RESEARCH ARTICLE

Zero-crossing Derivative Spectrophotometry for Simultaneous Determination of Amoxicillin and Diazepam

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Received: 3rd March, 2021; Revised: 09th June, 2021; Accepted: 20th July, 2021; Available Online: 25th September, 2021

ABSTRACT

An unpretentious, cheap, and perfect spectrophotometric technique institute advanced for synchronous placement of amoxicillin and diazepam in the mixture contend them utilization first and second zero-crossing derivative technique. First zero-crossing derivative technique (D1) amplitudes at 238 and 285 nm and amoxicillin at 227, 258, 273, 344, and 384 nm for diazepam. The second zero-crossing derivative (D2) amplitudes at 249.5 nm for amoxicillin and 222.5, 238, 264.5, and 383 nm for diazepam. The linearity was recognized over the variety of (10–150 mg/L) and (1–40 mg/L) for amoxicillin and diazepam, and correlation coefficients R2 are estimated. The accuracy and precision of the determination method of amoxicillin and diazepam were evaluated. The method has been successfully applied to estimate amoxicillin and diazepam in their mixtures.

Keywords: Amoxicillin, Diazepam, Simultaneous determination, Zero-crossing Derivative spectroscopy.

International Journal of Drug Delivery Technology (2021); DOI: 10.25258/ijddt.11.3.21

How to cite this article: Al-Khalisy RS, Khalaf HS, Darweesh SA. Zero-crossing Derivative Spectrophotometry for Simultaneous Determination of Amoxicillin and Diazepam. International Journal of Drug Delivery Technology. 2021;11(3):782-786.

Source of support: Nil.

Conflict of interest: None

INTRODUCTION

Amoxicillin generally applied β-lactam antibiotic for the therapy of bacterial contagions like gullet, epidermis, snoot, ear, and the lower respiratory region produced by inclined microorganisms.[1]

Diazepam is a chief complex usually employed therapeutically for its calming, relaxant, sleepy, and anticonvulsant features.[2]

The HPLC method,[1,3-5] A 2D ultra-high performance liquid chromatography and multiple sclerosis (HPLC-MS/MS) method,[6] Spectrophotometric,[7] Electrochemical platforms,[8] Voltammetry methods,[9] Cloud Point Extraction,[10] have been reported in the literature for the estimation of amoxicillin.

Otherwise, several paper characterized the estimation of Diazepam such as spectrophotometric,[11,12] HPLC,[13,14] liquid chromatography,[15,16] electrochemical determination,[17,18] voltammetry,[19,20] flow injection.[21]

EXPERIMENTAL

Instruments

UV-Visible double beam spectrophotometer - shimadzu (with 10 mm quartz cell) 1800 and Windows 10 computer (HP).

Chemicals and Reagents

Pharmaceutical grade Amoxicillin and Diazepam (99.99%) were receipts from the "State Company for Drug Industries and Medical Appliances Samara-Iraq (SDI)", Panreac supplied hydrochloric acid (99.9%).

Preparation of Standard Amoxicillin and Diazepam Solution

The exact weighted (15 mg of pure drug) was dissolved in 1–2 mL (1 M hydrochloric acid) then diluted to 100 mL with distilled water to make the standard solution (150 mg/L) of amoxicillin and diazepam (Figures 1 and 2), the standard solution prepared by diluting the stock solution with distilled water.

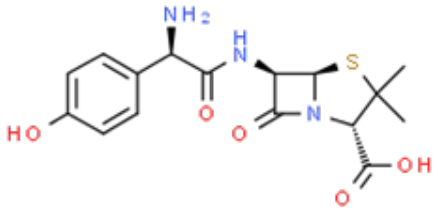

Figure 1: Amoxicillin chemical structure

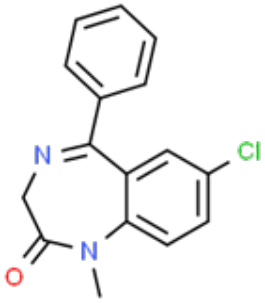

Figure 2: Diazepam chemical structure.

