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Optimization and Validation of a Rapid Spectrophotometric Method for the Determination of Paracetamol in Pure and Human Dosage Forms

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***Abstract*:**

Simple and reliable spectrophotometric method was developed for the determination of paracetamol in pure form and pharmaceutical formulations. The method is based on the oxidation of sodium nitroprusside by potassium ferrocyanide, followed by coupling with paracetamol to produce a stable green dye in a basic aqueous medium showing maximum absorbance at 675 nm. Several coupling reagents were examined to evaluate their reactivity toward paracetamol, and sodium nitroprusside was found to be the most effective, yielding a distinct and stable green aqueous product with superior analytical performance. The method obeys Beer`s law in the concentration range of 1-20 µg/mL, with a molar absorptivity of 4716.504 L/mol.cm and Sandall's sensitivity of 0.0320 µg/mL. This reaction produces green dye in a basic aqueous medium at a wavelength of 675 nm. The detection and quantification limits were 0.0665 µg/mL and 0.2217 µg/mL, respectively. This proposed method was successfully applied to solid and liquid pharmaceutical preparations, simplicity, sensitivity, and cost - effectiveness suitable for routine quality control analysis.

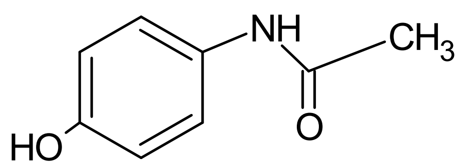
***Keywords*: Paracetamol, Sodium nitroprusside, Potassium ferrocyanide, Green dye formation.**

1. Introduction

In the current era we live in the spread of diseases, especially those that affect the immune system, is no secret to anyone Especially those diseases that have symptoms including fever and mild to moderate pain. Numerous studies and research have highlighted the importance of assessing medications used in everyday life, particularly when there is a need to detect unknown concentrations in medications manufactured by quality control laboratories in various countries. This work provides a simple, accessible, and feasible summary of the quantitative measurement of paracetamol, particularly in its pharmaceutical preparations, in their various forms and dosages. This work has achieved the availability of an aqueous green dye, measured using the simplest dual-wavelength spectrophotometer, which gives a peak absorption at 675 nm. Highly accurate and satisfactory results were practically obtained for the detection of the drug paracetamol in its standard aqueous solutions and in its preparations in three different formulations. Currently, the concentration of this drug is measured using very expensive measuring devices that require costly solvents, whereas this method of measurement is easy, inexpensive, and accessible to everyone. To clarify the research concept, the required standard solutions were prepared, the optimal measurement conditions were set, the percentage of interaction with pharmaceutical additives was determined, the limits of linear action of the drug were established, the accuracy of the method was assessed, and finally, the results obtained were compared with other methods for this drug (Sara Abdullah Kamil 2026).

Spectrophotometry is a technique used to measure the amount of light that is absorbed, transmitted, or reflected by a sample at different wavelengths. This technique is employed to determine the concentration of various substances in either solutions or solid material (Bunzel, M. and M.H. Penner,2024). Spectrophotometry relies on the fundamental principle that each substance absorbs or transmits light uniquely at different wavelengths, allowing for the identification and measurement of that substance. Direct - oxidation spectrophotometry is a method used to determine the quantity of a substance in a sample by measuring its light absorption or transmission. The working mechanism involves the interaction of the substance with an oxidizing agent, followed by measuring the change in light absorption (Papanna, R.K., et al.2015) This step includes the reaction of the substance with a suitable oxidizing agent, leading to a change in its chemical properties. After oxidation, light is passed through the sample, and the extent of absorption or transmission is measured at specific wavelengths. The recorded data is then analyzed to estimate the quantity of the original substance in the sample(Saleem, B.A.A.2019). The analysis relies on the relationship between the concentration of the substance and the amount of light absorbed or transmitted.

