepared by dissolving 100mg of paracetamol pure powdered drug in 50ml of 0.1M NaOH solution and diluted to 100ml with distilled water. 10ml of the above solution was transferred to a 100ml volumetric flask and further diluted to 100ml with distilled water.[11]

Preparation of standard dilutions:

6 standard dilutions were prepared from the above stock solution of 100 µg/ml by diluting 0.2 ml, 0.4 ml, 0.6 ml, 0.8 ml, 1.0 ml, and 1.2 ml to 10 ml with 0.1M NaOH. The absorbance of 6 standard dilutions of concentrations 2 µg/ml, 4 µg/ml, 6 µg/ml, 8 µg/ml, 10 µg/ml, and 12 µg/ml were determined against 0.1M NaOH solution as a blank. The calibration curve was plotted between absorbance vs concentration at 259.6nm

Preparation of Sample solution:

20 tablets were weighed and finely powdered by using a mortar and pestle. An accurately weighed quantity of powder equivalent to 75mg of Paracetamol was placed in a 100ml volumetric flask, to which 25ml of 0.1M NaOH and 50ml of distilled water were added and shaken by mechanical for 15 minutes, then diluted with sufficient amount of distilled water to produce 100 ml. The resulting solution was then filtered by passing it through Whatman filter paper No. 41. 10 ml of the filtrate was transferred to a 100ml volumetric flask and further diluted to 100ml with distilled water. Again 10ml of the resulting solution, 10ml of 0.1M NaOH was added and diluted to 100ml with distilled water and mixed thoroughly. The UV Spectrophotometer was put at zero by running a baseline (between 400-200nm) using 0.1M NaOH solution as blank. The absorbance of each sample was determined at 257nm. The percentage content of paracetamol was calculated using a linear regression equation obtained from the standard calibration plot (as shown in figure no:2).[12,13]

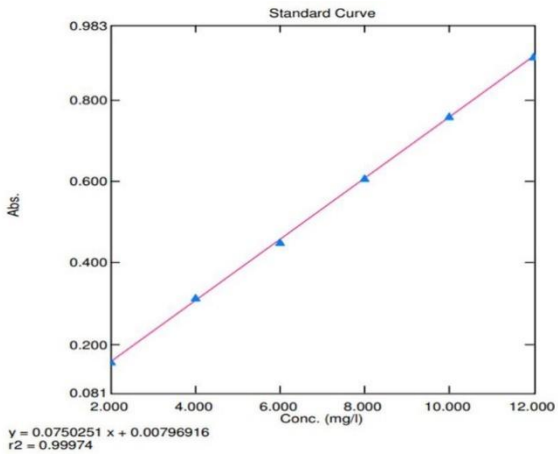

Figure 2: Standard Calibration Curve of Paracetamol.

The standard calibration curve of series of standard dilutions of Paracetamol is plotted against absorbance and concentration in ppm.[14]

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IV. CONCLUSION

The paracetamol assay is an important quality-control procedure for ensuring the efficacy, safety, and therapeutic stability of pharmaceutical formulations. Accurate paracetamol content assessment confirms adherence to pharmacopeial requirements and helps detect poor or fake products. Numerous analytical techniques, such as titrimetry, chromatographic procedures, and UV–visible spectrophotometry, produce precise, reliable, and reproducible data for routine analysis. Spectrophotometric techniques are the most widely used among them due to their price, convenience of use, and suitability for routine laboratory use. All things considered, maintaining medicine quality, guaranteeing patient safety, and adhering to pharmaceutical practice rules depend on routine assay testing of paracetamol formulations.

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