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Research Article

Qualitative and Quantitative Determination of Folic acid in Tablets by FTIR Spectroscopy

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Abstract

Qualitative and quantitative determination of chemicals especially that deal with drugs and pharmaceuticals can be considered as important issues in scientific research to insure human safety and security.

With this direction of scientific research, folic acid had been determined qualitatively and quantitatively through applying FTIR technique. By applying a weight range of the pure compound, the obtained results showed several absorption peaks with standard curves that obeyed Lambert-Beer Law. Also, HPLC technique applied and compared with FTIR of different pharmaceuticals in local Iraqi market.

The relative percentage error (E%) and Recovery percentage (Rec. %) results for both methods proved that sampling procedure in FTIR technique for both pure and pharmaceutical samples was more superiority beside simplicity.

Keywords: Folic acid tablets, HPLC and FTIR.

INTRODUCTION

Folic acid is one of the most necessary vitamin B group for the human body, especially for the formation and maturation of red blood cells, an effective treatment for increasing the number of blood cells in the anemia cases (malignant pernicious, during pregnancy, severe megaloblastic) by digging the production of red and white blood cells and platelets[1].

It also has a distinct role in the formation of nucleic acids [2] and split the fetus cells during its first three months of pregnancy beside clear role by protecting the fetus from congenital malformations such as a split skull, occurrence of paralysis, loss of bladder, heart deformation, brain lack, and the fetus death inside the uterus [3].

It also contributes in reducing the proportion of natural histidine as a contributor in arteries clogging and thus helps to prevent strokes and heart diseases[4]. Also, its low concentration in blood increases the incidence of Alzheimer's disease, uterine cancer, liver, pancreas, skindiseases[5].

It is well known [6] that the need for a pregnant woman to folic acid is high (0.8 mg), be less for breastfeeding women (0.6 mg) and in both cases the daily need for adult (0.4 mg) that stored in liver (5-20) mg before small intestine absorption while increasing raises through lactation.

Folic acid can be estimated by several methods [7-16] such as spectral, colorimetric, potentiometric, or chromatographic. Also, Ultraviolet spectroscopy had been used in capsules, tablets, and injections estimations. Potassium permanganate, and Folin – Ciocaleteu had been applied as colorimetric reagents for folic acid determination. Scientific studies proved that the efficiency of coupling reactions in its estimation through the linearity, relative error, relative standard deviation, and recovery results. The trend of many researchers represents in the estimation of folic acid by special chromatographic techniques such as High performance Liquid Chromatography (HPLC) with different separation columns, mobile phases, and sensitive detectors.

The aim of this study was directed to determine folic acid qualitatively and quantitatively in different commercial tablets in Iraqi markets.

MATERIALS AND METHODS

Chemicals: Pure folic acid (Merck) was used without further purification while the commercial tablets were from local Iraqi markets.

- Sample (A):trademarked ACID FOLIC 5, the State Company for Drugs Industry and Medical Appliances, Samarra SDI contains 5 mg of folic acid.
-Sample (B): GALFAR Julphar (Gulf Pharmaceutical Industries) and trademarked Folicum contains 5 mg or 1 mg of folic acid.
- Sample (C): Strides ArcoLab Limited (Lic.No. KD-195), imported by private sectors from theregistered Strides company in Iraqi Ministry of Health and according to what is stated on the product.

These tablets contain different additives in addition to the active ingredient (folic acid) that could be repeated and its presence within the medication or may not mentioned them:Maize starch (dried), colloidal silicon dioxide, microcrystalline cellulose, lactose spray dried, talc (fine powder), E460, and stearic acid (or magnesium streate).

For standard curve, FTIR analysis had been done byapplying several different weights and the extent of (0.5-6.7) mg, according to the efficiency of the balance and the ability of an analyst to adjust the weight and mix all the weight of the unit with pure potassium bromide so that the total weight of the sample (40 mg).As for commercial pharmacological tablets,10 tablets have been crushed, mixed well and then calculated for one tablet(0.1000 mg).

