EUROPEAN JOURNAL OF BIOMEDICAL AND PHARMACEUTICAL SCIENCES
http://www.ejbps.com

ISSN 2349-8870
Volume: 5
Issue: 3
348-352
Year: 2018

NEW SPECTROPHOTOMETRIC ESTIMATION OF METRONIDAZOLE IN THE TABLETS USING MIXED SOLVENCY APPROACH

Sanjay Jain[1]*, R. K. Maheshwari[2], Rajesh Kumar Nema[3] and Indrajeet Singhvi[4]

[1]Research Scholar, Faculty of Pharmacy, Pacific Academy of Higher Education and Research University Udaipur.
[2]Department of Pharmacy, Shri G.S. Institute of Technology and Science, Indore 452003, Madhya Pradesh, India.
[3]Lakshmi Narain College of Pharmacy (RCP), Indore 453331, Madhya Pradesh, India.
[4]Department of Pharmacy, Pacific Academy of Higher Education and Research University, Udaipur, Rajasthan, India.

***Corresponding Author: Dr. Sanjay Jain**
Research Scholar, Faculty of Pharmacy, Pacific Academy of Higher Education and Research University, Udaipur.

Article Received on 26/12/2017 **Article Revised on 16/01/2018** **Article Accepted on 06/02/2018**

ABSTRACT
Organic solvents are most frequently employed in spectrophotometric analyses. They may be sources of pollution. Some of them may be toxic while others may be costlier. Volatility may be a source of inaccuracy in spectrophotometric estimations. In the present investigation, it was proposed to solubilize Metronidazole by use of mixed solvency concept. Metronidazole shows maximum absorbance in the concentration range of 5-25 µg/ml at 320 nm. Method of analyses have been validated for different parameters like linearity, accuracy, precision, LOD and LOQ. The percent drug estimated in tablet formulation of Batch-I and of Batch-II were 99.74±0.735 and 99.97±0.784 respectively. The range of percent recoveries varied from 99.95±0.242 to 101.32±0.596. The analytical method was found to be simple, safe (free from toxicity), economic and eco-friendly.

KEYWORDS: Metronidazole, UV-Spectrophotometry, solid dosage formulation, mixed solvency concept.

INTRODUCTION
Increasing the aqueous solubility of Insoluble and slightly soluble drugs has been done by various methods to avoid the usage of organic solvents. Because of toxicity, volatility and also high cost of organic solvents, an alternative method has been developed. Mixed solvency concept is one of the methods to enhance the aqueous solubility of less water soluble drugs. Mixed solvency concept may be a proper choice to preclude the use of organic solvents. So there is a broad scope for mixed solvency concept in quantitative estimation of other less water soluble drugs.

By application of this concept, innumerable solvent system can be developed. Maheshwari[1-6] is one of the opinions that each substance possesses solubilizing power. He has given several ecofriendly methods in the area of drug estimations and formulations precluding the use of toxic organic solvents. The solubility of large number of poorly soluble drugs has been enhanced by mixed solvency concept.[1-31]

The present research work also provides an ecofriendly method to estimate spectrophotometrically, the Metronidazole drug in tablet formulations without the help of organic solvent.

Metronidazole is chemically: 2-(2-methyl-5-nitroimidazol-1-yl) ethanol White to pale-yellow crystalline powder with a slight odour. Bitter and saline taste and Odorless. Metronidazole is a nitroimidazole used to treat amebiasis; vaginitis; trichomonas infections; giardiasis; anaerobic bacteria. The solubility of Metronidazole in g/100 ml at 20 deg C: 1.0 in water, 0.5 in ethanol, less than 0.05 in ether, chloroform; sol in dilute acids; sparingly sol in dimethylformamide Approximate solubility of Metronidazole in blend (10% sodium caprylate, 10% niacinamide and 10% sodium benzoate) was more than2.5%w/v.

Experimental
Chemicals and Reagents
Pharmaceutical grade Metronidazole was a gift from Modern Laboratories Pvt. Ltd. Indore and its dosage formulations Flagyl-400 (different batches) were purchased from local market. All other chemicals were of analytical grade.

