Research & Reviews: Journal of Pharmaceutical Analysis

Spectrofluorometric and UV Spectrophotometric Methods for the Determination of Flurbiprofen in Pharmaceutical Preparations

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Research Article

Received date: 20/10/2015
Accepted date: 02/11/2015
Published date: 10/11/2015

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Keywords: Flurbiprofen; Spectrofluorometry; UV Spectrophotometry; Validation

ABSTRACT

In this study, a new and rapid spectrofluorometry and UV spectrophotometry methods were developed for determination of flurbiprofen in pure and pharmaceutical preparations. The solvent system and wavelength of detection were optimized in order to maximize the sensitivity of both the proposed methods. The linearity was established over the concentration range of 50-350 ng ml^{-1} for spectrofluorometry and 1-14 µg ml^{-1} for UV spectrophotometry method. The intra- and inter-day relative standard deviation (RSD) was less than 3.80 and 3.20% for spectrofluorometry and UV spectrophotometry, respectively. Limits of quantification (LOQ) were determined as 0.03 and 0.60 µg ml^{-1} for spectrofluorometry and UV spectrophotometry, respectively. No interference was found from tablet excipients at the selected assay conditions. Also, the methods were applied for the quality control of five commercial flurbiprofen dosage forms to quantify the drug and to check the formulation content uniformity.

INTRODUCTION

Non-steroidal anti-inflammatory drugs (NSAIDs) are among the most commonly prescribed agents worldwide to treat a variety of pain-related conditions, including arthritis and other rheumatic diseases. In addition, epidemiological studies have shown that long-term use of NSAIDs reduces the risk of developing Alzheimer's disease and delays its onset [1-3].

Flurbiprofen **(Figure 1)** is a non-steroidal anti-inflammatory agent, one of the propionic acid group, which has significant anti-inflammatory, analgesic and antipyretic properties. Clinically, it is used for the treatment of rheumamatoid arthritis, degenerative joint disease, osteoarthritis, ankylosing spondylitis, acute musculoskeletal disorders, low back pain and allied conditions [4-7]. It contains a fluorine atom in its molecular structure, producing better effects at a lower therapeutic dose and with less adverse effects compared with similar drugs.

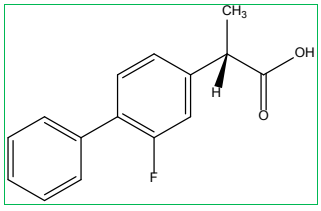

Figure 1. Chemical structure of flurbiprofen.

Several methods have been reported for the determination of flurbiprofen including high performance liquid chromatography (HPLC) [8-19] and liquid chromatography-mass spectrometry (LC-MS) [20]. Over the last 20 years, several HPLC methods using UV

or fluorescence detection have been reported for the estimation of flurbiprofen either alone or together with their metabolites in plasma/serum [8-13], in urine [14-18] and in ocular fluids [19].

USP 2000 [21] and BP 1993 [22] both have recommended HPLC method for analysis of pure flurbiprofen and in dosage form (tablet and ophthalmic drops). Both the methods recommended use of a mobile phase of acetonitrile-water-glacial acetic acid (60:35:5) at a flow rate of 1 ml min^{-1}. IP 1996 [23] has suggested titrimetric method for flurbiprofen estimation. On extensive survey of literature, no spectrofluorometry method is reported till date for determination of flurbiprofen in pure and pharmaceutical dosage forms.

Spectrofluorometric and UV methods for the determination of drugs can be used in laboratories where modern and expensive apparatuses such as that required for GC or HPLC are not available. However, spectrofluorometric and UV methods are versatile and economical particularly for developing countries. Spectrofluorometric and UV methods have several advantages such as being easy, less expensive and less time consuming compared with most of the other methods. Spectrofluorometric and UV methods are simple and rapid; so these methods can be successfully used for pharmaceutical analysis, involving quality control of commercialized product and pharmacodynamic studies.

