WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.084
Volume 11, Issue 1, 549-557. Research Article ISSN 2277–7105

DEVELOPMENT OF UV METHOD FOR POLYMORPH OF MEBENDAZOLE THROUGH PROSPECTIVE STUDY OF SOLUBILITY, IR AND XRD.

Durgesh Nandkishor Boob*, Sonali Niraj Choudhari and Sonali Ramnath Sonawane

Sanjivani Group of Institute, Sanjivani Institute of Pharmacy and Research, Kopargaon.

Article Received on
16 Nov. 2021,

Revised on 05 Dec.2021,
Accepted on 26 Dec. 2021

DOI: 10.20959/wjpr20221-22614

***Corresponding Author**
Durgesh Nandkishor Boob
Sanjivani Group of Institute, Sanjivani Institute of Pharmacy and Research, Kopargaon.

ABSTRACT

The Present research work discussed for the development of simple, sensitive, rapid and economical UV Spectroscopic method development for Polymorphs of Mebendazole along with the prospective study of Infrared spectroscopy, X ray diffraction technique, and Solubility study. Solubility study from different medium was carried out. From that it is concluded that drug is to be solubilised in the 0.1 N HCL along with certain concentration of SLS. Infrared interpretation has carried out on the basis of functional group has concluded (N-H Stretching-App.3400,C=O-1730-1750,O-CH3-2815-2850) and also decided which type of vibration is there. The XRD stud has carried out on the basis of Braggs law and qualitative phase analysis has carried out and determined the Position, d-spacing and Rel.Intensity(%). Double beam UV visible Spectrophotometer, Schimadzu, model UV 1800 with 1 cm Cuvette and test solution was prepared in the diluent methanol: water (60:40V/V) and absorption maxima shows 288 nm.

KEYWORDS: UV Spectrophotometer, Solubility, XRD**,** Infrared Spectrophotometer.

INTRODUCTION

Analysis seeks ever-improved means of measuring the physical and chemical composition of natural and synthetic materials. The discipline of analytical chemistry consists of qualitative and quantitative analysis. The former deals with the identification of elements, ions, or compounds present in a sample, while the latter deals with the determination of how much of one or more constituents are present in a material. Different quantitative analytical methods

are volumetric, gravimetric, electro analytical, thermal, spectrometric and chromatographic methods.

Analytical chemistry is a scientific discipline that develops methods, instruments and strategies to obtain information on the composition and nature of matter. Unlike other major sub disciplines of chemistry such as inorganic and organic chemistry, analytical chemistry is not restricted to any particular type of chemical compound or reaction. Analytical chemistry is concerned with the chemical characterization of matter and thus pharmaceutical analysis covers matter having pharmaceutical applications.

Table No 01: Drug Profile of Mebendazole.

Name of drug	**MEBENDAZOLE**
Dosage Form	Chewable Tablet
IUPAC Name	Methyl 5-benzoyl-2-benzimidazolecarbamate drug used for the treatment of Anthelmintic (Nematodes). It is a selective 5-benzoyl-1Hbenzimidazol-2-yl receptor type agonist.
Molecular Formula/Mass	C16H13N3O3, 295.29
Category	Anthelmintic (Nematodes)
Solubility	Freely soluble in formic acid, practically insoluble in dilute solution of mineral acid, in alcohol, in ether, and in chloroform. Practically insoluble in water.
Melting Point	288.5°C.
Dose	100 mg
Uses	Anthelmintic (Nematodes)

Preliminary Analysis

Table No 02: Preliminary Analysis: List of Instrument used.

Instrument	**Usage of Instrument**	**Make of Instrument**
Analytical balance	To weigh the chemicals and ingredient.	Meter Toledo
PH meter	To measure the PH of solution.	Fischer Scientific
Ultrasonic bath	For solubilisation of solution.	AM Technologies
UV spectrophometer	To determine the analytical wavelength of drug.	Schimadzu
XRD apparatus	To determine the diffraction angle of the powder.	Labline make

Chemicals and Reagents Used for Experimental

Table No 03: List of Reagent and Chemical.

