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The Use of Diphenylamine Sulfonate Redox Indicator in Spectrophotometric Micro-determination of Non-Steroidal Anti-Inflammatory Drugs

M. A. Zayed*[1] and M. Farouk. El Sayed[2]

[1]*Chemistry Department, Faculty of Science, Cairo University, 12613 Giza, Egypt*

[2]*Galaxy Chemicals Egypt for Surfactants, Suez, Egypt.*

THE MAIN aim of this paper is the use of Diphenylamine Sulfonate (DPAS) redox indicator in its oxidized or reduced form in microdetermination of non-steroidal anti-inflammatory drugs such as Ketoprofen (KETO) and Indomethacin (INDO) in pure and in their pharmaceutical preparations. DPAS prepared in its oxidized form by its titration against $K_2Cr_2O_7$ in 2N sulfuric acid to give its blue-violet colour of quinoid form of of λ_{max} = 555 nm. The reaction between DPAS oxidized blue-violet form and each drug within 10 min has been studied in the visible range. This study proved the formation of red products. The reactions of the indicator reduced reread form and the studied drugs are also studied in the UV range at 255 nm after passage of 30 min leading to the form of brown products. Also the stoichiometries of these reactions are formed to be 1:1 and 2:1 (Drug: indicator) and the proposed equations representing them are also formulated. The two proposed reactions in both Vis and UV ranges are applied for microdetermination of these anti-inflammatory drugs in both standard and in their pharmaceutical formulations. The analytical parameters of the reactions of DPAS in its two forms and the given drugs in both Vis and UV ranges such as standard deviation (SD), relative standard deviation (RSD), Sandell's sensitivity (S), LOQ and LOD of were calculated in order to check accuracy, sensitivity and precision of the given procedures. In the visible region; Beer's law has been valied in the concentration range of KETO = 5.1-50.9 μg $mL^{-1}$and INDO = 10.7-71.6 μg mL^{-1}. Beer's law in the UV range procedure valied in the concentration ranges of KETO = 1.27-6.36 μg mL^{-1} μg mL^{-1} and INDO = 0.72-14.31 μg mL^{-1}. The values of % recovery are found to be 100.39 and 100.24 and those of SD are 0.2 and 0.14 in violet form; while % recovery = 99.95 and 100.25 and those of SD are 0.031 and 0.015 in brown form for KETO and INDO respectively. These values refer to the accuracy, reliability, and precision of the proposed procedures. The proposed methods had been applied successfully for the analysis of the studied drugs in pure forms and pharmaceutical formulations. As example KETO had been analyzed in Ketolgin tablet (UV- region) in the concentration range of 1.53-4.07 μg mL^{-1} of recovery percent = 99.36-100.61, SD = 0.01-0.03. The results obtained were found to be in good agreement with those obtained by official methods. This evaluation had been done by F- and t- tests.

Keywords: Non-steroidal anti-inflammatory drugs, Ketoprofen, Indomethacin, Diphenyl amine sulfonate (DPAS), Spectrophotometric methods.

Introduction

Non-steroidal anti-inflammatory drugs (NSAIDs) constitute an important class of drugs in treatment of inflammatory conditions such as rheumatoid arthritis (RA) and osteoarthritis (OA) starting from the classic drug aspirin to the recent rise and fall of selective COX-2 [1] inhibitors has provided an enthralling evolution [2]. Acetyl salicylic acid 1 (aspirin) the more palatable form of salicylic acid was introduced into the market by Bayer in 1899 [3,4]. However, the mechanism of action of anti-inflammatory and analgesic agents [5] such as aspirin and indomethacin remained elusive until the early 1960's. John

*Corresponding author: E-mail:mazayed429@yahoo.com, Tel. 02- 01005776675

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Vane discovered the mechanism of action of aspirin and other nonsteroidal anti-inflammatory drugs (NSAIDs) thereby increasing our ability to develop novel anti-inflammatory therapies [6]. The success of NSAIDs in treating validated inhibition of the enzyme prostaglandin H synthase (PGHS) orcyclooxygenase (COX) as a highly suitable target in anti-inflammatory therapies [7-9]. However, the gastrointestinal (GI) toxicities associated with wide spread NSAIDs use proved to be a major drawback during long term therapy [10]. Non-Steroidal Anti Inflammatory Drugs (NSAIDs) have been commonly used to reduce pain and inflammation in different arthritic and post-operative conditions [11]. Non-steroidal anti-inflammatory drugs (NSAIDs) are effective agents commonly used for the relief of both acute and chronic pain, inflammatory conditions [12]. NSAIDs can be classified depending on their chemical structures; NSAIDs can be classified depending on their chemical structures into six major classes as shown in Table 1 [13].

The selected drugs; Ketoprofen (KETO) and Indomethacin (INDO) belong to non-steroidal anti-inflammatory drugs which their structural formulas are shown in Fig 1.

TABLE 1. Classification of NSAIDS.

Class	Example
Acetyl salicylic acid	Aspirin
Acetic acid	Diclofenac, Indomethacin Ketorolac, Nabumetone Sulindac, Tolmetin
Fenamates	Meclofenamate, Mefenamic acid
Enolic acids (Oxicams)	Piroxicam, Meloxicam Tenoxicam, Lornoxicam
Aryl Propionic acid	Ibuprofen, Ketoprofen, Naproxen, Oxaprozin
Coxib	Celecoxib, Rofecoxib, Valdecoxib

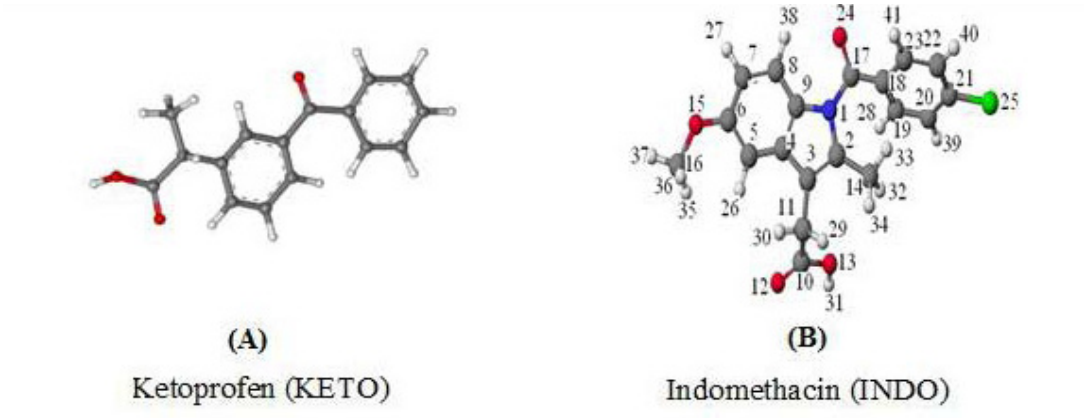


Fig. 1. The structural formulas of: (A) Ketoprofen (KETO), (B) Indomethacin (INDO).