We wanted to develop new spectrofluorometric and UV methods for the determination of flurbiprofen in pharmaceutical preparations without the necessity of sample pre-treatment. In both the proposed methods, there is no need to extract the drug from the formulation excipient matrix thereby decreasing the error in quantization. Formulation samples can be directly used after dissolving and filtration. After developing spectrofluorometric and UV methods were also carried out and all optimization parameters were also considered. Also, the developed methods were applied to commercial preparations (Majezik, Frolix, Maximus, Zero-P and Fortine) as tablet. The results obtained were statistically compared.

MATERIALS AND METHODS

Chemicals

Flurbiprofen was obtained from Sigma (St. Louis, MO, USA). Acetonitrile, ethanol and methanol were purchased from Sigma-Aldrich (St. Louis, MO, USA). All chemicals were of analytical grade. Majezik, Frolix, Maximus, Zero-P and Fortine tablets (100 mg flurbiprofen) were obtained the pharmacy (Erzurum, Turkey).

Spectrofluorometric and UV System

All fluorescence measurements were done on a SHIMADSU RF-5301 PC spectrofluorometer equipped with a 150 W Xenon lamp. Experimental parameters were slit width 5.0 nm, λ_{ex}=248 nm and λ_{em}=308 nm.

A Thermospectronic double-beam UV-Visible spectrophotometer (HΕλΙOSβ, Thermo Spectronic, Cambridge, UK) with the local control software was used. UV spectra of reference and sample solutions were recorded in 1 cm quartz cells at a scan speed of 600 nm min^{-1}, a scan range of 190-320 nm and fixed slit width of 2 nm.

Preparation of the Standard and Quality Control Solutions

The stock standard solution of flurbiprofen was prepared in acetonitrile to a concentration of 100 μg ml^{-1} and kept stored at -20 C in dark glass flasks. Working standard solutions were prepared from the stock standard solutions. Standard solutions were prepared as 50-350 ng ml^{-1} (50, 100, 150, 200, 250, 300 and 350 ng ml^{-1}) for spectrofluorometry and 1-14 μg ml^{-1} (1, 2, 4, 6, 8, 10, 12 and 14 μg ml^{-1}) for the UV method.

The quality control (QC) samples were prepared by adding aliquots of standard working solution of flurbiprofen to final concentrations of 75, 225 and 325 ng ml^{-1} for the spectrofluorometry and 3, 9 and 13 μg ml^{-1} for the UV method.

Procedure for Pharmaceutical Preparations

The average tablet mass was calculated from the mass of tablets of Majezik, Frolix, Maximus, Zero-P or Fortine (100 mg flurbiprofen tablet, which was composed of flurbiprofen and some excipients). They were then finely ground, homogenized and portion of the powder was weighed accurately, transferred into a 100 ml brown measuring flask and diluted to scale with acetonitrile. The mixture was sonicated for at least 10 min to aid dissolution and then filtered through a Whatman 42 paper. An appropriate volume of filtrate was diluted further with acetonitrile so that the concentration of flurbiprofen in the final solution was within the working range and then recorded against acetonitrile.

Data Analysis

All statistical calculations were performed with the Statistical Product and Service Solutions (SPSS) for Windows, version 10.0. Correlations were considered statistically significant if calculated P values were 0.05 or less.

RESULTS AND DISCUSSION

Method Development and Optimization

For spectrofluorometry method, various solvent systems (water, methanol and acetonitrile) were investigated. The final

decision for using acetonitrile as the solvent was based on sensitivity, suitability for drug content determination and stability studies.

To develop a sensitive UV spectrophotometric method, the experimental conditions such as the solvent, the wavelength range and smoothing were optimized. Optimum results were obtained by measuring the wavelength range 190-320 nm through using high smoothing (Δλ = 21.0 nm) for UV method. In this assay, various solvent systems such as water, methanol, ethanol and acetonitrile were tried either individually or in combinations of different proportions. The final decision of using acetonitrile was based on sensitivity, interference, and easy preparation, suitability for drug, content estimation and cost, respectively.

