Asian Journal of Pharmaceutical and Health Sciences
www.ajphs.com

An Eco-friendly spectrophotometric analysis of poorly water-soluble drug (Nimesulide) using the mixed hydrotropic concept

Mr. Ketan Soni[1], Kavita Sharma[2]

1 Research Scholar, Shri Vaishnav Vidyapeeth Vishvavidhyalaya, Indore, Madhya Pradesh, India.
2 Professor & Co-coordinator, Shri Vaishnav Institute of Forensic Science, SVVV, Indore, Madhya Pradesh, India.

ARTICLE HISTORY

Received: 03.11.2019

Accepted: 20.12.2019

Available online: 31.12.2019

Keywords:

Nimesulide, UV-Spectrophotometry, mixed hydrotropic concept

***Corresponding author:**

Email : ketan.soni5050@gmail.com
Phone : +91 -

ABSTRACT

Poor solubility is one of the most difficult problems of maximum drugs. Mixed hydrotropy is one of the advanced method, in which aqueous solubility of poorly water-soluble drugs is increased by adding other highly water-soluble substances. Such agents used to increase the solubility of poorly water-soluble drugs in aqueous medium are known as hydrotropic agents or hydrotropes like Sodium Benzoate, Niacinamide, Sodium Citrate, Sodium Acetate, and Urea. The mixed hydrotropic solubilization technique is to increase the solubility of poorly water-soluble drugs in the blends of hydrotropic agents.

The present study was aimed at the enhancement of nimesulide solubility using the mixed hydrotropic concept. The present research work also provides an eco-friendly method to estimate spectrophotometrically, the Nimesulide drug in tablet formulations without the help of organic solvent. Mixed hydrotropic tends to decrease the concentration of individual solubilizers and toxicity.

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. In the present investigation, it was proposed to solubilize Nimesulide by use of the mixed hydrotropic concept. Nimesulide shows maximum absorbance in the concentration range of 10-50µg/ml at 390 nm. The method of analysis has been validated for different parameters like linearity, accuracy, and precision. The percent drug estimated in tablet formulation of tablet-I and of tablet-II were 102.61± 0.669 and 102.10± 0.461 respectively. The range of percent recoveries varied from 102.24±0.508 to 102.83±0.442. Sodium citrate and phenol do not interfere above 300 nm. The analytical method was found to be simple, free from toxicity, economic and eco-friendly.

INTRODUCTION

Increasing the aqueous solubility of Insoluble and slightly soluble drugs has been done by various methods to avoid the usage of organic solvents. Poor solubility is one of the most difficult problems of maximum drugs [1-3]. Drug analysis of pure or final products also important. The drawback of these organic solvents includes high cost, volatility, pollution, and toxicity. Organic solvents are harmful if swallowed, inhaled or absorbed through the skin. Also, as per I.C.H guideline Q3 CR3 (impurities guideline for residual solvents), these solvents come under the category of Class 2 solvent i.e solvents which are in limited use. So, there is an urgent need to replace organic solvent with a safe eco-friendly, cost-effective solvent for spectrophotometric analysis [4-5]. Concentrated aqueous solutions of sodium benzoate, sodium salicylate, urea, niacinamide, sodium citrate, and sodium acetate have been employed to enhance the aqueous solubilities of a large number of poorly water-soluble drugs [6].

A mixed hydrotropic concept is one of the methods to enhance the aqueous solubility of poorly water-soluble drugs [7-9]. A

mixed hydrotropic concept may be a proper choice to preclude the use of organic solvents. So there is a broad scope for the mixed hydrotropic concept in quantitative estimation of poorly water-soluble drugs[10-12]. The mixed hydrotropic solubilization technique is to increase the solubility of poorly water-soluble drugs in the blends of hydrotropic agents [13]. The present research work provides an eco-friendly method to estimate spectrophotometrically, the Nimesulide drug in tablet formulations without the help of organic solvent.

