

Quantitative Determination of Clindamycin and Clindamycin Phosphate by the Method of Iodometry using Peroxomonosulfate

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The pH-dependent kinetics and mechanism of the oxidation reaction of clindamycin hydrochloride (CLN) with potassium hydrogen peroxomonosulfate (KHSO₅) at 20°C was studied in order to develop a novel assay method. It has been established that the reaction kinetics obey the general laws of specific acid-base catalysis. Stoichiometrically, KHSO₅ was found to react with CLN in an alkaline medium (pH 8.0–9.0), at a 3:1 mole ratio, to form the corresponding sulfone-N-oxide. Methods for the oxidimetric determination of CLN and Clindamycin phosphate (CLN-P) were developed using KHSO₅ as an analytical reagent: a known excess of the reagent is added and after a specified time its residual amount is determined by iodometry. The developed method was successfully used to determine clindamycin in dosage forms such as capsules and injection. RSD does not exceed 1.7%.

Keywords: clindamycin hydrochloride, clindamycin phosphate, iodometry, oxidimetric titration, oxone, potassium hydrogen peroxomonosulfate, assay

Introduction

Clindamycin (CLN, *syn.* Cleocin, Aclinda, Basocin, Tidact etc) (Fig. 1) is a semisynthetic antibiotic of the lincosamide group, a derivative of lincomycin, synthesized from it by replacing the 7(R)-hydroxyl group with chlorine. This drug exceeds lincomycin in all positive respects, including absorption into the gastrointestinal tract, antibacterial activity, and antimicrobial spectrum [1, 2]. Being both bacteriostatic and bactericidal, CLN has been reported to have significant activity against nonenterococcal gram-positive organisms and numerous anaerobes, including *B. fragilis*. It is available as capsules and pediatric powders of water-soluble salts [3–5].

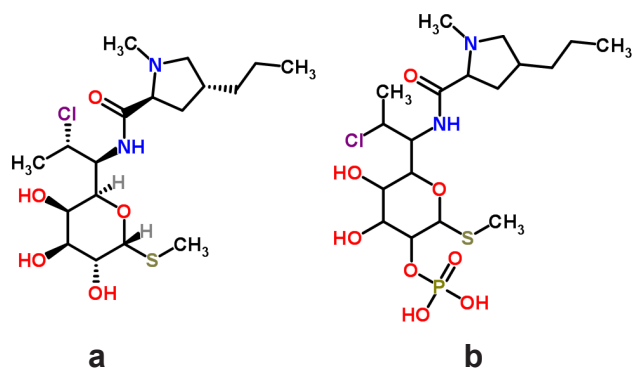


Fig. 1. Chemical structures of clindamycin (a) and clindamycin phosphate (b).

There are several analytical techniques available to determine CLN and clindamycin phosphate (CLN-P)

in different matrices. Among these, HPLC-UV is recommended by the State Pharmacopoeia of Ukraine, European Pharmacopoeia and the USP [6–8]. HPLC is accurate and specific, making it the most commonly used method [9–14]. Other techniques such as liquid chromatography-mass spectrometry [15–17], micellar chromatography [18], chemiluminescence [19, 20], electrochemiluminescence [21], potentiometry [22], capillary electrophoresis [23], chemometrics [24], spectrophotometry [25], conductometry [26], flow injection spectrophotometric analysis [27], kinetic spectrophotometry [28], and voltammetry [29] are also used. But some of these techniques are time consuming, require extraction with organic solvents, and have complex designs that require expensive equipment or specific detectors.

Clindamycin hydrochloride has been titrated with 0.5 potassium hydroxide using potentiometry. The point at which $\Delta E/\Delta V$ was greatest was considered the endpoint [30]. A direct titrimetric assay based on the oxidation of the drug by *N*-bromosuccinimide in acidic medium has been reported [31]. While most of the methods described above were complex and required expensive equipment, literature reviewed so far reveals no reports of a sensitive and efficient analytical method for the titrimetric determination for CLN or CLN-P analyses using peroxomonosulfate.