Equipments:

Infrared spectra were recorded using a Fourier Transform Infrared spectrophotometer Shimadzu FTIR-8400, Japan. High Performance Liquid Chromatography was done with LC -2010 A HT Shimadzu, Japan, depending the following conditions: Mobile phase: 100% acetonitrile; Column: ODS C8, 25 cm, 4.6 mm id x 5µL, particle size 3µm; Temperature: room temperature; Flow rate: 1mL / min., Detector: U.V at 210 nm; Volume of Injection: 10 µL.

RESULTS AND DISCUSSION

Pure folic acid (Figure 1) infrared spectrumshowed several identical absorption bands including OH, NH, C=N, C=O agreed with literatures[17]as shown in Table 1. Infrared analysis was conducted pure folic acid weighted (0.5 -6.7) mg then mixed with potassium bromide to obtain total mixed weight (40) mg (Figure -2).Calibration curve obtained from FTIR spectra (Figures 3, 4, and 5) between the weight of folic acid and the absorbance at a specific an frequently wavelength number for all applied weights and comparing the resulted correlation coefficient (r^2) values for calibration curves (Table 2, Figure 2).

Different commercial folic acid tablets in local Iraqi markets had been used to estimate this application of FTIR method. Table -3- shows the obtained results for the United Arab Emirates (UAE), Iraqi, Indian tablets.

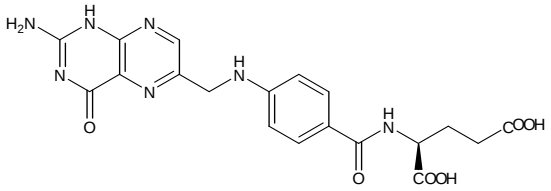


Figure 1
Chemical Structure of Folic acid.

The choice of the appropriated wave number was made after taking into consideration several factors, including selected wave number represents a special and distinctive frequency for a distinct group of folic acid and cannot be presented or repeated by other added materials within the commercial tablet (see experimental part).As well as the consistency issue of the selected wave number of pure folic acid (Note Figure 5) and its presence within the FTIR spectrum, 1693.5 cm^{-1}showed high correlation coefficient (r^2) beside above mentioned bases.

For comparison, well known method stated in scientific researches[7-16]High Performance Liquid Chromatography (HPLC) technique has been applied for pure folic acid within the range of (2.5 - 40) ppm (Figure 7) and different commercial folic acid produced by United Arab Emirates (UAE), Iraqi (SDI), and Indian companies (Figure 8) according to the operating conditions. Figure 9 showed the standard curve for folic acid with HPLC method high correlation coefficient (r^2) value reflected the results accuracy of this method.

Tables 3 and 4 showed that folic acid concentration in United Arab Emirates (UAE) approach in both FTIR and HPLC, but the FTIR method proved more capability in terms of convergence with the real values registered by the companies and E% and Rec.%. The final results of this work showed that the new quantitative method for estimating folic acid using infrared technology are with high efficiency when compared with the standard method adopted in many scientific research, especially modern ones.

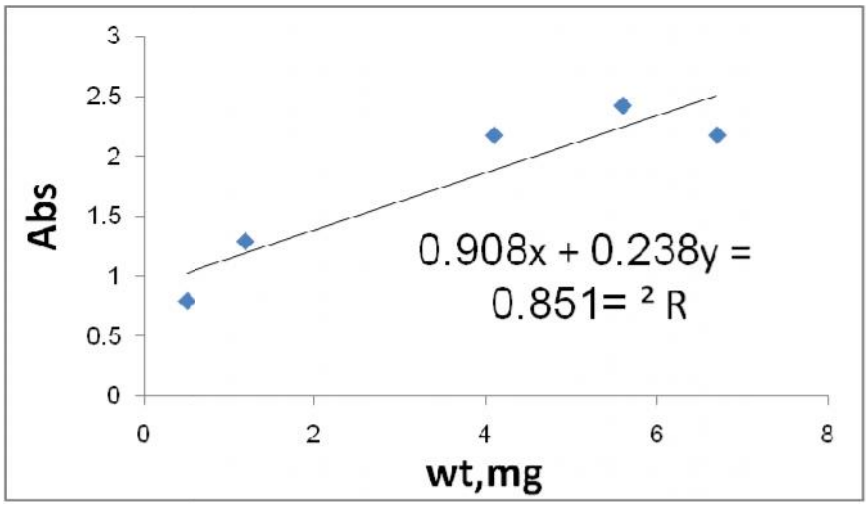


Figure 2
Standard folic acid curve from FTIR at 1693.5 cm^{-1}.