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Preparation of Amoxicillin Mixtures General Procedures

A total of 20 and 60 mL of (100 mg/L) Amoxicillin solution were transferred respectively with 3 mL (100 mg/L) Diazepam in 100 mL volumetric flask, and then the mixture was completed by distilled water. The spectrum was recorded. The zero-crossing derivative technique was then employed to change its to D1 and D2.

Preparation of Diazepam Mixtures General Procedures

A total of 10 and 25 mL of (100 mg/L) Amoxicillin solution were transferred respectively with 10 mL (100 mg/L) Diazepam in 100 mL volumetric flask, then the mixture was completed by distilled water. The spectrum was recorded. zero-crossing derivative technique was then employed to get its D1 and D2.

RESULTS AND DISCUSSION

The Maximum Wavelength Absorption (µMAX)

The µMAX. of amoxicillin was at 230 nm, and for diazepam was at 239 nm. Figure 3 shows all the absorption spectrum.

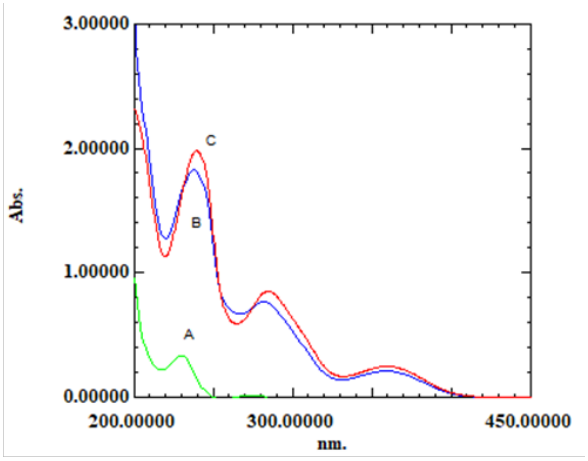

Figure 3 : Absorption spectra of;[A] 20 mg/LAmoxicillin, [B] 20 mg/LDiazepam and [C] a mixture of 10 mg/LAmoxicillin and 20 mg/LDiazepam.

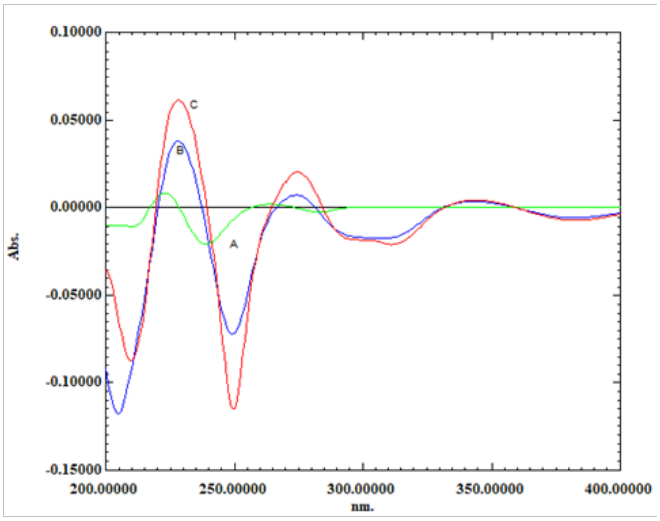

Figure 4: D1 of [A] 20 mg/L Amoxicillin, [B] 20 mg/L Diazepam and [C] A mixture of 10 mg/L Amoxicillin and 20 mg/L Diazepam.

First and Second Derivative Modes

When amoxicillin and diazepam exist in the selfsame solution, the spectrum overlaps so; they cannot estimate using absorption mensuration. For this cause, the D1 and D2 has the feature that it can conceal overlap in the zero-order spectrum. D1 and D2 (shown in the order in Figures 4 and 5) are enough because they permit rise amplitude with good spectra shape.

Calibration Curves for Amoxicillin and Diazepam

The calibration curves were built by drawing the graphically estimated (nm) amplitudes at the specified (µ) for D1 and D2 spectra against the matching concentrations (10–150 mg/L amoxicillin) and (1–40 mg/L diazepam) Figures 6 and 7. Figures 8 and 9 shows D1 and D2 spectra of studied medicines. Table 1 reviews all the results for amoxicillin and diazepam examination by D1 and D2.