Despite these contributions, literature surveys have revealed a gap: no reports exist on titrimetric methods employing peroxomonosulfate for the selective determination of CLN or CLN-P.

Given this analytical void, our study focuses on the development of a rapid, sensitive, and cost-effective

iodometric titration method utilizing potassium peroxomonosulfate (commonly available as oxone: $2\text{KHSO}_5 \cdot \text{KHSO}_4 \cdot \text{K}_2\text{SO}_4$) [32, 33] to determine CLN and CLN-P in pure form and pharmaceutical preparations.

Experimental part

Reagents and instruments. Clindamycin hydrochloride was obtained in pharmaceutical-grade quality from Zhejiang Tiantai Pharmaceutical Co., Ltd. (China). Its empirical formula is $\text{C}_{18}\text{H}_{33}\text{ClN}_2\text{O}_5 \cdot \text{HCl}$ (MW = 461.44 g/mol), and its content was confirmed as 97.8% anhydrous substance via HPLC. The compound is freely soluble in water (~50 mg/mL), and its pKa is approximately 7.77 [34].

Clindamycin phosphate was acquired from Qingdao Fengchen Technology and Trade Co., Ltd. (China), with a chemical formula of $\text{C}_{18}\text{H}_{34}\text{ClN}_2\text{O}_8\text{PS}$ (MW = 504.97 g/mol), and an assay value of 99% for the phosphate ester. This compound also dissolves readily in water (1:2.5) and has a pKa of 7.6.

Commercial dosage forms included CLN capsules (0.15 g CLN base/capsule) from PJSC "Monfarm" (Ukraine) and DALACIN® C injection (150 mg/mL CLN-P) from Pfizer Ltd. Certificate of analysis confirmed active ingredient contents within pharmacopeial specifications.

Preparation of Analytical Solutions. A 0.01 mol/L solution of CLN hydrochloride was prepared by dissolving an accurately weighed quantity of the substance in double-distilled water to a final volume of 100 mL.

The oxidizing agent, KHSO_5 , was used as a 0.04 mol/L solution prepared from Oxone by dissolving ~1.4 g in water, with final concentration determined via iodometry.

Various buffers and standard solutions (e.g., NaOH, $\text{Na}_2\text{S}_2\text{O}_3$, KI, HCl, H_2SO_4 , potassium pyrophosphate) were prepared using standard titrants or analytical-grade reagents. Buffer systems at pH values of 7.0; 7.9, 9.2, and 10.5 were adjusted with acid or base and verified using glass electrode with an Ag/AgCl reference and potentiometer "mv-870 Digital-pH-messgera" (Germany).

The kinetics of the oxidation reaction of CLN with KHSO_5 were investigated via iodometric titration across varying pH values. The reaction was monitored by the amount of iodine liberated upon acidification and iodide addition.

Kinetic Study of Clindamycin Oxidation by KHSO_5 . To investigate the reaction kinetics of CLN with KHSO_5 , 10.00 mL of 0.01 mol/L CLN solution was combined with 60 mL of buffer solution and 10.00 mL of 0.04 M KHSO_5 in a 100 mL volumetric flask. The mixture was diluted to volume with distilled water, thoroughly mixed, and the reaction initiation time was marked using a stopwatch. At defined time intervals (30 seconds, 1, 3, 5, 10, and 20 minutes), 10.00 mL of the reaction mixture was transferred to an Erlenmeyer flask containing 2 mL of 1 mol/L H_2SO_4 . Subsequently,

1 mL of 5% potassium iodide solution was added with shaking. Liberated iodine was titrated with 0.02 M sodium thiosulfate solution, adding 1 mL of 1% starch indicator near the endpoint. A blank titration was performed using distilled water.

Fourier-Transform Infrared (FT-IR) Spectroscopy. Infrared spectra were acquired in the functional group region ($4000\text{--}650\text{ cm}^{-1}$) using a Shimadzu FT-IR spectrometer (Shimadzu, Kyoto, Japan). Samples were prepared by compressing a tablet composed of 2 mg of analyte (1% w/w) and 200 mg of KBr under standard conditions.