Ketoprofen chemical IUPAC name is (RS) 2-(3-benzoylphenyl)-propionic acid. It has a general formula $C_{16}H_{14}O_3$ and mol. Mass = 254.281 g mol^{-1}. It is a white crystalline solid with a melting point of 93-96 ^oC and it is slightly soluble in water, but soluble in ethanol and acetone on the other hand Indomethacin chemical IUPAC name is 2-{1-[(4-Chlorophenyl) carbonyl]-5-methoxy-2-methyl-1H-indol-3-yl} acetic acid. It has a general formula $C_{19}H_{16}ClNO_4$ and mol. Mass = 357.787 g mol^{-1}. Its colour is white to off-white powder [14-16] with a melting point of 155-160 ^oC. Both drugs are slightly soluble in water, but soluble in ethanol and acetone [17]. Analytical procedures have been described for the estimation of both drugs in either pure and combination dosage form; including Titrimetry, Spectrophotometry, electrophoresis and high performance liquid chromatography. Spectrophotometric estimation of the studied drugs based on the reaction with N-bromosuccinimide (NBS) [18] and the residual reagent is then determined by formation of violet colour with 2, 2-diphenyl-l-picryl hydrazine (DPPH). The consumed NBS would correspond to the drug. Also via reaction with 2-nitrophenylhydrazine hydrochloride to give an intensive violet colour at λ_{max} = 550 nm [19]. nm [19]. Ketoprofen in capsules or vials can be estimated based upon oxime formation followed by charge transfer complexation with o-chloranil has been developed by El-Sadek et al in 1993 [20]. Indomethacin estimated spectrophotometrically based on the coupling reaction of hydrolyzed (INDO) with diazotized p-phenylenediamine dihydrochloride (PPDD) in sulphuric acid medium to give a red coloured product having the absorption maximum at 510nm [21]. Another quantative determination of Indomethacin based on oxidation of drug by using alkaline $KMnO_4$ has been developed [22]. Other methods included voltametry [23-26], titrimetry [27-29] and chromatographically [30-36] reported for the determination of the studied drugs. This paper aims chiefly to find simple spectrophotometric method for the micro determination of the studied drugs in pure forms and their tablet formulations via redox reaction with DPAS oxidant indicator through Visible region to their completion at UV region including the studying of the optimum conditions for the reactions.

Experimental

Materials and Reagents:

All materials used were of analytical reagent grade and some of them were used as such without any further purification. They included ketoprofen (KETO) provided by MP Biomedical-USA and Indomethacin (INDO) provided by Kahira pharmaceuticals and chemical industries– Egypt. Stock solutionsof the studied drugs were prepared aas 1 x 10^{-3} where KETO and INDO were prepared by dissolving the accurately weighed amount of the pure drug in 0.05 M Sodium Bicarbonate ($NaHCO_3$) solution with gentle warming, and finally the volumes were completed to 100 mL measuring flask by distilled water. The solutions were stable for at least two weeks if they had been stored in a cool (<25 ^oC) and dark place. Sodium Diphenylamine Sulphonate (DPAS) supplied from Alpha chemika– India, and was prepared in distilled water as 1x10^{-3}M. Sulfuric acid (H_2SO_4) was supplied from Merck, and was prepared in distilled water as 2N. Potassium dichromate ($K_2Cr_2O_7$) was supplied from Merck, and was prepared in distilled water as 0.1M Solutions of lower concentration were obtained by accurate dilution with distilled water. Ketolgin were obtained from Amoun Pharmaceutical, Egypt, labeled to contain (50 mg KETO/tablet). Indocid capsules were obtained from Kahira pharmaceuticals and chemical industries, Egypt, labeled to contain (25 mg INDO/capsule).

Instrument and apparatus

PerkinElmer UV-Visible spectrophotometer (Model; lambda 25), equipped with 1 cm matched quartz cells was used for spectrophotometric measurements. Weights measurement was performed by using Mettler Toledo Sensitive analytical balance 0.0001 g, Model: MS204S/01. Stirring and heating were performed by using WiseStir Heating Magnetic Stirrer Theromostated Hot Plate, Model: MSH-20D-korea. Automatic Micropipettes, Model: Labopette-Germany, Volume range 100-1000 µL were used to measure the small volumes.

General recommended procedures

Procedure for drugs in pure form

Solution of DPAS in its oxidized form was prepared by its titration in 2 N H_2SO_4 against 0.1 M $K_2Cr_2O_7$ till violet color. Solutions of equimolar amounts were prepared between the studied drugs and DPAS indictor in its oxidized form to be (2.5 x10^{-4} M for KETO, 2 x 10^{-4} M for INDO) and

spectrophotometric determinations were carried out at visible region within 10 min. and at UV-region (after 30 min. for KETO and 40 min. for INDO) after dilution to (2.5 x 10^{-5} M for KETO, 2 x 10^{-5} M for INDO).

Procedure for dosage forms:

Each ten tablets of Ketolgin (50 mg/tablet) and each ten capsules of Indocid (25mg/Capsule) were weighed and powdered well. Equivalent amount of powder to one tablet or capsule of the drugs was weighed, and dissolved in sufficient amount of 0.05 M NaHCO3 solution, with gentle warming. The resulting solutions were shaked well. The solutions of the drugs were transferred into 100 mL volumetric flask and the volume completed to the mark with distilled water. Analysis was completed as previously mentioned under the general procedure to be measured in both Vis and UV regions. The nominal content of drug in the tablets was thus calculated either from a previously plotted calibration graph or using the regression equation.

Result and Discussion

Spectral studies of redox reactions of DPAS oxidant indicator and some NSAID$_S$:

DPAS used as an indicator in redox reaction between oxidant like pot. Dichromate $K_2Cr_2O_7$ and reducing agents like ferrous in sulfuric acid medium aiming to detect end-point in volumetric titrations [37]. In this thesis DPAS is used as an oxidant in its oxidized form and as spectrophotometric self-indicator in reaction with NSAID$_S$ such as Indomethacin (INDO) and Ketoprofen (KETO) spectrophotometrically, DPAS indicator preparation in its oxidized form to give its blue-violet color of reaction product ε = 0.42 x 10^4 L mole^{-1}cm^{-1} λ_{max} = 555 nm (Fig 2).

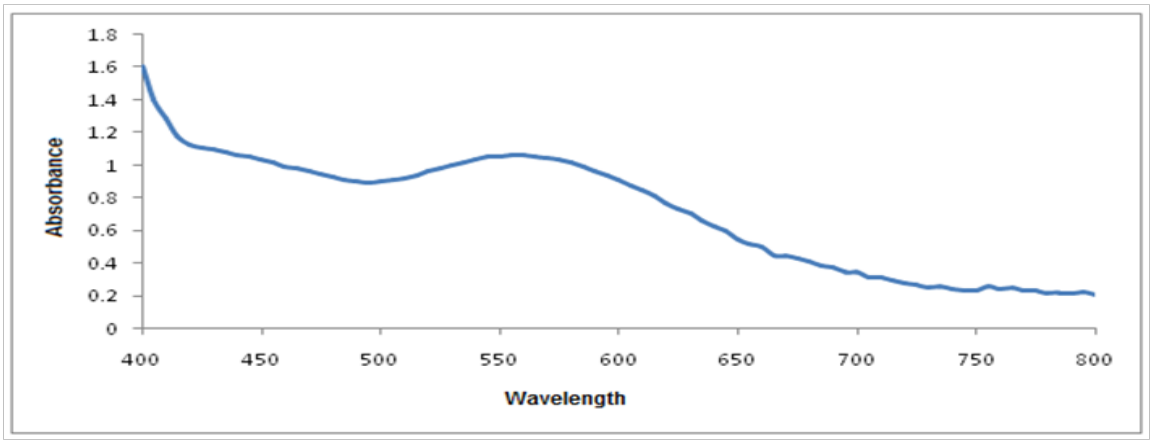


Fig. 2.Visible spectrum of 2.5 x 10^{-4} M DPAS oxidant indicator.

