A spectrophotometric method is described for the determination of several fluoroquinolones as bulk drug and in dosage form by complexation of the drug with chloranilic acid. Job's method revealed a 1:1 complexation between the drug and chloranilic acid. Quantitative recoveries were obtained from bulk drug as well as from commercially available dosage forms.

Fluoroquinolones have found extensive use in therapy because of their wide antibacterial spectrum and are effective against both gram positive and gram negative bacteria. For ciprofloxacin (CFLX) USP and BP, an HPLC method and for norfloxacin (NFLX) assay, a potentiometric titration procedure using 0.1 N perchloric acid is given (USP). A polarographic method for the analysis of enoxacin (ENX) and complexation with ammonium reineckate method for lomefloxacin (LMFX) have been reported. For CFLX in pharmaceutical formulations HPLC method and spectrophotometric method using 1% FeCl₃, p-benzoquinone and 3-methyl benzothiazoline-2-one has been described. A colorimetric determination using 1% FeCl₃ and ion pair colorimetric method for NFLX tablets and capsules respectively, has also been reported. For ENX tablets UV spectrometric method has been described and for LMX tablets HPLC method has been reported. The assay procedure for CFLX, NFLX, ENX and LMFX tablets and CFLX ophthalmic solution is based upon the extraction of drug and subsequent determination of its absorbance. In the present study an attempt has been made to develop a simple and sensitive spectrophotometric method for the assay of various fluoroquinolones viz. CFLX, NFLX, ENX and LMFX as bulk drug and in dosage forms based on the interaction of drug with chloranilic acid to form a 1:1 purple-violet complex.

CFLX, CFLX HCL and LMFX were gift from Max Laboratories (New Delhi), ENX (Parke-Davis, Germany), LMFX and LMFX. HCl pure drug powder was obtained from Sytopic laboratories (Faridabad). CFLX eye drops (CIFRAN, eye drops, Ranbaxy), CFLX(CIFRAN, Ranbaxy), NFLX (NORFLOX, Cipla), ENX (PENETREX, Parke Davis) and LMX (LOMEX, Torrent) tablets were obtained commercially. P-chloranilic acid and other chemicals used were of analytical reagent grade. Chloranilic acid 0.005 M and 0.0025 M solutions were prepared by dissolving p-chloranilic acid in 1,4 - dioxane and stored in a dry, amber colored glass bottle in a dark place and is stable up to 6 weeks. CFLX, NFLX and ENX solutions 0.005 M each were prepared 1, 4-dioxane. Solutions of CFLX. HCl and ENX. Solutions 0.005 M each were prepared in 1, 4 dioxane. Solutions of CFLX. HCl and LMFX HCl. HCl 0.25% w/v were prepared by first dissolving the weighed quantity of salt in water in a separating funnel, alkalinizing it with dilute ammonia and extracting the liberated base with chloroform.

Spectrophotometric measurements were done on Bausch and Lomb Spectronic-21 or on Hitachi Model 150 double beam spectrophotometer using 1 cm² silica cells. For the analysis of ophthalmic solutions, the contents of three bottles containing 3 ml each of 0.3% w/v CFLX. HCl were pooled together. Six ml of the pooled solution was transferred into a 100 ml separating funnel containing about 5 ml water. After alkalinizing with dilute ammonia, the liberated base was extracted with three 3-ml each quantity
of chloroform and each extract was transferred to a 10 ml volumetric flask and the volume made up to mark with chloroform.

For the analysis of five tablets were weighed and crushed to a fine powder in a glass pestle and mortar. An aliquot of the powder equivalent to 250 mg of CFLX, 400 mg ofNFLX, 400 mg of ENX and 400 mg of LMX was weighed and transferred to a 25 ml volumetric flask. In case of CFLX.HCI and LMX.HCI tablets, the tablet powder was suspended in water, alkalinized with dilute ammonia and liberated base was extracted with chloroform. For NFLX and ENX tablets, 1,4-dioxane was used as solvent. The flask was shaken and allowed to stand for 1 h. The clear supernatant solution was used for assay.