Instrumentation
UV Visible spectrophotometer (Model 1800, Shimadzu, Japan) with 10 –mm path length connected to a computer was used for spectrophotometric analysis.

Calibration curve

Standard stock solution of Metronidazole (5000µg/ml) was prepared by weighing 50 mg of Metronidazole and transferred to a 10 ml volumetric flask and was dissolved in 6 ml blend of 10% sodium caprylate,10% niacinamide and 10% sodium benzoate. Then finally volume was made up to 10ml with the same blend to get a concentration of 5000 µg/ml. Appropriate volumes of this solution were further diluted with distilled water to obtain final concentrations in the range of 10-50 µg/ml. The absorbances of these standard solutions were noted at 320 nm against respective reagent blanks.

Table 1: Data of calibration curve.

S. No.	Concentration (µg/ml)	Stock Solution in (ml)	Final volume with distilled water(ml)	Absorbtion
1	5	0.1	100	0.275
2	10	0.2	100	0.550
3	15	0.3	100	0.810
4	20	0.4	100	1.110
5	25	0.5	100	1.350

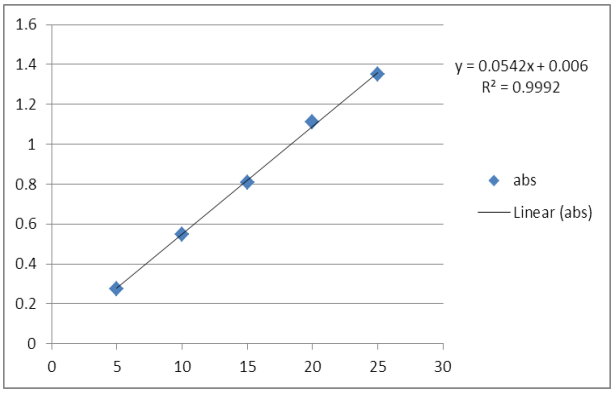

Figure 1: Calibration curve of Metronidazole.

Preliminary solubility studies

To determine the solubility of the drug in distilled water and mixed solvent blend (10% sodium caprylate, 10% niacinamide and 10% sodium benzoate) at room temperature sufficient excess amount of the drug was added to a 25 ml capacity vial containing distilled water and the mixed solvent blend. After putting the vial cap and applying the aluminum seal, the vial was shaken mechanically for 12 hours at room temperature (27^0C) in an orbital flask shaker. The solution was allowed to equilibrate for 24 hours undisturbed and then filtration was done through Whatmann filter paper#41. The filtrate was appropriately diluted with distilled water to measure the absorbance at 320 nm against reagent blanks.

Proposed method of analysis

20 tablets of tablet formulation-I were accurately weighed and finely powdered. Amount of powder equivalent to 50 mg of bulk drug was transferred into 10ml volumetric flask with 6 ml of blend (10% sodium caprylate, 10% niacinamide and 10% sodium benzoate) and the drug present in tablet powder was dissolved by sonication for 20 minutes. The flask was filled to the mark with the same blend and the resulting solution was filtered through Whatmann filter paper #41. One ml of the above filtrate was diluted to 100 ml. Method was followed as described under analytical procedure and the absorbance was noted at 320 nm against the reagent blank. The drug content was calculated using the calibration curve. Same procedure was repeated for the tablet formulation II. The results of analysis are reported in Table-2. All analyses were performed thrice.

Table 2: Analysis data of Metronidazole tablet formulations with statististical evaluation (n=3).

Drug	Batch	Label claim mg/tab	% Labeled claim estimated (mean ±SD)	Percent coefficient of variation	Standard Error
Metronidazole	I	400	99.74±0.735	0.735	0.424
Metronidazole	II	400	99.97±0.784	0.783	0.452

Recovery studies

To perform the recovery studies, standard Metronidazole drug was added (40mg, 50mg and 60mg separately) to the pre-analyzed tablet powder equivalent to 50 mg of Metronidazole and the drug content was determined by the proposed method. Results of analysis were reported in Table3.