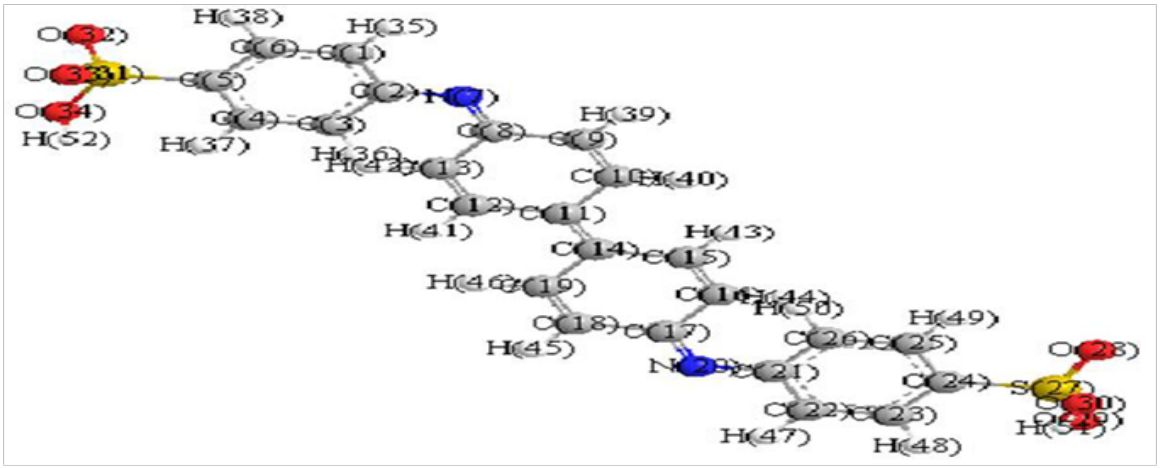


Fig. 3. Oxidized form of DPAS indicator

Selection of suitable wavelengths in violet form

This violet DPAS of quinoid form reacts with Ketoprofen (KETO) drug to give a reaction product of $\varepsilon = 0.54 \times 10^4$ L mole^{-1} cm^{-1} at 555 nm within 10 minutes.On the other hand; it reacts with Indomethacin drug (INDO) as shown in Scheme 1 [38] to givea reaction product of $\varepsilon = 0.6 \times 10^4$ L mole^{-1} cm^{-1} at 550 nm (Fig. 4).

Effect of time

On studying the reaction of DPAS indicator and the studied drugs in sulfuric acid medium at different time intervals and at ambient temperature; it was observed absorbance decrease with time as shown in Fig 5. This decrease may be attributed to the change of DPAS violet color of quinoid form into a reread form which has another λ_{max} 250 nm.

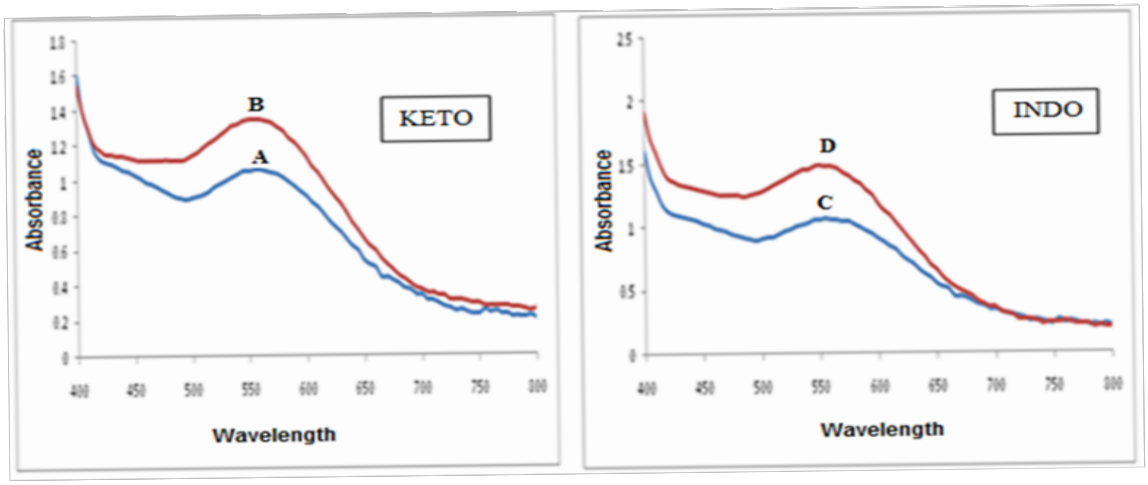
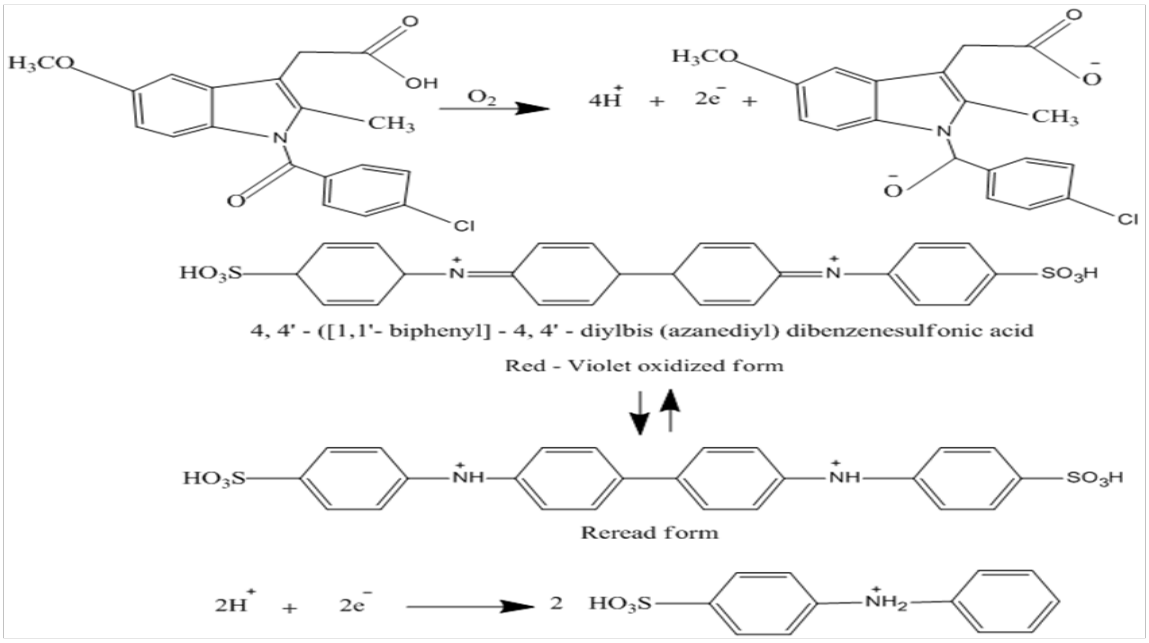


Fig. 4. Visible spectra of:
(A) 2.5 x 10^{-4} M DPAS oxidant indicator, at normal temp and within 10 min.
(B) Mixture of 2.5 x 10^{-4} M DPAS oxidant with 2.5 x 10^{-4} M KETO, at normal temp and within 10 min.
(C) 2 x 10^{-4} M DPAS oxidant indicator, at normal temp and within 10 min.
(D) Mixture of 2 x 10^{-4} M DPAS oxidant with 2 x 10^{-4} M INDO, at normal temp and within 10 min.