Accuracy and Precision

To discuss the suggested technique's accuracy, the relative error percentage was executed for three duplicate testes of two various concentrations of every medication (with Beer's law). To find the precision of the technique, two medication solutions were analyzed every three times for both D1 and D2, and the percent coefficient of variation was estimated, Table 2 listed all scores.

Application in Amoxicillin and Diazepam Mixture

To estimate the competence of D1 and D2 in the estimation of amoxicillin and diazepam medication, zero crossing D1 and D2 were application for amoxicillin in a mixture containing 20 and 60 mg/L in existence 3 mg/L diazepam. Diazepam in mixture contains 10 and 25 mg/L in existence 10 mg/L amoxicillin. Pretty recovery% and C.V% showed the appropriateness of the technique for pattern tests of amoxicillin and diazepam. The scores are listed in Table 3.

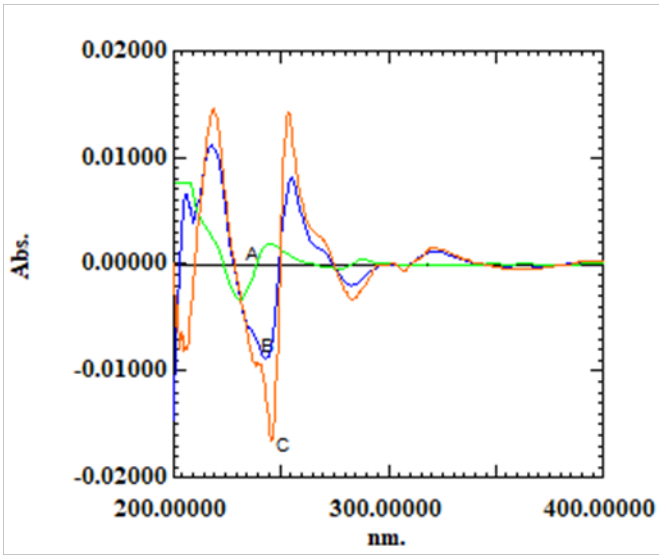

Figure 5: D2 of [A] 10 mg/L Amoxicillin, [B] 20 mg/L Diazepam and [C] A mixture of 10 mg/L Amoxicillin and 20 mg/L Diazepam.

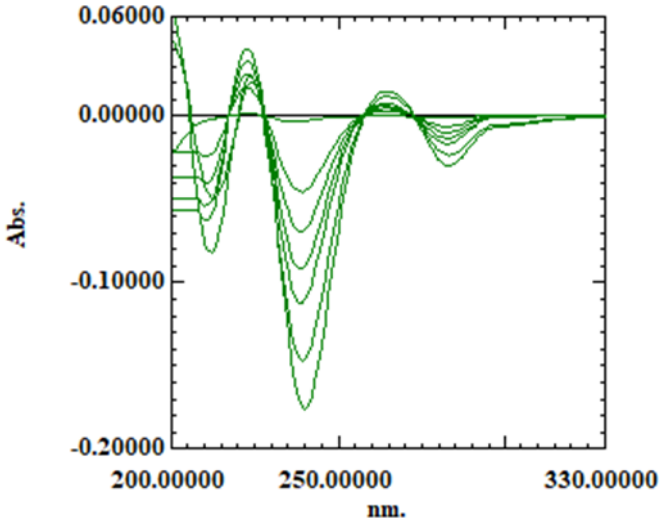

Figure 6: D1 of [10–150 mg/L] Amoxicillin

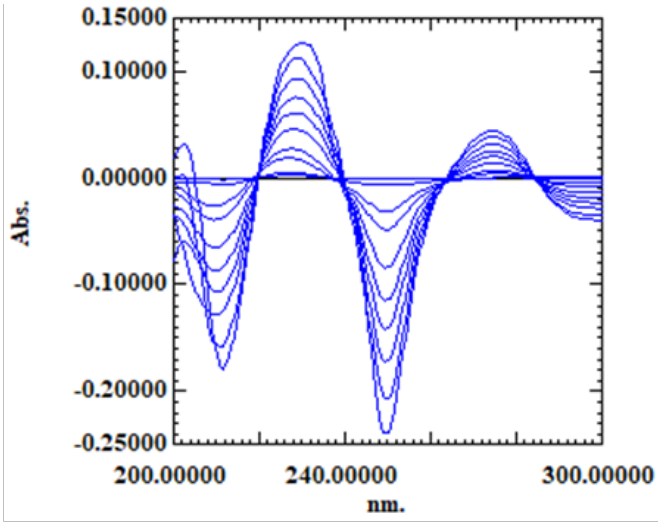

Figure 7: D1 of Diazepam [1–40 mg/L].

