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Promethazine Hydrochloride as a Colorimetric Reagent for Quantitative Sulfacetomide Drug Assay in Different Infection Treatment Preparations

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Abstract

THE METHOD for detecting Sulfacetoamide (SCA) using a basic, fast, and sensitive spectrophotometric method. Cerium ammonium nitrate (CAN) is used as the oxidizing agent in an acidic solution during the oxidative coupling reaction of promethazine hydrochloride (PRM) with (SCA), resulting in the creation of a stable, water-soluble product with a maximum absorption at 515 nm. The amount of SCA present will vary. With a molar absorptivity of 8.2 x 10^4 L.mol-1.cm-1, a relative error of -2.3 to +3.3, and a relative standard deviation of 0.136 to 0.319%, Beer's law is applied in the concentration range of 2-34 ppm. The detection limits (LOD) and (LOQ) were 0.645 ppm and 2.15 ppm, respectively. Sandell's sensitivity was 0.172 g.cm^{-1}. The recommended method has been successfully applied in a number of cases to ascertain SCA.

Keywords: Sulfacetoamide, Spectrophotometric Method, Colorimetric Assay, Promethazine hydrochloride.

Introduction

Sulfonamides, sometimes referred to as sulfa medicines, are benzenoidamino compounds that are generated from sulfanilic acid as its parent molecule. They function as bacteriostatics by preventing the synthesis of dihydrofolic acid, which is necessary for the growth of bacterial cells [1]. A significant family of antibacterial medications used in both human and veterinary medicine are sulfonamides [2]. Sulfa medications are frequently used to treat infections, particularly in those who are resistant to antibiotics. the pharmaceutical sciences' commercially significant division as well as the enormous economic success of these drugs [3]. Due to their ability to suppress the development of several germs, sulfa are frequently employed in medicine [4]. They are frequently used to treat trachoma, nocardiosis, toxoplasmosis, seborrheic dermatitis, seborrheic sicca, acne vulgaris, bacterial infections of the eyes, conjunctivitis, and skin infections[5]. Sulfacetoamide is a synthetic broad-spectrum antibiotic that belongs to the sulfanilamide family (SCA) [6]. One kind of sulfonamide antibiotic is Sulfacetomide.

It is administered topically to treat infections of the skin and eyes, respectively. It's applied topically to treat acne and seborrheic dermatitis [7]. Additionally, burn treatments and urinary tract infections are treated with it [8]. Because it does not irritate the eyes when taken in large amounts, it is used to treat ophthalmic infections [9]. The powder known as SAS is crystalline and white in color. It is easily soluble in water, ethanol, and acetone and it has some ether and chloroform solubility [10]. In acetone, it does not dissolve. Sulfacetamide's scientific name is N-[(4−aminophenyl)sulfonyl] acetamidemonosodium salt monohydrate. Its chemical composition is ($C_8H_9N_2NaO_3S$, H_2O) [11]. the chemical structure is as follows in fig. 1:

Numerous approaches, including techniques in spectrophotometry [13–15], chromatography [16,17], and electrical chemistry [18,19], have been published for the detection of sulphacetamide.The creation of an easy-to-use spectrophotometric technique to measure sulphacetamide sodium in pharmaceutical formulations is the goal of this study.

Material and Methods

Digital recording spectrometer with a double-beam- UV- visible is (160) wavelength (Japan) - Applied to the absorbance and spectral Measurements. Analytical balance (Sartorius BL210S).

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Materials

Samara, Iraq (SDI) was used to synthesize simple material (The state of the pharmaceutical industry and the Medical Appliances Company).

Getting the solutions ready

The chemicals that were utilised in the process were subjected to the following solution, which required no washing and had a high degree of purity:

Sulfacetoamid (SCA) (500 ppm)

Samarra-Iraq (SDI) (Pharmaceutical Industries and Medical Devices Company) produced the basic material. Using 0.05 g of the pure material, 10 ml of ethanol was used to increase its solubility before it was diluted in 100 ml of deionized water in a volumetric flask to create a 500 ppm SCA standard solution. Standard work is completed in order to preserve work concentrations(20).