MATERIALS AND METHODS

Nimesulide drug was obtained as a gift sample from Schon pharmaceutical Ltd. Indore and nimesulide tablets of two different companies (Dr. Reddys and Combitic global) were purchased from the local market of Indore. All other chemicals used were of analytical grade.

Instrumentation

UV Visible spectrophotometer (Model 1800, Shimadzu) was used for spectrophotometric analysis.

Preliminary solubility studies

To determine the solubility of the drug in distilled water and mixed solvent blend (containing 25% Sodium Citrate and 30% phenol) at room temperature sufficient excess amount of the drug was added to 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 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 390 nm against reagent blanks.

Preparation of calibration curve of the drug (nimesulide)

Accurately weighed 50 mg of nimesulide standard drug and 8 ml blend A was transferred to a 10 ml volumetric flask. Complete dissolution of the drug was performed by shaking the flask after complete dissolution, sufficient blend A was added to make up the volume up to 10 ml. From this stock solution, various standard solutions of concentration 10, 20, 30, and 40 µg/ml were prepared by suitable dilution with distilled water. The absorbances of these solutions were noted at 390 nm against respective reagent blank.

Table 1 : Data of the calibration curve

S.no.	Concentration (µg/ml)	Absorbance
1	00	0.000
2	10	0.360
3	20	0.678
4	30	1.083
5	40	1.440

