# RP-HPLC Method & Validation For Estimation Of Flurbiprofen In Bulk And Its Formulation

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**ABSTRACT**
A simple, precise, accurate, and validated Reverse Phase High-Performance Liquid Chromatographic (RP-HPLC) method was developed for the estimation of Flurbiprofen in bulk drug and pharmaceutical dosage forms. Chromatographic separation was achieved using a C18 column under isocratic conditions. The optimized mobile phase consisted of Acetonitrile and Phosphate Buffer (60:40, v/v), adjusted to pH 4.5, which provided a sharp and reproducible peak for Flurbiprofen. The analysis was carried out at a detection wavelength of 247 nm with a flow rate of 1.0 mL/min. The developed method exhibited excellent chromatographic performance with satisfactory retention time, peak symmetry, and resolution. The method was validated according to International Council for Harmonisation (ICH) guidelines with respect to system suitability, specificity, linearity, accuracy, precision, robustness, limit of detection (LOD), and limit of quantification (LOQ). The calibration curve showed good linearity over the selected concentration range with a correlation coefficient close to unity. Recovery studies demonstrated the accuracy of the method, while intra-day and inter-day precision studies indicated excellent reproducibility with percentage relative standard deviation (%RSD) within acceptable limits. The method was found to be robust against small deliberate changes in chromatographic conditions and showed adequate sensitivity for routine analysis. The validated RP-HPLC method was successfully applied for the quantitative estimation of Flurbiprofen in bulk drug and pharmaceutical formulations. The results confirmed that the proposed method is simple, rapid, accurate, precise, economical, and suitable for routine quality control analysis of Flurbiprofen in pharmaceutical industries and research laboratories.

**Keywords:** Flurbiprofen, RP-HPLC, Method Development, Validation, Pharmaceutical Formulation, ICH Guidelines, Quantitative Estimation, Quality Control.
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## 1. INTRODUCTION

Flurbiprofen is a non-steroidal anti-inflammatory drug (NSAID) belonging to the phenylalkanoic acid derivative class. It possesses potent anti-inflammatory, analgesic, and antipyretic properties and is widely used in the management of rheumatoid arthritis, osteoarthritis, musculoskeletal disorders, postoperative pain, and dental pain. The therapeutic action of Flurbiprofen is attributed to the inhibition of cyclooxygenase (COX) enzymes, thereby reducing the synthesis of prostaglandins responsible for inflammation and pain.

High-performance liquid chromatographic (HPLC) is the most frequently applied technique in the determination of drugs in biological fluids and dosage forms. We believe that the availability of this new method, with increased simplicity, sensitivity and selectivity, will be very useful for the determination of Flurbiprofen in raw material and pharmaceutical preparations. This gradient HPLC method uses a simple mobile phase and does not require complicated sample preparation. The aim of this study was to develop a simple, rapid and reproducible reversed-phase HPLC method.

Accurate quantitative estimation of Flurbiprofen in bulk drugs and pharmaceutical dosage forms is essential to ensure product quality, safety, and efficacy. Various analytical techniques such as UV spectrophotometry, High-Performance Liquid Chromatography (HPLC), High-Performance Thin-Layer Chromatography (HPTLC), and Liquid Chromatography-Mass Spectrometry (LC-MS) have been reported for the determination of Flurbiprofen. Among these techniques, Reverse Phase High-Performance Liquid Chromatography (RP-HPLC) is the most preferred due to its high sensitivity, specificity, accuracy, precision, and reproducibility.

Method development is a critical step in pharmaceutical analysis, involving the optimization of chromatographic conditions to obtain satisfactory separation and quantification of the analyte. Parameters such as mobile phase composition, pH, flow rate, column type, and detection wavelength significantly influence chromatographic performance. The selection of an appropriate mobile phase is essential to achieve a sharp, symmetrical peak with suitable retention time and resolution.

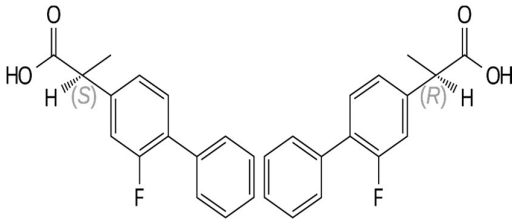
The objective of this study was to develop a simple, rapid, accurate, precise, and cost-effective RP-HPLC method suitable for routine quality control analysis of Flurbiprofen in pharmaceutical industries and research laboratories.

## 2. EXPERIMENTAL

### 2.1 Materials

Flurbiprofen was generously provided as gift sample by Alembic Pharmaceuticals. All other reagents and chemicals utilized in this investigation were of analytical grade. Sodium hydroxide was purchased from Molychem (Mumbai). Hydrochloric acid and hydrogen peroxide was procured from LOBA Chemie Pvt. Ltd. (Mumbai). HPLC grade methanol and acetonitrile was purchased from S. D. Fine-chem Ltd. (Mumbai) whereas HPLC grade water was purchased from Merck Ltd.