Method Validation

Specificity

All the solutions were scanned from 200 to 400 nm at a slit width of 5.0 nm and checked for change in the emission at respective wavelengths **(Figure 2).**

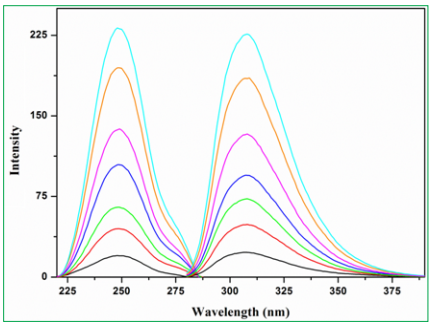

Figure 2. Spectra obtained from spectrofluorometry (50, 100, 150, 200, 250, 300 and 350 ng ml^{-1}) (λ_{ex}=248 nm and λ_{em}=308 nm).

In a separate study, the specificity of the UV method was investigated by observing interferences between flurbiprofen and excipients. **Figure 3** presents the overlay of UV spectra of flurbiprofen standard samples in acetonitrile. As demonstrated in the **Figure 3**, maximum peak is represented at 246 nm.

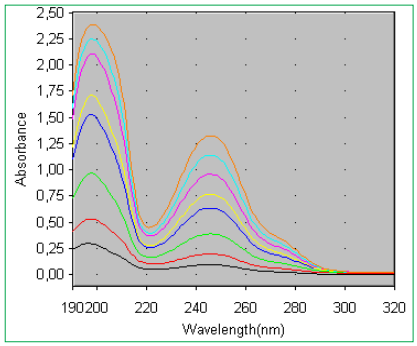

Figure 3. Spectra obtained from UV (1, 2, 4, 6, 8, 10, 12 and 14 µg ml^{-1}) (λ=246 nm).

Linearity

For spectrofluorometry and UV measurements, the solutions were prepared by dilution of the stock solution of flurbiprofen to reach a concentration range of 50-350 ng ml^{-1} and 1-14 µg ml^{-1}, respectively. Calibration curves were constructed for flurbiprofen standard by plotting the concentration of flurbiprofen versus emission and absorbance spectrum responses. The calibration curve constructed was evaluated by its correlation coefficient. The correlation coefficient (*r*) of all the calibration curves were consistently greater than 0.99. The regression equations were calculated from the calibration graphs, along with the standard deviations of the slope and intercept on the ordinate. The results are shown in **Table 1.**

Table 1. Results of regression analysis of flurbiprofen by the proposed methods.

Parameters	Spectrofluorometry	UV
Linearity	50-350 (ng ml^{-1})	1-14 (µg ml^{-1})
Regression equations[a]	y=0.695x-25.571	y=0.0944x+0.0104
Standard deviation of slope	0.148	2.89 × 10^{-3}
Standard deviation of intercept	0.0152	5.07 × 10^{-2}
Correlation coefficient	0.9954	0.9989
Standard deviation of correlation coefficient	1.57 × 10^{-3}	1.98 × 10^{-4}
Limit of detection (µg ml^{-1})	0.010	0.20
Limit of quantification (µg ml^{-1})	0.030	0.60

[a]Based on six calibration curves, y=Emission intensity (Spectrofluorometry method) and absorbance intensity (UV method).

Precision and accuracy

The precision of the spectrofluorometry and UV methods was determined by repeatability (intra-day) and intermediate precision (inter-day). Repeatability was evaluated by analyzing QC samples six times per day, at three different concentrations which were quality control samples. The intermediate precision was evaluated by analyzing the same samples once daily for two days. The RSD of the predicted concentrations from the regression equation was taken as precision. The accuracy of this analytic method was assessed as the percentage relative error. For all the concentrations studied, intra- and inter-day relative standard deviation values were ≤3.80% and for all concentrations of flurbiprofen the relative errors were ≤2.67%. These results were given in **Table 2.**

Table 2. Precision and accuracy of flurbiprofen by the proposed methods.