Getting the solution Nitric acid 1M

Concentrated nitric acid was taken in a volume of 1.385 ml and mixed and deionized water 20 ml Added to volumetric container and filled

Reagents:

The general medical supply and pharmacy facility in Samarra, Iraq provided the SCA standard material. and all of the compounds used in this experiment were analytical grade reagents.

Promethazine hydrochloride (PRM) solution, 1.5 x10^{-2}M

To make this solution, (.08533) g of PRM were dissolved in 20 ml of distilled water.

Ammonium ceric sulphate (ACS) solution, 4 x10^{-3} M

Take 0.0438g of (ACS) were dissolved in (20) ml of distilled water to create this solution.

Suggested procedure

Take equal volumes of standard solutions of SCA solution with concentration ranging from 2 to 34 ppm in a series of 20 ml volumetric flasks, sequentially one by one in the last volume, accompanied by the addition of 1 ml of 1M nitric acid and 1 ml of PRM and add 4 ml of ACS, and complete the volume of 20 ml by adding distilled water, then leaving the solutions for 10 minutes at room temperature, and the absorbance at 515 nm was measured step by step and a calibration curve was created [21]. Sulfacetomide in eye drop and cream dosage forms in Pharmaceutical preparations: Take 0.1 ml of drop and dilute it in 20 ml of distilled water (Table 1).

Results and Discussion

The effect of several variables on colour development was studied and the ideal conditions were determined. The results showed that the interaction between (SCA) and (PRM) gave results using spectroscopic analysis and the presence of the oxidizing agent (ACS) led to obtaining a product with a strong colour that can be used as a suitable testing technique for SCA in Pharmaceutical preparations such as eye drops. The violet product absorbs most of the light at a wavelength of 515 nm (Fig. 2).

Acidic impact

A small number of acids are taken, including HCl, CH_3COOH, H_2SO_4, and HNO3 at concentrations of 1M. When taking into account the highest absorption of the acids used to produce the colored solution, as a result, nitric acid gave the highest absorption value at the optimal volume, which is 1 ml, when using different volumes of nitric acid [22] (Fig. 3).

The impact of reagent concentration

To studies the effects of reagent on the absorbance concentration of (PRM). It turned into made using 1 ml of 500 Sulfacetoamid (SCA) drug, which turned into transferred into a chain of volumetric flasks with a quantity of 25 ml. Varying volumes for the reagent 1.5 x 10^{-2}M have been taken, starting from 0.1 to 2.2 ml, and the volumes were completed to (25 ml) through distilled water. For the formation, colored Leads to an observation delivered, and the appropriate size become (1) ml (PRM), which gives a especially absorptions, then become put to use within the appearing and next experiences in Fig. (4) [20].

Effect time in reaction

After preparing the colored solution of the drug (SCA), PRM, oxidizing agent (CAN), and nitric acid, and taking the best absorbance that was fixed for 10 minutes, the color intensity of the product was at its highest levels. In this way, the proposed technique showed that a 10-minute progression window was selected as the best. Within 24 hours, the color was stable. This can be seen in Fig. (5).

Calibration graph

The calibration diagram for (SCA) identification under controlled circumstances. With a correlation value of 0.9992, a slope of 0.0316, and an intercept of 0.0536, the graph is linear in the attention range of two-34 ppm. Give the absorbance molar of the yellow colur product turned into calculated to be(8.2 10^3) (L. mol^{-1} .cm^{-1}), like that the Sandall's sensibility became 3.07 g cm-1. LOD and LOQ had been 0.645 ppm and 2.15 ppm, respectively (Fig. 6).

Mechanism and Stoichiometry

The drug/PRM ratio was always (1) equivalent (1) (i:e., one mole used of the drug and one mole used of the substance reagent reacted) during the

stoichiometry assessment for the reaction between the stated reagent and the observed SCA. This process produced a new ligand, which at 515 (nm) reacted to form a new complex absorption. The molar ratio and the continuous variation approach similarly found that the ratio in this reaction between the produced ligand and both were 1:1. Based on these findings, it was assumed that the (SCA) interactions with (PRM) likewise proceeded in the mentioned manner [23] (Fig. 7).

