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Research Paper

Spectrophotometric Determination of Paracetamol Using Sodium bismuthate as Chromogen

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Abstract- *A simple and accurate method was developed by the authors for the detection and determination of paracetamol by spectrophotometric method in pharmaceutical formulations in the form of tablets and capsules. Paracetamol was dissolved in 4M sulphuric acid and treated with 10.0 mg of sodium bismuthate in the presence of 1M HCl and 1M acetic Acid. It exhibited a stable bluish-violet colour. The coloured compound showed a λ_{max} at 550 nm. Beer's law was obeyed in the range of 100-300µgmL^{-1} in 1M HCl and 300-800 µgmL^{-1} in 1M acetic acid medium, with detection limits of 0.03µgmL^{-1} in 1M HCl and 0.05 µgmL^{-1} in 1 M acetic acid medium respectively. The method developed by the authors was found to be precise and accurate for qualitative and quantitative determination of paracetamol.*

Keywords: Paracetamol, spectrophotometry, determination of paracetamol.

Introduction

Paracetamol is a pharmaceutical compound widely used as analgesic and antipyretic. It belongs to the class of drugs, known as aniline analgesics. It is commonly used for the relief of headache, other minor aches, pains, inflammations and a major ingredient in numerous cold and flu remedial combination drugs. While generally safe for use at a recommended dose, toxicity of paracetamol is the foremost cause of acute gastro intestinal problems [1,2] . It could be considered as one in Non Steroidal Anti Inflammatory Drugs (NSAID). Many methods for its determination have been described in literature, including chromatography, spectrophotometry and electro chemistry. In the standard method (IP and BP), paracetamol is determined titrimetrically with Ce (IV) in acidic medium, using ferroin as indicator. The titration is performed in cold conditions and hence the estimation takes long time with limited accuracy. Hence a quicker and accurate method needed is developed by the authors.

During the course of experiments in search of specific colour reagents for paracetamol, it is noticed that a solution of paracetamol gives a stable bluish- violet coloured product with 10.0 mg of sodium bismuthate, in the presence of 1M hydrochloric acid and in 1 M Acetic acid solutions. A survey of literature [3-8] indicated that this specific colour reaction between paracetamol and bismuth

(V) has not been reported previously. The over dosage of the drug induces toxicity and there is a need of quality tests for its purity. Thus the present study on paracetamol estimation becomes relevant for accuracy, simplicity and specificity, which may find a wide range of application in quick estimation.

Material and Methods

Reagents: Paracetamol pure form: This was prepared in our laboratory by acetylation of p-amino phenol and subsequent recrystallization. The pure crystalline product of paracetamol has been standardized.[9]

Paracetamol Tablets: Ten tablets of paracetamol of each pharmaceutical firm under study were weighed and ground to a fine powder. From this, a sample of 500 mg of paracetamol was weighed, mixed with about 40 ml of 4M sulphuric acid and 50 ml of distilled water, heated to a temperature of 80^{o}C for 90 min. After complete dissolution, the cooled solution was filtered through a Whatman No 40 filter paper. The solution was made up to the mark into a 100 ml volumetric flask and standardized [9].

All the other reagents used were of AnalaR grade only.

Apparatus: An ELICO- SL-177, Scanning Visible Spectrophotometer with recording unit and matched set of 1 cm. glass or quartz cuvettes was used for recording the spectra. All the weighing measurements were made by a Shimadzu-AUX-220 model digital electronic balance. All the pH-measurements were made by an ELICO-LI-127 pH-meter.

Recommended procedure for the determination of paracetamol using sodium bismuthate: An aliquot of paracetamol solution (2.0 ml) was mixed with 1.0 ml of 1M hydrochloric acid and 10.0 mg of sodium bismuthate, to a give a stable bluish- violet coloured product. The mixture was made up to 25 ml in a volumetric flask, filtered through a Whatmann No.41 filter paper and the spectra were taken for an aliquot of the solution of the filtrate. The coloured product showed a λ_{max} at 550 nm (Figure 1).

For the determination of paracetamol, an aliquot volume of paracetamol was mixed with 1.0 ml of 1 M hydrochloric acid and 10.0 mg of the reagent to a give a stable bluish-violet coloured product and the mixture was made up to the mark. The solution was taken in an optically matched cuvette of the ELICO spectrophotometer and the absorbances were measured at 560nm. The absorbance was compared with the standard curve (Figure 3). Beer's law was found to be obeyed in the range100- 300µg ml^{-1} of paracetamol (Figure 3). The same procedure was recommended for the determination of paraceatmol with sodium bismuthate in presence of 1M acetic acid, the coloured product showed a λ_{max} at 550 nm (Figure 2), Beer's law was found to be obeyed in the range 300-800 µg ml^{-1}, in the acetic acid medium (Figure 4).