For analysis, an aliquot of the assay solution was transferred to a 10 ml volumetric flask and 2 ml of chloranilic acid solution (0.005 M or 0.0025 M) was added and the volume was made to 10 ml with 1,4-dioxane. The absorbance was measured at the corresponding λmax (530 nm for CFLX and LMX and 540 nm for NFLX and ENX) against a blank solution prepared similarly but without any drug. The concentration was read from the calibration curve and percentage recovery was calculated.

In 1,4-dioxane/chloroform medium, the fluoroquinolone drugs under study reacted instantaneously with chloranilic acid to give a purple color indicating the formation of a complex. Chloranilic acid exists in three forms14, the neutral yellow $H_2A$ at very low pH, the dark violet $HA$ which is most stable at pH 2, and the pale violet $A^2$, stable at high pH. It gives purple colour in water, acetonitrile, dimethylformamide and ammonia. As the reaction products in nonaqueous medium are purple it can be concluded that HA interacts with the fluoroquinolones drug to form complexes. Both continuous variation and molar ratio methods showed that a 1:1 complex is being formed as expected from the single donor center in the drugs. Using Benesi-Hildebrandt15 equation the molar absorptivities and association constants for the complex were calculated (Table 1). Plots of absorbance vs concentration were linear in the concentration range shown in Table 1.

Various dosage forms of the drugs were assayed by the proposed method. The recovery values as shown in the Table 2 are based on the amount found and that calculated to be present according to the labelled strength of the product. Pharmaceutical excipients likely to be present in the dosage form e.g. starch, lactose, t alc and magnesium stearate in tablets and buffers, preservatives

<table>
<thead>
<tr>
<th>Drug chloranilic acid complex</th>
<th>Molar absorptivity</th>
<th>Association constant (K)</th>
<th>Concentration range for Beer’s Plot (mg/ml)</th>
<th>Regression coefficient (r)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ciprofloxacin</td>
<td>1.3 x 10³</td>
<td>7.5 x 10²</td>
<td>0.01-0.18</td>
<td>0.9976</td>
</tr>
<tr>
<td>Norfloxacin</td>
<td>1.3 x 10⁴</td>
<td>6.2 x 10³</td>
<td>0.03-0.30</td>
<td>0.9992</td>
</tr>
<tr>
<td>Enoxacin</td>
<td>5.5 x 10³</td>
<td>1.2 x 10²</td>
<td>0.03-0.32</td>
<td>0.9974</td>
</tr>
<tr>
<td>Lomefloxacin</td>
<td>1.35 x 10³</td>
<td>3.0 x 10²</td>
<td>0.01-0.19</td>
<td>0.9994</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bulk drug</th>
<th>Recovery %*</th>
<th>Dosage form</th>
<th>Recovery %!</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFLX</td>
<td>98.17(±1.63)</td>
<td>CFLX tablets</td>
<td>99.16(±2.08)</td>
</tr>
<tr>
<td>CFLX.HCI</td>
<td>98.46(±1.64)</td>
<td>NFLX tablets</td>
<td>98.35(±2.43)</td>
</tr>
<tr>
<td>NFLX</td>
<td>99.10(±1.48)</td>
<td>ENX tablets</td>
<td>98.87(±1.26)</td>
</tr>
<tr>
<td>ENX</td>
<td>97.84(±1.47)</td>
<td>LMX tablets</td>
<td>98.54(±1.37)</td>
</tr>
<tr>
<td>LMX.HCI</td>
<td>97.50(±1.43)</td>
<td>CFLX eye drops</td>
<td>97.89(±1.38)</td>
</tr>
</tbody>
</table>

*Average of minimum 4 determinations (±SD), ! Recovery based on label claim (±S. D.)
in eye drops exhibited no interference during the assay procedure.

The proposed procedure is useful in the routine analysis and quality control of these drugs.

REFERENCES