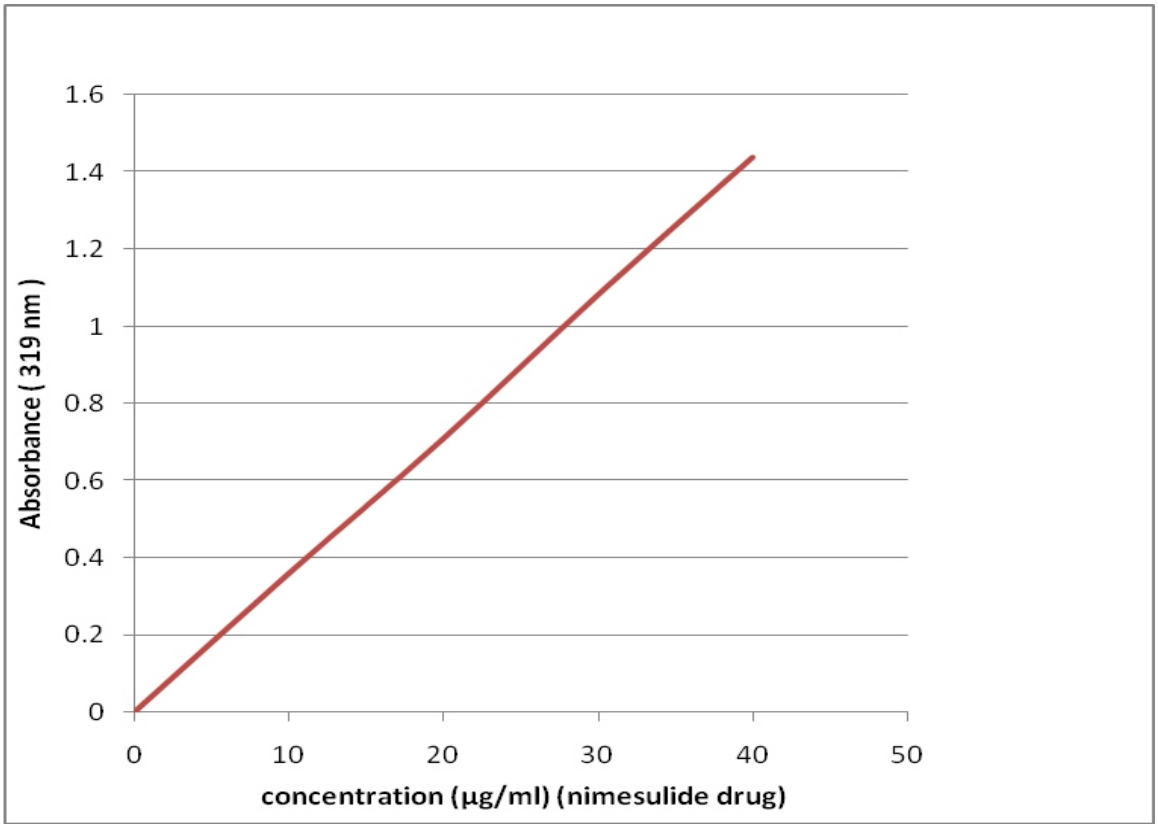

Fig. 1 : Calibration curve of nimesulide

Proposed method of analysis

Tablet powder equivalent to 50 mg nimesulide and 8ml of blend solution was transferred to a 10 ml volumetric flask. The flask was shaken vigorously for 10 min and a sufficient blend solution was added to make up the volume up to 10 ml. Filtration was carried out through Whatman filter paper no. 41 to remove the tablet excipients. 0.6 ml filtrate was diluted to 100 ml with distilled water and the absorbance was noted at 390 nm against the reagent blank. The same procedure was repeated for tablet II. The results of the analysis are reported in table II after calculation using the calibration curve. All types of analyses were repeated thrice.

Table 2 :

Tablet formulation	Label claim mg/tablet	Percent drug estimated (mean ± SD)	The percent coefficient of variation	Standard error
I (Dr. Reddys)	100	102.61± 0.669	0.651	0.375
II (Combitic global)	100	102.10± 0.461	0.451	0.260

Recovery studies

To perform the recovery studies, standard nimesulide drug was added (20 mg and 40 mg separately) to the pre-analyzed tablet powder equivalent to 50 mg nimesulide and the drug content was determined by the proposed method. All types of analyses were repeated thrice. The results of the analysis are reported in Table III.

DISCUSSION

The results of solubility studies indicate that aqueous solubility of nimesulide was enhanced in a hydrotropic solution (containing 25 % Sodium Citrate and 30% phenol) as compared to solubility in distilled water. Therefore, this hydrotropic solution was selected to study the effect on enhancement in solubility of nimesulide.The drug showed a good regression value at 390nm. It

Table 3 : Results of recovery studies with statistical analysis (n=3)

Tablet formulation	The drug in pre-analyzed tablet powder (mg)	Amount of standard drug added (mg) (spiked)	Percent drug estimated (mean ± SD)	The percent coefficient of variation	Standard error
I (Dr. Reddys)	50	20	102.83±0.442	0.429	0.247
I (Dr. Reddys)	50	40	102.57±0.444	0.432	0.249
II (Combitic global)	50	20	103.63±0.155	0.149	0.086
II (Combitic global)	50	40	102.24±0.508	0.496	0.286

RESULTS

The solubility of nimesulide in distilled water at room temperature was found to be 0.017 mg/ml and the solubility of nimesulide in blend solution was 25 mg/ml of a blend. Table II denotes that the mean percent estimations of nimesulide tablets determined by spectrophotometric analysis using mixed hydrotropic solubilization technique (by use of Sodium Citrate and phenol solution) ranged from 102.10 (formulation II) to 102.61 (formulation I). Observed values of the mean percent estimation are very close to 100, indicating the accuracy of the proposed method. Low values of standard deviation (0.461 to 0.669), percent coefficient of variation (0.451 to 0.651) and standard error (0.260 to 0.375) validated the proposed method of analysis.