Chemical / Reagent	Grade	Manufacturer
Potassium dihydrogen Phosphate	Analytical Grade	Merck Chemicals, Mumbai, India
Ortho phosphoric acid	Analytical Grade	Merck Chemicals, Mumbai, India
Methanol	HPLC Grade	Merck Chemicals, Mumbai, India
Acetonitrile	HPLC Grade	Merck Chemicals, Mumbai, India
Hydrogen peroxide 3%	Analytical Grade	Merck Chemicals,
Water	HPLC Grade or Equivalent	Milli -Q
Hydrochloric acid	Analytical Grade	Merck Chemicals, Mumbai, India

Solubility study pattern

Solubility is the property of a solid, liquid, or gaseous chemical substance called ***solute*** to dissolve in a solid, liquid, or gaseous solvent. The solubility of a substance fundamentally depends on the physical and chemical properties of the solute and solvent as well as on temperature, pressure and the pH of the solution. The extent of the solubility of a substance in a specific solvent is measured as the saturation concentration, where adding more solute does not increase the concentration of the solution and begins to precipitate the excess amount of solute. The solubility of a substance is an entirely different property from the rate of solution, which is how fast it dissolves.

Table no 04: Solubility Comparison.

Term	Mass parts of solvent required to dissolve 1 mass part of solute
Very soluble	<1
Freely soluble	1 to 10
Soluble	10 to 30
Sparingly soluble	20 to 100
Slightly soluble	100 to 1000
Very slightly soluble	1000 to 10,000
Practically insoluble or insoluble	≥ 10,000

Determination of solubility for Mebendazole API

Saturation solubility is done to know the maximum amount of drug dissolved in media. This study helps in deciding the volume of media & which media to used. This study is useful particularly for poor solubility drugs. Also by this study you can know about how much drug of maximum strength can release from a formulation.

Table No 05: Solubility Assessment.

Medium	Solubility(mg/ml)	Remark
Water	0.0000	No further dilution
Water+0.1%SLS	0.0002	No further dilution
Water+0.25%SLS	0.0005	No further dilution
Water+0.5%SLS	0.0010	No further dilution
0.1 N HCL	0.0188	No further dilution
0.1 N HCL+0.1%SLS	0.0058	No further dilution
0.1 N HCL+0.2%SLS	0.0932	No further dilution
0.1 N HCL+0.5%SLS	0.2414	No further dilution
0.1 N HCL	**0.0194**	**further dilution**
0.1 N HCL+0.1%SLS	**0.051**	**further dilution**
0.1 N HCL+0.2%SLS	**0.0952**	**further dilution**
0.1 N HCL+0.5%SLS	**0.2447**	**further dilution**
Acetate buffer 4.5	0.0000	No further dilution
Acetate buffer 4.5+0.1%SLS	0.0007	No further dilution
Acetate buffer 4.5+0.25%SLS	0.0029	No further dilution
Acetate buffer 4.5+0.5%SLS	0.0066	No further dilution
Phosphate buffer 6.8	0.0000	No further dilution
Phosphate buffer 6.8+0.1%SLS	0.0001	No further dilution

CONCLUSION

Solubility study from different medium was to be carried out. From that it is concluded that drug is to be solubilised in the 0.1N HCL along with concentration of SLS.

IR Interpretation

The qualitative aspects of infrared spectroscopy are one of the most powerful attributes of this diverse and versatile analytical technique. Over the years, much has been published in terms of the fundamental absorption frequencies (also known as group frequencies) which are the key to unlocking the structure–spectral relationships of the associated molecular vibrations. Applying this knowledge at the practical routine level tends to be a mixture of art and science. While many purists will argue against this statement, this author believes that it is not possible to teach a person to become proficient as an interpretive spectroscopes by merely presenting the known relationships between structure and the observed spectra. Instead, the practical approach, which has been adopted in this text, is to help the reader appreciate the visual aspects of the spectroscopy and how to interpret these relative to the structure and chemistry of the sample. This is achieved by recognizing characteristic shapes