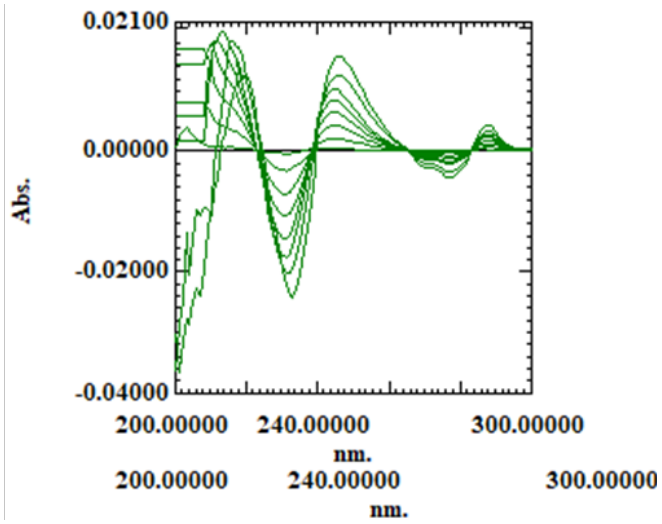

Figure 8: D2 of [10-150 mg/L] Amoxicillin

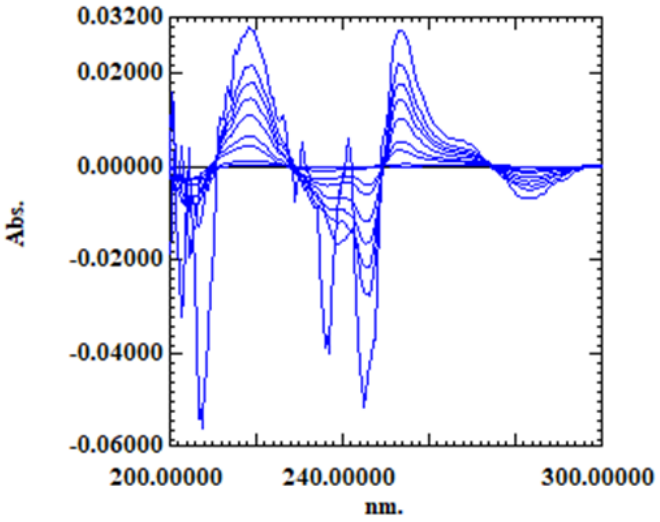

Figure 9: D2 of Diazepam [1-40 mg/L].

Table 1: Statistical analysis for the estimation of amoxicillin and diazepam using D1 and D2.

Medicine	*Derivative Order*	*nm (λ)*	*Regression equation*	*R2*
Amoxicillin	D1	238	y = -0.0012x + 0.0037	R^2 = 0.9979
		285	y = -0.0002x + 0.0015	R^2 = 0.9880
	D2	249.5	y = 7E-05x - 0.0002	R^2 = 0.9952
Diazepam	D1	227	y = 0.003x – 0.0007	R^2 = 0.9973
		258	y = -0.0015x – 0.0013	R^2 = 0.9962
		273	y = 0.0011x – 0.0024	R^2 = 0.9930
		344	y = 0.0002x – 0.0005	R^2 = 0.9941
		384	y = -0.0004x + 0.0004	R^2 = 0.997
	D2	222.5	y = 0.0005x – 0.0004	R^2 = 0.9976
		238	y = -0.0005x + 0.0002	R^2 = 0.9945
		264.5	y = 0.0002x - 1E-05	R^2 = 0.9967
		283	y = -0.0002x + 0.0002	R^2 = 0.9972

Table 2: Estimation of accuracy and precision for estimating amoxicillin and diazepam by D1 and D2.