Interferences influence

The following excipients were examined: calcium chloride, sodium disulfate, PVP, sodium sulfite, lactose, benzoic acid, trimethoprim, and fructose. These excipients were included in the cream's dosage forms together with SCA, but they had no influence on these measures. SCA was a component of the study's solution, and each ingredient was added separately at concentrations 10 times higher than SCA's, and they were all assessed using same procedure In the medication's calibration chart. For spot dilution and interference investigation, 1 milliliter of each 5000 ppm excipient and 1 milliliter of 500 ppm solution were provided. When an evaluation for (SCA) revealed no interference, the degree of interaction was considered defendable if inaccuracy did no exceed ± 2 percentile relative to projected level [24] (Tables 3,4).

The application pharmaceutical

The use of pharmaceuticals Using drops and cram the medicinal applicability of this approach was investigated. For each of the aforementioned applications, calibration curvy were created and precision and accuracy were determined (Table 4). Three distinct concentrations were calculated for each sample using drops and cram.

Biological activity

The capacity of a molecular entity to achieve a certain biological impact on a target is known as biological activity. Potency, or the quantity of a molecular entity needed to achieve the intended effect, is used to quantify it. A biologic test is performed to determine biological activity. To assess a The capacity of a molecular entity to achieve a certain biological impact on a target is known as biological activity. Potency, or the quantity of a molecular entity needed to achieve the intended effect, is used to quantify it.mical's biological activity, the impact of the biological test is compared to that of a reference preparation on a specified therapeutic target. It is also how an agent's efficacy in terms of pharmacological target responses is determined. According to the data in Table (6), several drugs are effective against certain pathogens [25].

Conclusions

At the time, the spectrophotometric technique was Low, SCA concentrations can be determined using a rapid, simple, sensitive, and accurate approach. This method can determined SCA of trace amounts in aqueous of solution, a quick, accurate, and sensitive spectrophotometry method based on the conjugation reaction with (Bromethizin hydrochloride, PRM), the presence of nitric acid, and an oxidizing agent of ceric ammonium nitrite was developed. The suggested procedure took fifteen minutes to complete at room temperature without the need for a solvent extraction step.

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Conflicts of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Author Contributions

The study's principal investigators were SM and M M. proposed the topic of this research and designed the study. MM collected the data. All authors contributed to preparing the final draft of the manuscript, revised the manuscript, and critically reviewed the intellectual contents. In addition, they have all read and approved the final manuscript and are responsible for its accuracy and integrity.

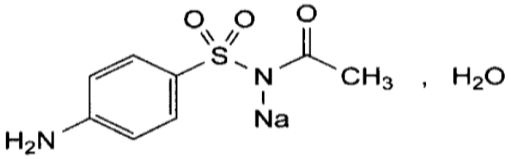


Fig. 1. Molecular weight: 254.2 g/ mo

TABLE 1. Drops and cream are used for solution models in the paper and its companions

The solution preparation	Company applied
Sulfacetomide drops (each 10 ml of drops contains 1 gm **sulfacetomide**	Pharmaceutical Industries Company sina darou Tehran , Iran
KON-SULTRINE cream(each 1gram contains 28.6mg **sulfacetomide)**	Kontam Pharmaceuticals (zhongshan) Company. LTD

