Iraqi National Journal of Chemistry

Journal homepage:
http://iqnjc.com/Default.aspx

Facile and sensitive Spectrophotometric Determination of Lidocaine in Pharmaceutical preparations and Environmental wastewater samples

Alaa Ali Hussein*

***College of Education for Girls, Dept. of Chemistry, Univ. of Mosul-Iraq**

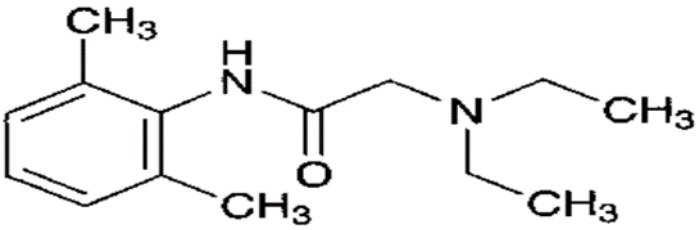
Abstract

A rapid, accurate, precise, simple, economical, and sensitive UV spectrophotometric approach was devised to determine the amount of lidocaine present in pharmaceutical preparations and environmental wastewater samples. This approach exhibits maximum absorbance at 265 nm in 0.1MHCl. Beer's law was followed between 0.05 and 0.7mg/ml. The technique's molar absorptivity has been 45 ×104L.mol-1.cm-1, its relative standard deviation has been no more than 1.0%, and its accuracy (avg. recovery percentage) has been 100 ± 1.10. Lidocaine concentrations in pharmaceutical formulations (ointments) and samples of industrial wastewater were successfully determined using this methodology. Precision and sensitivity tests were used to validate the suggested approach, demonstrating its applicability for routine Lidocaine measurement in real samples.

Keywords: Lidocaine, Spectrophotometry, Pharmaceutical Preparations, Environmental wastewater samples.

Introduction:

Lidocaine, a crystalline powder that is white, nearly white, or slightly yellow, having a distinct odor, 66° to 70° M.P. Extremely soluble in alcohol, chloroform, and dichloromethane; easily soluble in benzene and ether; almost insoluble in water; dissolves in oils. 2-Diethylamino-N-(2,6-di-methylphenyl) acetamide is referred to as lidocaine. Fig [1] By preventing the sensation of pain, lidocaine works as a local anesthetic by obstructing the transmission of peripheral nerve impulses. [1-3] Lignocaine, a local anesthetic of the amide type, numbs the tissues in a specific area [4]. A literature survey revealed that numerous approaches had been published for



C14H22N2O= 234.34

2-Diethylamino-N-(2,6-di-methylphenyl) acetamide.

Figure 1:- Chemical structure of Lidocaine.

Lidocaine's quantitative analysis, both in combination with other drugs and alone, could be done using spectrophotometric methods, electro-analytical approach, gas chromatography approach, official titrimetric approach, selective membrane electrode approach, capillary electrophoresis approach, LC-MS/MS approach, HPLC-MS/MS approach, spectrophotometric approach, and HPLC [5,6,7, 8], which could be utilized for drug determination, quality control of the final product, and control during the whole drug manufacturing process,. Its advantages include reproducibility, speed, accuracy, sensitivity, and selectivity. This research describes creating a novel UV technique to measure lidocaine in environmental water samples and ointments.

Experimental

Apparatus

Absorption was measured using a Shimadzu UV1700 pharmaspec (double beam) spectrophotometer equipped with 1.0cm quartz cells.

Reagents

Every chemical utilized was of pharmaceutical or analytical grade, and AL-hakama firm supplied the Lidocaine standard material for the Pharmaceutical Industries (HPI) in Mosul, Iraq. HCL: 0.1M was utilized as a solvent. Lidocaine standard solution: 50ppm.In a calibrated flask, 5 mg of lidocaine was dissolved in 100 ml of 0.1M HCl to create this solution.

Determination of absorption maxima

A scan of the standard Lidocaine solution (0.4 mg/ml) in the 220-300 nm range revealed peaks at 265 nm (Figure 2). Consequently, a wavelength of 265 nm was chosen for the calibration curve's creation.