This process is applied in mineral analysis, pollutant detection, and pharmaceutical analysis, and it is characterized by accuracy, sensitivity, speed, and versatility. Paracetamol (acetaminophen: acetyl-para-aminophenol) (Fig1.) is a widely used analgesic and antipyretic. It is derived from tar and is the active metabolite of phenacetin (Dadi, M. and M. Yasir,2022). There are many side effects and is often available in pharmacies without a prescription. It is generally used to treat fever, headaches, and mild aches and pains. Paracetamol is also effective in managing more severe pain when combined with anti-inflammatory medications (Bloukh, S., M. Wazaify, and C. Matheson. 2021), and it is a key ingredient in many cold and flu formulations. Although it is safe for humans within the recommended dosage and for short-term use, excessive intake can potentially lead to liver toxicity. Paracetamol is considered safe and effective when used correctly (Brune, K., B. Renner, and G. Tiegs.2015), as it is relieves pain by inhibiting the production of chemicals responsible for pain sensation and also affects the neurotransmitters that regulate body temperature, thereby reducing fever. The effects of paracetamol begin relatively quickly; its analgesic and antipyretic actions typically appear within (30 – 60) minutes after administration (Mallet, C., et al. 2023).



N-(4-hydroxyphenyl)acetamide

Figure.1 Structure of Paracetamol

The level of paracetamol in the blood is estimated using various methods, including spectrophotometry, high-performance liquid chromatography (HPLC), mass spectrometry, and immunoassay. These methods are used to measure the concentration of paracetamol in blood samples, especially in cases of overdose or potential poisoning. The method of estimation may vary depending on the type of sample (such as blood or urine) and the purpose of the analysis (Khan, H.2024). Paracetamol can be administered in the form of tablets, syrup, or suppositories, with the dosage for adults and children ranging from 4 to 6 times daily, as needed. For adults, the recommended dosage is 500 to 1000 mg per single dose (Franco, F.W. and M.C.2021). This is equivalent to one to two 500 mg tablets, with a maximum daily dose not exceeding 4000 mg (4 grams = 8 tablets of 500 mg) (Amaechi, O., M.M. Human, and K. Featherstone, 2021). For children, the dosage varies depending on the form: suppositories: (10 – 15) mg per kilogram of body weight, syrup (125 mg/5 mL) prescribed for children under 6 years within the recommended doses, as following: Ages 1-3 months, 2.5 ml, a maximum of twice in 24 hours. For ages 3-6 months, 2.5 mL, up to 4 times in 24hours. Up to 24 months, 5 mL, up to four times daily. Ages 2-4 years, 7.5 mL, up to four times daily. Ages 4-6 years, 10 ml, up to four times daily(Zempsky, W.T., P.K. Bhagat, and K. Siddiqui2020). The medication takes effect within 30 minutes of administration. It should be stored in its tightly closed container, at room temperature, out of reach of children, and away from heat and humidity (Bateman, D.N.2015).

Finally, this work includes an important summary of the most prominent problems it addresses, the proposed solutions, and the new advantages that distinguish this work from others.

Problem:
The widespread use of paracetamol for treating symptoms such as fever and mild to moderate pain makes it essential to ensure accurate drug concentration in pharmaceutical products. However, current analytical methods are often expensive, require advanced instrumentation, and depend on costly or harmful solvents, limiting their routine use in many laboratories.

Solution:
This study introduces a simple, cost-effective, and environmentally friendly method for the quantitative determination of paracetamol. The method is based on the formation of a green aqueous dye, measured using a dual-wavelength spectrophotometer at 675 nm. It is easy to apply and does not require complex equipment or expensive reagents.

Novelty (What makes this research unique):

- Development of a green analytical method that avoids harmful solvents
- Significant reduction in cost compared to conventional techniques
- Simplicity and accessibility for routine laboratory use
- High accuracy and reliable results comparable to advanced methods

2. Experimental

The practical part includes several sections: equipment, chemicals, standard and secondary solutions, and preparation of pharmaceutical samples**.**

2.1 Apparatuses and chemicals

The devices that used in this research were PD-303 Spectrophotometer (Apel /Japan) and Sensitive balance (Sartorius / M-Power Japan). The chemicals used in this research included Paracetamol (SDI),Sodium Nitroprusside (SDI), Potassium Ferrocyanide (B.H.D), Potassium Hydroxide (Merck), Potassium Carbonate (B.H.D), Sodium Carbonate (B.H.D), Sodium Benzoate (Merck), Glucose (SDI), Starch (SDI) and Sucrose (SDI). All chemicals were of analytical grade.