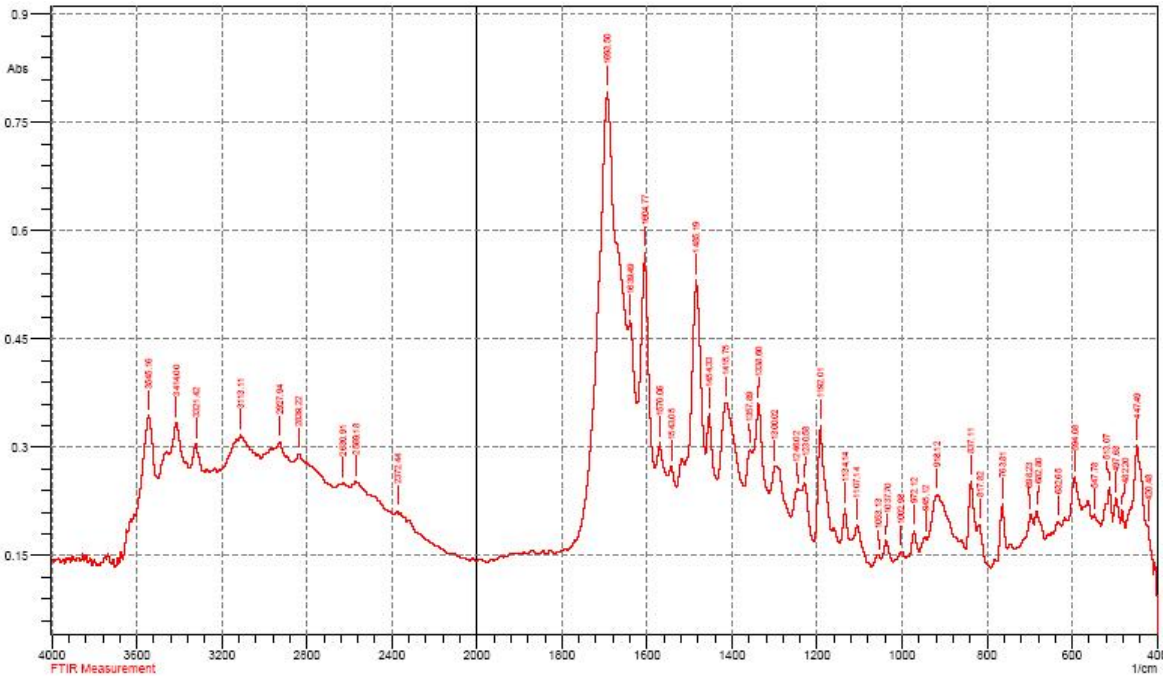


Figure 3
FTIR spectrum of standard folic acid (0.5 mg) (KBr disc).