Oxidation of Clindamycin Phosphate and Isolation of Sulfoxide Derivatives. An aqueous solution (20 mL) containing 0.2 mmol of KHSO_5 (61.4 mg Oxone, 10 mL of 20 mM) was reacted with 0.2 mmol of CLN-P (101 mg, 10 mL of 20 mM) at 25°C . After 10 minutes, the mixture was neutralized to pH 6 using 2 M NaOH, cooled, and filtered. The solvent was evaporated under reduced pressure. The residue was treated with 20 mL of methanol, stirred thoroughly, and filtered. The methanolic phase was evaporated under vacuum, and the solid product was dried over P_4O_{10} at 25°C and 13.3 Pa. The resulting white amorphous product had a decomposition point of $160\text{--}168^\circ\text{C}$. FTIR-ATR analysis (KBr pellet) revealed absorption peaks at 783 and 848 cm^{-1} (C–Cl stretching of the C7–chloro group), 919 , 988 , and 1076 cm^{-1} (S=O stretching), 1569 cm^{-1} (amide II), 1679 cm^{-1} (amide I), and 3204 cm^{-1} (O–H stretching in the galactose moiety).

Synthesis of Clindamycin Phosphate Sulfone trans-N-Oxide. To synthesize the trans-N-oxide sulfone derivative of CLN-P, 10 mL of a 33 mM KHSO_5 solution (101.4 mg Oxone, 0.33 mmol) was added to 10 mL of 10 mM CLN-P (50.5 mg, 0.1 mmol) in water. The mixture was stirred at room temperature for 10 minutes, neutralized to pH 8.5 with 2 M NaOH, and then shaken for 1 hour at ambient temperature. After acidifying to pH 6 using 2 M HCl, the reaction was processed following the same procedure used for the sulfoxide derivative. The final product, a white amorphous solid, melted at $168\text{--}170^\circ\text{C}$ and was identified as a mixture of R- and S-isomers. FTIR-ATR spectra showed key bands at 1446 and 1293 cm^{-1} (asymmetric SO_2 stretching), and a distinct absorption at 922 cm^{-1} corresponding to the N-oxide moiety—absent in the spectrum of unoxidized CLN-P. Additional peaks were observed at 759 , 1085 , 2930 , and 3303 cm^{-1} . The intense 922 cm^{-1} band was attributed to N^+-O^- stretching, consistent with heterocyclic N-oxides, which are known to exhibit distinct spectral and physicochemical properties compared to trialkylamine N-oxides. Melting points were measured using a PTP-M open capillary instrument.

Quantitative Determination of CLN Hydrochloride in Model Solutions. To quantify CLN hydrochloride in reference solutions, 10.00 mL of a test solution containing 1–5 mg of CLN was placed in a 100 mL Erlenmeyer flask. Sequential additions included

5.00 mL of 0.008 mol/L KHSO_5 , 5.00 mL of 0.2 mol/L buffer (pH 9.2), and 1.00 mL of 0.02 mol/L NaOH. The reaction was allowed to proceed for 6 minutes at room temperature. After cooling, 2.00 mL of 1.0 mol/L H_2SO_4 and 1.00 mL of 10% potassium iodide solution were added with stirring. Following a brief interval (≈ 10 seconds), iodine liberated was titrated with 0.01 mol/L sodium thiosulfate, using 1 mL of 1% starch near the endpoint. A blank determination was also conducted.

Determination of CLN Hydrochloride in Bulk Substance. Approximately 0.5 g of CLN hydrochloride (accurately weighed) was dissolved in 70 mL of distilled water and diluted to 100 mL in a volumetric flask. From this stock, 10.00 mL was transferred to another 100 mL flask. To this, 70 mL of pH 9.0 buffer and 10.00 mL of 0.04 M KHSO_5 were added. The solution was diluted to volume with water and mixed thoroughly. After 6 minutes, a 10.00 mL aliquot was transferred into an Erlenmeyer flask containing 2.00 mL of 1 mol/L H_2SO_4 . Then, 2.00 mL of 5% potassium iodide solution was added with shaking. The iodine released was immediately titrated with 0.01 M sodium thiosulfate, using 1.00 mL of 1% starch solution near the endpoint. A blank was performed using distilled water.