Added	Intra-day			Inter-day		
	Found ± SD [a] (X ± SD)	Precision % RSD [b]	Accuracy [c]	Found ± SD [a] (X ± SD)	Precision % RSD [b]	Accuracy [c]
Spectrofluorometry (ng ml^{-1})						
75	73.6 ± 1.509	2.05	-1.80	75.6 ± 2.874	3.80	0.80
225	229.5 ± 3.462	1.51	2.00	221.2 ± 4.853	2.19	-1.69
325	318.2 ± 5.743	1.80	-2.09	332.4 ± 6.825	2.05	2.28
UV (µg ml^{-1})						
3	3.06 ± 0.056	1.83	2.00	3.08 ± 0.064	2.08	2.67
9	9.12 ± 0.176	1.93	1.33	9.18 ± 0.259	2.82	2.00
13	13.09 ± 0.406	3.10	-0.69	12.86 ± 0.412	3.20	-0.46

[a] SD: Standard deviation of six replicate determinations, [b] RSD: Relative standard deviation
[c] Accuracy: %relative error: (found-added)/added × 100

LOD and LOQ

For spectrofluorometry and UV measurements, LOD and LOQ of flurbiprofen were determined using calibration standards. The LOD and LOQ values were calculated as 3.3 σ/S and 10 σ/S, respectively, where S is the slope of the calibration curve and σ is the standard deviation of y-intercept of regression equation (n=6).

The LOD and LOQ for spectrofluorometry were 0.010 and 0.030 µg ml^{-1}, for UV 0.20 and 0.60 µg ml^{-1}, respectively. Among the two methods, spectrofluorometry is more sensitive than UV **(Table 1).**

Recovery

To determine the accuracy of the spectrofluorometry and UV methods and to study the interference of formulation additives, the recovery was checked as three different concentration levels. Analytical recovery experiments were performed by adding known amount of pure drugs to pre-analyzed samples of commercial dosage forms. The recovery values were calculated by comparing concentration obtained from the spiked samples with actual added concentrations. These values are also listed in **Tables 3 and 4.**

Table 3. Recovery values of flurbiprofen in pharmaceutical preparations by spectrofluorometry

Preparation	Intra-day				Inter-day		
	Added (ng ml^{-1})	Found ± SD [a] (X ± SD)	Recovery	RSD [b]	Found ± SD [a] (X ± SD)	Recovery	RSD [b]
Majezik (100 ng ml^{-1})	50	49.1 ± 1.320	98.2	2.69	48.9 ± 1.298	99.8	2.65
	150	149.1 ± 6.143	99.4	4.12	152.2 ± 5.953	101.5	3.91
	250	254.0 ± 8.865	101.6	3.49	244.8 ± 3.554	97.9	1.45
Frolix (100 ng ml^{-1})	50	49.2 ± 1.432	98.4	2.91	49.2 ± 1.328	99.4	2.69
	150	148.6 ± 4.945	99.1	3.33	147.9 ± 5.324	98.6	3.59
	250	254.0 ± 8.865	101.6	3.49	256.6 ± 4.298	102.6	1.67
Maximus (100 ng ml^{-1})	50	49.2 ± 1.198	98.4	2.43	50.9 ± 1.312	101.8	2.58
	150	152.2 ± 3.668	101.4	2.41	151.9 ± 4.823	101.3	3.18
	250	246.8 ± 3.638	98.7	1.47	254.2 ± 3.727	101.7	1.47
Zero-P (100 ng ml^{-1})	50	49.8 ± 1.214	99.6	2.44	50.6 ± 1.621	101.2	3.20
	150	152.1 ± 4.423	101.4	2.91	147.6 ± 5.426	98.4	3.68
	250	253.9 ± 3.637	101.6	1.43	242.7 ± 3.616	97.1	1.49
Fortine (100 ng ml^{-1})	50	49.4 ± 1.209	98.8	2.45	51.2 ± 1.098	102.4	2.14
	150	147.9 ± 3.846	98.6	2.60	148.9 ± 5.924	99.3	3.98
	250	255.8 ± 4.319	102.3	1.69	245.6 ± 3.944	98.2	1.61

[a]SD: Standard deviation of six replicate determinations, [b]RSD: Relative standard deviation

Table 4. Recovery values of flurbiprofen in pharmaceutical preparations by UV.