Medicine	*Derivative order*	*λ(nm)*	*Medicine conc. (mg/L)*		*RE%*	*RSD%*
			Taken	**Found*		
Amoxicillin	D1	238	20	20.0376	0.1878	0.4127
			60	60.2527	0.4212	0.4298
		285	20	19.8229	-0.8857	0.7565
			60	57.7754	-3.7077	1.4674
	D2	249.5	20	19.2824	-3.5881	2.1725
			60	61.5994	2.6656	1.9101
Diazepam	D1	227	10	10.0950	0.9502	0.1227
			25	25.1137	0.4548	0.8189
		258	10	10.1629	1.6289	0.6389
			25	23.7863	-4.8548	0.5282
		273	10	9.4405	-5.5946	0.9205
			25	24.1402	-3.4391	0.8732
		344	10	10.3589	3.5885	0.3972
			25	27.0690	8.27616	0.1812
	D2	384	10	9.7452	-2.5493	-2.5493
			25	22.9712	-8.1153	0.6696
		222.5	10	10.0980	0.9805	0.6071
			25	24.9670	-0.1319	0.8215
		238	10	9.5707	-4.2933	1.5011
			25	25.6193	2.4774	4.5401
		264.5	10	9.2898	-7.1018	3.9083
			25	23.4539	-6.1842	2.2135
		283	10	9.3673	-6.3265	1.7865
			25	23.9556	-4.1776	2.3112

*Average of three estimations.

Table 3: Application of zero-crossing derivative technique for the estimation of amoxicillin (with 3 mg/L of diazepam) and diazepam (with 10 mg/L of amoxicillin)

Medicine	*Derivative Order*	*λ[nm]*	*Medicine conc. [mg/L]*		*Rec. %*	*R.S.D %*
			Taken	**Found*		
Amoxicillin	D1	238	20	20.0515	100.2573	0.4853
		238	60	60.3083	100.5138	0.5804
	D2	249.5	20	19.3348	96.6738	3.2089
		249.5	60	62.1708	103.6180	2.71610
Diazepam	D1	258	10	10.2561	102.5613	0.6385
		227	25	24.8303	99.3214	0.2520
	D2	222.5	10	10.2117	102.1174	1.3979
		222.5	25	24.8953	99.5814	1.1403

*Average of three estimations.

CONCLUSION

The D1 and D2 were established to be sensitive, humble, inexpensive, and rapid. It may be applied in amoxicillin and diazepam pattern tests in their uncontaminated formulae and in the contaminated mixtures without prior isolation or management.

REFERENCE

1. Unutkan T, Bakırdere S and Keyf S (2018) Development of an Analytical Method for the Determination of Amoxicillin in Commercial Drugs and Wastewater Samples, and Assessing its Stability in Simulated Gastric Digestion. Journal of Chromatographic Science 56(1), 36-40.
2. Mutair A A, Koya P A and Al–Areqi N A S (2016) Spectrophotometric Determination of Diazepam in Pharmaceutical Forms by Ion–Pairing with Ferrithiocyanide Complex. Science Journal of Analytical Chemistry 4 (4), 52-58.
3. Mahmood A, Al–Haideri H, and Hassan F (2019) Detection of Antibiotics in Drinking Water Treatment Plants in Baghdad City, Iraq. Hindawi, Advances in Public Health J. 2019, 10.
4. Gülfen M, Canbaz Y and Özdemir A (2020) Simultaneous Determination of Amoxicillin, Lansoprazole, and Levofloxacin in Pharmaceuticals by HPLC with UV–Vis Detector. Journal of Analysis and Testing 4, 45-53.
1. 5. Smerikarova M, Bozhanov S and Maslarska V (2019) Development and Validation of a RP–HPLC Method to Quantify Amoxicillin, Tinidazole, Esomeprazole and Lansoprazole in a Mixture. Indian J Pharm Sci 81(6), 1122-1127.
6. Rehm S and Katharina M. R (2020) A 2D HPLC–MS/MS method for several antibiotics in blood plasma, plasma water, and diverse tissue samples. Analytical and Bioanalytical Chemistry. 412, 715-725.
7. Hemn A, Qader N and Fakhre (2015) Spectrophotometric Determination of Amoxicillin Trihydrate in Pure and Pharmaceutical Dosage Forms, Ibn Al–Haitham J. for Pure & Appl. Sci. Baghdad University. 28; (3), 142-153
8. Wong A, Santos A M, Cincotto F H, Moraes F C (2020) OrlandoFatibello–Filho, Maria D.P.T.Sotomayor, "A new electrochemical platform based on low cost nanomaterials for