Results and Discussion

The specific colour reaction between paracetamol and bismuth (V) is studied in various concentration ranges of the reagent and different acid media. In very low concentrations as 1M the colour was found to be stable. At higher concentrations of the acid the colour appeared, but rapidly faded away. Hence, the concentration of the acid was fixed and recommended as 1M for both HCl and acetic acid. The colour reaction between paracetamol and different acids such as hydrochloric acid, sulphuric acid, and phosphoric acid was studied. It was found that table colour was not produced by the reaction between the drug sample and sodium bismuthate in varied concentrations of sulphric acid and phospohoric acid. The colour produced by the reaction between the drug sample and sodium bismauthate was found to be stable in 1M concentrations of both hydrochloric acid and acetic acid. Absorbance measurements were recorded after 45 minutes in presence of hydrochloric acid medium (Figure 5) and 60 minutes in presence of acetic acid medium (Figure 6) were found to be stable. The bluish-violet colour obtained was found to be stable for 12 hours. The concentration of the reagent also had an appreciable effect on the colour produced. An amount of 10mg of the reagent exhibited stable colour. The colour produced with higher amount than 10mg of the chromogen was observed to fade rapidly again and was found to have an appreciable change in the absorbance measurements with respect to time. Hence the amount of the reagent was prescribed at 10mg. The λ_{max} for the bluish violet colour product was 560 nm (Figure 1), with molar absorptivity, ε = 77.27 M^{-1} cm^{-1} at 560 nm in presence of 1M hydrochloric acid solution and was that of 100.0 M^{-1} cm^{-1} at 560 nm in presence of 1M acetic acid solution. There was no overlap of the spectra of the bluish-violet coloured product of bismuth (V) and other species present in the solution. There were no interferences observed. Beer's law was found to be obeyed over the range of 100-300 µg ml^{-1} of paracetamol in presence of 1M hydrochloric acid and 300-800 µg ml^{-1} in presence of 1M acetic acid medium. The optical and statistical measurements were reported in Table.1. The correlation coefficient in presence of 1M hydrochloric acid was found to be 0.9678, LOD as 0.03 µg ml^{-1} , LOQ as 0.09 µg ml^{-1} and RSD as 1.7%. The correlation coefficient in presence of 1M acetic acid was found to be 0.9958, LOD as 0.05 µg ml^{-1} and RSD as 1.8%. All the statistical measurements were in the prescribed limits.

Conclusion

Paracetamol solution gave a stable bluish-violet coloured product with 10 mg of sodium bismuthate in presence of 1M hydrochloric acid and 1M acetic acid. The λ_{max} for the bluish violet colour product was 550 nm (Figure1and Figure2), with molar absorptivity, ε= 77.27 M^{-1} cm^{-1} at 560 nm in 1M hydrochloric acid and 100.0 M^{-1} cm^{-1} in 1M acetic acid. Beer's law was found to be obeyed over the range of 100-300 µg ml^{-1} of paracetamol in 1M hydrochloric acid and 300-800 µg ml^{-1}. This determination of paracetamol prescribed by the authors was found to be rapid and accurate.

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References

1. Acetaminophen Drugs.com.
2. Sarg Michael, Gross Ann D and Roberta Altman. *The Cancer Dictionary*. Infobase Publishing. **ISBN 978081606 4113 (2007).**
3. Murty B Sreerama, G V S R Pavan Kumar, Ramana P. and Sravanthi N. "Detection and spectrophotometric determination of paracetamol using V (V), -- J. Indian Chem. Soc, Vol **88**, No.**6**, **pp 893-895 (2011)**.
4. Srivastava M. K., Ahmed S., Singh D. and Shukla 1. C, Analyst, **110, 735 (1985)**.
5. Salah. M Sultan et al "Use of cerium (IV) sulphate in the spectrophotometric determination of paracetamol in pharmaceutical formulations",--, Analyst, August, **111 pp.919 (1986)**.
6. Afkhami Abbas, Sarlak Nahid and Ali Reza Zarei "Spectrophotometric determination of salicylamide and paracetamol in biological samples and pharmaceutical formulations by a differential kinetic method", --- *Acta Chim. Slov. 53*, 357–362 (**2006**).
7. Shrestha Buddha Ratna and Pradhananga Raja Ram "Spectrophotometric method for the determination of paracetamol", --------- *J. Nepal Chem. Soc., vol. **24**,* **pp 39-44 (2009).**
8. Kamyabi Mohammad Ali "Simultaneous spectrophotometric determination of paracetamol and p-aminophenol by using mean centering of ratio kinetic profiles",--- *Journal of the Chinese Chemical Society*, *56*, **142-149 (2009).**
9. "British Pharmacopeia 1980," HM Stationery Office, London, **p. 326(1980).**

