RESEARCH ARTICLE

1,2-Naphthaquinolinc-4-Sulphonate Sodium as Reagent for Spectrophotometric Determination of Rivoglitazone

Inam J. Radhi[1], Ahmed A. Al-Khafagi[2*], Mohammed K. Kahlol[3], Muthana S. Mashkoor[3]

[1]*Department of Chemistry, College of Education for Pure Science, University of Kerbala, Karbala, Iraq*
[2]*Collage of Health and Medical Techniques, Al-Furat Al-Awsat Technical University, Al-Kufa, Iraq*
[3]*Department of Chemistry, Faculty of Science, Kufa University, Al-Najaf, Iraq.*

Received: 15th August, 2021; Revised: 28th September, 2021; Accepted: 15th November, 2021; Available Online: 25th December, 2021

ABSTRACT

A simple, sensitive, & accurate spectrophotometric technique for quantifying Rivoglitazone is devised. The technique is based on the amino groups' interaction in medicines with the reagent 1,2-Naphthaquinolinc-4-Sulphonate Sodium (NQS). The products' spectra exhibit maximum absorption at 459 nm and beer's law is seen for concentrations ranging from 0.3 to 25 ppm, with a molar absorptivity of 1.94103 $L.mole^{-1}cm^{-1}$ and limit of detection (LoD) 0.34 ppm with limit of quantitative (LoQ) 1.138 ppm to the above drug. The percent recoveries are 99.87, and the relative standard deviation RSD% is 0.103. Stability constant is 1.07×10^{13} with stoichiometry drugs to reagent 1:2. The technique was successfully applied to Rivoglitazone tablets & utilized to investigate the effects of various surfactants on the determination procedure.

Keywords: 1,2-naphthaquinolinc-4-sulphonate sodium, Insulin receptors, Rivoglitazone, Spectrophotometric determination.

International Journal of Drug Delivery Technology (2021); DOI: 10.25258/ijddt.11.4.5

How to cite this article: Radhi1 IJ, Al-Khafagi AA, Kahlol MK, Mashkoor MS. 1,2-Naphthaquinolinc-4-Sulphonate Sodium as Reagent for Spectrophotometric Determination of Rivoglitazone. International Journal of Drug Delivery Technology. 2021;11(4):1146-1149.

Source of support: Nil.

Conflict of interest: None

INTRODUCTION

Rivoglitazone (Rivo) is an orally accessible sulfonyl-urea antibiotic with a medium to long half-life (Figure 1).[1] Rivo is recommended to treat type 2 diabetes mellitus; its mechanism of action is to enhance pancreatic insulin production.[2] Its usage has declined precipitously, as studies have shown clear links with an increased risk of heart attack and mortality.[3]

The gastrointestinal system is irritated as a result of ingesting rivoglitazone.[3] Rivo, like other sulfonylureas, works as an insulin secretagogouge, lowering blood sugar via increasing insulin release from pancreatic beta cells and inducing enhanced insulin receptor activity intracellularly.[4]

Rivo, also known as Lamictal, is an anticonvulsant drug utilized to treat epilepsy and bipolar disorder.[5] It was invented in 1987 and granted medical approval in 1999.[6] Over 13,000 lawsuits were filed against rosiglitazone alleging adverse consequences.[7] It is utilized to treat partial seizures.[8]

Rivo has been linked to a reduction in the number of white blood cells (leucopenia).[9] When antiepileptic medicines of the sodium channel blocking type are utilized, this may suppress glutamate & aspartate release.[10]

Several methods have been utilized to determine Rivo sucrose, including voltammetry,[11] titrimetry,[12] atomic absorptions,[13] ion-selective,[14] flow injection,[15] and chromatographic methods.[16] However, while all of these techniques are sensitive, they are also quite expensive, particularly the echoic and daily spectrophotometry methods.[17]

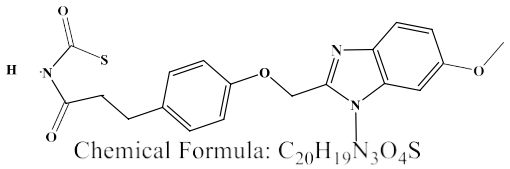

Figure 1: Chemical structure of Rivo

It is shown in this research that a simple and sensitive spectrophotometric method for determining Rivo in pure and dosage forms may be accomplished via using NQS as the chromogenic reagent.

