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Ecofriendly Application of Mixed Hydrotropy for Titrimetric Analysis of Ibuprofen Tablets

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Abstract: ***In the present study, mixed hydrotropy blend (MHB) containing 15% sodium salicylate, 5%w/v niacinamide, 5%w/v sodium acetate and 5%w/v sodium citrate have been employed to solubilize a poorly watersoluble drug, ibuprofen for its titrimetric analysis in tablets. Results of analysis by proposed methods were comparable with those of standard Indian pharmacopeial method. Results of analysis have been validated statistically. The proposed method is quicker than pharmacopeial method with its novelty, simplicity, accuracy and reproducibility.***

Keywords: Mixed hydrotropy, ibuprofen, sodium salicylate, niacinamide, sodium acetate, sodium citrate, titrimetry

1. Introduction

In titrimetric analysis, costlier organic solvents are more often employed to solubilize the poorly water –soluble drugs. Volatility and pollution are drawbacks of such solvents. Various techniques are employed to enhance the aqueous solubility of poorly water-soluble drugs. Mixed hydrotropy blend phenomenon has been widely used to enhance the aqueous solubility of a large number of poorly water-solubledrugs. Aqueous solubility of ibuprofen bulk drug [a poorly water-soluble NSAID] was enhanced to a great extent (approx 40 folds) with a mixed hydrotropic blend (MHB) containing 15% sodium salicylate,5%w/v niacinamide, 5%w/v sodium acetate and 5% sodium citrate. The primary objective of the present investigation was to employ this hydrotropic mixture to extract the drug from its dosage form, precluding the use of costlier organic solvents. The proposed method of analysis is new, simple, accurate, environment friendly and reproducible. Statistical data proved the accuracy, reproducibility and the precision of proposed method. The results of titrimetric analysis by use of mixed hydrotropy compared very well with the results of pharmacopeial method.

Mixed hydrotropy refers to the ability of a concentrated solution of chemical compounds to increase the aqueous solubility of another compund [usually a sparingly soluble organic compound]. Compounds that have this property are called 'hydrotropes'. Sodium benzoate, sodium salicylate, sodium acetate, sodium ascorbate, sodium citrate are the most popular examples of hydrotropic agents which have been used to solublize a large number of poorly water soluble compounds. Mixed hydrotropic solution {sodium salicylate,niacinamide,sodium acetate, sodium citrate} was employed as solubilizing agent for the analysis of ibuprofen [a poorly water soluble drug] by titrimetric estimation. Chemically, ibuprofen is 2-(4-isobutylphenyl)propionic acid. There was tremendous increase in solubility of ibuprofen in mixed hydrotropic solution. Therefore, it was thought worthwhile to solubilize this drug in mixed hydrotropic solution to carry out the titrations precluding the use of organic solvent. Solubility of a large number of poorly water soluble drugs have been enhanced by mixed hydrotropy 1-33.

2. Experimental

Materials and reagents

The bulk drug sample of ibuprofen was generously supplied by Wilcure Remedies, Indore. Commercial tablets of ibuprofen were procured from local market. Other chemicals used were of analytical grade.

Methods

Preliminary solubility studies of ibuprofen

Equilibrium solubility studies were conducted at room temperature for water and MHB using titrimetry. Solubility of ibuprofen was found to be 0.028% in water at room temperature and 1.144% w/v in MHB at room temperature.
Solubility of ibuprofen in water = 0.028% w/v

Solubility of ibuprofen in mixed hydrotropic blend (MHB) containing 15% sodium salicylate, 5%w/v niacinamide, 5%w/v sodium acetate and 5% sodium citrate = 1.144% w/v
Solubility enhancement ratio =1.144/0.028=40.85
More than 40 folds enhancement in solubility.

Analysis of ibuprofen tablets by the proposed analytical method

Twenty tablets of formulation (I) were weighed and powdered finely. Tablet powder equivalent to 200 mg ibuprofen was accurately weighed and transferred to a conical flask. After adding 50 ml of MHB, the flask was shaken for 10 minutes for complete solubilization of drug from fine powder. Titration was done with 0.1 N NaOH solution using 1 ml phenolphthalein solution as indicator. Blank determination was conducted to make the required correction and amount of ibuprofen was computed (Table 1). Similarly analysis was conducted for formulation (II).

Recovery studies

For recovery studies, pre-analyzed tablet powder was spiked with ibuprofen bulk drug sample at two levels. For this, 200 and 400 mg of ibuprofen bulk drug was added to tablet powder equivalent to 600 mg of ibuprofen and analyzed by same proposed method. Percentage recoveries were calculated and reported in Table-2.

Table 1: Results of analysis of tablets (n=3)

Tablet formulation	Label claim (mg/tab)	Percent label claim estimated (mean±s.d.)	Percent coefficient of variation	Standard error
I	400	101.33±1.298	1.281	0.749
II	400	99.87±0.886	0.887	0.511

3. Results and Discussion

Solubility studies at preliminary stage showed that the enhancement in solubility of ibuprofen in mix hydrotropic blend was more than 40 folds as compared to aqueous solubility. Table 1 indicates that the percent label claims of ibuprofen estimated in the tablets using the proposed method of analysis [101.33 ±1.298 and 99.87±0.886] are very close to 100 indicating the accuracy of proposed method which is further confirmed by satisfactory low values of standard deviation, % coefficient of variation and standard error [Table 2]

Table 2: Results of recovery studies (n=3)

Tablet formulation	Drug in preanalyzed tablet powder [mg]	Amount of drug added [spiked] [mg]	Percent recovery estimated [mean±S.D]	Percent coefficient of variation	Standard error
I	200	40	98.72±0.883	0.894	0.510
I	200	80	99.44±1.780	1.790	1.028
II	200	40	98.07±1.008	1.027	0.582
II	200	80	98.76±0.429	0.434	0.248

Accuracy, reproducibility and precision of the proposed method were further confirmed by % recovery values which were closed to 100 [ranged from 98.07±1.008 to 99.44±1.780] with satisfactory low values of statistical parameter viz standard deviation, % coefficient of variation and standard error [Table-2]

4. Conclusion

It is, thus, concluded that the proposed method is simple, cost effective, accurate, safe, precise and can be successfully employed in routine analysis of ibuprofen tablets. There is good scope for other poorly water-soluble drugs which may be solubilized by hydrotropic agents to carryout titrimetric analysis, precluding the use of costlier and unsafe organic solvents.

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