Table 1: Optical characteristics and validation data

Parameters	1M HCl	1M Acetic acid
λ_{max} (nm)	550	550
Beer's law limit (μgmL^{-1})	100-300	300-800
Molar absorptivity (cm^{-1} lit $mole^{-1}$)	77.27	100.0
Stability (h)	14	14
Correlation coefficient, r	0.9678	0.9958
t-test, p, CI (%)	0.0010	0.0010
	4.57, 98	4.57, 98
Relative standard deviation RSD*	1.7%	1.8%
Limit of detection (μgmL^{-1})	0.03	0.09
Limit of quantification (μgmL^{-1})	0.05	0.17

***** 10 replicate analysis of 400 μgmL^{-1} and for 700 μgmL^{-1}

Table 2: Analysis for paracetamol formulations of different companies

Commercial formulations analyzed	PM#	SM@	RSD**
Calpol 600mg	99.7	100.0	1.5
Tyfe	99.8	99.6	1.8
Panadol 500mg	98.7	99.5	1.5
Crocin 500mg	99.5	99.6	1.8

Proposed method @Standard method ** Relative standard deviation

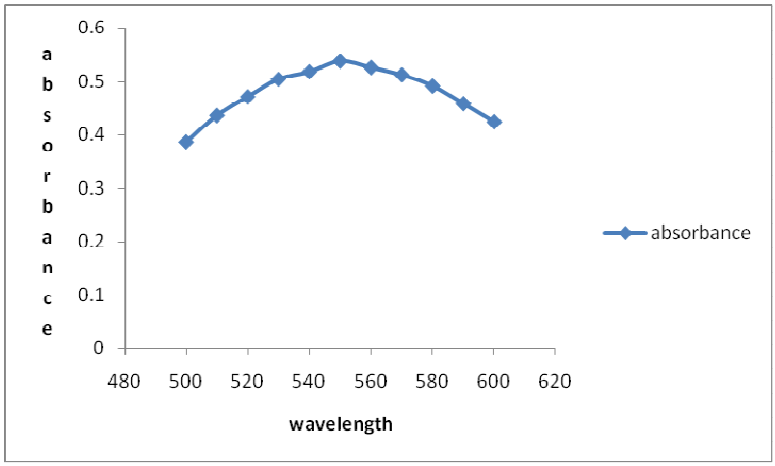

Figure 1: Absorption spectrum of the bluish-violet coloured product obtained by the reaction between paracetamol and sodium bismuthate in 1M HCl. The λ_{max} recorded was 550 nm

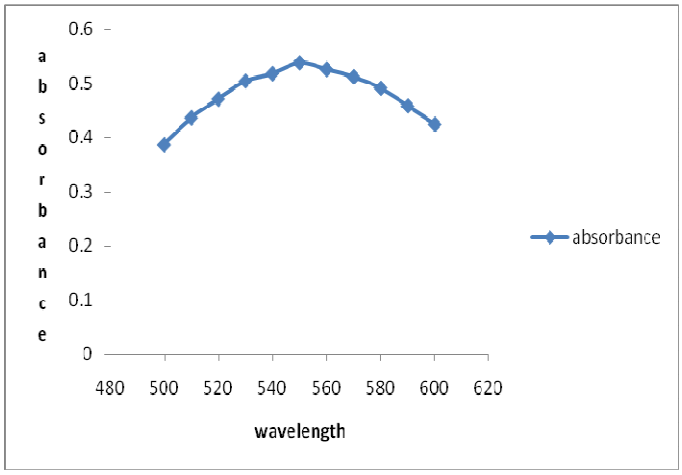

Figure 2: Absorption spectrum of the bluish-violet coloured product obtained by the reaction between paracetamol and sodium bismuthate in 1M Acetic acid. The λ_{max} recorded was 550 nm

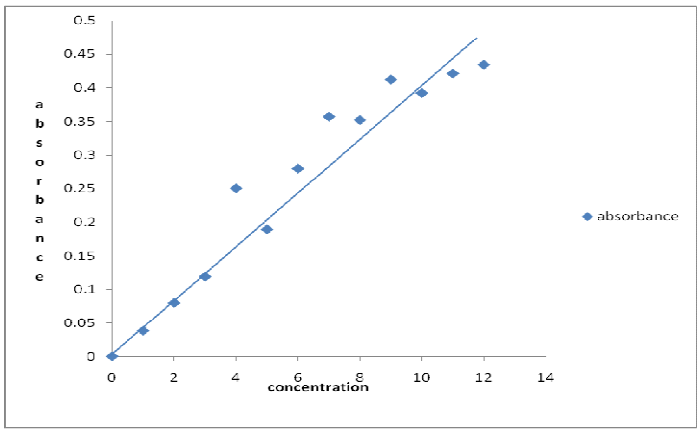

Figure 3: Calibration plot for the estimation of paracetamol with sodium bismuthate in 1M HCl. Beer's law obedience was in the range of 100-300µgmL^{-1}