2.2 Standard paracetamol solution (100µg/ mL)

A standard solution was prepared by dissolving 0.01 g of pure paracetamol in distilled water and diluting to 100 mL in a volumetric flask. The solution was stored in an opaque volumetric flask until ready for use (Gamal, Sherief, et al.2023).

2.3 Preparations of chemicals and reagents

A 0.01M solution of the oxidizing agent potassium ferrocyanide and the reagent of sodium tungstate was prepared.The appropriate weight of each substance was measured separately and dissolved in 100 mL of distilled water with continuous shaking and stirring. Potassium hydroxide solution was prepared at a concentration of 1M by dissolving the required weight in 100 mL of distilled water.The Potassium hydroxide solution was stirred and shaken until completely dissolved. All prepared solutions were stored in opaque volumetric flasks and then kept in a suitable place (Sanghvi, Malav R., Karan W. Chugh, and S. T. Mhaske.2025).

2.4 Secondary chemical solutions

Several secondary materials were used to complete our experiment, including alkaline solutions and oxidizing agents. All alkaline solutions were prepared at the concentration of one molar by dissolving the appropriate mass in 100 mL of distilled water. All oxidizing agents were prepared at the concentration of 0.01% by dissolving the required weight in 100 mL of distilled water.All oxidizing agents were stored in opaque volumetric flasks after shaking (Wang, Peng, et al.2024).The solutions of the interfering substances were prepared at a concentration of 100 µg / mL by dissolving the required mass in 50 mL of distilled water.The prepared solutions were thoroughly mixed and stored in 50 mL volumetric flasks for further use (Lotfy, Hayam M, et al.2023)(Vandy, Ahmed, et al.2024).

2.5 Preparations of pharmaceutical samples

Tablets: Ten commercial paracetamol tablets were weighed and finely milled. The appropriate mass of the crushed tablets was taken to obtain a concentration of 100 µg/ mL of the paracetamol.The required mass was dissolved in 50mL of distilled water and thoroughly mixed. The resulting solution was stored in an opaque volumetric flask for later use (Abdulla, Alaa A., and Murtada A. Oshi.2024)..

Intravenous nutrition and syrup **:** Appropriate volumes of both the intravenous solution and syrup were taken to obtain 100 µg/ mL of commercial paracetamol individually.The obtained solutions were dissolved in 50 mL of distilled water with continuous mixing and stored in opaque volumetric flasks (Munir,Muhammad Abdurrahman, et al.2023).

3. This third part of the research includes adjusting the reaction fraction, absorption spectrum, titration curve, and results tables.

3.1 Optimization of reaction conditions

A volume of 1 mL of 0.01M sodium nitroprusside reagent (NAS)was used with 1 mL of 100 µg/ mL paracetamol and 1 mL of 0.01 M of each oxidizing agent, tested separately. One milliliter of 1M potassium hydroxide was added to 20 mL volumetric flasks.The flasks were filled to the mark with distilled water, thoroughly mixed, and the resulting absorbance was measured. Potassium ferrocyanide (KF) was chosen as the best oxidizing agent because it produced the highest absorbance, yielding an emerald -green color. A volume of 1 mL of 0.01M sodium nitroprusside reagent (NAS) was used with 1 mL of 100 µg / mL paracetamol and increasing volumes ranging from 0.1 to 2 mL of 0.01M potassium ferrocyanide. A volume of 1 mL of 1M potassium hydroxide was added to 20 mL volumetric flasks, which were then filled to the mark with distilled water. A volume of 0.5 mL of oxidizing agent (potassium ferrocyanide, KF) was selected as the most appropriate for the next step. For selection of coupling reagent,a volume of 0.5 mL of 0.01M oxidizing agent (potassium ferrocyanide, KF) was taken with 1 mL of 0.01M sodium nitroprusside reagent and1 mL of 100 µg /mL paracetamol. Then 1 mL of 1M potassium hydroxide (KOH) was added, and the flasks were diluted to the mark with distilled water in 20 mL volumetric flasks. Sodium nitroprusside (NAS) was selected as the best coupling reagent because it produced the highest absorbance.For selection a best volume of coupling reagent a volume of 0.5 mL of 0.01M oxidant agent (KF) was used with 1 mL of 100 ppm paracetamol and increasing volumes of 0.01M sodium nitroprusside reagent (NAS). Finally, 1 mL of 1M KOH was added to 20 mL volumetric flasks, and the volumes were completed to the mark with distilled water.The absorbance of the prepared solutions was measured, and it was found that the best volume of the reagent (NAS) was1.6 mL.