and patterns within the spectrum, and by applying the information obtained from published group frequency data, along with other chemical and physical data from the sample. Included in the text is a discussion of the interrelationships that exist between the practical side of acquiring the spectrum, the chemistry and physics of the sample under study, the physical interactions of the sample with its environment, and the impact of the structure on the spectrum. In essence, the interpretation of infrared spectra is much more than simply assigning group frequencies. The spectrum is rich in information, and this article is intended to help the reader to extract the maximum using the knowledge available for the sample and the acquired spectral data. It must be understood that this article addresses the issue of infrared spectral interpretation from the perspective of the average operator of an infrared instrument. It is not a detailed treatise on the theory of infrared spectroscopy where the modes of vibration are discussed in terms of group theory, and where mathematical models are used to compare theoretical and observed values for the fundamental vibrations of a molecule. There are many excellent texts that cover this subject. Instead, this article focuses on the day to day problems associated with characterizing a material or attempting to perform some form of identification. One of the main challenges in presenting a text on spectral interpretation is to form a balance between the theory that is needed to appreciate the links between molecular structure and the observed spectrum and the practice. For this reason, a minimum amount of relevant theory is included in the next section, which provides a basic understanding of why the spectrum exists, how it is formed, and what factors contribute to the complexity of observed spectra. It has been assumed that the reader has a fundamental knowledge of molecular theory and bonding, and that there is an understanding of basic structures, in particular for organic compounds.

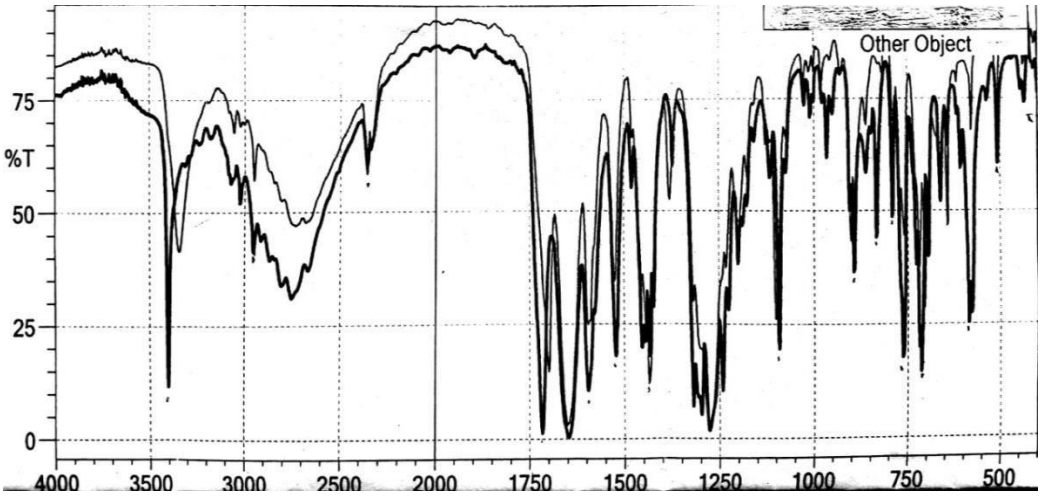

Fig 01: The IR Spectrum of Mebendazole Form A.

Interpretation of IR Spectroscopy

Table No 06: Interpretation of IR Spectrum.

Group	Type of vibration	Region and intensity
N-H Streching	1^0 amines, amides (H bonded)	Approximately 3400
N-H Streching	Aromatic primary amine	3460-3570
C=O	Esters	1730-1750
O-CH_3	Methoxy, Methyl ether	2815-2850
C-N	Tertiary amine	1210-1150

X RAY DIFFRACTION

Every crystalline phase of a given substance produces a characteristic X –ray diffraction pattern. Diffraction patterns can be obtained from a randomly oriented crystalline powder composed of crystallites or crystal fragments of finite size. Essentially three types of information can be derived from a powder diffraction pattern: the angular position of diffraction lines (depending on geometry and size of the unit cell), the intensities of diffraction lines (depending mainly on atom type and arrangement, and particle orientation within the sample), and diffraction line profiles (depending on instrumental resolution, crystallite size, strain, and specimen thickness). The X ray powder diffraction (XRPD) method provides an advantage over other means of analysis in that it is usually non-destructive in nature (to ensure a randomly oriented sample, specimen preparation is usually limited to grinding). XRPD investigations can also be carried out under in situ conditions on specimens exposed to non-ambient conditions such as low or high temperature and humidity.