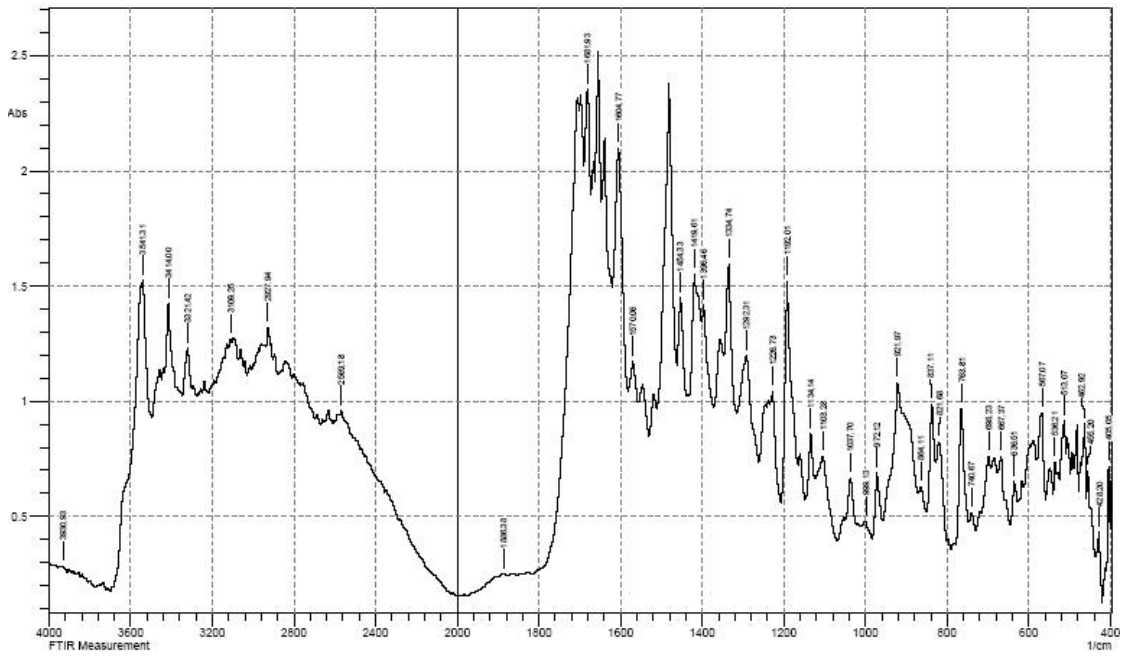


Figure 4
FTIR spectrum of standard folic acid (6.7 mg) (KBr disc).