To adjust the basic conditions, after applying all the previous optimal conditions, several basic solutions were tested. One milliliter of each 1M base was used separately, and it was found that the best base was KOH with 0.8 mL, It was found that the best volume of KOH was 0.8 mL, as it produced the highest absorbance of the solution, when comparing this method with another method, it was found that it uses acid first and then uses the base NaOH which indicates the ease of the method used here (Pasha, Chand. 2020). After adjusting all the optimum conditions mentioned above, the settling time of the final product was studied. It was found that the best stabilization time for the final absorbance product in the oxidation-conjugation process is 5 minutes; all values are shown in table 1.Finally to select the order of addition several series of material additives were tested in this work. It was found that the best sequence for adding components is to add the oxidizing agent first (KF), followed by KOH, then the reagent (NAS), and finally paracetamol as. shown in table 2. All solutions were added at their most appropriate experimental volumes. In this method all solutions are prepared in aqueous medium and is similar to other different methods for the same drug(Masood, Zaheer, Haji Muhammed, and

Iftikhar Ahmed Tahiri.2024) (Van, Huu Tap, et al.2020) (ALjeboree, Aseel M., et al.2022).This sequence produced the highest absorbance and was adopted in the subsequent steps.

Table 1: Summary of optimal conditions for the method

λ max	Temp (°c)	Stability period (min)	NAS 0.01% Vol.	KF 0.01% Vol.	KOH 1 M Volume	Sequence of additions	Suitable solvent
675nm	25 °C	5 min	1.6 mL	0.5mL	0.8 mL	KF+KOH+NAS+PAR	Distilled Water

*NAS = reagent, * KF = oxidant, *PAR = Paracetamol

Table 2 : The effect of order of addition

Order	Sequence	Absorbance
1	NAS+PAR+KF+KOH	0.420
2	NAS+KF+PAR+KOH	0.489
3	KF+NAS+PAR+KOH	0.474
4	PAR+NAS+KF+KOH	0.402
5	KF+PAR+NAS+KOH	0.565
6	PAR+KOH+KF+NAS	0.457
7	KF+KOH+NAS+PAR	0.577

Table 1 summarizes the conditions used for the reaction to obtain the best experimental results and the highest absorption value, as also shown in Table 2.

3.2 Absorption spectrum and calibration curve

This method is based on the formation of a green dye that exhibits the highest absorbance at 675 nm. The reagent, sodium nitroprusside (NAS), is oxidized by the oxidizing agent, potassium ferrocyanide (KF),in a basic medium of KOH. The oxidized agent and oxidizing reagent are then combined with paracetamol in an aqueous medium, Figure 1.