Scheme 1. The proposed redox reaction of DPAS oxidant and INDO drug reductant in acidic medium

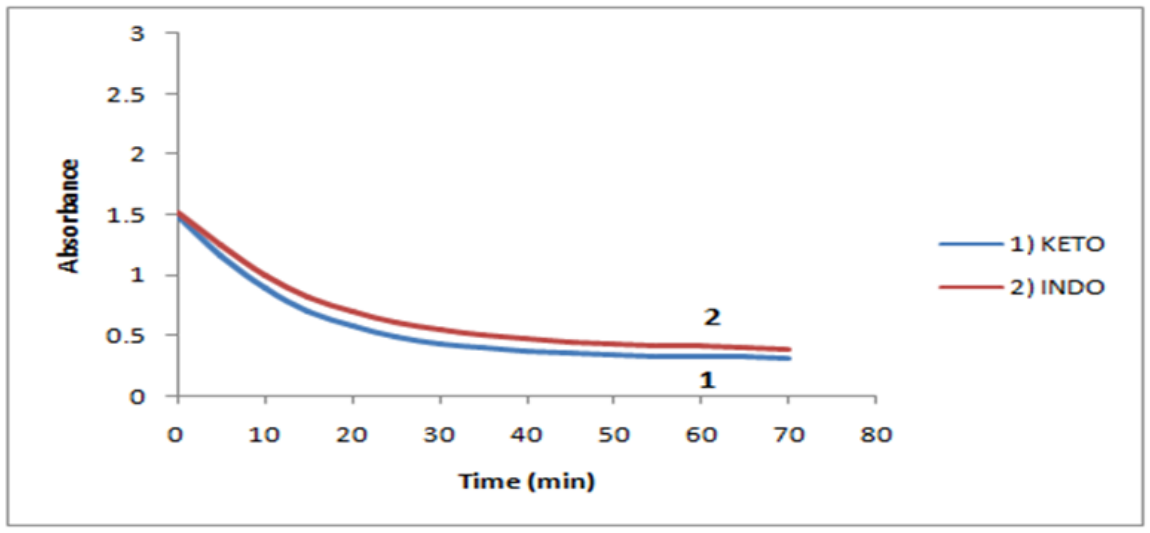


Fig. 5. Effect of time at normal Temp. on the spectra of 2.5 x 10^{-4} M mixture of DPAS with drug : 1) Ketoprofen at 555 nm and 2) Indomethacin at 550 nm.

Selection of suitable wavelengths in Brown form

On studying changing of DPAS from violet quinoid form into reread brown form and its reaction with KETO and INDO drugs; It is obvious From Fig 6; that the λ_{max} of DPAS indicator is shifted from 555 nm (violet form) to 250 nm (brown form) $\varepsilon = 0.26 \times 10^5$ L mole^{-1} cm^{-1} after 30 min; while the λ_{max} of the reaction product of KETO with DPAS is shifted from 555 nm to 255 nm (brown form) with $\varepsilon = 0.42 \times 10^5$ L mole^{-1} cm^{-1} after 30 min. On the other hand the λ_{max} of the reaction product of INDO with DPAS is shifted from 550 nm (violet form) to 250 nm (brown form) with $\varepsilon = 0.412 \times 10^5$ L mole^{-1} cm^{-1} after 40 min.

Effect of temperature

On studying the effect of temperature on the reaction product between DPAS and the studied drugs in the temperature range 30-90°C in sulfuric acid medium (at 255 nm, after 30 min. for Ketoprofen) and (at 250 nm, after 40 min.for Indomethacin). The obtained results are given in Fig 7.

These data refer to the sensitivity of redox reaction between DPAS oxidant indicator and kETO & INDO drugs in the sulfuric acid medium to the temperature variation. It's observed from these data that temperature doesn't affect on reaction mechanism between DPAS and the selected drugs, so spectral studies of using DPAS oxidant indicator for microdetermination of these drugs can be carries out under ambient temperature.

Stoichiometric ratio:

Stoichiometric ratio in the violet form: The Stoichiometric ratio of the reaction between DPAS violet color oxidant and the studied drugs reductant in sulfuric medium was studied by molar ratio method [39] with constant concentration of DPAS and variable concentrations of these drugs (KETO& INDO). The result obtained is shown in Fig 8.

The results obtained indicate the formation of 1:1 and 2:1 ratios [drug]: [DPAS] ion–pairs through the electrostatic attraction between positive protonated DPAS indicator and drug negative anion. The reaction between KETO and DPAS occurs in a ratio 1:1,while the reaction between INDO and DPAS occurs in a ratio 1:1 and 2:1 which confirmed to be 1:1 as it shown in Scheme 2 by applying continues variation method [40] which shown in Fig 9.

Stoichiometric ratio in the brown form: On studying Stoichiometric ratio of reaction between DPAS and the selected drugs in UV- region; It was observed the formation of 1:1 and 2:1 ratios [drug]: [DPAS] as it shown in Fig 10 which confirmed to be 1:1 by applying continues variation (Fig. 11).

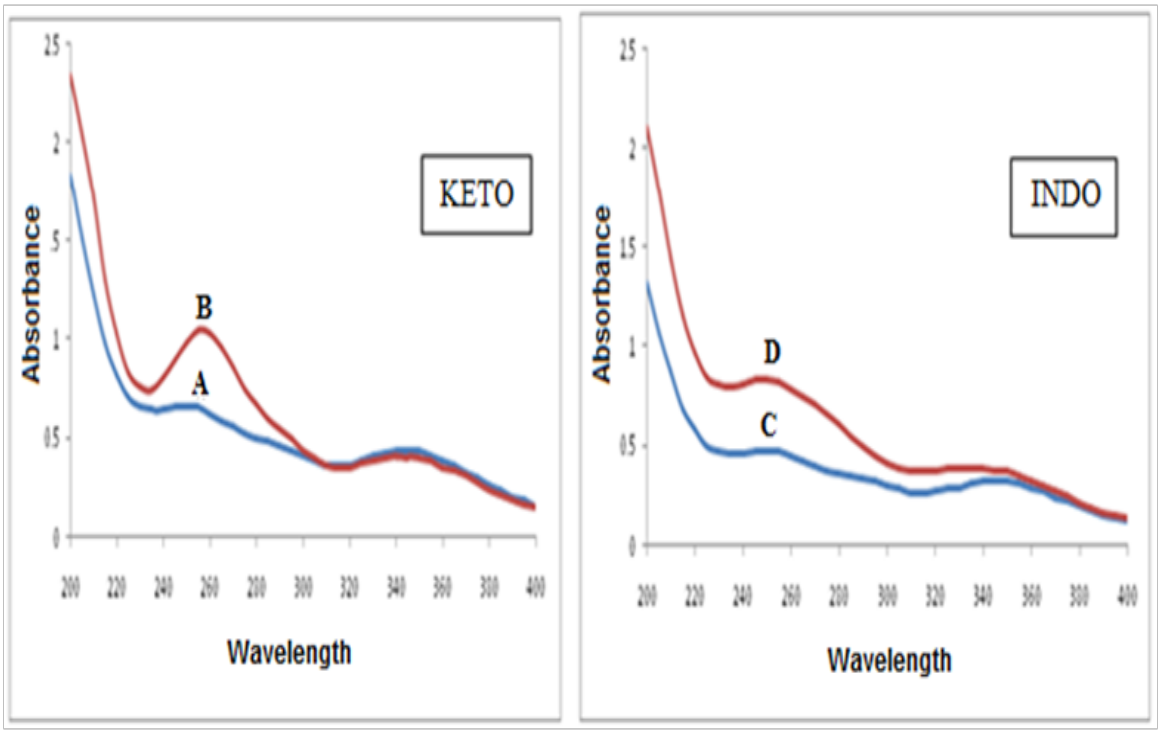


Fig. 6. UV spectra of:
A) 2.5 x 10^{-5} M DPAS oxidant indicator, at normal temp after 30 min.
(B) Mixture of 2.5 x 10^{-5} M KETO with 2.5 x 10^{-5} M DPAS oxidant, at normal temp after 30 min.
(C) 2x 10^{-5} M DPAS oxidant indicator, at normal temp after 40 min.
(D) Mixture of 2 x 10^{-5} M INDO with 2 x 10^{-5}M DPAS oxidant, at normal temp after 40 min.