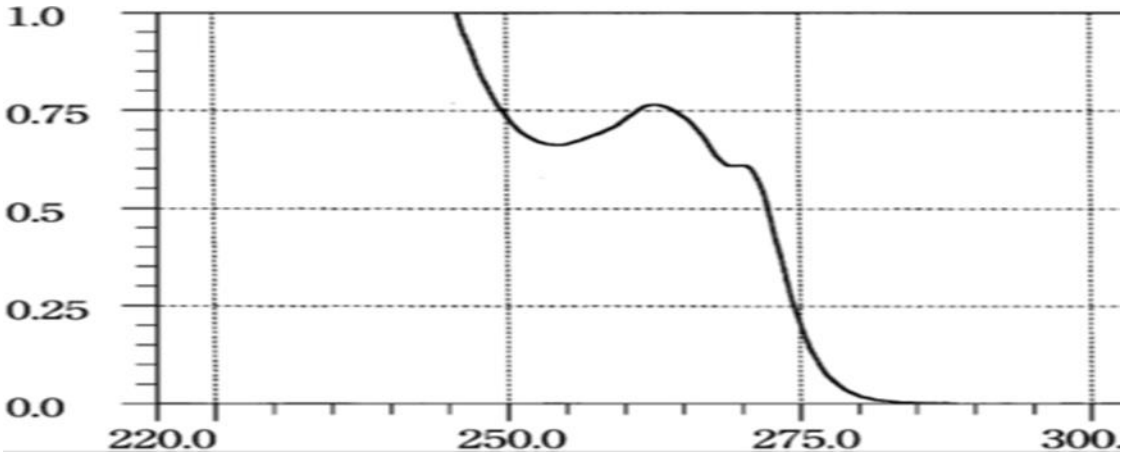


Figure2:-Absorption spectra of Lidocaine [0.4mg/ml] against blank

Recommended process

A calibration curve was created from the absorption maxima in a 0.05–0.7mg/ml concentration range. At 265 nm, the absorbance has been measured using 0.1M HCL as a blank. The calibration curve could be used to calculate the sample solution's concentration.

Procedures for pharmaceutical preparations (ointments)

In a 125-ml separating funnel, disperse a portion of the ointment containing 5% gm of lidocaine in 50 ml of 0.1M HCL. Shake gently for 20 mins while heating the contents over a water bath (40–60 degrees Celsius). After separating the layers, move the lower layer to a 50ml flask. 2 x 10ml of 0.1M HCL should be used to repeat the extraction. To obtain a 0.5 mg/ml solution, dilute the combined extracts to 100 ml using 0.1M HCL. Utilizing 0.1MHCl as a blank, measure the absorbance level at 265nm. The concentration was computed using the curve of calibration of such an approach.

Process for real water samples

Real water samples have been evaluated using this approach to show its practical application. AL-hakama Co. for pharmaceutical industries (HPI) in Mosul, IQ, had fortified its industrial wastewater with lidocaine at quantities ranging from 0.1 to 0.6 mg/ml. The above-mentioned recommended process was followed to analyze the fortified water samples, and the calibration curve regarding such an approach was utilized to determine the concentration.

Result and Discussion

UV- Vis. spectrophotometry is still considered an affordable and practical way to determine pharmaceuticals [15, 16]. It was discovered that the technique for measuring lidocaine in environmental wastewater samples and pharmaceutical formulations was sensitive, straightforward, repeatable, and accurate. In Fig 3, the 0.05-0.7mg/ml concentration range has been found to comply with Beer's law, as indicated by a 0.9997 correlation coefficient, 1.9484

slope, and intercept of 0.0142. It was discovered that the conditional molar absorptivity was 45x104 l/mol.cm.