EXPERIMENTAL

Apparatus

In addition to the T80 UV-vis spectrophotometer and the EMC-11-UV-visible spectrophotometer 1100, which have a path length of 1.0 cm and may be utilized to measure absorbance and spectrum, the pH meters are fitted with glass electrodes to detect the acidity and alkalinity of the water sample.

Chemicals

All of the chemicals utilized in this research are of the highest quality, and they were acquired from Fluka, BDH, Merck,

**Author for Correspondence: a.a.2761987@gmail.com*

the United Kingdom, and Sigma Aldrich, among other sources. NQS 0.01 M is made via dissolving 0.26 g of NQS in 100 mL of distilled water (freshly generated) & then utilizing the solution.

Rivo 100 ppm was generated via dissolving 0.01 g in 100 mL of distilled water and filtering the solution (SDI).

RESULTS AND DISCUSSION

The reagent NQS interacted preferentially with amino groups in Rivoin basic medium to produce a red-orange cooler instantly at maximum absorption of 459 nm, while the reagent had a maximum absorption of 416 nm. As a result, the highest absorption wavelength utilized in all tests was 459 nm.

Reaction Conditions Optimized

We evaluated and refined the impact of various factors on the absorbance of color goods.

Effects of pH

The influence of various pH (1–12) a 10 ppm solution of Rivo synthesized using the NQS reagent was determined via comparing the absorbance at 459 nm to a blank reagent and the optimum pH is 10.

Effect of NQS Reagent's Concentration

The influence of various reagent concentrations (0.001–0.5) M with 10 ppm Rivo at pH 10 & 10 ppm was determined via comparing the absorbance at 459 nm to a blank reagent.

As seen in the Table 1, the absorbance rose as the reagent concentration climbed until it reached 0.01 M, at which point it became constant since all 10 ppm of pharmaceuticals react at this concentration (Figure 2). Therefore, the research utilized 0.01 M of reagent (Figure 3).

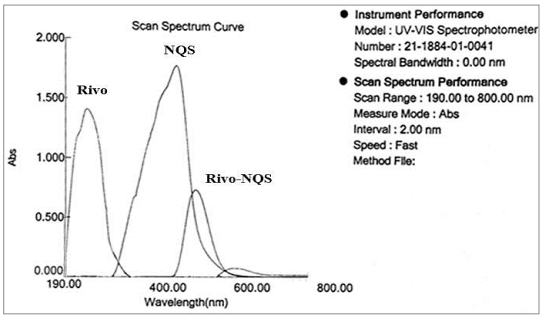

Figure 2: Absorption spectra of Rivo-NQS

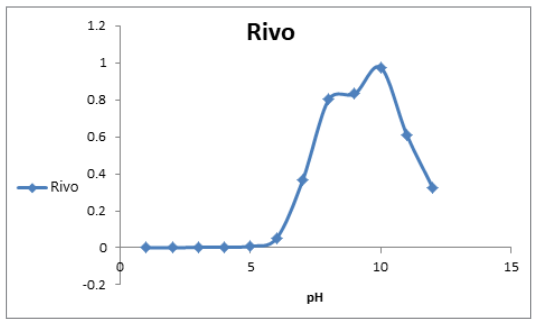

Figure 3: The Effects of pH on a 10 ppm solution of Rivo synthesized using the NQS reagent.

Influence of Reagent Volume

The absorbance at 459 nm was determined in this research using a varied volume (0.1–3.5) mL of 0.01 M NQS reagent with 1-mL of 10 ppm Rivo at pH 10 and 10 ppm. According to Figure 4, a 1-mL reagent is an optimal volume for reacting with 2.5 mL of 10 ppm Rivo.

Effects of Time on Reaction

The influence of time on reactions using 0.01 M reagent and 10 ppm of pharmaceuticals at various time points (1–40) minutes. As shown in Figure 5, the highest absorbance was achieved after ten minutes of exposure to Rivo.

Effects of Temperature

The influence on reactions involving 0.01 M NQS and 10 ppm of medication was investigated at various temperatures (15–70)°C compared to the previously optimal reaction conditions. The findings from Figure 6 indicate that the 20 to 25°C range provides the highest absorbance for Rivo, but that the absorbance decreases beyond this range owing to the reagent's instability with pharmaceuticals.

