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# Quantitative Estimation of Naproxen in Bulk Sample and Tablet Formulation Using Niacinamide as Hydrotropic Solubilizing Agent

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In the present investigation, 2.0 M niacinamide (an economic solubilizing agent) was employed to solubilize poorly water-soluble antiinflammatory drug, naproxen for its titrimetric analysis. The proposed method is new, environmentally friendly, accurate and reproducible. Accuracy, reproducibility and precision of the proposed method were validated statistically.

**Key Words: Hydrotropy, Naproxen, Niacinamide, Titrimetry.**

## INTRODUCTION

Hydrotropy refers to the ability of a concentrated solution of a chemical compound to increase the aqueous solubility of another compound (usually a sparingly soluble organic compound). Compounds that have this property are called 'hydrotropes'. Sodium benzoate, sodium salicylate, sodium acetate, sodium ascorbate, niacinamide and sodium citrate are the most popular examples of hydrotropic agents which have been used to solubilize a large number of poorly water-soluble compounds[1-13]. Hydrotropic solution of niacinamide was employed as solubilizing agent to analyze a poorly water-soluble drug naproxen by titrimetric estimation.

There was tremendous increase in solubility of naproxen (a widely used non-steroidal antiinflammatory agent) in 2.0 M niacinamide solution. Therefore, it was thought worthwhile to solubilize the drug with the help of niacinamide solution (2.0 M) to carry out the titrations. Chemically, naproxen is 2-(6-methoxynaphthalen-2-yl) propanoic acid.

## EXPERIMENTAL

All chemicals and solvents used were of analytical grade. Naproxen bulk drug sample was procured from M/s Alkem Lab. Ltd., Mumbai as gift sample. Commercial tablets of naproxen were purchased from local market.

**Preliminary solubility studies of drug:** Solubility of naproxen was determined in distilled water and 2.0 M niacinamide solution at 28 ± 1 ºC. Solubility was found to be increased by < 210-fold in 2.0 M niacinamide solution, as compared to the solubility in distilled water.

**Analysis of naproxen bulk drug sample by the method of British Pharmacopoeia[13]:** Accurately weighed (200 mg) naproxen bulk drug sample was dissolved in a mixture of 25 mL distilled water and 75 mL methanol and titrated with 0.1 M sodium hydroxide using 1 mL of phenolphthalein solution as indicator. Blank determination was carried out and necessary correction was made to calculate the drug content (Table-1).

TABLE-1
ANALYSIS DATA OF BULK SAMPLE OF NAPROXEN

| Amount of drug taken (mg) | Method of analysis | Amount estimated* (mean ± SD) (mg) | % Coefficient of variation | Standard error |
|---|---|---|---|---|
| 200 | PM | 198.2 ± 0.982 | 0.991 | 0.567 |
| 200 | BPM | 197.0 ± 1.121 | 1.136 | 0.656 |

PM = Proposed method; BPM = British Pharmacopoeial method; *n = 3.

**Analysis of naproxen bulk drug sample by the proposed method:** Accurately weighed (200 mg) naproxen bulk drug sample was transferred to a conical flask. After adding 50 mL of 2 M niacinamide solution, the flask was shaken for 5 min for complete solubilization of drug. Titration was performed with 0.1 M NaOH using 1 mL of phenolphthalein solution as indicator. Blank determination was carried out and necessary correction was made to calculate the drug content (Table-1).

**Analysis of commercial tablets of naproxen by the proposed method:** 20 Tablets were weighed and finely powdered. Tablet powder equivalent to 200 mg naproxen was transferred to a conical flask. After adding 50 mL of 2 M niacinamide solution, the flask was shaken for 5 min for solubilization of drug. Titration was performed with 0.1 M sodium hydroxide using 1 mL of phenolphthalein solution as indicator. Blank determination was carried out and necessary correction was made to calculate the drug content (Table-2).

TABLE-2
ANALYSIS DATA OF TABLET FORMULATION WITH STASTICAL EVALUATION

| Tablet formulation | Label claim (mg/tablet) | % Label claim estimated* (Mean ± SD) | % Coefficient of variation | Standard error |
|---|---|---|---|---|
| I | 250 | 99.08 ± 1.203 | 1.214 | 0.695 |
| II | 750 | 99.27 ± 0.881 | 0.887 | 0.509 |

*n=3; I = Naproxen (RPG Life Sci. Ltd.) II = Xenar-CR (Elder Health Care Ltd)

**Recovery studies:** For recovery studies, same procedure (proposed method used to estimate drug content of tablets) was repeated using 20 and 40 mg of naproxen bulk sample as the spiked drug together with the preanalyzed tablet powder equivalent to 200 mg drug. The results of analysis are presented in Table-3.

TABLE-3
RESULTS OF RECOVERY STUDIES OF TABLET FORMULATION WITH STASTICAL EVALUATION

| Tablet formu-lation | Drug present in preanalyzed tablet powder (mg) | Amount of bulk drug added (mg) | % Recovery estimated* (Mean ± SD) | %Coefficient of variation | Standard error |
|---|---|---|---|---|---|
| I | 200 | 20 | 100.33 ± 1.197 | 1.193 | 0.689 |
| | 200 | 40 | 98.88 ± 0.974 | 0.985 | 0.568 |
| II | 200 | 20 | 99.14 ± 1.020 | 1.029 | 0.594 |
| | 200 | 40 | 99.38 ± 1.423 | 1.432 | 0.827 |

*n=3; I = Naprosyn (RPG Life Sci. Ltd.) II = Xenar-CR (Elder Health Care Ltd.)

## RESULTS AND DISCUSSION

Results of solubility studies of naproxen revealed that enhancement in solubility in 2.0 M niacinamide solution was < 210 fold as compared to solubility in distilled water.

It is evident from Table-1 that the amount of naproxen estimated in bulk drug sample by British Pharmacopoeial and proposed method are 197.3 ± 1.121 and 198.2 ± 0.982, respectively. The result of analysis by the proposed method is comparable to the result obtained from a standard pharmacopoeial method. As evident from Table-2, per cent label claims were 99.08 ± 1.203 and 99.27 ± 0.881. Per cent label claims are close to 100 showing the accuracy of the proposed method. Low values of standard deviation, per cent coefficient of variation and standard error validated the proposed method. The per cent recovery values ranged from 98.88 ± 0.974 to 100.33 ± 1.197, which are close to 100, indicating the accuracy of the proposed method. Low values of standard deviation, % coeff. of variation and standard error further validated the proposed method.

### Conclusion

It is thus concluded that proposed method is new, easy, cost-effective, environment friendly, accurate and reproducible. Decided advantage is that the organic solvent is precluded but not at the expense of accuracy. There is a good scope for other poor water soluble drugs which may be tried to get solubilized by suitable hydrotropic agents to carry out their titrimetric analysis excluding the use of costlier and unsafe organic solvents.

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