The content of CLN hydrochloride in the substance in terms of the anhydrous $\text{C}_{18}\text{H}_{33}\text{ClN}_2\text{O}_5\text{S}\cdot\text{HCl}$ (w , %) was calculated with the formula:

$$w = \frac{(V_0 - V) T \times 100 \times 100 \times 100}{10 \times 10 \times a [100 - w(\text{H}_2\text{O})]},$$

where: V_0 = volume of thiosulfate in control sample, mL; V = volume of thiosulfate in sample, mL; T = conversion factor for 1 mL of $\text{Na}_2\text{S}_2\text{O}_3$; a = sample mass, g; $w(\text{H}_2\text{O})$ = moisture content (determined by Karl Fischer, found: 4.3%); The constants (100, 10, etc.) correspond to volumetric flasks and aliquot volumes used during preparation and analysis.

The acceptable range for clindamycin hydrochloride content is 91.0–102.0% on the anhydrous basis.

Determination of Clindamycin in Injectable Dosage Form (DALACIN® C 150 mg/mL). To quantify CLN-P in DALACIN® C solution for injection (150 mg/mL), a 1.50 mL aliquot of the test solution was transferred using a micropipette into a 100 mL volumetric flask, diluted to volume with double-distilled water, and mixed thoroughly. A 20.00 mL aliquot of this diluted solution was used in the same analytical procedure as described in “determination in bulk substance”.

The clindamycin phosphate content, expressed as mg of anhydrous clindamycin base per mL of injection solution, was calculated using the equation:

$$X = (V_0 - V) \times 0.7083 \times 50/1.50,$$

where V_0 and V – are as defined above (control and sample titrations, respectively); 50 = dilution factor; 1.50 = volume (mL) of dosage form taken for analysis; 0.7083 = amount (mg) of anhydrous clindamycin base corresponding to 1.00 mL of 0.0100 mol/L thiosulfate.

According to specification, the CLN-P content in the injectable formulation should range from 135.0 to 157.5 mg/mL in terms of anhydrous clindamycin base.

Determination of Clindamycin Hydrochloride in Capsules (Clindamycin-M, 150 mg). Approximately 0.279 g (accurately weighed) of the homogenized contents from 20 capsules was dissolved in 70 mL of double-distilled water in a 100 mL volumetric flask, diluted to volume, and mixed thoroughly. A 20.00 mL aliquot of this solution was then analyzed following the same protocol described for the bulk substance (Section 2.6).

The clindamycin hydrochloride content in the capsule formulation, expressed in terms of the average weight of capsule content, was calculated using:

$$X = \frac{(V_0 - V) T \times 100 \times 100 \times \bar{m}}{20 \times 10 \times a},$$

where V_0 and V – are the titrant volumes for blank and test, respectively: 100 and 100 – volumes of volumetric flasks, mL; 20 – volume of dosage form solution taken for analysis, mL; A – sample weight of capsules content of the, g; $\bar{m}$ – average weight of the capsule content, g; 10 – volume of the reaction mixture taken for titration, mL; T – amount of CLN hydrochloride, which corresponds to 1 mL of a 0.0100 mol/L standard thiosulfate solution, g.

The clindamycin hydrochloride content should be within the range of 0.135–0.165 g per capsule, calculated on the basis of anhydrous clindamycin base and expressed relative to the average capsule fill weight.

Results and discussion

Figure 2 illustrates the oxidation profiles at pH 7.0, 7.9, and 9.0 under the conditions: $c(\text{KHSO}_5) = 4.0 \times 10^{-3}$ mol/L, $c(\text{CLN}) = 1.0 \times 10^{-3}$ mol/L.