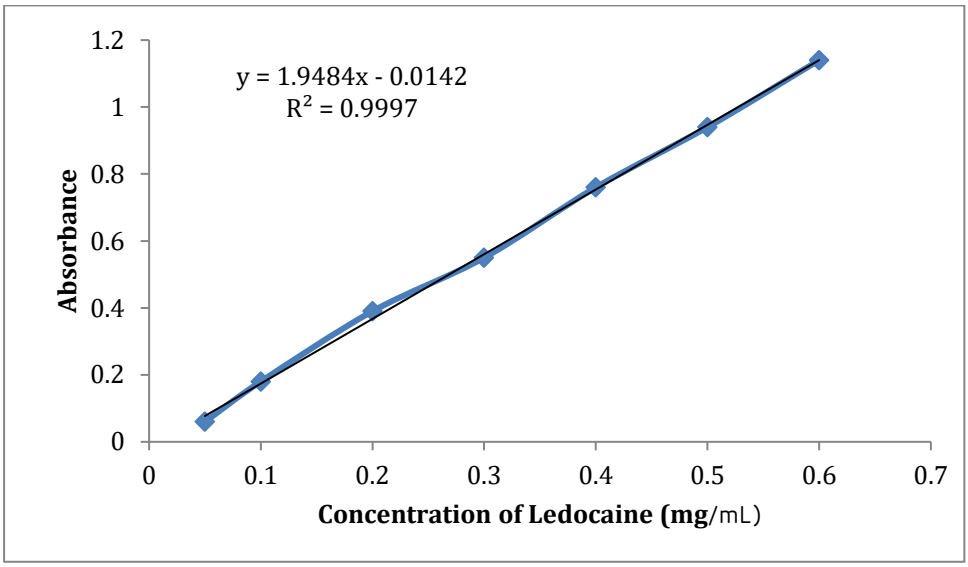


Figure 2: Calibration graph of lidocaine

A pure drug solution has been examined at 3 distinct concentration levels, with every determination made 6 times, to test the approach's precision and accuracy. Table 1 summarizes the relative error (%) and relative standard deviation figures. Table 1 shows that the recovery studies have been nearly 100% and that the standard deviation values were acceptable. The approach has high accuracy when the RSD% figure is less than 1.4.

Table[I]: Precision and Accuracy levels of the proposed approach.

Lidocaine taken)mg/ml)	Er (%)[a]	RSD(%)
0.3	1.1	1.36
0.5	0.9	1.1
0.6	1.0	1.35

a: Mean of six determinations

The standard deviation of intercepts (σ) as well as mean calibration curve slope(s) have been used to compute limits of quantitation (LOQ) and detection (LOD). $0.024x10^{-3}$ mg/ml was the LOD (3.3σ/s) and $0.072x10^{-3}$ mg/ml was the LOQ (10.1σ/s). [17]. Table compiles the outcomes [2].

Table [2]: Statistical data and optical characteristics for regression equation of suggested approach

Parameter	Value
λ_{max} (nm)	265
Beer´s law limit ($mg.ml^{-1}$)	0.05-0.7
Molar absorptivity ($l.mol^{-1}cm^{-1}$)	45×10^4
Coefficient of Correlation (r^2)	0.9997
Regression eq. (Y= a × + b)	
Slope (a)	1.9484
Intercept (b)	- 0.0142
Recovery %	100±1.1
Relative standard deviation (%)	± 1.4
LOD, (µg\ml)	0.024µg/ml
LOQ, (µg\ml)	0.072µg/ml

Analytical application

The pharmaceutical preparation assay reveals close agreement between results acquired through the suggested approach, and the label claim Table and water specimen results confirm that the suggested approach has been applied satisfactorily to determine lidocaine in its pharmaceutical preparations samples of waste-water and ointments. The recovery values acquired have been close to 100%, as Table 4 illustrates.

Table [3]: Determination of Lidocaine formulations

Pharmaceutical formulations	Proposed method found*	Label amount
Lidocaine ointment (NDI)	**4.97%**	**5%**
Xylocaine ointment (HPI)	**5.04%**	**5%**

***Mean of 10 determinations**

Table 4: Determination of Lidocaine in samples of industrial waste-water

Waste-water samples	Added mg/ml	s	Recovery %(n=10)
Industrial waste-water	0. 10	0. 101	101
	0. 40	0. 401	100. 25
	0.60	0.6015	100. 25

*** Mean value of 10 determinations.**

Conclusion

It is discovered that the developed approach is highly accurate, sensitive, precise, straightforward, and cost-effective. It may be applied to routine quality control analyses of environmental wastewater samples, pure lidocaine samples, and pharmaceutical formulations.