Preparation	Intra-day				Inter-day		
	Added (µg ml^{-1})	Found ± SD [a] (X ± SD)	Recovery	RSD [b]	Found ± SD [a] (X ± SD)	Recovery	RSD [b]
Majezik (2 µg ml^{-1})	2	2.02 ± 0.043	101.0	2.13	2.03 ± 0.038	101.5	1.87
	6	6.11 ± 0.151	101.8	2.47	6.08 ± 0.142	101.3	2.34
	10	10.22 ± 0.198	102.2	1.94	10.18 ± 0.147	101.2	1.44
Frolix (2 µg ml^{-1})	2	1.99 ± 0.031	99.6	1.56	1.97 ± 0.058	98.5	2.94
	6	5.97 ± 0.146	99.4	2.45	5.98 ± 0.149	99.7	2.49
	10	9.85 ± 0.211	98.5	2.14	9.98 ± 0.366	99.8	3.67
Maximus (2 µg ml^{-1})	2	1.96 ± 0.038	97.7	1.94	2.03 ± 0.029	101.5	1.43
	6	5.98 ± 0.165	99.7	2.76	5.84 ± 0.192	99.3	3.29
	10	10.18 ± 0.147	101.2	1.44	10.14 ± 0.201	101.4	1.98
Zero-P (2 µg ml^{-1})	2	2.03 ± 0.067	99.7	2.17	2.01 ± 0.021	100.5	1.04
	6	5.98 ± 0.129	100.8	2.74	6.08 ± 0.287	101.3	4.72
	10	9.95 ± 0.385	99.5	3.87	9.95 ± 0.385	99.5	3.87
Fortine (2 µg ml^{-1})	2	2.03 ± 0.086	101.4	4.24	2.04 ± 0.026	102.0	1.27
	6	6.04 ± 0.228	100.7	3.77	5.84 ± 0.192	99.3	3.29
	10	9.88 ± 0.343	98.8	3.47	10.22 ± 0.198	102.2	1.94

[a]SD: Standard deviation of six replicate determinations, [b]RSD: Relative standard deviation

Stability

Stability studies indicated that the samples were stable when kept at room temperature, +4°C and -20°C refrigeration temperature for 24 h (short-term) and refrigerated at +4 and -20°C for 72 h (long-term). There was no significant change in the analysis over a period of 72 hours. The mean RSD between peak areas for the samples stored under refrigeration (4 ± 1°C), at room temperature (25 ± 1°C) and refrigeration (-20 ± 1°C) were found to be 4.21%, 4.62% and 5.72%, respectively, suggesting that the drug solution can be stored without any degradation over the studied time interval **(Table 5).**

Table 5. Stability of flurbiprofen in solution (n=6).

Yöntem	Added	Room temperature stability, 24 h Recovery (Mean ± SD)	Room temperature stability, 72 h Recovery (Mean ± SD)	Refrigeratory stability, +4°C, 72 h Recovery (Mean ± SD)	Frozen stability, -20°C, 72 h Recovery (Mean ± SD)
Spectrofluorometry (ng ml^{-1})	100	99.7 ± 1.17	99.5 ± 1.41	98.7 ± 2.59	99.5 ± 1.41
	200	99.7 ± 1.17	97.6 ± 3.23	99.1 ± 1.68	99.1 ± 5.72
	350	98.5 ± 4.21	102.1 ± 4.62	98.3 ± 3.15	102.1 ± 4.62
UV (µg ml^{-1})	5	102.9 ± 0.064	98.76 ± 3.216	100.1 ± 1.020	98.70 ± 0.264
	10	98.09 ± 4.507	100.8 ± 2.034	99.30 ± 0.094	98.57 ± 0.214
	15	103.0 ± 1.228	99.18 ± 1.234	103.7 ± 0.076	101.5 ± 0.096

Also, The ICH guideline entitled stability testing of drug substances and products requires the stress testing to be carried out to elucidate the inherent stability characteristics of the active substance, and provide a rapid identification of differences that might result from changes in the manufacturing processes or source sample. Susceptibilities to acid, alkali and oxidation hydrolysis stability are the required tests.