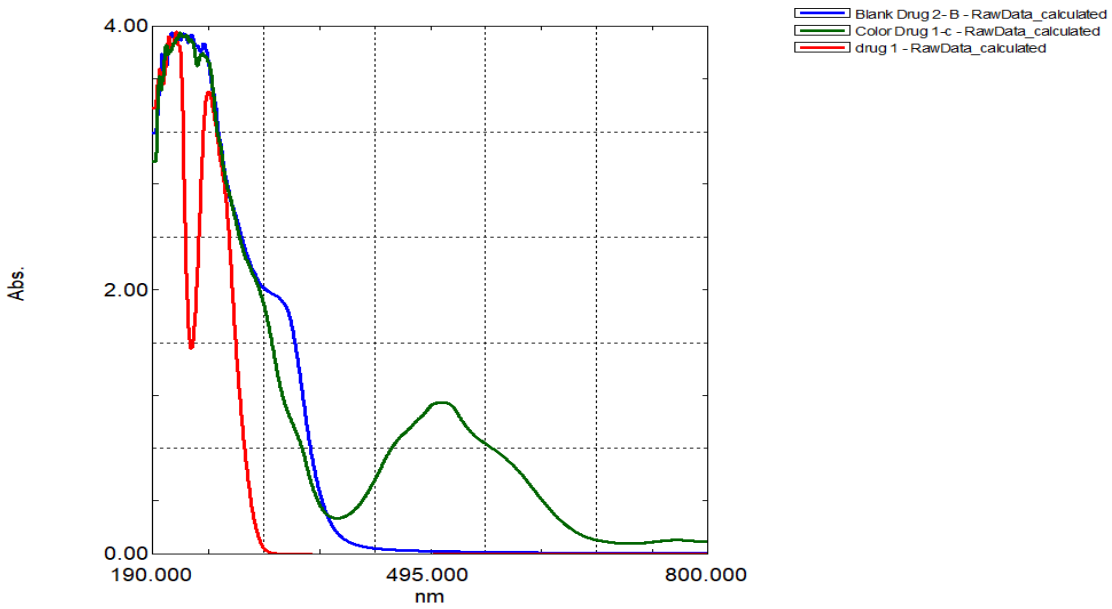


Fig. 2. Shows the absorption spectrum of 500 ppm SCA processed according to the proposed method and compares it with some (a: red) pure drugs (SCA) and (b: blue) all-natural ingredients without drugs(blank). (C: green) colored solution.

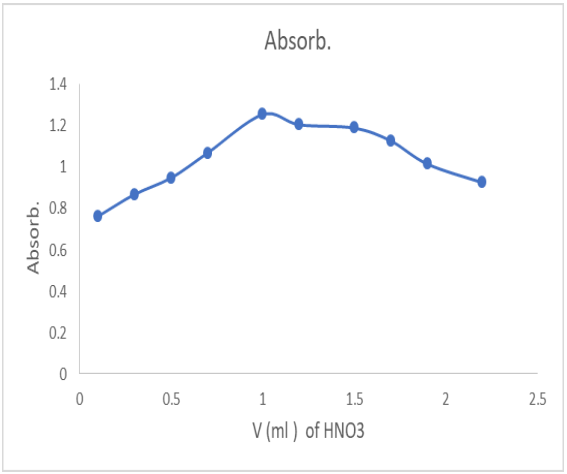


Fig. 3. Difference in acid volume (1M)