Acknowledgment

The authors would like to express their thanks to AL-hakama, the company for pharmaceutical industries, and the state company of medical appliance and drug industries, Ninavah (HPI and NDI) Mosul, Iraq, for granting permission and providing facilities to conduct this work, as well as for providing gift samples of pharmaceutical preparation and Lidocaine standard materials.

References

1.Sean Sweetman;Martindale "The Extra Pharmacopeia -The Complete Drug Reference"35 Edn pharmaceutical press, London,2007, P. 1862

2.British National Formulary (BNF)2009,58,P. 86

3.British pharmacopoeia,H.M.Stationery office,London,UK, 2014, P.. II-108

4. Hanif, S.; Sarfraz, R.M.; Syed, M.A.; Mahmood, A.; Hussain, Z. Smart mucoadhesive buccal chitosan/HPMC scaffold for sore throat: In vitro, ex vivo and pharmacokinetic profiling in humans: J. Drug Deliv.Sci.Technol.2022, 71, 103271.

5. Chen, L., Simultaneous determination of nikethamide and lidocaine in human blood and cerebrospinal fluid by high performance liquid chromatography, Journal of Pharmaceutical and Biomedical Analysis, 2007, 43 (5), 1757–1762.

6. Kang, L., Jun, H. W., Macall, J. W.; HPLC assay of lidocaine in plasma with solid phase extration and UV detection. J. Pharm. Biomed. Anal, Amsterdam,1999, 19, p. 737-745,

7. Ter Weijden, E.; Van den Broek, M.P.H.; Ververs, F.F.T. Easy and fast LC–MS/MS determination of lidocaine and MEGX in plasma for therapeutic drug monitoring in neonates with seizures. J. Chromatogr. B 2012, 881, 111–114.

8. Ingle, S.; Tegeli, V.; Birajdar, A.; Matole, V.; Adlinge, S.; Nangare, G.:UV Spectrophotometric Method Development and Validation of Lignocaine Hydrochloride in Bulk and Semisolid Dosage Form. Res. J. Pharm. Technol. 2021, 14, 5280–5282.

9. Chik, Z.; Johnston, A.; Tucker, A.T.; Burn, R.T.; Perrett, D. Validation and application of capillary electrophoresis for the analysis of lidocaine in a skin tape stripping study. Biomed. Chromatogr. 2007, 21, 775–779.

10. The Japanese Pharmacopoeia,14th edn, English Version, The Ministry of

Health, Labor and Welfare,, 2011,p1035.

11. Grigoriev A., Nikitina A., Yaroshenko I., Sidorova A. Development of a HPLC-MS/MS method for the simultaneous determination of nifedipine and lidocaine in human plasma. J. Pharm. Biomed. Anal. 2016;131:13–19.

12. Marakkarakath, H.C.; Bannimath, G.; Raikar, P.P. Simultaneous estimation of lidocaine and prilocaine in topical cream by green gas chromatography: J. Appl. Pharm. Sci. 2019, 9, 66-72.

13. Oliveira, R.; Salazar B.G.; Ferreira, V.; Oliveira, S.; Avaca, L. Electroanalytical determination of lidocaine in pharmaceutical preparations using boron-doped diamond electrodes. Electroanalysis. 2007, 19, 1189–1194.

14. Giahi, M.; Pournaghdy, M.; Rakhshaee, R. A new lidocaine-selective membrane electrode based on its sulfathiazole ion-pair. J. Anal. Chem. 2009, 64, 195–200.

15. Alaa Ali Hussein,Nief Rahman Ahmed,Rawya Nathem Rashed,; Ultra Violet estimation of Promethazine HCl in Pharmaceutical Formulation and Industrial Waste Water Sample,; Eurasian Chem. Commun. 2023, 5(5),404-410

16. Nief Rahman Ahmed, Alaa Ali Hussein and Rawya Nathem Rashed, Indirect Determination of Diphenhydramine hydrochloride in Wastewater and Pharmaceutical Preparations, European Journal of Biomedical and Pharmaceutical Sciences,2022;9(3):43-47

17. Nief Rahman Ahmed,' High Performance Liquid Chromatographic Method for Determination of Tadalafil in Tablets and Wastewater, Iraqi Journal of Pharmacy, 2014, 14(1),87-94