sensitive detection of the amoxicillin antibiotic in different matrices. Talanta J. 206, 120252.
9. Gabriela M, Valenga P, LurdesFelsner M, Matos CF, Castro E G, Galli A (2020) Development and validation of voltammetric method for determination of amoxicillin in river water. Analytica Chimica Acta 1138, 79-88.
10. Nassir H B and Fadhil KA (2020) Micellar Determination of Amoxicillin in the Pharmaceutical Compounds by using Cloud Point Extraction. Research Journal of Pharmacy and Technology. 13 (2):732-741.
11. Salem A A, Barsoum B N and Izake E L (2004) Spectrophotometric and fluorimetric determination of diazepam, bromazepam and clonazepam in pharmaceutical and urine samples. Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy. 60(4), 771-780.
12. Dahham Q F and Ahmed E D (2020) Spectrophotometric determination of Diazepam and Propranolol hydrochloride in pharmaceutical by dual wavelengths method. Samarra Journal of Pure and Applied Science, 2(2), 11-18.
13. Li J, Zhang J and Liu H, (2016) A comparative study of primary secondary amino (PSA) and multi-walled carbon nanotubes (MWCNTs) as QuEChERS absorbents for the rapid determination of diazepam and its major metabolites in fish samples by high-performance liquid chromatography–electrospray ionisation-tandem mass spectrometry. Journal of the Science of Food and Agriculture, 96(2), 555-560.
14. Zendelovska D , Pavlovska K, Atanasovska E, Gjorgjievska K, and Petrusevska M (2017) High Performance Liquid Chromatographic Method for Direct Determination of Diazepam in Whole Blood and Serum - Optimization of Solid-Phase Extraction Method. Contributions. Sec. of Med. Sci., 38(3), 543-544.
15. Famiglini G, Termopoli V, Palma P (2016) Liquid chromatography-electron ionization tandem mass spectrometry with the Direct-EI interface in the fast determination of diazepam and flunitrazepam in alcoholic beverages. Electrophoresis J. 37(7-8), 1048-1054.
16. Jiang F , Wang R, Johansen S S, Ni C, Liang C, Zheng S, Ye H and Zhang Y (1016) Sensitive, automatic method for the determination of diazepam and its five metabolites in human oral fluid by online solid-phase extraction and liquid chromatography with tandem mass spectrometry. Journal of Separation Science (JSS), 39(10), 1873-1883.
17. Rahimi–Nasrabadi M, Khoshroo A and Mazloum–Ardakani M. Electrochemical determination of diazepam in real samples based on fullerene–functionalized carbon nanotubes/ionic liquid nanocomposite. Sensors and Actuators B: Chemical, 2017;240, 125-131.
18. Amini R and Asadpour–Zeynali K. Layered double hydroxide nanoparticles embedded in a biopolymer: a novel platform for electroanalytical determination of diazepam. New J. Chem., 2019l43(19):7463-7470.
19. Nunes C N, Anjos V E and QuináiaS B P. Determination of Diazepam and Clonazepam in Natural Water - a Voltammetric Study. Electroanalysis J, 2018;30(1):109-118.
20. Dehghanzade M and Alipour E. Voltammetric determination of diazepam using a bismuth modified pencil graphite electrode. Analytical Methods J., 2016;8(9):1759-9660.
21. Antunović V, Tešanović S, Perušković D, Stevanović N, Baošić R, Mandić S, and Lolić A Development of a Flow Injection System for Differential Pulse Amperometry and Its Application for Diazepam Determination. Journal of Analytical Methods in Chemistry, 2018, 6.