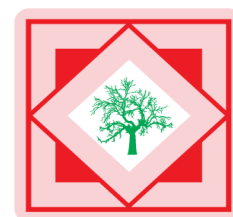




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### Effects of variables on degradation of folic acid

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#### ABSTRACT

*Folic acid, a member of vitamin B group is used in many medical disorders. The study aimed at investigating the onset and extent of degradation of folic acid from treatments of acids, alkalis and ultraviolet (UV) radiations. Solutions of folic acid were prepared in dilute acid (0.1N HCl) and alkali (0.1N NaOH) as well as powdered folic acid placed under UV light. The three treatments were allowed for 5 hrs. The results showed that acidic solution (pH 4.2) has faster onset and highest extent of degradation followed by UV then alkali treatment. All the variables have effects on folic acid degradation, hence the need to take precaution of storage condition of folic acid tablets and powders as well as ingredients to be used in formulation or compounding folic acid syrup.*

**Key words:** folic acid, acid, alkali, UV radiation, degradation.

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#### INTRODUCTION

Folic acid is a member of the vitamin B group; it is a yellow crystal with a molecular weight of 441.4. It has limited solubility in water, but is soluble in acidic and alkaline solutions and insoluble in organic solvents [1]. Folic acid is more stable in alkaline than acidic conditions, thus standards for folic acid derivatives are prepared in basic solution [2]. Chemically folic acid is made up of a bicyclic pterin linked by a methylene bridge (C9–N10) to para-aminobenzoic acid (pABA), which is joined by peptide linkage to a single molecule of L-glutamic acid, also called pteroylglutamic acid. The pteridine moiety of folates can exist in either oxidized or reduced states. There may be a one-carbon substituent group present in N5 or N10 positions of tetrahydrofolic acid, resulting in a number of folate derivatives [3].

Folic acid is present in many foods, partly as free folic acid but chiefly conjugated with several glutamic acid residues. It is vital for important biochemical processes like DNA synthesis and repair [4]. Deficiency of folic acid was reported to cause megaloblastic anemia, Alzheimer's disease [5], infertility in males [6], mood disorders [7], pregnancy complication [8], Downs syndrome [9] and many kinds of cancer [10]. The majority sources of folates are green leafy vegetables, liver, beans and legumes, egg yolk, wheat germ and yeast [3]. Folic acid is a photosensitive compound [11] and is degraded in aqueous solution by sunlight ultraviolet light and visible light to various products [12]. The study therefore, investigated the onset and extent of degradation of folic acid when treated with acid, alkali and ultraviolet radiation.

### MATERIALS AND METHODS

Folic acid powder, sodium hydroxide, ammonium solution, hydrochloric acid, sodium nitrate, potassium per manganate and ammonium sulphate were purchased from commercial source and are all Analar grade.

#### Method

A 0.001%w/v stock solution of folic acid powder in 0.1N NaOH was prepared for calibration curve. The stock solution was diluted to give concentration of 0.0005, 0.00025, 0.000125 and 0.0000625%w/v. The absorbances of the different concentrations of folic acid were measured using spectrophotometer (Beckmann and Coulter) at 283 $\mu$ m.

Fifty (50) gram of folic acid powder was weighed into a beaker clamped under UV light. An ultraviolet (UV) lamp (previously switched on for 30 mins to warm up as stated by the manufacturer) was clamped above the beaker containing the folic acid powder. The powder was stirred continuously using the magnetic stirrer. The powder was allowed to stay under the UV lamp for 5 hours. At specific interval (1 hr) 5g was removed for assay of folic acid. Three hundred (300) milliliters of 0.001%w/v folic acid in 0.1N HCl was prepared, the solution was divided into 3 portions. Using phosphate buffer the solutions were adjusted to pH 4.2, 5.4 and 6.4 respectively. Another 200ml of 0.001%w/v folic acid in 0.1N NaOH was prepared, 100ml each was adjusted to pH 7.4 and 8.2 respectively. The solutions were kept in cool place away from light for 5 hrs. At 1 hr interval 15ml of the solutions were withdrawn for spectrophotometric determinations.

The untreated and treated folic acids were withdrawn at an hour interval and scanned using spectrophotometer at varying wavelength from 240 – 400  $\mu$ m.

### RESULTS AND DISCUSSION

The absorbance of both 1hr UV treated and untreated folic acid is shown in figure 1, the UV treated folic acid has higher absorbance at each wavelength hence lower concentration, particularly at peaks 258, 283 and 368 $\mu$ m respectively. This higher absorbance observed with UV treated folic acid could be as a result of electron transition between orbitals as explained by Bohr's theory. According to the theory, energy sources like heat or light can cause promotion of electron from one orbital (ground state orbital) to a higher orbital in molecule of any substance. Thus the molecule becomes excited and the excited molecule may give up the excess energy and

drops back to the lower level. If this occurs, the energy is given off in the form of heat or light, the latter known as fluorescence. Folic acid molecule after excitation with UV light instead of dropping back to lower level with subsequent emission of heat or light. The molecules disintegrate into fluorescent products.