Table 1: The influence of reagent concentration on Rivo's absorbance

Concentration of NQS (M)	*Mean absorbance of Rivo*
0.001	0.241
0.005	0.834
0.01	1.231
0.05	1.231
0.1	1.230
0.5	1.231

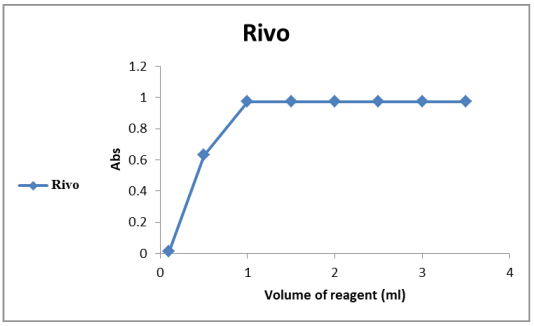

Figure 4: The effects of reagent volume on a 10 ppm Rivo solution at pH 10 were investigated.

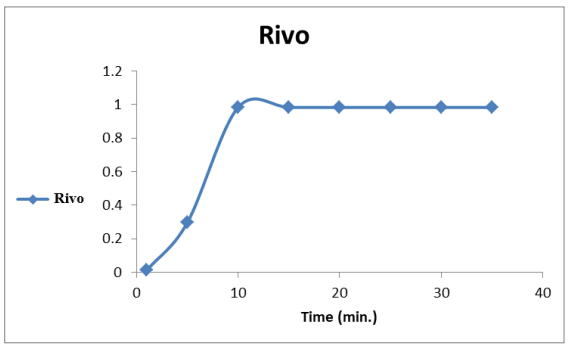

Figure 5: Time Effects on NQS (0.01)M Response with Rivo

Calibration Curve Construction

After preparing an average of various concentrations of Rivo between 0.1 to 30 ppm using previously optimized reaction conditions, compare absorbance to reagent blank. Figure 7 illustrates the calibration curve for Rivo at its maximum absorption wavelength of 459 nm; the beer's law is followed in the concentration range of 0.3 to 25 ppm with a molar absorptivity 1.94103 $L.mole^{-1}.cm^{-1}$ to the medication mentioned above.

Additionally, many metrics and statistical data are assessed in Table 2, including the LoD, LoQ, recovery percent, and relative standard deviation RSD%.

Stoichiometry[19]

Figures 8 and 9 illustrate the Job's technique and mole ratio utilized to determine the ratio of 0.01 M Rivo to 0.01 M NQS reagent at previously optimal reaction conditions. According to these figures, the ratio of Rivo to reagent is 1:2.

Stability Constant[20]

Table 3 summarizes the dissociation degree & stability constant (Kst.) Values.

Effects of Surfactants

The Effects of different surfactants on Rivo are seen in Table 4. The results showed no discernible interaction with these chemicals, suggesting that the suggested technique may be utilized in pharmaceutical formulations.

Applications

Table 5 refers to research on the use of Rivolitazone tablets to determine Rivo. The results in the table establishes the feasibility of using the suggested technique in pharmaceutical formulations.