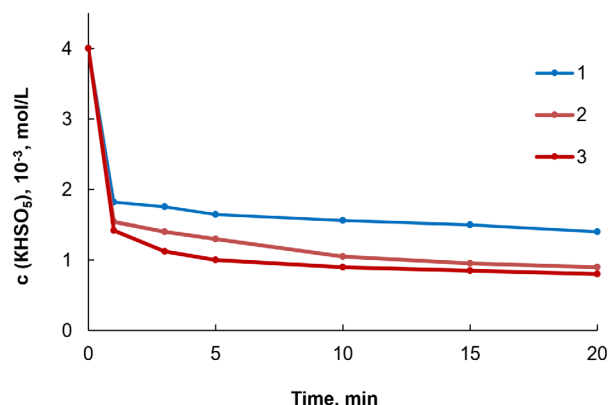


Fig. 2. Kinetic curves of the oxidation reaction of CLN with KHSO_5 depending on pH. $c(\text{KHSO}_5) = 4.0 \times 10^{-3}$ mol/L; $c(\text{CLN}) = 1.0 \times 10^{-3}$ mol/L; pH: 1 – 7.0; 2 – 7.9; 3 – 9.0.

At pH 8.0–9.0, complete oxidation of CLN was achieved within 5–12 minutes, with a molar ratio of approximately 3:1 between oxidant and CLN, indicating stoichiometric consumption. This suggests that three oxidative equivalents are required per mole of CLN, consistent with concurrent S-oxidation and N-oxidation reactions.

Semilogarithmic anamorphoses of the kinetic curves of the CLN with KHSO_5 oxidation reaction depending on the pH are linear, which indicates the second order of the reaction (where c_0 - initial molar concentration of peroxymonosulfate; c_t - current molar concentration at the time of the reaction). The slopes of these dependences are the k_{obs} of the CLN S,N-oxidation reaction (Fig. 3).

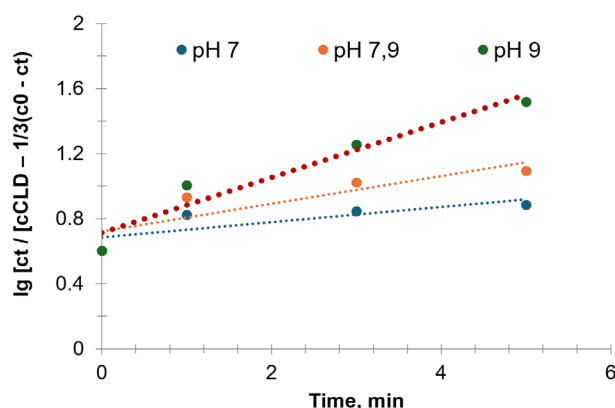


Fig.3. Semilogarithmic anamorphosis of the kinetic curves of the CLN with KHSO_5 oxidation reaction. pH: 1 – 7.0; 2 – 7.9; 3 – 9.0. $c_{\text{CLN}} = 1.0 \times 10^{-3}$ mol/L, $c(\text{KHSO}_5) = 4.0 \times 10^{-3}$ mol/L.

It is assumed that the reaction involves the neutral (non-protonated) form of clindamycin (CLN^0), the hydrogen peroxymonosulfate monoanion (HSO_5^-), and, to a lesser extent, the dianion form (SO_5^{2-}). Based on this, the observed reaction rate can be described by the following kinetic expression:

$$\text{Rate} = k_{\text{obs}} \times c(\text{CLN}^0) \times c(\text{KHSO}_5),$$

$$k_{\text{obs}} = K \alpha(\text{CLN}^0) \times [\alpha(\text{HSO}_5^-) + \beta \times \alpha(\text{SO}_5^{2-})],$$