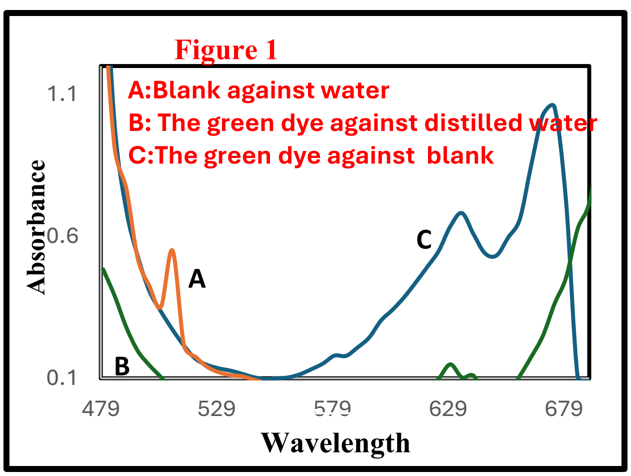


Figure 1: Absorption spectrum of paracetamol at 675 nm by Uv-Visible

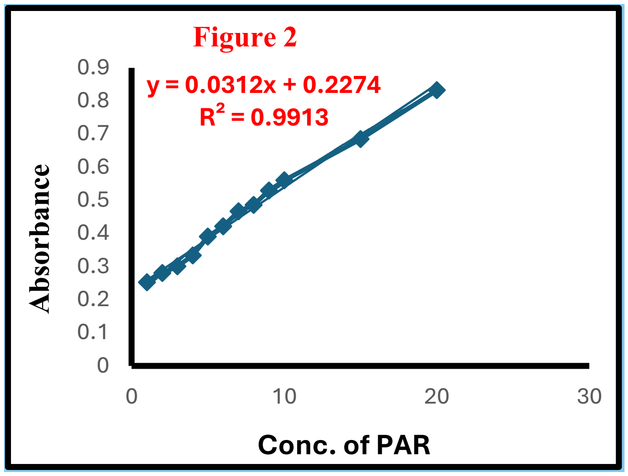


Figure 2 : The calibration curve of paracetamol at 675 nm

To determine the calibration curve for 100 µg / mL in paracetamol (Eraqi, Mostafa M., et al. 2025), several volumes were used, ranging from 0.2 to 5mL. A volume of 0.5 mL of 0.01M oxidizing agent (KF) was added to 20 mL volumetric flasks. Then, 1mL of 1 M KOH was added while stirring, followed by1.6 mL of 0.01M reagent (NAS). Finally, increasing volumes of 100 µg / mL paracetamol, ranging from 0.2 – 5mL, were added. After shaking and stirring the prepared solutions, they were left for 5 minutes, and the absorbance was measured at 675 nm against the blank. It was found that the linearity in this method follows Beer`s law within the limits 1-20 µg / mL (Elbaramawi, Samar s., et al.2024), with a molar aabsorption coefficientof 4716.504 L / mol.cm, Figure 2 and table 3. When this spectral method was compared with other analytical methods using infrared spectroscopy, it was found that it gave limits ranging from 1-100 µg / mL, while it gave a higher detection limit than this method (Hosseini,Mehdi, Rodrigo Castillo, and Mousa Soleymani.2025). Some coulometric methods have shown that they are close to the resulting linearity and are better in terms of detection limits (Osman, Alaa M., et al. 2025) (Nagaraja, P., KC Srinivasa Murthy, and K.S. Rangappa.1998) (Swami, Mdhuri Vishwanath, et al. 2025) (Ali, Mohamed S., and Tilal Elsaman.2021). Table.3 shows that the variables resulting from the calibration curve correlation coefficient resulting from the straight-line equation is almost obtained in other previous works (Reid, Imad Osman Abu, and A. Khatir Sam. 2024) (Qasim, Faroq Omer, et al. 2024) (Saeed, Ahmed Mahdi. 2017).

Table 3 : Variables resulting from the calibration curve

Drug	Slope	The calibration coefficient R^2	Linearity range (µg/mL)	Molar absorptivity (L/mol.cm)	LOD (µg/mL)	LOQ (µg/mL)	Sandall` S Index (µg/mL)
PAR	0.0312	0.9913	1- 20	4716.504	0.0665	0.2217	0.0320

4. Result discussion

This section examines the accuracy, precision, and impact of interfering factors, as well as pharmaceutical dosing applications, and then compares this method with other modern methods.

4.1 Accuracy and precision

After establishing the optimal conditions the accuracy and precision of this method were tested using three concentrations of paracetamol. Each concentration was measured three times, and it was found that table. 4 shows that the average accuracy readings are 98.71%, and the average standard deviation reading is 0.0387 % which turned out to be of high accuracy when compared to other previous works (Ben - Hander, Gazala Mohamed, Mohammed Eshtewi Gaeth, and Nasser Ali Otmaan.2022) (Ismail, Aram.2024).

Table 4 : Accuracy, average percentage and precision

Amount taken µg/mL	Abs	Amount found µg/mL	Acc %	Avg. of Acc%	RSD%
3	0.319	2.935	97.83%		
3	0.319	2.935	97.83%	98.18%	0.0184 %
3	0.320	2.967	98.9%		
10	0.541	10.05	100.5%		
10	0.542	10.08	100.8%	100.7 %	0.0173 %
10	0.542	10.08	100.8%		
15	0.680	14.506	96.70%		
15	0.683	14.602	97.34%	97.27%	0.0805 %
15	0.685	14.666	97.77%		

Three different concentrations of the drug (3, 10, and 15) were replicated, all of which gave high accuracy limits and good standard deviation values. As shown in table 4