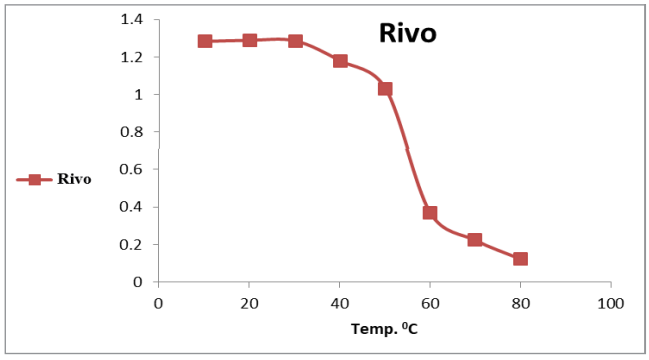

Figure 6: The influence of temperature on the Rivo reaction products

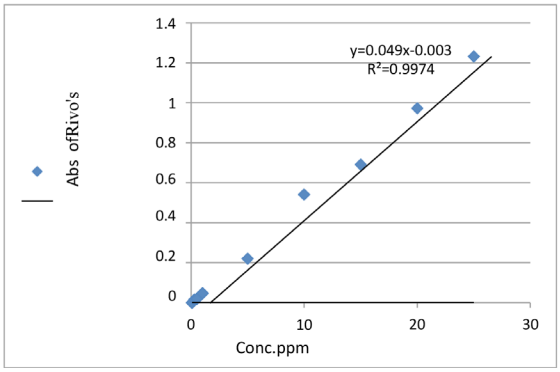

Figure 7: Rivo's calibration curve

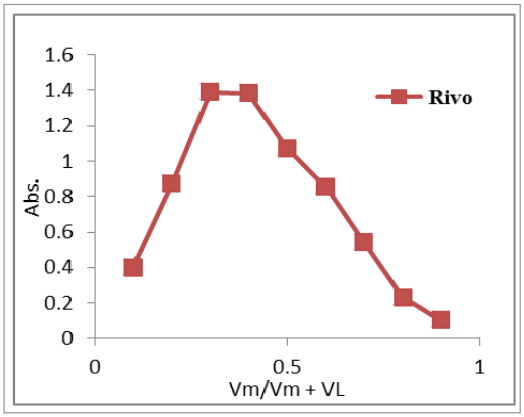

Figure 8: Job's technique for Rivo

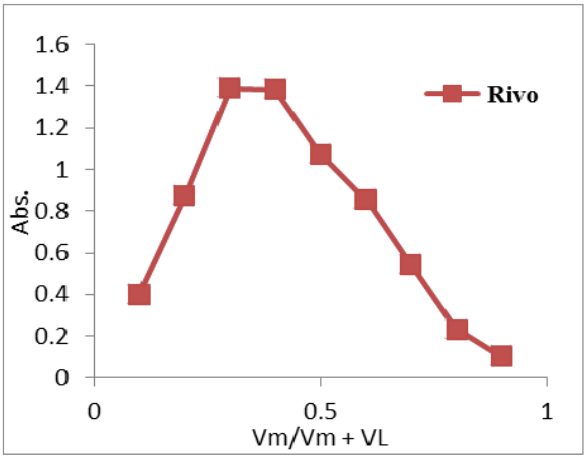

Figure 9: Method of calculating the mole ratio of the Rivo product

Table 2: A overview of some of the proposed method's characteristics

Parameter	*Rivo*
λ_{max} (nm)	459
Linear range (ppm)	0.3–20
Absorption capacity of a molecule $mol^{-1}.cm^{-1}$ $L.mole^{-1}.cm^{-1}$.[17]	1.94×10^3
LoD (ppm)	0.34
LoQ (ppm)	1.138
Correlation coefficient	0.9974
Slope	0.049
Average recovery %.	99.87
RSD%	0.103

Table 3: Constant of stability for Rivo products containing NQS

Kst.L.mole^{-1}	*A*	*Absorbance increases with the reagent's concentration (Am)*	*Absorbance as a function of quantitative concentration (As)*	*Drug concentration (M)*	*Drug*
1.07×10^{13}	0.033	0.541	0.523	2.5×10^{-5}	Rivo

Table 4: The influence of surfactants on Rivo

	(15 ppm) Rivo		
Surfactants	*Conc.*	*E%*	*Rec%*
Tween 80	14.93	-0.46	99.54
PVP	15.18	+1.2	101.2
Acacia	15.16	+1.06	101.06
NaCl	14.85	-1.00	99.00
Mannitol	15.18	+1.2	101.2
Talc	14.93	-0.46	99.54
Benzoic acid	15.13	+1.13	101.13
Lactose	14.94	-0.4	99.96
Sucrose	15.14	+0.93	100.93

Table 5: Rivo in Rivolitazonn tablet application

	Concentration			
Rivolitazone tablet	*Prepared ppm*	*Measured Ppm*	*E%*	*Rec%*
	15	15.34	+0.022	100.02
	20	21.59	+0.07	100.7
	25	23.82	-0.04	99.95

CONCLUSION

Spectrophotometric determination of Rivo via NQS in its pure form & pharmaceutical preparations to get a high sensitivity, a low detection limit, good compliance with Beers legislation, and a high degree of precision and accuracy.

The analytical techniques for the determination of Rivo in medicinal formulations have been utilized.