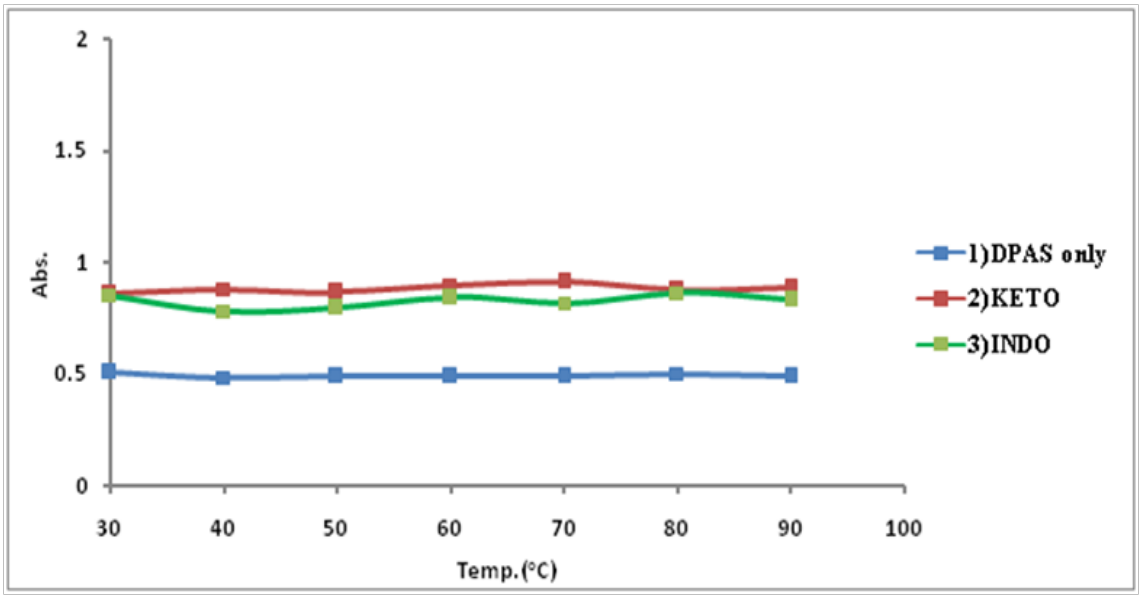


Fig. 7. Effect of temp. (30-90 °C) on the spectra of:
(1) 2.5 x 10^{-5} M DPAS oxidant, at 250 nm after 30 min.
(2) Mixture of 2.5 x 10^{-5} M KETO and 2.5 x 10^{-5} M DPAS oxidant, at 255 nm after 30 min.
(3) Mixture of 2 x 10^{-5} M INDO and 2 x 10^{-5} M DPAS oxidant, at 250 nm after 40 min.

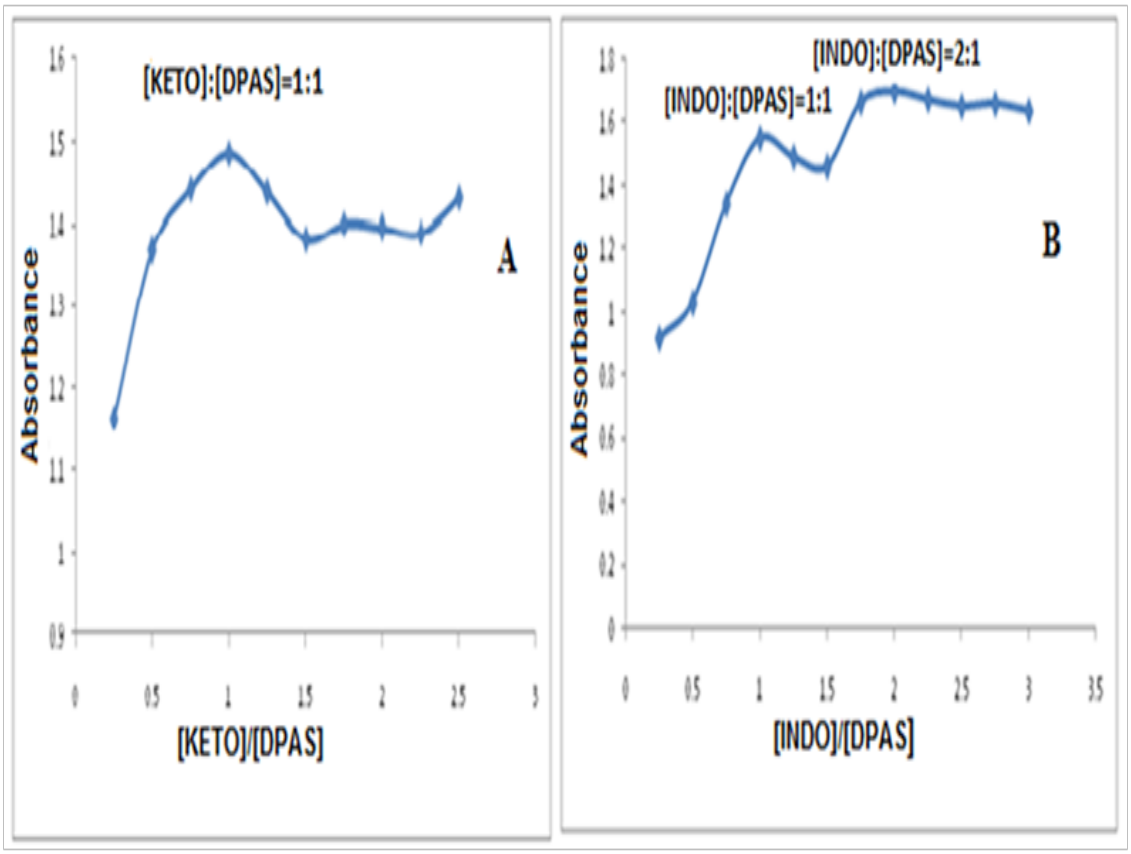


Fig. 8. Molar Ratio of DPAS with different conc.of A) KETO (555 nm) and B) INDO (550 nm), and at room Temp.