Acid and alkali hydrolysis

Aliquot of 0.2 ml of flurbiprofen solution (50 µg ml^{-1}) was transferred to a small rounded flask. The solution was mixed with 0.8 ml of 0.1 N hydrochloric acid, or 0.1 N sodium hydroxide. The prepared solutions were subjected to reflux for 2 h in a boiling water bath. The samples were cooled to room temperature (25 ± 5°C), neutralized with an amount of acid or base equivalent to that of the previously added. From the resulting neutral solution, 10 µl was injected into the HPLC system.

Oxidation

0.2 ml of flurbiprofen solution (50 µg ml^{-1}) was transferred to rounded flask. The contents were then mixed with 0.8 ml of 30% hydrogen peroxide solution, and the reaction mixture was allowed to proceed at room temperature (25 ± 5°C) for 2 h with intermittent shaking. A volume of 10 µl was injected into the HPLC system. The percentage variation observed in acid, alkali and oxidation hydrolysis was within the limit of 15%.

Ruggedness

In this study, spectrofluorometric and UV determination of flurbiprofen were carried out by a different analyst in same instrument with the same standard **(Table 6).** The results showed no statistical differences between different operators suggesting that the developed method was rugged.

Comparison of the Methods

Flurbiprofen is a non-steroidal anti-inflammatory agent, one of the propionic acid group, which has significant anti-inflammatory, analgesic and antipyretic properties. In this study, a fast and simple spectrofluorometric and UV methods are employed in analysis of commercial preparations in drug industry. The proposed method is used so much because it is a method easy to apply. Also, Pharmacopoeias [21-23] have reported tritrimetric and liquid chromatographic methods for the analysis of flurbiprofen in pure form and in pharmaceutical formulations. Titrimetric method involves dissolving about 0.5 g of accurately weighed flurbiprofen in 100 mL of alcohol (previously neutralized with 0.1 M sodiumhydroxide versus to the phenolphthalein end point) and then, titrating the same (after adding phenolphthalein) with 0.1 M sodium hydroxide versus till the first appearance of faint pink colour that persists for not less than 30 seconds. Each ml of 0.1 M sodium hydroxide is equivalent to 24.43 mg of flurbiprofen. Other method has recommended liquid chromatographic (HPLC) method for analysis of related substances in pure flurbiprofen and assay of flurbiprofen in pharmaceutical dosage form (tablet and ophthalmic drop). The methods recommended use a mobile phase of water-acetonitrile-glacial acetic acid (60:35:5, *v/v*) at a flow rate of 1 ml min^{-1}, using UV detection (254 nm) on a stainless steel column (4 µm, 3.9 × 15 cm i.d.).

Table 6. The results of analyses of flurbiprofen by a different analyst[a].

Method	λ (nm)	Added	Found X ± SD	Recovery (%)	RSD[a] (%)
Spectrofluorometry (ng ml^{-1})	λ_{ex}: 248 nm	50	49.1 ± 1.320	98.2	2.69
	λ_{em}: 308 nm	150	149.1 ± 6.143	99.4	4.12
		250	254.0 ± 8.865	101.6	3.49
UV (µg ml^{-1})	λ : 246 nm	2	1.98 ± 0.033	99.0	1.67
		6	5.97 ± 0.146	99.4	2.45
		10	9.94 ± 0.194	99.4	1.95

λ: Wavelength (nm), X: Mean, [a]Mean measurements of six replicate determinations.