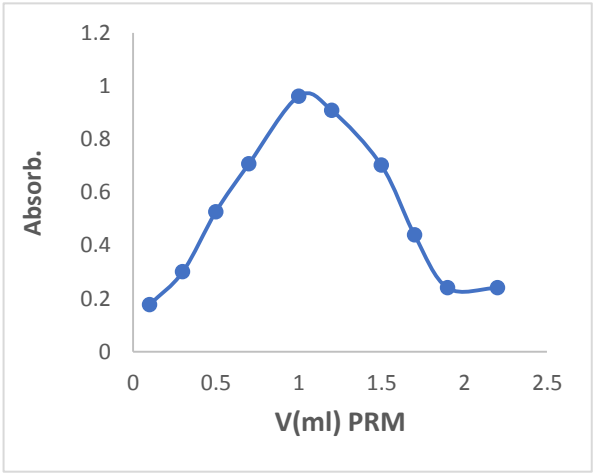


Fig. 4. The reagent's volume effective at the reaction

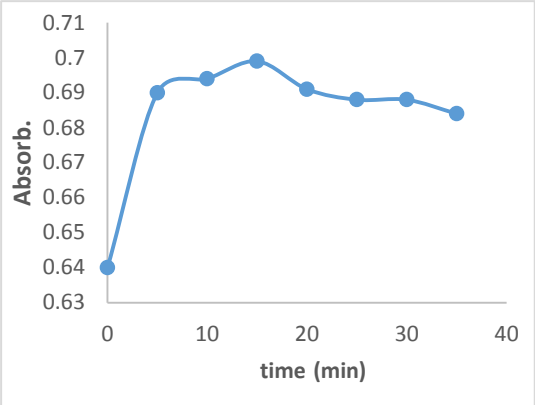


Fig. 5. The time effect of reaction

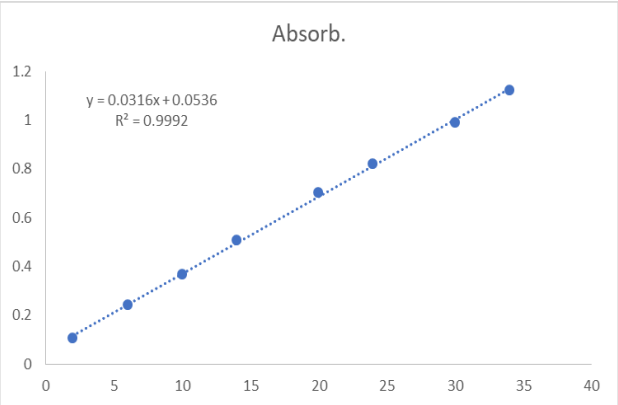


Fig. 6. The curves for calibrating of SCA

TABLE 2. Analytical Information for the Process under Study

Parameters	Value
λ max, (n.m)	515
R2, the correlation coefficient	0.9992
(b) Slope	0.0316
Molecular Absorptivity (L . mol^{-1} . cm^{-1})	$8.2x10^3$
Beer limitations: Law (ppm)	2 - 34
Sandell Sensitivity ($g.cm^{-1}$)	3.070
Intercept: (a)	.0536
The limit of quantitation (LOQ): (ppm)	.645
The limits of detection (LOD): (ppm	2.15