where, $\alpha(\text{CLN}^0)$ – mole fraction of CLNbase; $\alpha(\text{HSO}_5^-)$ – mole fraction of hydrogenperoxymonosulfate monoanion; $\alpha(\text{SO}_5^{2-})$ – mole fraction of hydrogenperoxymonosulfate dianion, which are respectively equal to: $\alpha(\text{CLN}^0) = K_a / (K_a + [\text{H}^+]) = \alpha(\text{CLN}) = 10^{-7.7} / (10^{-7.7} + 10^{-\text{pH}})$; $\alpha(\text{HSO}_5^-) = (10^{-0.4} \times 10^{-\text{pH}}) / [(10^{-\text{pH}})^2 + (10^{-0.4} \times 10^{-\text{pH}}) + (10^{-0.4} \times 10^{-9.4})]$; $\alpha(\text{SO}_5^{2-}) = (10^{-0.4} \times 10^{-9.4}) / [(10^{-\text{pH}})^2 + (10^{-0.4} \times 10^{-\text{pH}}) + (10^{-0.4} \times 10^{-9.4})]$, where K_a – dissociation constant of the CLN acidic form.

It should be taken into account that

$$\text{pH} = -\lg [\text{H}^+], \text{ and } [\text{H}^+] = 10^{-\text{pH}};$$

$$\text{pK}_a = -\lg K_a, \text{ and } K_a = 10^{-\text{pK}_a}. \text{ pK}_a(\text{CLN}) = 7.7.$$

In these expressions, β is the ratio of the rate constants for oxidation of CLN by the dianion (SO_5^{2-}) and monoanion (HSO_5^-) forms of peroxymonosulfate.

Caro's acid exhibits two dissociation equilibria,

with corresponding pK_a values of 0.4 for the first dissociation (pK_{a1}) and 9.4 for the second dissociation (pK_{a2}).

Dependence of the observed rate constant (second order) of the CLN oxidation reaction on the product of the CLN base mole fractions and the sum of the mole fractions of peroxomonosulfate monoanion and partly its dianion (with a value of $\beta = 0.2$) is presented in Fig.4 (correlation coefficient $R = 0.9$, which is close to 1).

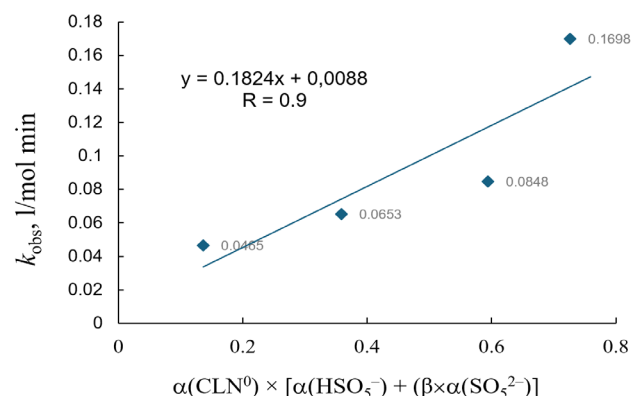


Fig.4. Dependence of the observed rate constant (second order) of the CLN oxidation reaction on the product of the CLN base mole fractions and the sum of the mole fractions of peroxomonosulfate monoanion and partly its dianion ($\beta = 0.2$).

The linearity of the titrimetric response was confirmed by examining the correlation between the titration endpoint and varying amounts of CLN (Table 1). A direct linear relationship was observed, supporting the validity of the method for quantitative analysis. The method was then successfully applied to the determination of CLN hydrochloride (Table 2) in raw substances and pharmaceutical forms (capsules and injectable solutions). Recovery values and calculated contents fell within acceptable pharmacopoeial limits (Table 3).

The oxidation of CLN-P under controlled aqueous conditions yielded distinct oxidation products. Reaction of CLN-P (0.2 mmol) with an equimolar amount of KHSO_5 (0.2 mmol) at room temperature (25°C) for 10 minutes resulted in the formation of the sulfoxide derivative. The product, isolated after neutralization, filtration, and recrystallization, was a white amorphous solid with a melting point of 160–168°C (decomposition). FTIR-ATR analysis showed characteristic peaks confirming sulfoxide formation (S = O: 919, 988, 1076 cm^{-1}) as well as amide (1569, 1679 cm^{-1}) and O–H (3204 cm^{-1}) functionalities. The peak at 848 cm^{-1} corresponded to the C–Cl stretching vibration, indicating retention of the chloro group.