4.2 The effect of interference

The primary objective of the pharmaceutical industry is to protect public health(Ntorkou, Marianna, and Con stantinos K. Zacharic. 2025) (Chaachouay, Noureddine.2025), therefore to study the effect of drug-interacting substances on the proposed method, several interacting substances were tested. Three concentrations of each interfering substance were used with a fixed concentration of paracetamol, and the resulting absorbance of the mixture was measured after adjusting the optimal conditions. The resulting green dye was not affected by the interfering materials and exhibited high-resolution boundaries as shown in table. 5, Figure.3.This review is valuable to understanding selectivity principles and latest in nanotechnological approaches for improving nervous system drug delivery (Alves, Patricia Alencar, et al. 2025).

Table 5 : Summary of the effect of interfering substances

Interferences	Conc. µg/mL	Conc. Taken of paracetamol µg/mL	Abs	Conc. Found of paracetamol µg/mL	Acc%
Sodium benzoate	10	10	0.545	10.179	101.79%
	20	10	0.542	10.083	100.833%
	30	10	0.543	10.115	101.153%
Starch	10	10	0.544	10.147	101.47%
	20	10	0.543	10.115	101.153%
	30	10	0.544	10.147	101.47%
Glucose	10	10	0.546	10.21	102.11%
	20	10	0.542	10.083	100.833%
	30	10	0.546	10.21	102.11%
Sucrose	10	10	0.545	10.179	101.79%
	20	10	0.544	10.147	101.47%
	30	10	0.543	10.115	101.153%

All pharmaceutical additives were shown in table 5 to be successful and highly accurate, with the average accuracy values equal to 101.44%.

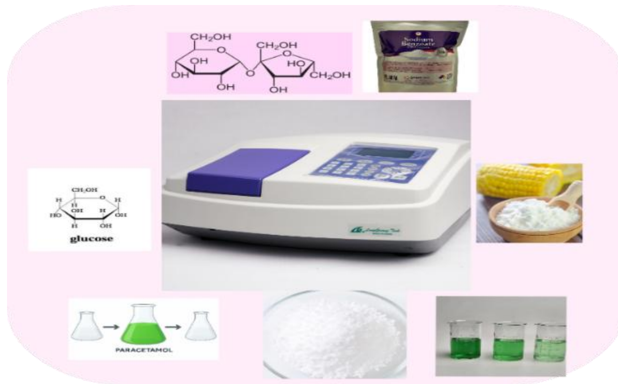


Figure 3 :The graphical abstract for the interferences with paracetamol

4.3 Applications of pharmaceutical dosage

The direct method was conducted to determine of paracetamol in three pharmaceutical preparations (Velevska, Nena, et al.2025). Solutions of 100 µg / mL concentration of each preparation were prepared, and three different concentrations were applied. All pharmaceutical preparations exhibited high accuracy, with values of at least 98.66% after applying the optimum conditions (Al-Samarrai, Mumin F.Hamad, et, al.2024). see table 6.

1. Paracetamol tablets (500 mg), company of ASWAR AL-KHALEEJ COMPANY

2. Antipyrol syrup (120mg / 5mL), company of MDI-IRAQ BAGHDAD

3. Intravenous nutrition Paracerol (10 mg / ml), company of AROMA ILAJ TURKEY

Table 6: Pharmaceutical applications dosage

Pharmaceutical Formula	Conc. Taken of paracetamol µg/mL	Conc. Found of paracetamol µg/ mL	Acc %	Avg.Rec%
Intravenous nutrition	3	2.871	95.7 %	98.66 %
	10	10.300	103 %	
	15	14.602	97.3 %	
Syrup	3	3.00	100 %	99.96 %
	10	10.211	102.11 %	
	15	14.667	97.78 %	
Tablets	3	3.03	101%	100.296 %
	10	10.147	101.47%	
	15	14.762	98.418 %	

We can see from the table that the accuracy rate ranges between 98.66% and 100.296% for pharmaceutical forms. For all given concentrations.

4.4 Comparison with other methods

The results obtained from this work were compared with other existing methods. The comparisons show that this method produces results comparable to previous studies in terms of the linearity limits and Sandall`s index. This method also yielded a higher absorbance peak than other methods. The comparison demonstrated that this method can be applied to a wider variety of paracetamol preparations, producing highly accurate results table 7.