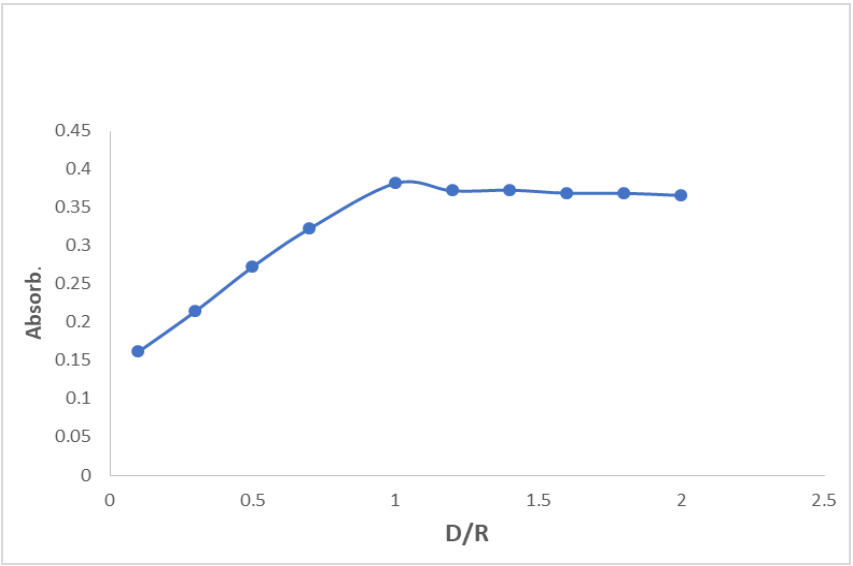


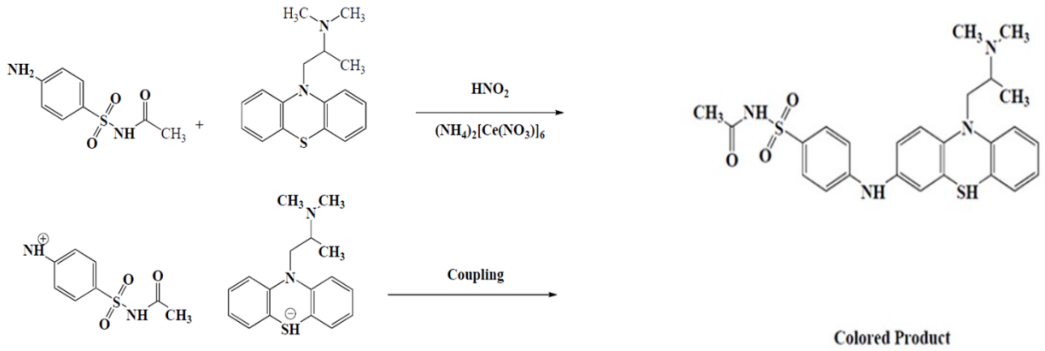
Fig. 7. The mole ratio of SCA

TABLE 3. Shows accuracy and precision data

SCA Concen. (ppm)		Error%	Recovery%	RSD%
True	Found			
6	6.2	3.3	103.3	0.906
20	20.5	2.5	102.5	0.819
34	33.2	-2.3	97.7	0.636

TABLE 4. The assessment of medicine on The effect of chemicals used as excipients

Interferencees	Conc. of SCA Found (ppm)	The error %	The Recovery %
Calcium Chloride	19.79	-1.05	98.95
Sodium Disulfite	19.953	-0.235	99.765
Starch	19.941	-0.295	99.705
Talc	19.77	-1.15	98.85
Lactose	19.87	-0.65	99.35
Fructose	19.8	-1	99
Sodium Sulfite	19.78	-1.10	98.90
PVP	19.91	-0.45	99.55
Benzoic acid	19.94	-0.30	99.70
Sucrose	19.83	-0.85	99.15
Trimethoprim	19.97	-0.15	99.85



(SCA) + PRM ----------► Color product

Fig. 8. Scheme 1. Potential reaction mechanism for the figuration of(SCA medicine complexes with + PRM) by finding the(nitric acid and ceric ammonium nitrate)

TABLE 5. Precision and accuracy results for drops and cram containing SCA

NO.	Composition	Present methods		Standard methods	
		% Recovery	% RSD	% Recovery	%RSD
1-	Pure SCA	101.2	0.787	98.6	.754
2-	drops this medicine (SCA)	98.5	0.766	98.5	.805
3-	Cram this medicine	97.5	.756	101.5	.792

TABLE 6. Demonstrates the bactericidal impact of *SCA*

The drug	*Staphylococcus aureus*	*Enterococcus facalis*	*Enterobacter cloacae*
Pure *SCA*	20	22	19