PRINCIPLE

X ray diffraction results from the interaction between X rays and electron clouds of atoms. Depending on atomic arrangement, interferences arise from the scattered X rays. These interferences are constructive when the path difference between two diffracted X ray waves differs by an integral number of wavelengths. This selective condition is described by the Bragg equation, also called Bragg's law,

$$N \lambda = 2d \sin \theta$$

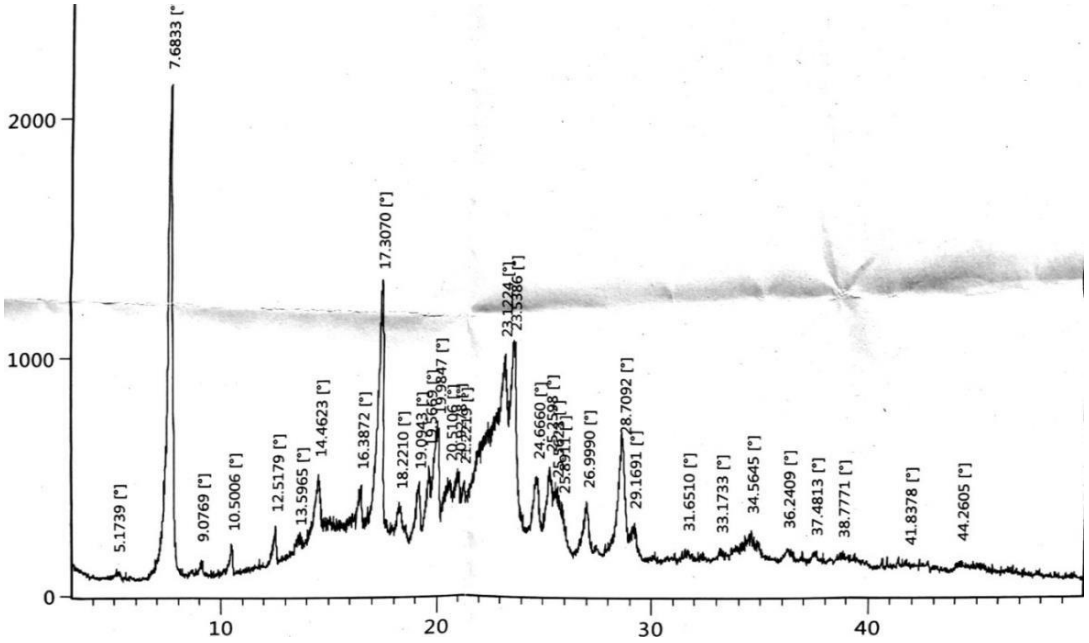

Fig 02: Graphical Interpretation by XRD.

Table No 07: Peak List.

Pos (^{0}2θ)	d-spacing (A)	Rel. Int (%)
5.1739	17.080	1.30
7.6833	11.506	100.00
9.0769	9.7429	3.50
10.5006	8.4248	5.61
12.5179	7.0714	9.37
13.5965	6.5127	6.50
14.4623	6.1247	20.32
16.3872	5.4093	17.39
17.3070	5.1239	58.85
18.2210	4.8689	13.13
19.0943	4.6481	17.13
19.5669	4.5369	21.66
19.9847	4.4430	28.35
20.5106	4.3302	18.57

Selection of analytical wavelength:- Identification by UV

Preparation of Diluent-1:- Dilute 8.5 ml of concentrated HCL acid to 1000 ml with Methanol.

Preparation of Diluent-2:- Mix Methanol with water in 60:40 v/v. sonicate to degas.

Preparation of standard solution:- (About 10 ppm of Mebendazole):- Weigh and transfer about 50 mg of Mebendazole standard in to 100 ml of volumetric flask. Add 50 ml of diluent-1. Sonicate to dissolve and dilute up to the mark with diluent 1.

Preparation of test solution:- (About 10 ppm of Mebendazole) :- Weigh not less than 5 tablet to determine the average weight. Crush the content to fine powder. Weigh the powder equivalent to 20 mg of mebendazole and transfer in to 100 ml volumetric flask. Add about 50 ml of diluent 1 and sonicate for 30 min with intermediate shaking. Cool and dilute up to mark with diluent- 1. Mix well and filter the solution through 25 mm, 0.45um Whatman Nylon filter w/GMF syringe filter.

Further dilute 5.0 ml of filtrate to 100 ml with diluent-2 and mix well

Record the spectra of standard solution and test solution from 400nm to 200nm using suitable spectrophotometer and 1 cm cuvette, against the diluents-2 as blank.

Sample and standard show maxima at around 288 nm.

