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Determination of Fexofenadine Using Silver Nanoparticles By Spectrophotometric Method

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Abstract : A new spectrophotometric method is described for determination of fexofenadine (FEX) by using silver nanoparticles. The method based on reduction of silver nitrate by sodium borhydride. The size of nanoparticles increased by increaing of FEX concentration which caused increase in absorbance. Calibration graphs was linear over the range 4.0-52.0 mg/l of FEX. The detection limit was 0.52 mg/l for FEX. The proposed method were suitably applied to assay of pharmaceutical preparations.
Keywords: Silver nanoparticles, Fexofenadine, sodium borhydride.

1. Introduction

Fexofenadine hydrochloride were used in asthma, allergic reactions, allergies, allergen, allergic sinusitis, allergic cough. This is a real world study fexofenadine Hydrochloride drug interactions for a 26 year old female patient who has Asthma, Allergy to Animal Dander[1].

It is usually administered orally. Fexofenadine is indicated for the relief from physical symptoms associated with seasonal allergic rhinitis and treatment of chronic urticaria[2]. One such combination contains 120 mg of Fexofenadine hydrochloride.

Several methods were reported for quantitative determination of FEX by various method such as voltametric[3], capillary electrophoresis[4], spectrophotometry[5,6] and HPLC method using various detectors[7]. The voltametric, capillary electrophoresis and spectrophotometry is very complicated and lengthy.

Silver nanoparticles have unique optical, electrical, and thermal properties and are being incorporated into products that range from photovoltaics to biological and chemical sensors. Examples include conductive inks, pastes and fillers which utilize silver nanoparticles for their high electrical conductivity, stability, and low sintering temperatures. Additional applications include molecular diagnostics and photonic devices, which take advantage of the novel optical properties of these nanomaterials. An increasingly common application is the use of silver nanoparticles for antimicrobial coatings, and many textiles, keyboards, wound dressings, and biomedical devices now contain silver nanoparticles that continuously release a low level of silver ions to provide protection against bacteria[8].

Silver colloids show different colors due to light absorption and scattering in the visible region based on plasmon resonance. The resonance wavelength depends on particle size and shape. Here we report chemical reduction method for preparation of silver nanoparticles exhibiting difference in absorbance in aqueous solutions. Depending on chemical conditions the obtained nanoparticles are different regarding size and morphology[9].

In the proposed method, a simple, rapid, sensitive and selective method has been developed for determination of fexofenadine in pharmaceutical formulation by using silver nanoparticles.

2. Experimental

2.1. Reagents

All chemical and solvents were of analytical reagent grade and were used without further purification. A standard stock solution of FEX (1000.0 mg/l) was prepared by dissolving 0.1g of fexofenadine (Merck) in water and diluting with distilled water to 100.0 ml in volumetric flask. Titrazol buffers (Merck) were used at different pHs for this study.

2.2. Pharmaceutical Products

A commercial tablet product (fexofenadine ® tablet, Deva Pharm.Ind., Turkey, Batch no. 432-1775) is containing 180 mg FEX tablet, was studied .

2.3. Apparatus

All spectral measurements and treatment of data were carried out in 1cm quartz cells using a Perkin-Elmer Lambada 25 double beam spectrophotometer. Measurements of pH were made using a Jenway Model 3510 pH-meter equipped with a glass-saturated calomel combined electrode.

2.4. Procedure

One of the most popular methods to synthesize silver nanoparticles is by the use of ice-cold sodium borohydride to reduce silver nitrate. A large excess of sodium borohydride is needed both to reduce the ionic silver and to stabilize the formed nanoparticles. Add 30 mL of 0.002M sodium borohydride (NaBH4) to anErlenmeyer flask. Add a magnetic stir bar and place the flask in an ice bath on a stir plate. Ice bath is used to slow down the reaction and give better control over final particle size/shape. Stir and cool the liquid for about 20 minutes. Drip 2 mL of 0.001M silver nitrate ($AgNO_3$) into the stirring $NaBH_4$ solution at approximately 1 drop per second. Stop stirring as soon as all of the $AgNO_3$ is added.By mixing both solutions (i.e. NaBH4 and $AgNO_3$), Ag ions were reduced and clustered to form monodispersed Nano particles as a transparent sol in the aqueous medium. Transfer a small portion of the solution to a test tube. The addition of a few drops of 1.5 M sodium chloride (NaCl) solution causes the suspension to turn darker yellow, then grey as the nanoparticles aggregate. The Ag solution became yellow because of absorption at 391nm. Transfer a small portion of the solution to a test tube. Add a drop of 0.3% Polyvinylpyrrolidone (PVP). PVP prevents aggregation. Addition of NaCl solution then has no effect on the colour of the suspension. Add enough solid polyvinyl alcohol (PVA) to give a 4% solution. To get the PVA to dissolve,slowly add it to the stirred, hot, silver colloid solution. Thenpour the mixture into a mould leaving air bubbles and undissolved PVA in the beaker. Evaporate in a toaster oven for about 30 minutes. The silver nitrate reduction reaction can be written as[10].

$$AgNO_3 + NaBH_4 \rightarrow Ag + \tfrac{1}{2} H_2 + \tfrac{1}{2} B_2H_6 + NaNO_3$$

2.5. Analysis of Pharmaceutical Formulations

For preparation of sample, 20 tablets were accurately weighed and powdered in a mortar. A mass corresponding to a tablet was dissolved in 0.1 M HCl in 100 ml calibrated flask. After 30 min of mechanically shaking, the solution was filtrated in a 100 ml calibrated flask through Whatman no: 40 filter paper. The residue was washed three times with 10 ml solvent then the volume was completed to 100 ml with 0.1 M HCl and then was diluted 1:500 with water.