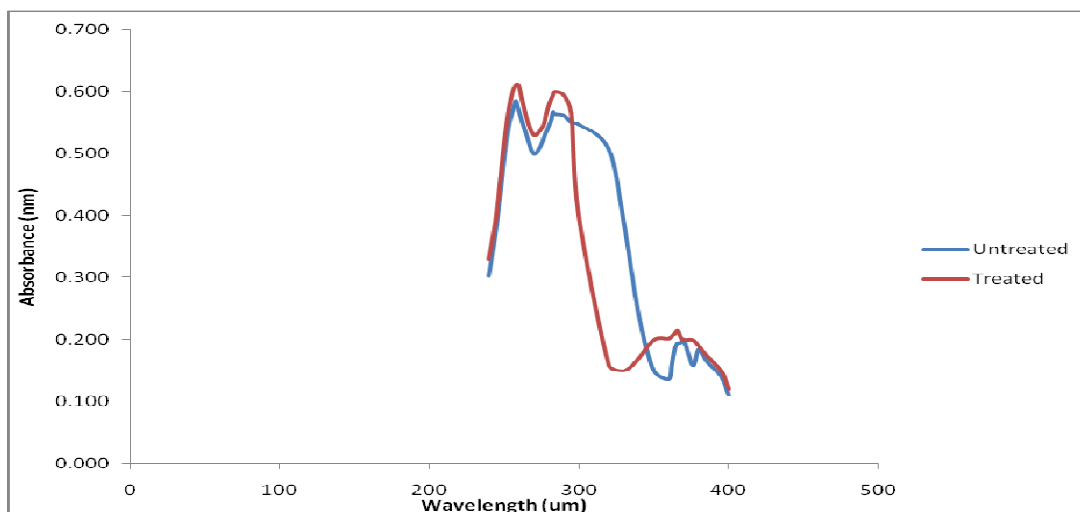


Figure 1: plots of absorbance vs. wavelength of 1hr UV treated and untreated folic acid.

Moreover, Hydroxyl radicals have been found to cause oxidative N-dealkylation of amines including folic acid via a hydrogen atom transfer mechanism [13]. One of the important examples of this biochemical reaction is the C9–N10 bond cleavage of folic acid leading to the formation of the amine 2 and 6-substituted pterins.

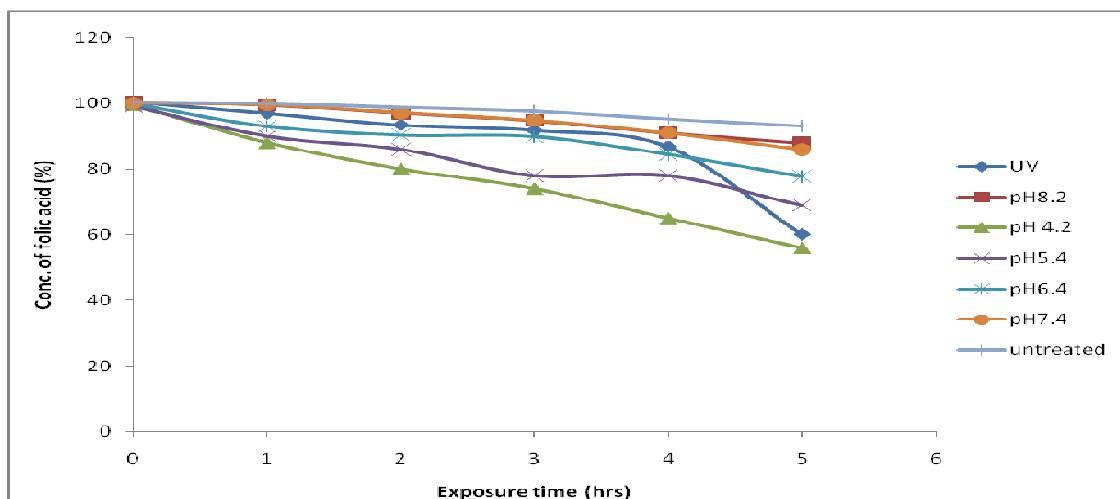


Figure 2: percentage of folic acid after treatment with UV, acid and alkali.

The untreated folic acid has both lowest onset and extent of degradation. The result showed that the lower the pH the higher the onset of degradation of folic acid up to neutral pH. Further increase above neutral pH, (increased alkalinity) lead to increased onset and extent of degradation, which was found to be consistent with an earlier work reported[2]. UV radiation

(figure 2) showed slower onset than acidic pH but higher degradation was observed especially at 5 hr exposure.

All the treated folic acid formulations showed similar pattern of degradation with increased exposure time, however, solution at pH 4.2 has the highest onset of degradation. At 5 hr exposure, folic acid solution at pH 4.2 was the most degraded when compared with UV radiation and alkali treated folic acid.

### CONCLUSION

Acid, alkali and UV all have effects on degradation of folic acid. The onset and extent of degradation was acid>UV>alkali. Therefore all folic acid preparations should be kept in containers resistant to UV penetration. When formulating folic acid or compounding folic acid syrup from tablets for paediatric use, formulators should note the ingredients and vehicles to be used especially those that may decrease pH such as citric acid, vitamin C *et.c.*

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