Table 7: Statistical results in our study and compared with other methods

Analytical parameter	Literature method *(23)	Literature method **(20)	This method
Reagent	4-Aminoantipyrene	1,3-Dinitrobenzene	Sodium nitroprusside
Beer`s law µg/mL	(2 -100)	(0.8 - 20.5)	(1 - 20)
λ_{max} nm	520	429	675
Molar absorptivity coefficient L/mol* cm	861	19650	4716.504
Solvent	Distilled water	Distilled water	Distilled water
Accuracy %	(98.33 - 100.166%)	(98.20 - 100.40%)	(97.27 - 100.7%)
RSD %	0.484%	----------------------	(0.0184 – 0.08%)
Sandall`s Index µg/mL	$6.62 * 10^{-6}$	$7.692 * 10^{-3}$	$3.20 * 10^{-2}$
Pharmaceutical preparation	Tablets	Tablets	Tablets, syrup, Intravenous nutrition
Color	Red	-----------------------	Green
LOD µg/mL	$5.59*10^{-5}$	$2.64 * 10^{-1}$	$6.65 * 10^{-1}$
LOQ µg/mL	$1.86 * 10^{-2}$	$8 * 10^{-1}$	$2.217 * 10^{-1}$

5. Conclusion

This analytical work presents a new, simple and straightforward spectrophotometric method for the determination of paracetamol in its pure form and its various pharmaceutical preparations. This method involves the oxidation reaction between potassium ferrocyanide and sodium nitroprusside under alkaline conditions, followed by combining the resulting product with paracetamol. The green dye gave a good recovery, ranging from 97.27% to 100.7 %, and also provided reliable recovery limits for pharmaceutical preparations. The green dye was prepared in an aqueous medium without the need for heating or cooling and remained stable for more than one hour.

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تحسين وتوثيق طريقة قياس طيفية سريعة لتحديد الباراسيتامول في الأشكال الصيدلانية النقية والبشرية

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الملخص:

طُوِّرت طريقة طيفية ضوئية بسيطة وموثوقة لتحديد تركيز الباراسيتامول في صورته النقية وفي المستحضرات الصيدلانية. تعتمد هذه الطريقة على أكسدة نايتروبروسيد الصوديوم بواسطة فيروسيانيد البوتاسيوم، ثم تفاعله مع الباراسيتامول لإنتاج صبغة خضراء مستقرة في وسط مائي قاعدي، تُظهر أعلى امتصاص عند ٦٧٥ نانومتر. دُرست عدة كواشف تفاعل لتقييم فعاليتها تجاه الباراسيتامول، ووُجد أن نايتروبروسيد الصوديوم هو الأكثر فعالية، إذ يُنتج مُنتجًا مائيًا أخضر اللون ومستقرًا يتميز بأداء تحليلي فائق. تخضع هذه الطريقة لقانون بير في نطاق تركيز يتراوح بين ١ و٢٠ مايكروغرام/مل، بمعامل امتصاص مولاري قدره ٤٧١٦,٥٠٤ لتر/مول.سم وحساسية ساندال قدرها ٠,٠٣٢٠ مايكروغرام/مل. ينتج عن هذا التفاعل صبغة خضراء في وسط مائي قاعدي عند طول موجي ٦٧٥ نانومتر.تخضع الصبغة الخضراء لقانون بير في نطاق تركيز يتراوح بين ١ و٢ مايكروغرام/مل. بلغت قيمة الامتصاصية المولارية وحساسية ساندال للباراسيتامول ٤٧١٦,٥٠٤ لتر/مول.سم و٠,٠٣٢٠ ميكروغرام/مل على التوالي. أما حدود الكشف والتقدير فكانت ٠,٠٦٦٥ مايكروغرام/مل و٠,٢٢١٧ ميكروغرام/مل على التوالي. وقد طُبقت الطريقة المقترحة بنجاح على المستحضرات الصيدلانية الصلبة والسائلة، إذ تتميز بالبساطة والحساسية والفعالية من حيث التكلفة، مما يجعلها مناسبة لتحليلات مراقبة الجودة والسيطرة النوعية الروتينية.

الكلمات المفتاحية: : باراسيتامول، نايتروبروسيد الصوديوم، فيروسيانيد البوتاسيوم، مركبات الصبغة الخضراء