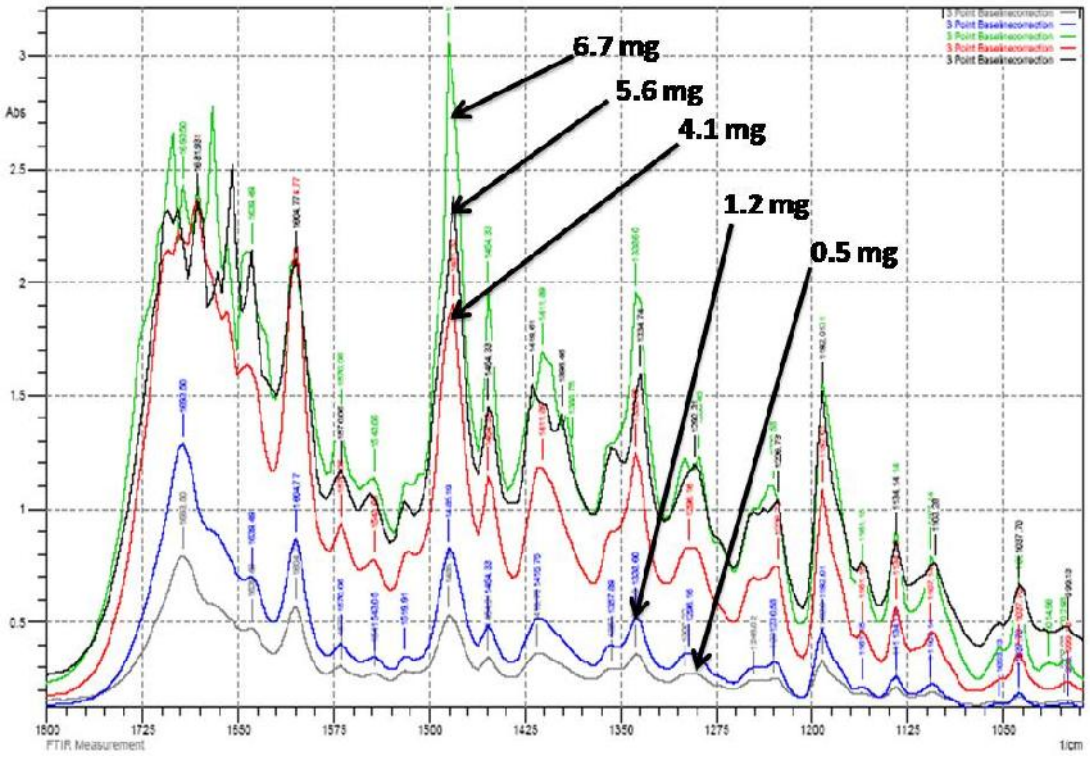


Figure 5
Overlapped FTIR spectra of standard folic acid samples (0.5-6.7)mg (KBr disc).

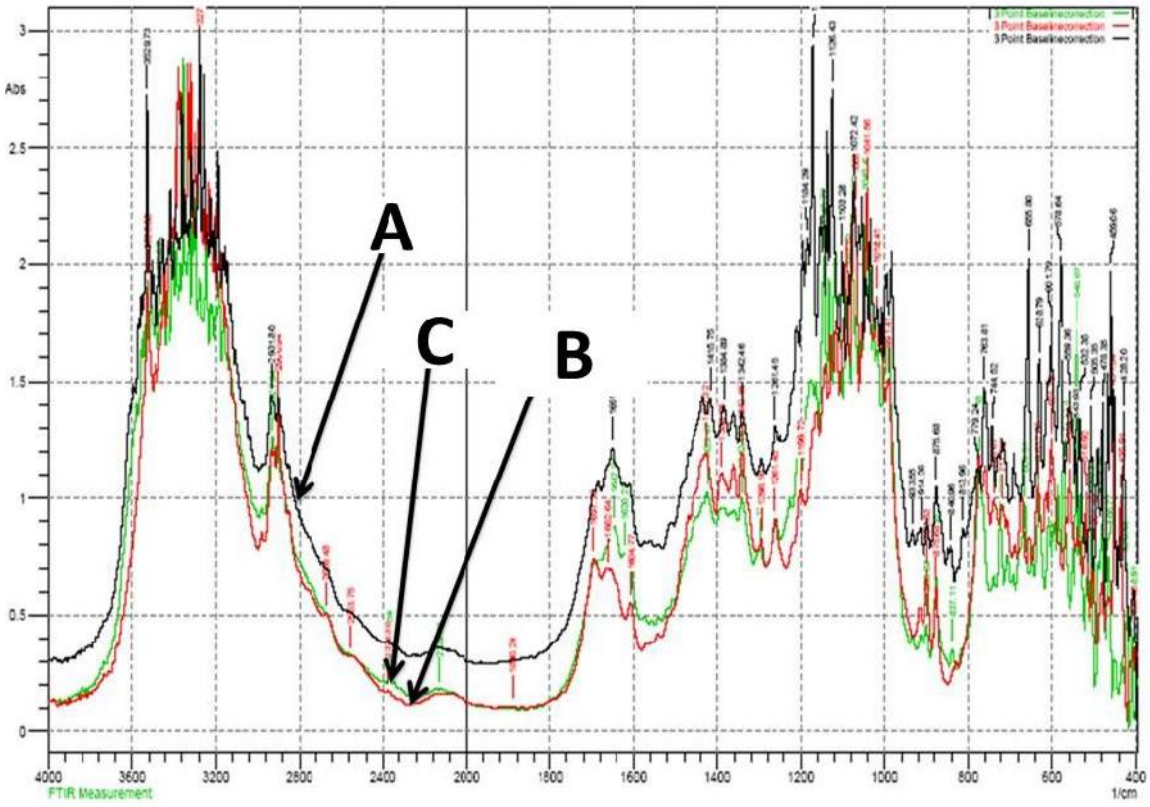


Figure 6
Overlapped FTIR spectra of commercial folic acid samples (KBr disc).