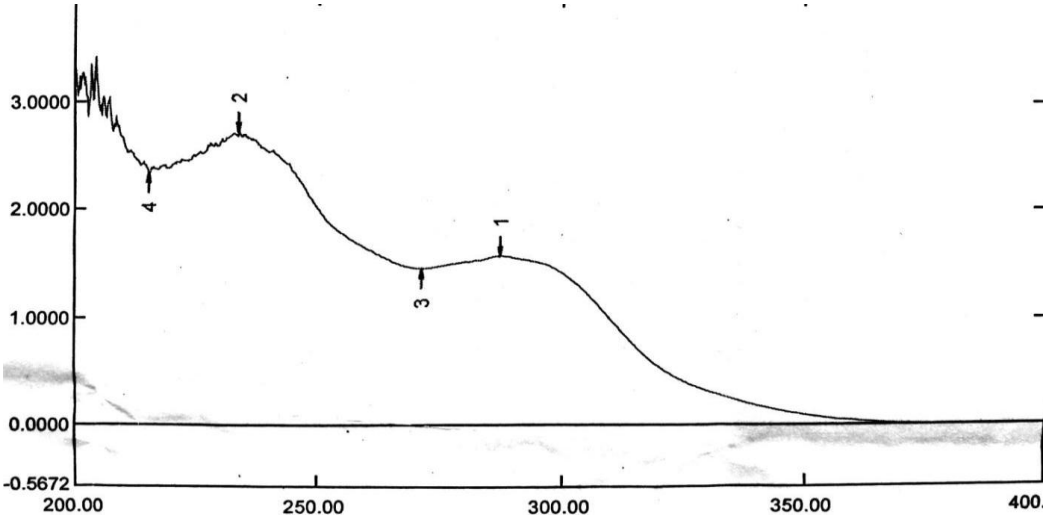

Fig 03: Scan spectra of Mebendazole.

Wavelength Range (nm): 200 to 400

Table No 08: Absorbance of Mebendazole.

No	Wavelength	Abs.
1	287.40	1.5535
2	233.80	2.7178
3	271.20	1.4396
4	215.60	2.3418

CONCLUSION

The UV Method developed and validated for mebendazole which is found to be Linear accurate and Precise which is economical which can be used for the testing of its pharmaceutical formulation and Prospective study has carried out through the solubility, Infrared Spectroscopy, and X Ray Diffraction Techniques.

REFERENCES

1. Potdar, M. A., Pharmaceutical Quality Assurance, Nirali prakashan, Pune, 2006; 8.1, 8.288.30.
2. Kasture A. V., Wadodkar S. G., Mahadik K. R., and More H. N., Textbook of Pharmaceutical Analysis – II, 11th Edition, Published By Nirali Prakashan, 1996; Page no: 1: 156-165.
3. Beckett A. H., Stenlake J. B.; Practical Pharmaceutical Chemistry, 4th Edition, Part II, CBS Publications and Distributors, New Delhi, 1997; 1: 275-300.
4. Chan, C.C.; Lam, H.; Lee, Y.C.; Zhang, X.M., Analytical Method Validation and Instrument Verification, 16-21.
5. Martindale-The Complete Drug Reference, 33rd edition, 1993; 1084.
6. Christian, G. D., Analytical Chemistry, 5th edition, 2001; 3.
7. Aneesh T.P, Rajaskaran A., Stress Degradation Studies and Development and Validation of RP-HPLC Method for the Estimation of Asenapine Maleate, International Journal of Pharmacy and Pharmaceutical Sciences, 2012; 4(4).
8. Sudesh B., Uttamrao K., Determination and Validation of Valsartan and its Degradation Products by Isocratic HPLC,J. Chem. Metrl, 2009; 3(1): 1-12.
9. Elena K., Roy E., Peter S., Neil M.; Chromatographic Science Series, Handbook of HPLC, 1999; 78: 293.
10. Lee JY. Recent trends in Process validation. In: Berry IR, Nash RA, editors, Pharmaceutical Process Validation. 2nd edition, New York, Marcel Dekker, 1993; p. 582583.
11. Maynard, DW 2008, Validation of Critical Utilities. In: Agalloco J, Carleton FJ. Validation of Pharmaceutical Processes. New York: Informa Healthcare, 51 59.