### 2.2 Chemical structure:




### 2.3 Instrumentation

The HPLC system consisting of Thermo Separation Quaternary Gradient HPLC pump Spectra System P4000 with PDA detector of Spectra System, manual rheodyne injection system, the software was an Data ace software version 6.1. The chromatographic separation was performed using Grace $C_{18}$ (250mm × 4.6 mm i.d., 5mm particle size) Separation was achieved using a mobile phase consisting of Acetonitrile: Phosphate Buffer pH 4.5 in the ratio (60:40) at a flow rate of 1ml/min and UV detection at 247 nm. The column was maintained at ambient temperature with injection volume of 20 µl. The mobile phase was filtered through 0.45 µm Chrom Tech Nylon-66 filter and degassed in ultrasonic bath prior to use. A blank chromatogram was recorded before the studies. Quantization of result was performed using peak area counts.

### 2.4 Standard preparation

Accurately weighed quantity 10 mg of flurbiprofen was dissolved in Acetonitrile and volume was made up to 100 ml mark (100 µg/ml). The 1 ml of stock standard solution was diluted further with 10 ml methanol to get final concentration of about 10 µg/ml of flurbiprofen then various trial are taken & mobile phase finalized where proper resolution of the drug were seen. This was found that the sample preparation in mobile phase gives sharp resolution hence all samples were prepared in mobile phase. The stock solution was prepare in mobile phase of 100µg/ml.

### 2.5 System suitability test:

System suitability is a pharmacopoeial requirement and is used to verify, whether the resolution and reproducibility of the chromatographic system are adequate for analysis to be done. The tests were performed by collecting data from five replicate injections of standard solutions.

### 2.6 Application of proposed method for estimation of FLURBIPROFEN in laboratory sample

Three different laboratory mixtures of flurbiprofen were prepared by appropriately weighing the quantities of drug samples so as to get the concentration of 10 µg/ml of flurbiprofen. The peak area of standard laboratory sample and Test laboratory sample was compared to obtain the concentration.

### 2.7 Application of proposed method for estimation of flurbiprofen in formulation:

For the estimation of drug from formulation twenty tablets were weighed accurately. The average weight was determined, finely powdered and powder equivalent to 10 mg of drug was transferred. The test and sample solution prepared, the solution was filtered through Whatman filter paper no. 41. Further dilution was made to get final concentration of 10 µg/ml of flurbiprofen. Equal volume (10µg /ml) of standard and sample solution was injected separately after equilibrium of stationary phase. The chromatograms were recorded and response i.e. peak area were measured.

## 3 RESULT & DISCUSSION:

### 3.1 Preparation of Calibration Curve: -

The mobile phase was allowed to equilibrate with the stationary phase until steady baseline was obtained. The series of concentration from 5-50 µg/ml of drug solutions were injected and peak area was recorded. The graph plotted as the concentration of the drug Vs peak area depicted in Fig. No.2.

### 3.2 Method Validation

#### 3.2.1 Specificity (Selectivity)

Specificity was measured as ability of the proposed method to obtain well separated peak for flurbiprofen without any interference from component of matrix. The values obtained were very close to that in standard laboratory mixture indicates no interference from the component of matrix. Mean retention time for –

Flurbiprofen – 3.412

**3.2.2. Accuracy and precision**

It was ascertained on the basis of recovery studies performed by standard addition method. The results of recovery studies and statistical data are recorded in Table No. 3 Precision of an analytical method is expressed as S.D or R.S.D of series of measurements. It was ascertained by replicate estimation of the drugs by proposed method.

**3.2.3 Ruggedness:**

The studies of ruggedness were carried out under two different conditions-

a) Days

b) Analyst.

**a) Interday (Different days):**

Same procedure was performed as under marketed formulation analysis on different days. The % label claim was calculated. Data obtained for day 1, day 2, and day 3 is shown in Table No. 4

**b) Different analyst:**

The sample solution was prepared by two different analysts and same procedure was followed as described earlier. The % label claim was calculated as done in marketed formulation estimation.