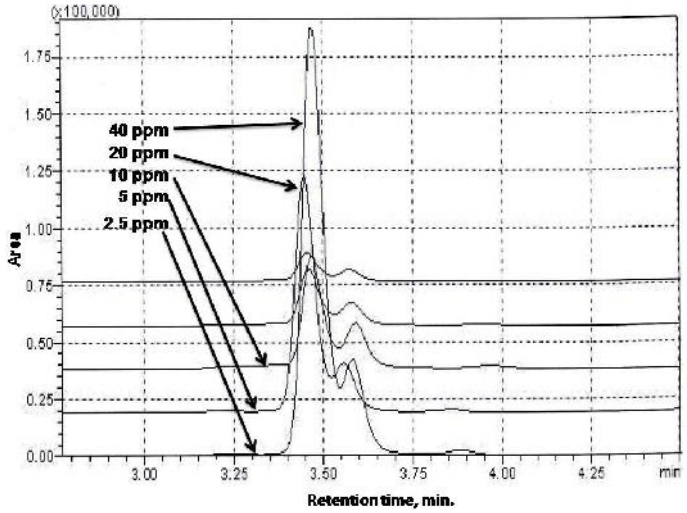


Figure 7
HPLC chromatograms of standard folic acid samples.

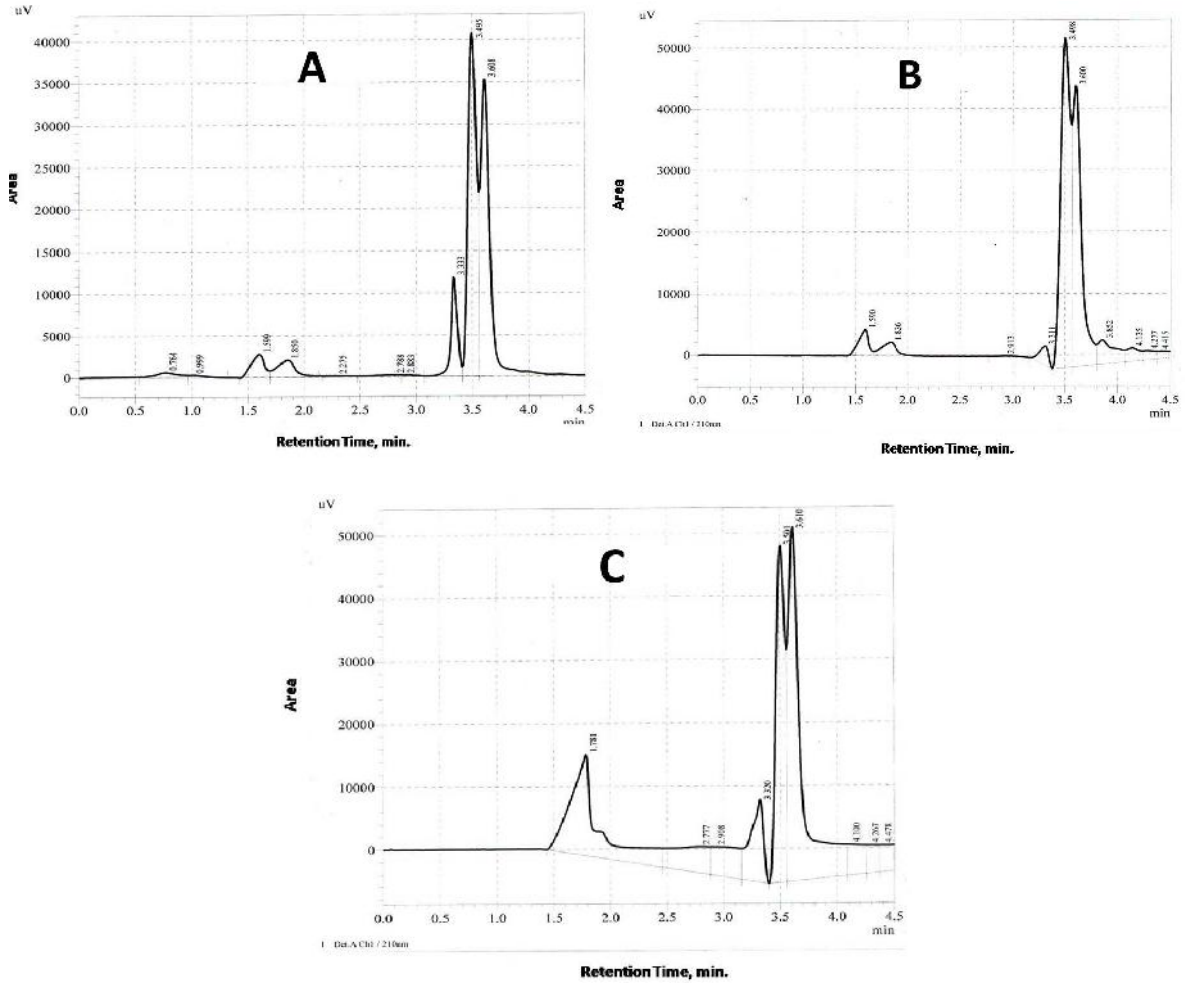
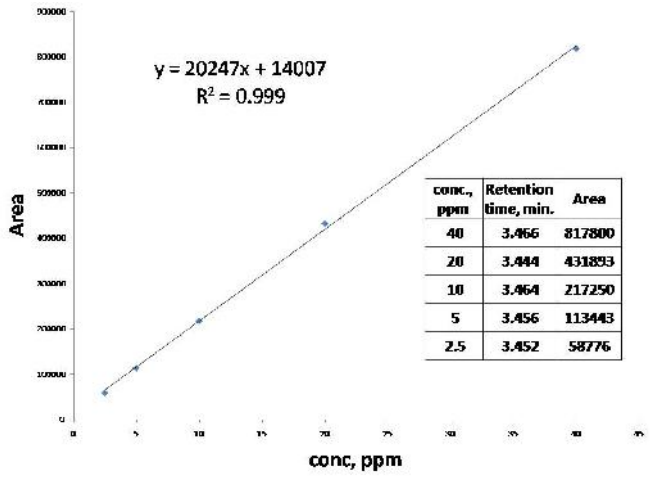