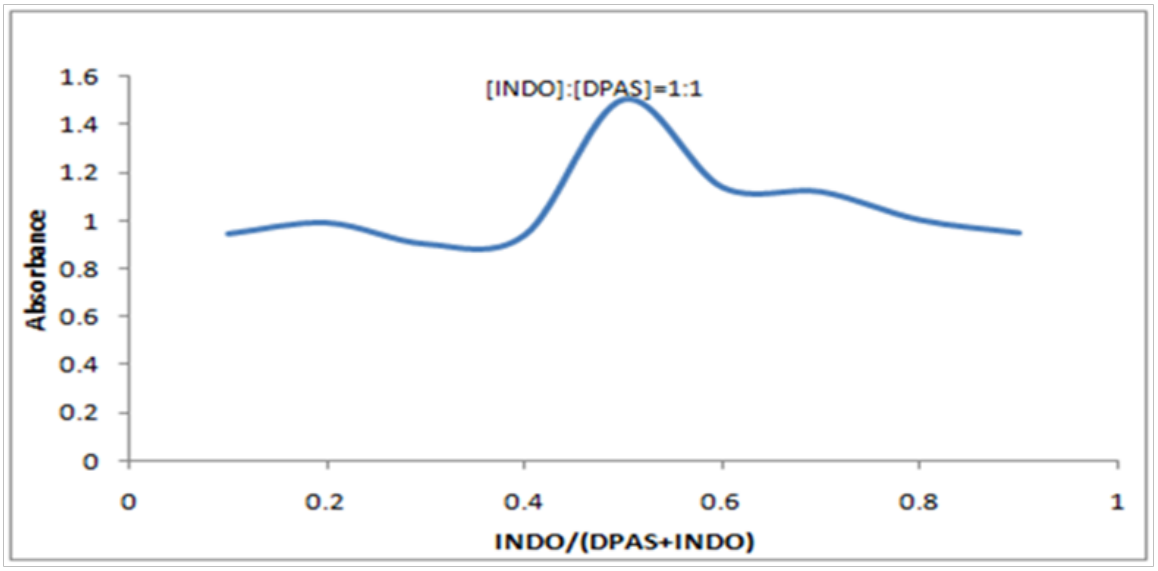
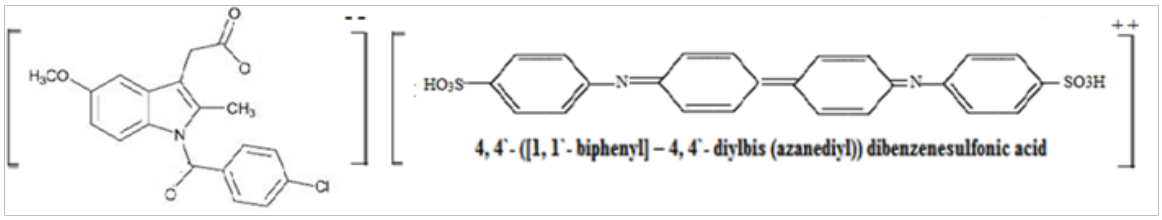


Fig. 9. Continuous variation of (0.5:4.5) x 10^{-5} M DPAS oxidant with (0.5:4.5) x 10^{-5} M INDO conc. at 550 nm at ambient Temp. within 10 min.



Scheme 2. The proposed formation of 1:1 (DPAS: INDO) reaction ion-pair product.

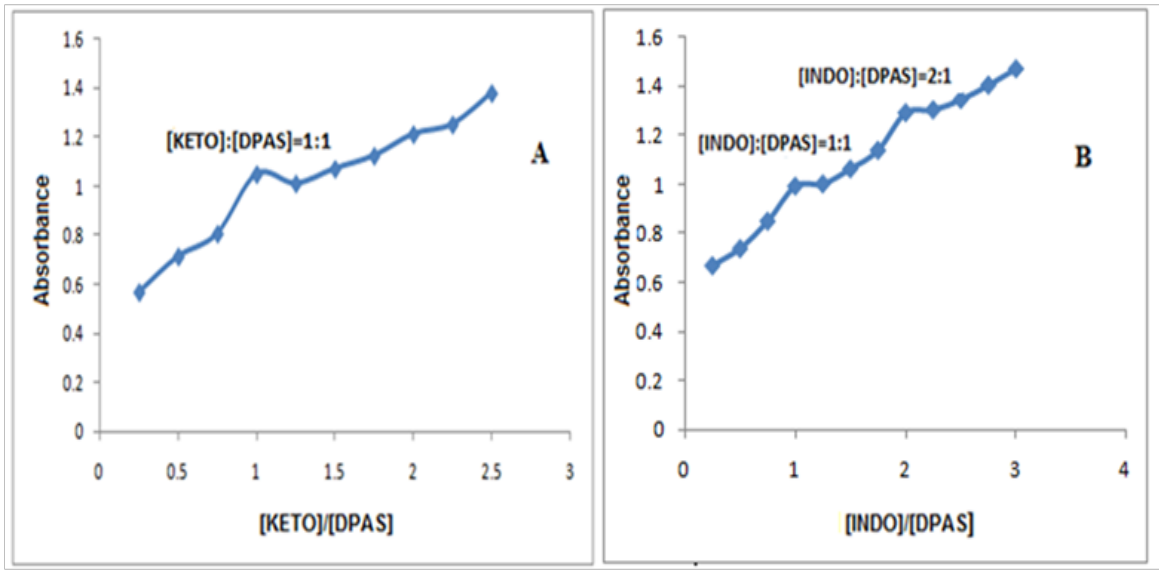


Fig. 10. Molar Ratio of DPAS with different conc.of A) KETO (255 nm, after 30 min.) and B) INDO (250 nm, after 40 min.), and at room Temp.

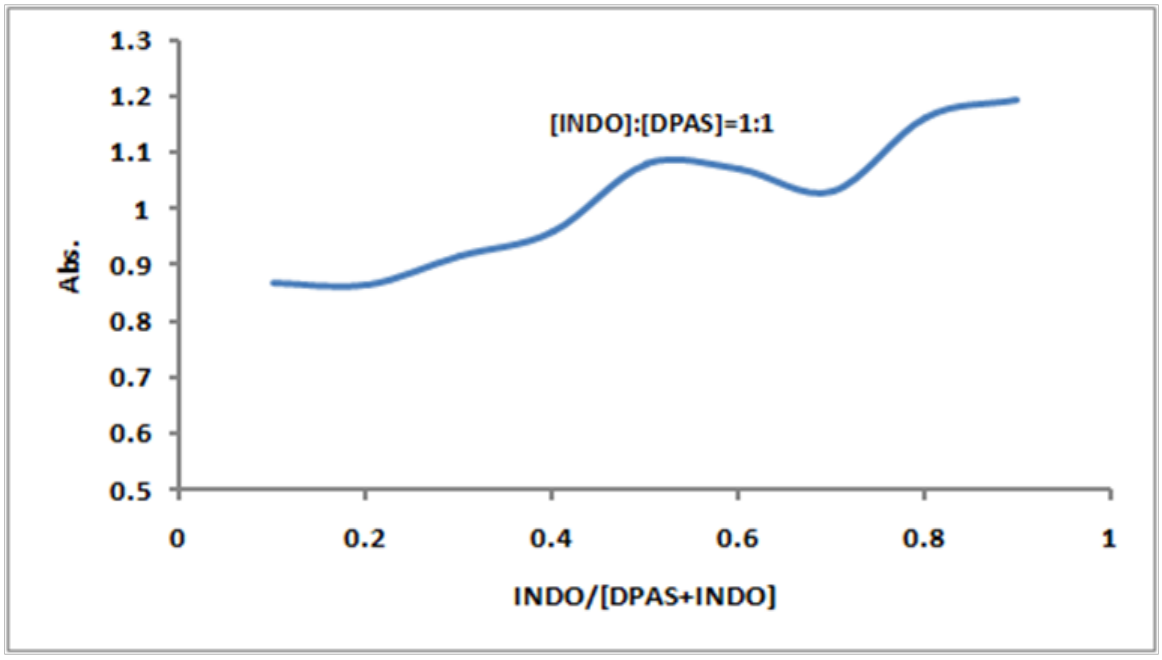


Fig. 11. Continuous variation of (0.5:4.5) x 10^{-5} M DPAS oxidant with (0.5:4.5) x 10^{-5} M INDO conc. at 250 nm at ambient Temp. after 40 min.