A survey of literature reveals that no spectrofluorometric method for determination of flurbiprofen in pharmaceutical preparations. The present work describes the validation parameters stated either by USP 26 [21] or by the ICH guideline [24] to achieve spectrofluorometric method for determination of flurbiprofen. The proposed method is very effective for the assay of flurbiprofen in five different tablets. The validity of the proposed method was presented by recovery studies using the standard addition method. For this purpose, a known amount of reference drug was spiked to formulated tablets and the nominal value of drug was estimated by the proposed method. Each level was repeated six times. The results were reproducible with low SD and RSD. No interference from the common excipients was observed. The RSD for intra- and inter-day variation was less than 3.80% for spectrofluorometric and UV method, which fall well below the acceptance criteria described by Shah et al. [25].

In comparison with earlier reported and official methods for estimation of flurbiprofen in pharmaceutical formulations the proposed spectrofluorometry method gave a lower LOD and LOQ at 10 and 30 ng ml^{-1} when compared to 100 ng ml^{-1} and 1 mg ml^{-1} of earlier two proposed methods [26,27]. The proposed methods also gave a comparable or in most cases lower range of the calibration plot. Unlike reported methods, the proposed method does not utilizes a special extraction step for recovering the drug from the formulation excipients matrices thereby decreasing the degree of error and time in estimation. The proposed methods of estimation of flurbiprofen is, therefore, more accurate and precise, rugged, reproducible and easier compared to other reported methods. Also, the sample recoveries in all formulations were in good agreement with their respective label claims and thus suggested the validity of the methods and non-interference of formulation excipients **(Table 7).**

Table 7. Determination of flurbiprofen in pharmaceutical preparationsa.

Method	Commercial Preparation (100 mg)	n	Found (mg) X ± SD	Recovery (%)	RSD [a] (%)	Confidence Interval	F- test
Spectrofluorometry	Majezik	6	99.4 ± 2.53	99.4	2.54	98.2-101.6	
	Frolix	6	100.4 ± 1.864	100.4	1.86	99.8-101.2	
	Maximus	6	100.1 ± 3.043	100.1	3.04	98.9-10134	
	Zero-P	6	99.8 ± 2.742	99.8	2.75	98.5-100.7	
	Fortine	6	100.8 ± 2.64	100.8	2.62	99.4-102.1	4.18[a]
	Majezik	6	101.4 ± 3.235	101.4	3.19	101.2-101.7	
	Frolix	6	100.9 ± 2.896	100.9	2.87	99.9-101.6	
UV	Maximus	6	100.2 ± 3.186	100.2	3.18	98.8-101.4	
	Zero-P	6	101.2 ± 3.764	101.2	3.72	100.5-102.0	
	Fortine	6	99.8 ± 2.360	99.8	2.36	98.4-101.7	

SD: Standard Deviation of six replicate determinations, RSD: Relative Standard Deviation, [a]Average of six replicate determinations, Ho hypothesis: no statistically significant difference exists between five pharmaceutical preparations,
Ho hypothesis is accepted (P>0.05), [a] Theoretical values at P=0.05.

The results show the high reliability and reproducibility of two methods. The results were statistically compared using the F-test. At 95 % confidence level, the calculated F-values do not exceed the theoretical values.

CONCLUSION

The proposed methods were found to be accurate, precise and easy for the determination of flurbiprofen. The medium for dissolving of flurbiprofen is the same at spectrofluorometry and UV analysis. The sample recoveries in a formulation were in good agreement with their respective label claims. No extraction procedure is involved. The apparatus and reagents used seem to be accessible even for the simple laboratories. Therefore, developed methods can be recommended for routine and QC analysis of flurbiprofen.

ACKNOWLEDGMENTS

This study was supported by a Grant from Ataturk University Research Foundation (Project no:2011/296). Also, we are thankful to Kadem Meral (Department of Chemistry, Faculty of Science, Ataturk University, 25240, Erzurum, Turkey) for his help in spectrofluorometric analyses.

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