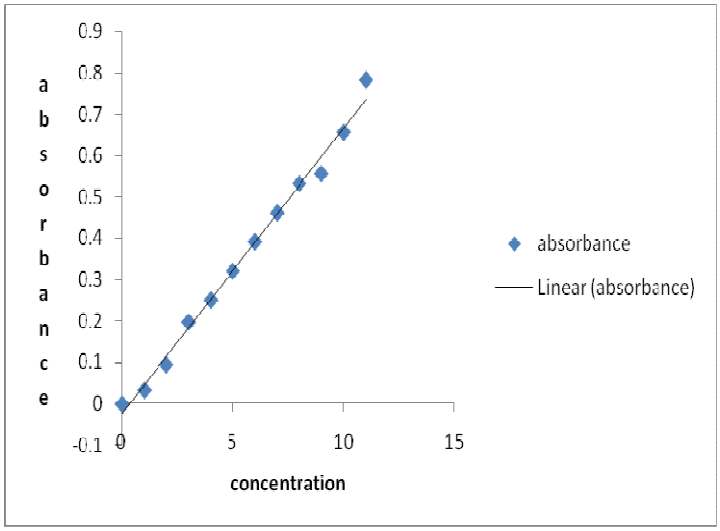

Figure 4: Calibration plot for the estimation of paraceatmol with sodium bismuthate in 1M acetic acid medium. Beer's law obedience was in the range of 300-800µgmL^{-1}

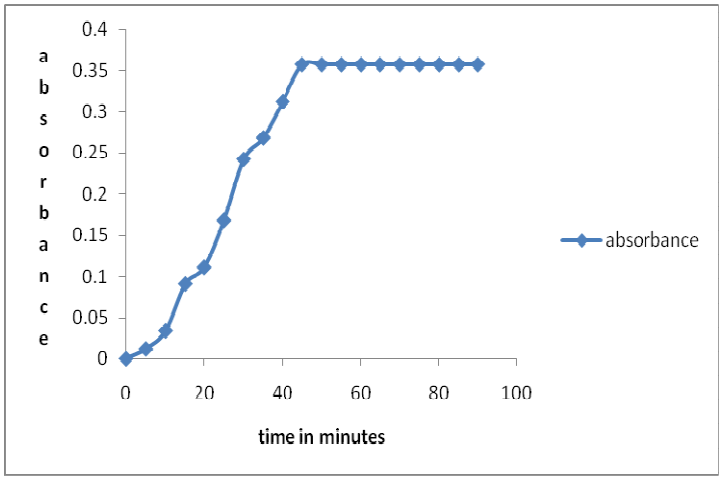

Figure 5: Effect of time on the absorbance measurements of the bluish-violet coloured product obtained by the reaction between paracetamol and sodium bismuthate in 1M HCl

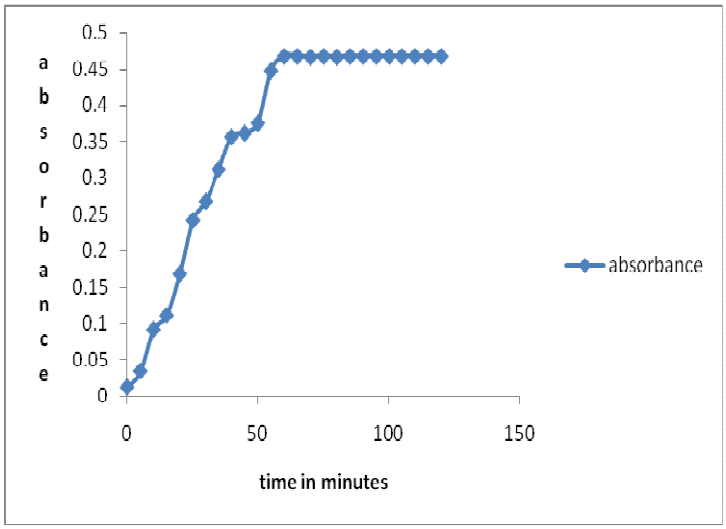

Figure 6: Effect of time on the absorbance measurements of the bluish-violet coloured product obtained by the reaction between paracetamol and sodium bismuthate in 1M acetic acid