Validity of Beer's law

Under the proper condition, Beer's law was valid (Fig 12) under the concentration ranges 5.1-50.9 µg mL^{-1} and 10.7-71.6 µg mL^{-1} in the visible region, while 1.27-6.36 µg mL^{-1} and 0.72-14.31 µg mL^{-1} in the UV- region for KETO and INDO respectively.

Analytical parameters obtained such as slope, intercept, correlation coefficient, Sandell sensitivity, molar absorpitivity (ε), standard deviation, and relative standard deviation, limit of quantification and limit of detection are shown in Table 2.

It is obvious from the data given in Table 2; the linearity of calibration graphs are proved by the high values of the correlation coefficient (r) and the small values of the y-intercepts of the regression equations. The accuracy and precision of the proposed methods are indicated by the small values of SD and RSD. The calculated values of Sandell sensitivity (S.S) and Molar absorpitivity (ε) confirm the sensitivity of the methods. The limits of detection (LOD) and quantification (LOQ) values are explaining the validation of theroposed method.

Within-day and In-between day measurements

In order to prove the validity and applicability of the proposed methods and the reproducibility of the results obtained at brown form, five replicate experiments within 5 hours at five concentrations of studied drugs are carried out within the linearity range which shown in Table 3 in which it is observed that RSDs values are less than 1 %.

Spectrophotometric determination of studied drugs in pharmaceutical preparations using DPAS as oxidant indicator in violet and brown forms

The proposed methods were successfully applied to determine KETO and INDO in their pharmaceutical preparations in which analysis not affected by the other constituents and additives. The SD and % recoveries were calculated. the proposed method evaluated by statistical data including F- and t- tests [41] for the studied drugs compared with that of the official methods [42,43] which are given in Table 4, The values did not exceed the theoretical tabulated values indicating that there is no significant difference between the proposed and the official methods regarding accuracy and precision.

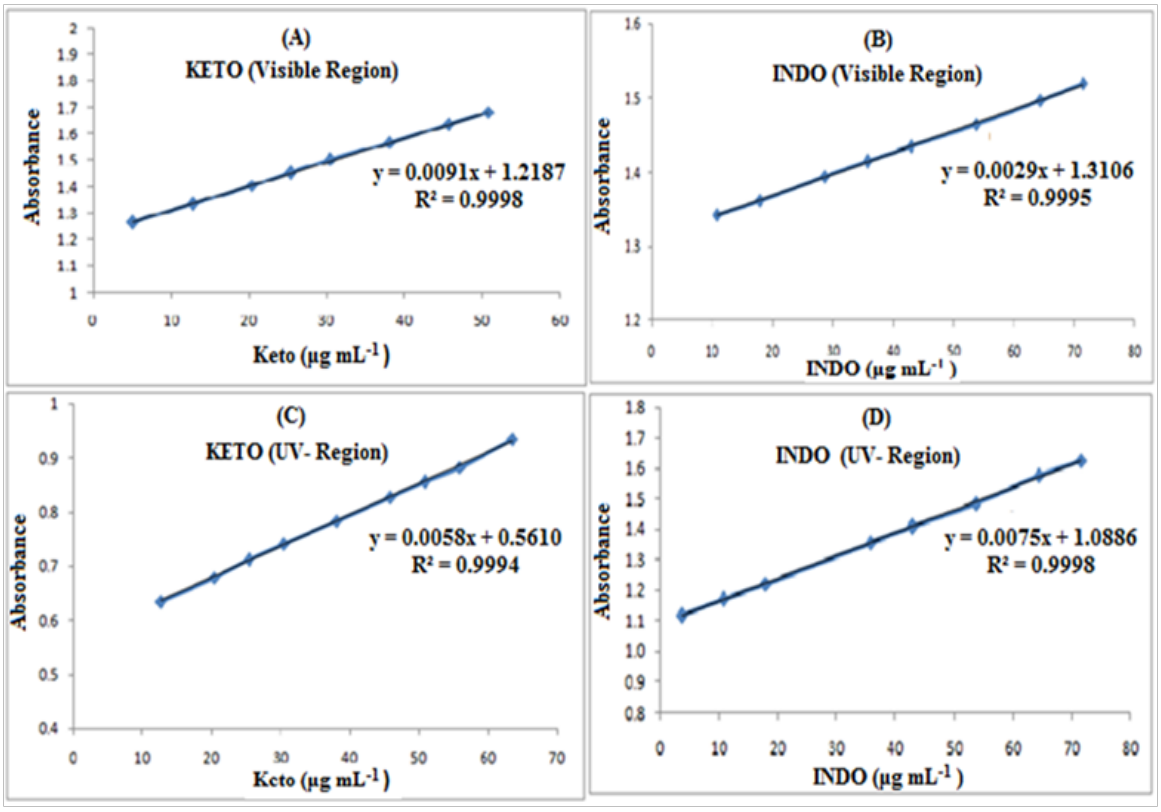


Fig. 12. Calibration curve of KETO and INDO at constant conc. of DPAS oxidant in visible and UV-region.

TABLE 2. Analytical parameters for spectrophotometric Determination of standard KETO and INDO drugs by the proposed DPAS methods in visible region and UV-region.

Drug	Visible Region		UV- Region	
	KETO	INDO	KETO	INDO
λ_{max} (nm)	555	550	255	250
Beer's law (µg mL^{-1})	5.1-50.9	10.7-71.6	1.27-6.36	0.72-14.31
LOD (µg mL^{-1})	0.71	1.7	0.15	0.27
LOQ (µg mL^{-1})	2.15	5.15	0.46	0.82
R^2	0.9998	0.9995	0.9994	0.9998
Regression equation (* Y)	y = 0.0091x + 1.2187	y = 0.0029x + 1.3106	y = 0.0582x + 0.561	y = 0.0375x + 1.0886
Molar Absorpitivity (L moL^{-1} cm^{-1})	0.2319 x 10^4	0.1040 x 10^4	0.1480 x 10^5	0.1341 x 10^5
SD	0.2	0.14	0.031	0.015
RSD%	0.73	0.33	0.78	0.21
Sandell sensitivity (µg cm^{-2})	0.1099	0.3448	0.017	0.027
Recovery %	100.39	100.24	99.95	100.25

*=DPAS.
* At room temperature

TABLE 3. Within–day and In between- days spectrophotometric micro-determination of standard KETO and INDO drugs by the proposed DPAS method at UV region (Brown Form).

Drug	Within Day					In Between Day				
	[wt] taken (µgmL^{-1})	[wt] found (µgmL^{-1})	Recovery (%)	SDa	RSD(%)	[wt] taken (µgmL^{-1})	[wt] found (µgmL^{-1})	Recovery (%)	SDa	RSD(%)
KETO	1.53	1.49	97.6	0.008	0.53	1.53	1.48	97.07	0.008	0.52
	2.29	2.26	98.64	0.01	0.45	2.29	2.24	97.91	0.009	0.42
	3.31	3.33	100.66	0.012	0.36	3.31	3.32	100.42	0.008	0.25
	4.07	4.01	98.54	0.01	0.24	4.07	3.99	98.14	0.009	0.23
	4.83	4.82	99.66	0.005	0.11	4.83	4.81	99.48	0.006	0.13
INDO	2.9	2.9	99.89	0.009	0.31	2.9	2.8	98.75	0.021	0.74
	6.4	6.4	99.56	0.013	0.21	6.4	6.4	99.1	0.014	0.22
	7.9	7.8	99.32	0.021	0.31	7.9	7.8	98.77	0.027	0.35
	9.3	9.3	99.74	0.033	0.35	9.3	9.2	99.01	0.021	0.22
	13.6	13.5	99.54	0.028	0.21	13.6	13.5	99.25	0.023	0.17

TABLE 4. Spectrophotometric micro – determination of KETO and INDO drugs in pharmaceutical Formulations by proposed DPAS method and official method.