References

1. Yadav, S.K., Choubey, P.K., Agrawal, B. and Goyal, R.N. Carbon nanotube embedded poly 1, 5-diaminonapthalene modified pyrolytic graphite sensor for the determination of sulfacetamide in pharmaceutical formulations. *Talanta*, **118**, 96-103 (2014).
2. Nagaraja, P., Yathirajan, H.S., Raju, C.R., Vasantha, R.A., Nagendra, P. and Kumar, M.H. 3-Aminophenol as a novel coupling agent for the spectrophotometric determination of sulfonamide derivatives. *Il Farmaco*, **58** (12), 1295-1300. (2003).
3. Nagaraja, P., Yathirajan, H.S., Sunitha, K.R. and Vasantha, R.A. A new, sensitive, and rapid spectrophotometric method for the determination of sulfa drugs. *Journal of AOAC International*, **85**(4), 869-874 (2002).
4. Al-Rufaie, M.M. New spectrophotometric method for the assay of sulfadiazine drug based on diazotization coupling reaction. *Acta. Chemica. Iasi*, **24**(2), 88-101(2016).
5. Darweesh, S.A., Al-Haidari, I.M.A., Mohammed, A.K. and Dikran, S.B. Spectrophotometric determinations of sulfacetamide following simple diazotization and coupling with chromotropic acid. *Ibn AL-Haitham Journal For Pure and Applied Science*, **26**(3), 281-295 (2017).
6. Safronova, E., Parshina, A., Kolganova, T., Yelnikova, A., Bobreshova, O., Pourcelly, G. and Yaroslavtsev, A. Potentiometric multisensory system based on perfluorosulfonic acid membranes and carbon nanotubes for sulfacetamide determination in pharmaceuticals. *Journal of Electroanalytical Chemistry*, **873**,114435 (2020).
7. Pargari, M., Marahel, F. and Godajdar, B.M. Design and Evaluation and Synthesis a Starch-Capped Silver NanoParticles Sensor and Determination trace Sulfacetamide Drug in the Presence Sodium borohydride in Blood and Urine Samples with Kinetic Spectrophotometric Method. *J. Phys. Theor. Chem*, **17**(1), 2 (2020).
8. Talal, Z. and Bashır, W.A. Spectrophotometric Determination of Sulfacetamide. *The Eurasia Proceedings of Science Technology Engineering and Mathematics*, **7**, 385-390 (2019).
9. El-Ragehy, N.A., Hegazy, M.A., AbdElHamid, G. and Tawfik, S.A. Validated chromatographic methods for the simultaneous determination of sulfacetamide sodium and prednisolone acetate in their ophthalmic suspension. *Journal of Chromatographic Science*, **55**(10), 1000-1005 (2017).
10. Al-Uzri, W.A. and Fadil, G. Spectrophotometric determination of sulfacetamide sodium in pharmaceutical preparation using 8-Hydroxy-7-iodoquinoline-5-sulfonic acid as chromogenic reagent. *Asian Journal of Chemistry*, **29**(4), 782. (2017).
11. Raauf, A.M., Ali, H.M. and Musa, L.A. Spectrophotometric determination of sulfacetamide in pure form and pharmaceutical formulations with metol and potassium hexacyanoferrate (III). *Al Mustansiriyah Journal of Pharmaceutical Sciences*, **12**(2), 189-199 (2012).
12. Al-Safar, R.S. and Othman, N.S., November. Spectrophotometric determination of sulphacetamide sodium via diazotization and coupling reaction. In *IOP Conference Series: Materials Science and Engineering,* **928**, 052017 (2020).
13. Qi, X., Ru, S. and Xiong, J.Q. Ecotoxicological effects of sulfacetamide on a green microalga, Desmodesmus quadricauda: Cell viability, antioxidant system, and biotransformation. *Environmental Technology & Innovation*, **26**,102278 (2022).
14. Parshina, A., Yelnikova, A., Titova, T., Kolganova, T., Yurova, P., Stenina, I., Bobreshova, O. and Yaroslavtsev, A. Multisensory systems based on perfluorosulfonic acid membranes modified with polyaniline and PEDOT for multicomponent analysis of sulfacetamide Pharmaceuticals. *Polymers*, **14**(13), 2545. (2022).
15. Jassam A.N., Dhahir, S.A., and Ali, H.H. Determination of Sulfacetamide Sodium in Pure and Their Pharmaceutical Formulations by Using Cloud Point Extraction Method. *Baghdad Science Journal*, **18**(3), 0575-0575 (2021).
16. Sayed, R.A., Mohamed, A.R., Hassan, W.S. and Elmasry, M.S. Earth-friendly-assessed chromatographic platforms for rapid analysis of sulfacetamide sodium and prednisolone acetate in presence of sulfanilamide impurity: Application on ophthalmic formulation and aqueous humor. *Sustainable Chemistry and Pharmacy*, **27**, 100694 (2022).
17. Qi, X., Ru, S. and Xiong, J.Q. Ecotoxicological effects of sulfacetamide on a green microalga, Desmodesmus quadricauda: Cell viability, antioxidant system, and biotransformation. *Environmental Technology & Innovation*, **26,** 102278 (2022).
18. El-Ragehy, N.A., Hegazy, M.A., AbdElHamid, G. and Tawfik, S.A. Validated potentiometric method for the determination of sulfacetamide sodium; application to its pharmaceutical formulations and spiked rabbit aqueous humor. *Bulletin of Faculty of Pharmacy, Cairo University*, **56**(2), 207-212 (2018).
19. Fu, L., Zhang, X., Ding, S., Chen, F., Lv, Y., Zhang, H. and Zhao, S. Recent developments in the electrochemical determination of sulfonamides. *Current Pharmaceutical Analysis*, **18**(1) 4-13 (2022).
20. Pawar, U.D., Naik, A.V., Sulebhavikar, A.V., Datar, T.A. and Mangaonkar, K. Simultaneous determination of aceclofenac, paracetamol and chlorzoxazone by HPLC in tablet dose form. *Journal of Chemistry*, **6**, 289-294 (2009).