REFERENCES

1. T. Hamaguchi, T. Hirose and R. Asakawa, Effects of some anti-diabetic and cardioprotective agents on proliferation and apoptosis of human coronary artery endothelial cells, Diabetes Res. Clin. Pract., 2004:11(66),29-32.
2. Manar K. Alquraishy, Oday M. Hadi and Ahmed A. Al-Khafagi, "New Plasmid Mediated Quinolone Resistance Gene (QNRC) Found In Proteus Mirabilis", Biochem. Cell. Arch., 2019;19(1): 2219-2222.
3. F. Jnosand C.Robin, "Analogue based Drugs Discovery", 2006; 450.
4. Stephen DN, Laso L, Johnand J, Keith P," The Pharmacological Basis of Therapeutics", 2005;60:163.
5. Ahmed A. AL-Khafagi, Manar K. Alquraishy and Alia H. Al-Mousawi , "Estimate the level of cholesterol and triglycerides in patient with typeII diabetes in the province of Najaf", Ann. Trop. Med. Public Health. 2019;22(8):1-6.
6. Abdalla A. Elbashir, Abir A. Ahmed, Shazalia M.A.Ahmed and Hassan Y. Aboui-Enein, "1,2-Naphthoquinone-4-Sulphonic Acid Sodium Salt (NQS) as an Analytical Reagent for the Determination of Pharmaceutical Amine by Spectrophotometry", Appl. Spectrosc. Rev. 2021;47(3):219-232.
7. Nissen SE, Wolski K, "PPARs: Protectors or Opponents of Myocardial Function" Engl. J. Med., 2015;56(24):1-19.
8. Marwa S Moneeb, "Spectrophotometric and spectrofluorimetric methods for the determination of saxagliptin and vildagliptin in bulk and pharmaceutical preparations", Bulletin of Faculty of Pharmacy, Cairo University, 2013;51(2),139-150.
9. Ibrahim A. Darwish, Heba H. Abdine, Sawsan M. Amer, and Lama I. Al-Rayes, "Simple Spectrophotometric Method for Determination of Paroxetine in Tablets Using 1,2-Naphtho-quinone-4-Sulphonate as a Chromogenic Reagent", Int J Anal Chem., 2009;10(22),1-8.
10. Mathson RH, Meldum BS, "Autiepleptic Drugs" 5th ed, 2002; 3-22.
11. Iversen L, Glennon RA, n Burger's "Medicinal Chemistry and Drug Discovery", D. J. Abraham, John Wiley & Sons, New York, NY, USA, 6th edition, 2003;6:483.
12. Erk N, Biryol I. Voltammetric and HPLC techniques for the determination of paroxetine hydrochloride. Die Pharmazie-Int. J. Pharm. Sci. Res. 2003;58(10):699-704.
13. Zainaghi IA, Lanchote VL, Queiroz RH. Determination of paroxetine in geriatric depression by high-performance liquid chromatography. Pharmacol. Res. 2003;48(2):217-21.
14. Jhee OH, Seo HK, Lee MH, Jeon YC, Shaw LM, Lee SH, Hur Y, Kim KH, Lee HS, Lee SE, Kang JS. Determination of Paroxetine in Plasma by Liquid Chromatography Coupled to Tandem Mass Spectrometry for Pharmacokinetic and Bio equivalence Studies. Arzneimittelforschung. 2007;57(7):455-461.
15. Zuccaro P, Altier I, Ricciarel G, Pini LA, Corrigendum to "Development and validation of LC-MS/MS assays for the quantification of bendamustine and its metabolites in human plasma and urine", J. Chromatogr. B Biomed. Appl., 1991; 567(2):485-490.
16. Li Q, Tan X, Li J, Pan L, Liu X, "Development of Graphene Quantum Dots-Based Optical Sensor for Toxic Metal Ion Detection", Spectrochim Acta A Mol Biomol Spectrosc., 2015; 15(141):5-10.
17. Muthana S. Mashkoor, Ahmed A. Al-Khafagi and Dakhil N. Taha, "A New Design Micro Total Analysis System for Determination Hydrazine in Pharmaceutical Samples", J. Pharm. Sci. & Res., 2018;10(2):248-253.
18. Mashkour MS, Kahloland MK, Shaheed HA," Colorimetric Determination of Metoclopramide Hydrochloride and Glutathione by using 1,2 Naphthaquinolinc-4-Sulphonate Sodium Reagents", Reserch J. Pharm and Tech. 2018;11(8):70-79.
19. Al-Araji RR, Mashkour MS, Al-Mulla AA," Spectrophotometric Determination of Vitamin Folic Acid B9 in Some Drugs Using 1,2-Naphthoquine-4-Sulphonate (NQS)", Nano Biomeed Eng , 2017;9(3):208-213.
20. Ahmed A.Al-Khafagi, M.S.Mashkoor, and M.K.Kahlol, "Determination of Naltrexone by using Phentermine as a New Spectrophotometric Coupling Agent", Sys Rev of Pharm, 2020;11(12):1655-1660.