Table 3: Results of recovery studies with statistical evaluation. n=3.

Tablet Formulation	Drug in Pre-Analyzed tablet powder(mg)	Amount of standard drug added(mg)	%Recovery estimated (mean±SD)	Percent coefficient of variation	Standard error
I	50	40	99.97±0.845	0.783	0.487
I	50	50	101.32±0.596	0.588	0.344
I	50	60	100.35±0.249	0.248	0.143
II	50	40	100.10±0.784	0.783	0.452
II	50	50	100.79±0.367	0.364	0.211
II	50	60	99.95±0.242	0.241	0.139

RESULTS AND DISCUSSION

The developed UV-spectrophotometric method was validated as per ICH guidelines in terms of linearity and range, specificity, precision, sensitivity and accuracy.

In order to determine linearity range of developed method, a series of solutions were prepared using Metronidazole stock solution at concentration range of 5-25µg/ml. The absorbances of the resultant solutions were measured at 320 nm against reagent blank. The calibration curves were constructed by plotting concentration on X axis and absorbance on Y axis. R^2 value not less than0.999 was regarded as acceptance criteria (Figure 1).

Table 4: Developed UV method specification.

Instrument and specification	UV-Spectrophotometer Shimadzu 1800
Scanning Range	200 nm to 400 nm
Solvent Used	Hydrotropic solvent
Strength of Solvent	10% sodium caprylate,10% niacinamide and 10% sodium benzoate
Composition of Solvent	10% sodium caprylate,10% niacinamide and 10% sodium benzoate
Wavelength Maxima of Metronidazole	320 nm

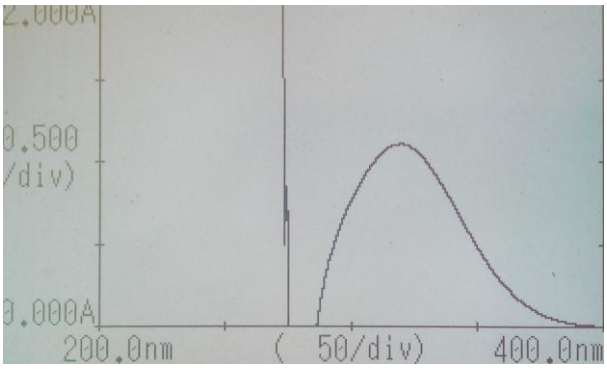

Figure 2: UV-Spectrum of Metronidazole.

Specificity was performed to exclude the possibilities of interference of solvent in the region of maximum absorbance peaks of Metronidazole. The specificity of the method was tested under the normal conditions and results of the tests proved that the components other than Metronidazole did not produce the deductable peaks at the maximum absorbance peaks of the drug.

Accuracy of the developed method was determined by recovery studies at three different levels. The pre analyzed samples were spiked with 80, 100 and 120% of mixed standard solution. The mixtures were analyzed and the recoveries were determined. The recovery study was carried out in triplicate. The mean % recovery of the Metronidazole at each level should not be less than 98% and not more than102% was considered as the acceptance criteria.

Precision was studied to find out intra- day and inter-day variations in the test method of Metronidazole, Intra- day assay precision was found by analysis of standard drug thrice on the same day in different intervals of time. Inter-day assay precision was carried out on three different days and percentage relative standard deviation (%RSD) was calculated. The %RSD should not be more than 2.0%.

Sensitivity of proposed method was estimated in terms of limit of Detection (LOD) and Limit of quantification (LOQ). The LOD and LOQ of Domperidone by proposed methods were determined using calibration standards. LOD and LOQ were calculated as 3.3s/S and 10s/S respectively. where S is the slope of calibration curve and s is standard deviation of response.

The solubility of Metronidazole in distilled water at room temperature was found to be 1%. Approximate solubility of Metronidazole in blend was more than 2.5%.