Figure 8
HPLC chromatograms of three commercial folic acid samples (A, B, and C).



conc., ppm	Retention time, min.	Area
40	3.466	817800
20	3.444	431893
10	3.464	217250
5	3.456	113443
2.5	3.452	58776

Figure 9
Standard folic acid curve from HPLC results.

Table 1
FTIR data of standard folic acid (KBr disc).

Wave number, cm^{-1}	FTIR assignment [8]
1485-1519	Phenyl and pterin ring
1604	NH bending
1619	C=C aromatic
1639	C=N
1650	C=O amide
1693	C=O carboxylic
3100-3500	OH carboxylic of glutamic acid moiety and NH group of pterin ring stretching

Table 2
Standard curve results of each wave number values (cm^{-1}).

Wave number, cm^{-1}	Standard curve equation	R^2
1037.7	y = 0.084x + 0.119	0.988
1192.01	y = 0.227x + 0.274	0.934
1415.75	y = 0.195x + 0.292	0.987
1604.77	y = 0.468x + 0.429	0.929
1639.49	y = 0.312x + 0.452	0.918
1693.5	y = 0.238x + 0.908	0.851

Table 3
Results of applied FTIR method.

Sample name	Tablet weight, mg		FTIR results at 1693.5 cm^{-1}		
	Average of one tablet	Applied	Resulted Folic acid, mg	E, %	Rec., %
A	71.9	6.6	5.048	0.96	100.96
B	114	10.6	4.57	-8.566	91.43
C	135.9	13.1	4.74	-5.18	94.81

*Available in one tablet = 5 mg.

Table 4
Results of applied HPLC method.
*Available in one tablet = 5 mg.

Table source	Tablet weight, mg		HPLC results at 3.4 min. as a retention time		
	Average of one tablet	Applied	Resulted Folic acid, mg	E, %	Rec., %
A	71.9	6.6	2.72	-45.41	54.58
B	114	10.6	4.45	-10.97	89.03
C	135.9	13.1	2.71	-45.70	54.30

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