21. Negoiu, M., Pasculescu, S., Roau, T., Georgescu, R. and Draghici, C. Synthesis and Characterisation of complex Cu (II) combinations with Schiff base ligands derived from 4-amino-1-phenyl-2, 3-dimethyl-3-pyrazole-5-one (4-amino-antipyrine) and Pentaatomic Heterocyclic Aldehydes. *Revista de Chimie (Bucharest)*, **61**, 762-766 (2010).

22. Jawad, A.A. and Kadhim, K.H. Spectrophotometric determination of metoclopramide hydrochloride in bulk and pharmaceutical preparations by diazotization-coupling reaction. Inter. *J. of Pharmacy and Pharmaceutical Sciences*, **5**, 294-299 (2013).

23. M Al-Abbasi, K., A Mohammed, S. and A Sarsam, L. Spectrophotometric Determination of Metoclopramide Hydrochloride in Pharmaceutical Preparations Using Diazotization Reaction. *Rafidain Journal of Science*, **22**(5), 76-88 (2011).

24. Ahmed, A., Ayoub, K., Chaima, A.J., Hanaa, L. and Abdelaziz, C. Effect of drying methods on yield, chemical composition and bioactivities of essential oil obtained from Moroccan Mentha pulegium L. *Biocatalysis and Agricultural Biotechnology*, **16**, 638-643 (2018).

25. Samie, A., Tambani, T., Harshfield, E., Green, E., Ramalivhana, J.N. and Bessong, P.O. Antifungal activities of selected Venda medicinal plants against Candida albicans, Candida krusei and Cryptococcus neoformans isolated from South African AIDS patients. *African Journal of Biotechnology*, **9**, 20 (2010).

استخدام البروميثازين هيدروكلوريد ككاشف لوني لمقايسة عقار السلفاسيتوامايد في مستحضرات علاج العدوى المختلفة

صالح مهدي شاكر ومهيمن محمد مجيد الرفيعي

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الخلاصة

طريقة للكشف وتقدير عن السلفاسيتوآميد (SCA) باستخدام طريقة طيفية أساسية وسريعة وحساسة. يتم استخدام نترات الأمونيوم السيريوم (CAN) كعامل مؤكسد في محلول حمضي أثناء تفاعل الاقتران التأكسدي لهيدروكلوريد البروميثازين (PRM) مع (SCA) ، مما يؤدي إلى تكوين منتج مستقر قابل للذوبان في الماء مع أقصى امتصاص عند 515 درجة. نانومتر. سوف يختلف مقدار SCA الموجود. مع الامتصاص المولي 8.2 – 34 جزء في المليون. وكانت حدود الكشف ((LODو0.645 (LOQ) جزء في المليون و2.15 جزء في المليون على التوالي. كانت حساسية ساندل 0.172 جم.سم-1. تم تطبيق الطريقة الموصى بها بنجاح في عدد من الحالات للتأكد من .SCA

الكلمات المفتاحية: سلفاسيتوأميد ، الطريقة الطيفية ، الفحص اللوني ، بروميثازين هيدروكلوريد.