It is evident from table-2 that the percent drug estimated in tablet formulation of Batch-I and of Batch-II were 99.74±0.735 and 99.97±0.784 respectively. The values are very close to 100, indicating the precision of the proposed analytical method. Further table-3 shows that the range of percent recoveries varied from 99.95±0.242 to 101.32±0.596 which are again very close to 100, indicating the accuracy of the proposed method. Proposed analytical method is further supported by significantly small values of statistical parameters viz.

standard deviation, percent coefficient of variation and standard error (table3).

The limit of detection was found to be0.311 µg/ml and the limit of quantification was found to be 0.933 µg/ ml.

CONCLUSION

A rapid, simple, and non-toxic UV spectrophotometric method has been developed for the determination and quantification of Metronidazole. The present method also validated as per ICH guidelines for linearity, precision, accuracy. The results of all these parameter shows that the present UV spectrophotometric methods found to be precise, linear, rapid and accurate and can be used for routine quality control analysis of Metronidazole in tablet dosage formulation in any laboratory.

REFERENCES

1. Maheshwari RK. "Mixed-solvency approach"- Boon for solubilization of poorly water-soluble drugs. Asian J Pharm, 2010; 4(1): 60-3.
2. Maheshwari RK. Solubilization of ibuprofen by mixed solvency approach. Indian Pharm 2009; 8(87): 81-4.
3. Maheshwari RK. "Mixed- solvency" – A novel concept for solubilization of poorly water-soluble drugs. Delving J. Tech Eng Sci, 2009; 1(1): 39-43.
4. Maheshwari RK. "Solid as solvent"- Novel spectrophotometric analysis of satranidazole tablets using phenol as solvent". Indian Pharm, 2014; 12: 37-40.
5. Maheshwari RK. "Solid as solvent"- Novel spectrophotometric analysis of norfloxacin tablets using phenol as solvent". Int J Curr Pharm Res, 2014; 6: 76-8.
6. Maheshwari RK. Potentiation of solvent character by mixed solvency concept: A novel concept of solubilization. J Pharm Res, 2010; 3(2): 411-3.
7. Maheshwari RK, Shilpkar R. Formulation development and evaluation of injection of poorly soluble drug using mixed solvency concept. Int J Pharm Biosci, 2012; 3(1): 179-89.
8. Maheshwari RK, Upadhyay N, Jain J, Patani M, Mathuria KC. New spectrophotometric estimation of naproxen tablet formulation employing mixed solvency concept (at 331 nm). Int J Pharm Technol, 2011; 3(4): 3618-23.
9. Maheshwari RK, Rajagopalan R. Formulation and evaluation of tinidazole syrup made by mixed-solvency concept. Der Pharm Lett, 2011; 3(6): 266-71.
10. Maheshwari RK, Karawande VU, Application of novel concept of mixed solvency in the design and development of floating microspheres of furosemide. Int J Pharm Sci, 2013; 15: 167-95.
11. Maheshwari RK, Upadhyay N, Jain J, Patani M, Pandey R. New spectrophotometric analysis of gatifloxacin tablets utilizing mixed solvency concept (at 288 nm). Der Pharm Lett, 2012; 4(1): 1-4.
12. Prashant B, Rawat S, Mahajan YY, Galgatte UC, Maheshwari RK. Formulation development and evaluation of aqueous injection of poorly soluble drug made by novel application of mixed solvency concept. Int J Drug Delivery, 2013; 2: 152-66.
13. Maheshwari RK, Rajagopalan R. Formulation and evaluation of paracetamol syrup made by mixed-solvency concept. Der Pharm Lett, 2012; 4(1): 170-4.
14. Chandna C, Maheshwari RK. Mixed solvency concept in reducing surfactant concentration of self-emulsifying drug delivery systems of candesartan cilexetil using D-optimal mixture design. Asian J Pharm, 2013; 7(2): 83-91.
15. Maheshwari RK, Upadhyay N, Jain J, Patani M, Mathuria KC. New spectrophotometric estimation of naproxen tablet formulation employing mixed solvency concept (at 331 nm). Int J Pharm Technol, 2011; 3(4): 3618-23.
16. Agrawal A, Maheshwari RK. Formulation development and evaluation of in situ nasal gel of poorly water soluble drug using mixed solvency concept. Asian J Pharm, 2011; 5(3): 131-40.
17. Bhawsar N, Maheshwari RK, Ansari A, Saktawat Y. New spectrophotometric estimation of gatifloxacin in the tablets using mixed solvency approach. Int J Pharm Sci, 2011; 2(2): 270-4.
18. Soni LK, Solanki SS, Maheshwari RK. Solubilization of poorly water soluble drug using mixed solvency approach for aqueous injection. Br J Pharm Res, 2014; 4(5): 49-68.
19. Maheshwari RK, Gupta S, Gharia A, Garg SK, Shilpkar R. Simple eco-friendly spectrophotometric estimation of tinidazole tablets by application of mixed-solvency technique. Bull Pharm Res, 2011; 1(1): 22-5.
20. Maheshwari RK. "Solid as solvent"-Novel spectrophotometric analysis of tinidazole tablets using melted phenol as solvent. Asian J Pharm Res, 2015; 5(1): 21-24.
21. Maheshwari RK, Putliwala M, Padiyar A. Novel approach for spectrophotometric estimation of naproxen in tablet dosage form using solids (eutectic liquid of phenol and niacinamide) as solubilising agents. Asian J Pharm Res, 2015; 5(1): 25-28.
22. Jain Sanjay, Maheshwari RK, Nema RK, Singhvi I. Development and validation of simple uv-spectrophotometric method of quantization of Nifedipine in solid dosage formulation using mixed solvency concept. World J of Pharm res, 2017; 6(13): 1014-1021.
23. Jain Sanjay, Maheshwari RK, Nema RK, Singhvi I. Development and validation of simple uv-spectrophotometric method of quantization of Ondansetron hydrochloride in solid dosage formulation using mixed solvency concept. International J of Pharm. sci. and drug research, 2017; 9(5): 252-255.
24. Jain Sanjay, Maheshwari RK, Nema RK, Singhvi I. Development and validation of simple uv-