Table III shows that the mean percent recoveries estimated using the proposed method ranged from 102.24 to 103.63, which are again very close to 100, indicating the accuracy of the proposed method. Validation of the proposed analysis method is confirmed by satisfactorily low values of statistical parameters viz., standard deviation (0.155 to 0.508), percent coefficient of variation (0.149 to 0.496) and standard error (0.086 to 0.286).

was evident that there is a good correlation between the amounts estimated and the label claim. Accuracy and reproducibility of the proposed method were further confirmed by the recovery studies. From this study, it is obvious that there was no interference of Sodium Citrate and phenol solution in the estimation of nimesulide. Currently, hydrotropic solutions possess high industrial demand due to their unique features such as easy availability, good recovery, absence of fire hazards and eco-friendly nature. The mixed hydrotropic technique can be effectively employed in the pharmaceutical field. It can be used

for spectrophotometric estimation of poorly water-soluble drugs from their bulk drug samples precluding the use of organic solvents providing simple, economic, eco-friendly, safe and accurate analytical methods.

CONCLUSION

It can be concluded that the Mixed hydrotropic technique can be used to replace the use of an organic solvent which is more costly and hazardous to our environment. There is definitely the further scope of a hydrotropic blend containing 25% sodium Citrate and 30% phenol as a hydrotropic solubilizing agent for the spectrophotometric analysis of other poorly water-soluble drugs precluding the use of organic solvents.

ACKNOWLEDGEMENT

The authors are thankful to Dr.R.K.Maheshwari for giving continuous guidance throughout the research work.

REFERENCES

1. Maheshwari RK. Solubilization of ibuprofen by mixed solvency approach. Indian Pharm, 2009:8(87): 81-4.
2. Pareek V, Tambe S, Bhalerao S, Shinde R, Gupta L. Spectrophotometric estimation of cefprozil by using Different hydrotropic agents. International Journal of Pharmacy and Pharmaceutical Sciences. 2010:2(1): 45-48.
3. Bhawsar N, Maheshwari RK, Ansari A, Saktawat Y. New spectrophotometric estimation of gatifloxacin in the tablets using a mixed solvency approach. Int J Pharm Sci, 2011:2(2): 270-4.
4. 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,201:3(4): 3618-23.
5. Patil DN. Spectroscopic Determination of Lovastatin by Hydrotropic Solubilization Technique. International Journal of Pharmaceutical and Chemical Sciences. 2012:5(2): 23-27.
6. Jayakumar C, Morais AB, Raja C, Gandhi NN. New Quantitative Estimation of Famotidine Using Hydrotropic Solubilizing Agents. International Journal of Pharmacy and Pharmaceutical Science Research. 2013: 5(6): 249-252.
7. Soni LK, Solanki SS, Maheshwari RK. Solubilization of poorly water-soluble drugs using mixed solvency approach for aqueous injection. Br J Pharm Res, 2014:4(5): 549-68.
8. Ruth BV, Kumar AS. Spectrophotometric determination of poorly water-soluble drug Lanzoprazole using Hydrotropic solubilization technique. Indo American Journal of Pharmaceutical Research. 2014: 6(3): 45-49
9. Maheshwari RK. "Solid as a solvent"-Novel spectrophotometric analysis of tinidazole tablets using melted phenol as a solvent. Asian J Pharm Res,2015:5(1): 21-24.
10. Jain S, 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.
11. Jain S, Maheshwari RK, Nema RK, Singhvi I. New Spectrophotometric Estimation of Frusemide in the Tablets using a mixed solvency concept Approach. International Journal of Current Advanced Research, 2017:6(12): 8510-8513.
12. Salunke PA, Rakhonde K, Rathod A, Rathod G, Patil S. Development and validation of mixed hydrotropic solubilization method for spectrophotometric determination of Ornidazole in bulk drug and tablet. Journal of Pharmacy Research. 2017: 11(11): 1114-1119.
13. Jain S, Maheshwari RK, Nema RK, Singhvi I. Development and validation of simple UV spectrophotometric method of quantization of Ornidazole in solid dosage formulation using mixed solvency concept. World Journal of Pharmacy and pharmaceutical sciences, 2018: 1(7): 824-832.