Drug	Proposed method (Violet Form)			Official method			Proposed method (Brown Form)			Official method		
	[wt] taken (μgmL^{-1})	[wt] found (μgmL^{-1})	Recovery (%)	[wt] taken (μgmL^{-1})	[wt] found (μgmL^{-1})	Recovery (%)	[wt] taken (μgmL^{-1})	[wt] found (μgmL^{-1})	Recovery (%)	[wt] taken (μgmL^{-1})	[wt] found (μgmL^{-1})	Recovery (%)
INDO in Indocid Capsule (25 mg/Capsule)	14.31	14.28	99.75	4	4.02	100.5	2.86	2.87	100.25	3	3.02	100.66
	21.47	21.66	100.91	7	6.95	99.29	4.29	4.28	99.75	6	5.95	99.16
	32.2	32.19	99.98	10	10.02	100.2	6.44	6.47	100.45	9	9.02	100.22
	39.36	39.38	100.06	13	12.95	99.61	7.87	7.85	99.74	12	11.95	99.58
	57.25	57.38	100.23				9.3	9.37	100.67			
Mean ± SD		100.18 ± 0.28			99.9 ± 55			100.17 ± 0.048			99.91 ± 0.67	
F-test			0.64 (6.59)**						0.4 (6.59)**			
t-test			0.84 (2.365)**						0.7 (2.365)**			
KETO in Ketolgin Tablet (50 mg/Tablet)	10.17	10.15	99.82	5		100	1.53	1.53	100.22	1	1	100
	15.26	15.36	100.69	10		99.9	2.29	2.28	99.7	2	2.01	100.5
	22.89	22.97	100.35	15		100.4	2.80	2.81	100.61	4	4.01	100.25
	33.06	33.16	100.32				3.31	3.31	100.10	6	6	100
	40.69	40.59	99.77				4.07	4.04	99.36	8	7.99	99.88
Mean ± SD		100.19 ± 0.17			100.1 ± 0.3			100 ± 0.022			100.13 ± 0.25	
F-test			2.25 (6.94)**						3.84 (6.39)**			
t-test			0.38 (2.447)**						0.86 (2.306)**			

Coclusion

The proposed methods are simple, reliable, sensitive and efficient for routine analysis of Ketoprofen and Indomethacin in raw materials and pharmaceutical dosage forms over a wide concentration range without interference from other constituents or additives. Moreover, it involves the advantage of the use of inexpensive instrument without losing accuracy. Therefore, these methods are useful for applications to the investigated drugs in bulk as well as in their tablets with high precision and good accuracy.

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استخدام ثنائي الفنيل امين سلفونات ككاشف مؤكسد في التقديرالطيفي الدقيق للأدوية غير الأستيرودية المضادة للألتهاب

محمد عبدالجواد زايد[١] ، محمود فاروق السيد محمد[٢]

[١] قسم الكيمياء - كلية العلوم - جامعة القاهرة - الجيزة - مصر، [٢]شركة جلاكسي للكيماويات - السويس - مصر.

لقد تم في هذا البحث استخدام ثنائي الفنيل امين سلفونات ككاشف مؤكسد في صورته المؤكسدة او المختزلة في التقدير الطيفي الدقيق للأدوية غير الأستيرودية المضادة للألتهاب مثل الكيتوبروفين والأندوميثاسين في صورتها النقية ومستحضراتها الصيدلانية. يحضر ثنائي الفنيل امين سلفونات في صورته المؤكسدة بالمعايرة مع ثاني كرومات البوتاسيوم في وسط ٢ عياري حمض الكبريتيك ليكتسب اللون الأزرق- البنفسجي والذي يمتص عند الطول الموجي ٥٥٥ نانوميتر. وقد درس التفاعل بين الكاشف المؤكسد مع كل دواء علي حده في زمن قدره عشر دقائق في المدي المرئي. وقد أثبتت هذه الدراسة تكوين نواتج ذات لون أحمر.وقد درس التفاعل بين الكاشف في صورته المختزلة مع الأدوية محل الدراسة في مدي الأشعة فوق البنفسجية عند الطول الموجي ٢٥٥ نانوميتر عند مرور زمن قدره نصف ساعة يتحول لون النواتج الي اللون البني. وبدراسة النسب الجزيئية بين المتفاعلات وجد أنها ١:١ و ١:٢ (الدواء: الكاشف) وقد وضع صيغ جزيئية مقترحة لتلك التفاعلات بين الكاشف والأدوية. وقد تم تطبيق هذه التفاعلات المقترحة في المدي المرئي ومدي الأشعة فوق البنفسجية للتقدير الطيفي الدقيق لتلك الأدوية المضادة للألتهاب في صورتها النقية ومستحضراتها الصيدلانية. وقد تم حساب المعاملات التحليلية لتفاعل الكاشف في صوره المختلفة (المؤكسدة والمختزلة) مع تلك الأدوية في المدي المرئي ومدي الأشعة فوق البنفسجية مثل الأنحراف المعياري ((SD والأنحراف المعياري النسبي (RSD) ومعامل حساسية ساندل ((S و حد الأكتشاف (LOD) و حد التقدير(LOQ) بهدف التأكد من دقة وحساسية الطرق المقترحة. وقد وجد أن قانون بير صالح في مدي التركيز المرئي عند تركيزات (٥,١-٥٠,٩) ميكروجرام/ميلليترللكيتوبروفين و(١٠,٧-٧١,٦) ميكروجرام/ميلليتر للأندوميثاسين وفي مدي تركيز الأشعة فوق البنفسجية عند تركيزات (١,٢٧-٦,٣٦) ميكروجرام/ميلليترللكيتوبروفين و(٠,٧٢-١٤,٣١) ميكروجرام/ميلليتر للأندوميثاسين. وقد وجد ان نسبة الأسترجاع عند اللون البنفسجي ١٠٠,٣٩(للكيتوبروفين) و١٠٠,٢٤(للأندوميثاسين) والأنحراف المعياري ٠,٢ (للكيتوبروفين) و ٠,١٤ (للأندوميثاسين) وقد وجد أن نسبة الأسترجاع عند اللون البني ٩٩,٩٥ (للكيتوبروفين) و١٠٠,٢٥ (للأندوميثاسين) والأنحراف المعياري ٠,٠٣١ (للكيتوبروفين) و٠,٠١٥ (للأندوميثاسين) والتي تعبر عن دقة الطرق المقترحة. ولقد طبقت الطرق المقترحة بنجاح لتقدير تلك الأدوية في صورتها النقية وتحضيراتها الصيدلانية. وقد قدر دواء الكيتوبروفين في أقراص الكيتولجين)مدي الأشعة فوق البنفسجية) عند تركيز (١,٥٣-٤,٠٧) ميكروجرام/ميلليتر بنسبة استرجاع (٩٩,٣٦-١٠٠,٦١) ونسبة الأنحراف المعياري (٠,٠٠١-٠,٠٠٣) . وقد أثبت النتائج توافق كبير مع الطرق القياسية الرسمية والذي تم اثباته باختباري F و T.