spectrophotometric method of quantization of Diazepam in solid dosage formulation using mixed solvency concept. International J of current Pharm res, 2017; 6(9): 15-17.

25. Jain Sanjay, Maheshwari RK, Nema RK, Singhvi I. Development and validation of simple uv-spectrophotometric method of quantization of Domperidone in solid dosage formulation using mixed solvency concept. A journal of drug design and discovery, 2017; 2(4): 19-23.
26. Jain Sanjay, Maheshwari RK, Nema RK, Singhvi I. Development and validation of simple uv-spectrophotometric method of quantization of Domperidone in solid dosage formulation using mixed solvency concept. European journal of biomedical and pharmaceutical sciences, 2017; 4(12): 48-51.
27. Jain Sanjay, Maheshwari RK, Nema RK, Singhvi I. simultaneous estimation of ofloxacin and tinidazole in solid dosage form by u v Spectrophotometry using mixed solvency concept. European Journal of pharmaceutical and medical Research, 2017; 4(12): 413-418.
28. Jain Sanjay, Maheshwari RK, Nema RK, Singhvi I. simultaneous estimation of norfloxacin and tinidazole in solid dosage form by u v Spectrophotometry using mixed solvency concept. World Journal of pharmaceutical and medical Research, 2018; 4(1): 112-117.
29. Jain Sanjay, Maheshwari RK, Nema RK, Singhvi I. Development and validation of simple uv-spectrophotometric method of quantization of Metronidazole in solid dosage formulation using mixed solvency concept. World journal of Pharmacy and pharmaceutical sciences, 2018; 1(7): 824-832.
30. Jain Sanjay, Maheshwari RK, Nema RK, Singhvi I. Development and validation of simple uv-spectrophotometric method of quantization of Indomethacin in solid dosage formulation using mixed solvency concept. The Pharma Innovation Journal, 2017; 6(12): 453-456.
31. Jain Sanjay, Maheshwari RK, Nema RK, Singhvi I. New Spectrophotometric Estimation of Frusemide in the Tablets using mixed solvency concept Approach. International Journal of current Advanced Research, 2017; 6(12): 8510-8513.