**Table 1: Summary of system suitability test results**

| Sr.no. | Parameter | Flurbiprofen |
|---|---|---|
| 1. | Peak area | 23458.8 |
| 2. | Retention time (min) | 3.4122 |
| 3. | Tailing Factor (T) | 1.1754 |
| 4. | No. of Theoretical plates (N) | 3145787.2 |

***Results are mean of five replicates**

**Table 2: Summary of laboratory mixture and marketed formulation analysis by RP-HPLC Method**

| Sr. no. | Sample | Statistical data | % Estimation | % Recovery |
|---|---|---|---|---|
| 1. | Standard Laboratory mixture | Mean | 100.13 | - |
| | | S.D. | 0.208 | - |
| | | C.V. | 0.002 | - |
| 2. | Formulation | Mean | 99.97 | 99.52 |
| | | S.D. | 0.321 | 0.48 |
| | | C.V. | 0.003 | 0.23 |

**Table 3: Summary of validation parameters for the proposed method**

| Validation Parameters | Flurbiprofen |
|---|---|
| Linearity µg mL-1 | 5-50 |
| Accuracy mean | 99.33 |
| Precision (% RSD) | 0.82 |

**Table 4: Summary of Ruggedness by RP-HPLC method**

| Parameter | Statistical data | % Estimation |
|---|---|---|
| Interday | Mean | 100.17 |
| | S.D. | 1.21 |
| | C.V. | 1.20 |
| Intraday | Mean | 99.53 |
| | S.D. | 0.93 |
| | C.V. | 0.94 |
| Different analyst | Mean | 99.89 |
| | S.D. | 0.2748 |
| | C.V. | 0.2750 |

**Table No.5: Result and statistical data of Different analyst study**

| Sr. No. | % Label claim | |
|---|---|---|
| | ANALYST I | ANALYST II |

| | | |
|---|---|---|
| 1 | 99.85 | 100.3 |
| 2 | 100.15 | 99.77 |
| 3 | 99.66 | 99.61 |
| 4 | 100.2 | 99.8 |
| 5 | 99.60 | 100.18 |
| **Mean** | 99.89 | 99.93 |
| **± S.D** | 0.2748 | 0.2933 |
| **C.V** | 0.2750 | 0.294 |

**Table 6: Observation of standard curve of flurbiprofen**

| Sr. No. | Conc.(µg/ml) | Peak Area |
|---|---|---|
| 1 | 5 | 11727 |
| 2 | 10 | 23455 |
| 3 | 15 | 35182 |
| 4 | 20 | 46910 |
| 5 | 25 | 58637 |
| 6 | 30 | 70365 |
| 7 | 35 | 82092 |
| 8 | 40 | 93820 |
| 9 | 45 | 105547 |
| 10 | 50 | 119275 |

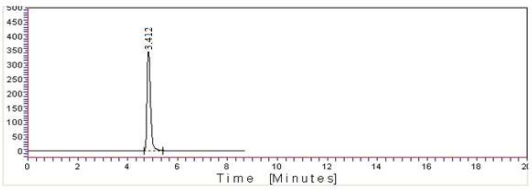



**Fig. 1: Chromatogram obtained by formulation of Flurbiprofen**

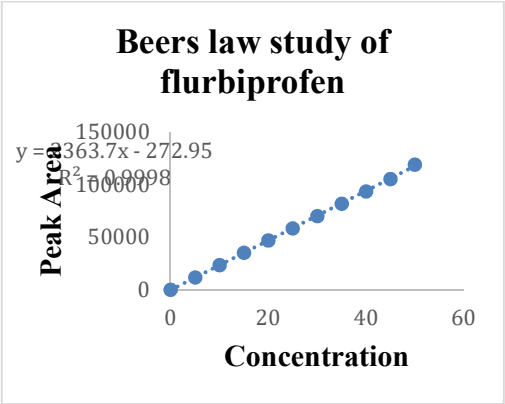



**Fig 2: Linearity and range study for Flurbiprofen**

## 4. CONCLUSION

A simple, rapid, accurate, precise, and economical RP-HPLC method was successfully developed and validated for the quantitative estimation of Flurbiprofen in bulk drug and pharmaceutical dosage forms. The chromatographic separation was achieved using a C18 column with a mobile phase consisting of Acetonitrile and Phosphate Buffer (60:40, v/v) adjusted to pH 4.5, and detection was carried out at 247 nm. The optimized chromatographic conditions produced a sharp, symmetrical peak with satisfactory retention characteristics.

The developed method was validated in accordance with ICH guidelines and demonstrated excellent performance in terms of specificity, linearity, accuracy, precision, robustness, sensitivity, and system suitability. The percentage recovery values confirmed the accuracy of the method, while low %RSD values indicated good precision and reproducibility. The method also exhibited adequate robustness against small deliberate variations in analytical conditions. The validated RP-HPLC method was successfully applied for the estimation of Flurbiprofen in pharmaceutical formulations without interference from excipients. Therefore, the proposed method can be effectively employed for routine quality control analysis, assay determination, and regulatory compliance testing of Flurbiprofen in bulk drug substances and finished pharmaceutical products. Its simplicity, reliability, and cost-effectiveness make it suitable for use in pharmaceutical industries, research laboratories, and academic institutions.

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