3. Results And Discussion

3.1. Effect of pH

The pH has plays on the formation and silver nanoparticles. The influences of pH of the aqueous solutions on the absorbtion intensity was investigated in the pH range 4-9. Fig. 1 shows that the best absorbance is in pH 8 on on determination of FEX.

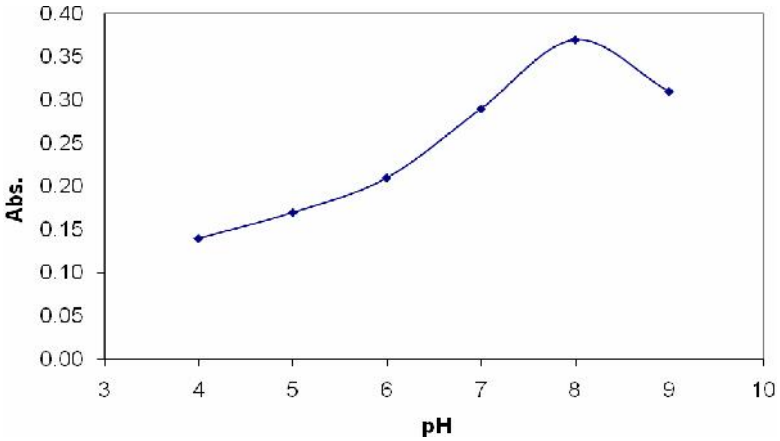

Fig. 1. Effect of pH on the FEX determination by perposed method.

3.2. Absorbtion spectra in the peresence of fexofenadine

For this purpose the absorbtion spectra were achived in the presence of different concentration of FEX in the range of 250-500 nm. As can be seen in Fig. 2 by increasing concentration of FEX, increase the absobance of silver nanoparticles which is due to incerase of particle size of nanoparticles.

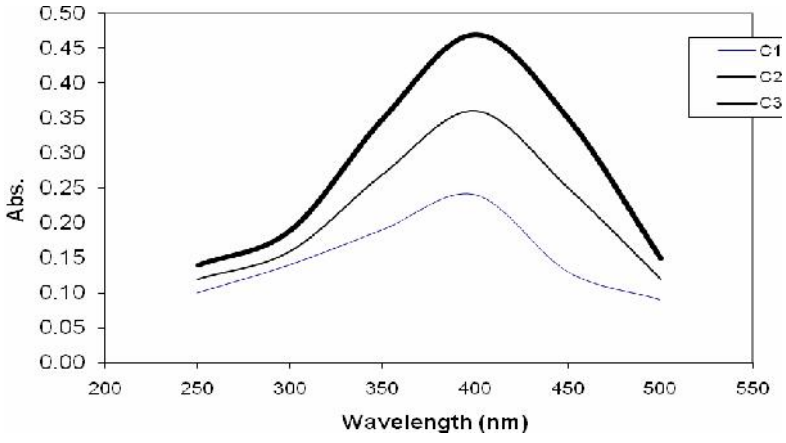

Fig. 2. Effect of concentration of FEX on absorbtion specra, C1=15, C2=30, C3=45 mg/l of FEX.

3.3 Figures of Merritt

The linear range of FEX is 4.0-52.0 and detection limit was obtained 0.54 mg/l. The relative standard deviation achieved was 1.8% for 20 mg/l of FEX (Table. 1).

Table.1. Calibration data for the determination of fexofenadine

Sample	Regression equation	λ (nm)	r	linear range (mg/l)	DL[a] (mg/l)	RSD
FEX	$dA/d\lambda=0.0108C_{FEX}-0.0586$	391	0.9983	4.0-52.0	0.54	1.8[b]

[a] detection limit (DL)=3sb/m
[b] concentartion of FEX=20.0 mg/L

3.3. Application

In order to confirm the usefulness of the proposed spectrophotometric method, it has been applied to the determination of fexofenadine in a sample commercial pharmaceutical where excellent agreement between reported and obtained results was achieved (Table 2).

Table 2: Determination of fexofenadine in pharmeucitical formulation

sample	Reported, Obtained [a,d]		Recovery%
fexofenadine ® tablet, No. 1	180.0	184.0±1.50	96%
fexofenadine ® tablet, No. 1	180.0	173.0±2.21	104%

[a] Mean ± standard deviation (mg) for four determination
[b]After dilution and determination by the proposed method

3.4. Conclusions

Nanotechnology has helped in overcoming the limitations of size and can change the outlook of the world regarding science and can be used for FEX determination. Synthesis of silver nanoparticles has become possible using $NaBH_4$ as a reducing agent and using $AgNO_3$as a reductant. These gave dark yellowish colour when synthesised by a protective layer of borohydride ions. The Ag solution became yellowish in colour because of absorption of wavelength at 391nm. As Silver nanoparticles are very delicate to the absorption of light, they interact with light due to very high dielectric constant that makes the light response occur in the visible region. Thus Silver nanoparticles absorption and scattering properties can be tuned by controlling the particle size, shape, and the local refractive index near the particle surface.

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