Further oxidation of CLN-P under increased oxidant concentration (0.33 mmol KHSO_5 per 0.1 mmol CLN-P) led to the formation of a mixed isomeric product: clindamycin phosphate sulfone trans-N-oxide.

Table 1. Titrimetric Determination Results of CLN Hydrochloride in Model Solutions Using Oxone (n = 5; P = 0.95).

Taken, mg	Found $\bar{x} \pm \Delta\bar{x}$, mg	RSD, %	Relative error*, δ %
1.11	1.12 $\pm$ 0.04	2.87	+0.9
2.21	2.23 $\pm$ 0.05	1.80	+0.9
4.42	4.44 $\pm$ 0.06	1.09	+0.5

* $\delta = ((\bar{x} - \mu)/\mu) \cdot 100$, where μ – known CLN hydrochloride content in the model solution, mg.

Table 2. The iodometric determination results for CLN hydrochloride and CLN-P substances using KHSO₅ (n = 5; P = 0.95).

Analyzed substance	Declared content, w, %	Found $\bar{x} \pm \Delta\bar{x}$, %	RSD, %	Relative error**, δ %
Clindamycin hydrochloride powder (substance) for pharmaceutical use (Zhejiang Tiantai Pharmaceutical Co., Ltd., China)	97.8*	98.2 $\pm$ 1.3	1.07	+0.41
Clindamycin Phosphate (Qingdao Fengchen Technology and Trade Co., Ltd., China).	99.0*	99.6 $\pm$ 1.2	0.97	+0.61

* Data from the official method (Eur.Pharmacopoeia - HPLC), ** $\delta = ((\bar{x} - \mu)/\mu) \cdot 100$, where μ : content (must be): 91.0-102.0% and 95.0-102.0% for CLD and CLD-P respectively (on a dry matter basis, without residual solvents).

Table 3. Assay results of Clindamycin Phosphate and Clindamycin hydrochloride in injection and capsules by the proposed method (n = 5; P = 0,95).

Analyzed substance, dosage form	Found $\bar{x} \pm \Delta\bar{x}$, mg in 1 mL or mg/capsule; Recovery, %	RSD, %	μ^* , mg/mL or g/capsule	$(\bar{x} - \mu) \times 100/\mu$, %
Clindamycin Phosphate, DALACIN® C Injection 150 mg/ml in 2mL ampoules; Manufactured By Pfizer Ltd., Series no HE0846	150.3 $\pm$ 3.2 R = 100.2 $\pm$ 2.1%	1,71	149.2 ¹	+0.74
Clindamycin hydrochloride, Clindamycin-M capsules of 0.15 g No. 10 in blisters. Manufactured By «Monfarm», PJSC (Ukraine). Series no 4	147.3 $\pm$ 3.0 R = 98.2 $\pm$ 2.0%	1.64	0.146 ²	+0.89

* From quality assurance certificate (HPLC), content should be: 1.90%...105% of C₁₈H₃₃ClN₂O₅S (from 135 to 157.5 mg/ml); 2. 90%...110% of C₁₈H₃₃ClN₂O₅S (from 0.135 to 0.165 g CLN hydrochloride in terms of CLN base (C₁₈H₃₃ClN₂O₅S) to one capsule).

The reaction was conducted at room temperature followed by neutralization to pH 8.5 and stirring for 1 hour. Upon acidification and workup, a second white amorphous product was isolated with a slightly higher melting point (168–170°C). FTIR spectra exhibited diagnostic peaks for the sulfone group (1446, 1293 cm⁻¹) and a prominent N–O stretching band at 922 cm⁻¹, absent in the spectrum of the parent CLN-P. These spectral differences confirm the introduction of

sulfone and N-oxide functionalities (Fig. 5).

The successful preparation of the two oxidation derivatives (sulfoxide and sulfone-N-oxide) confirms the selectivity and efficiency of KHSO₅ as a mild oxidant for clindamycin derivatives. Notably, the observed infrared signatures support the structural assignments and align with known vibrational modes of sulfoxide, sulfone, and N-oxide groups in heterocyclic compounds.

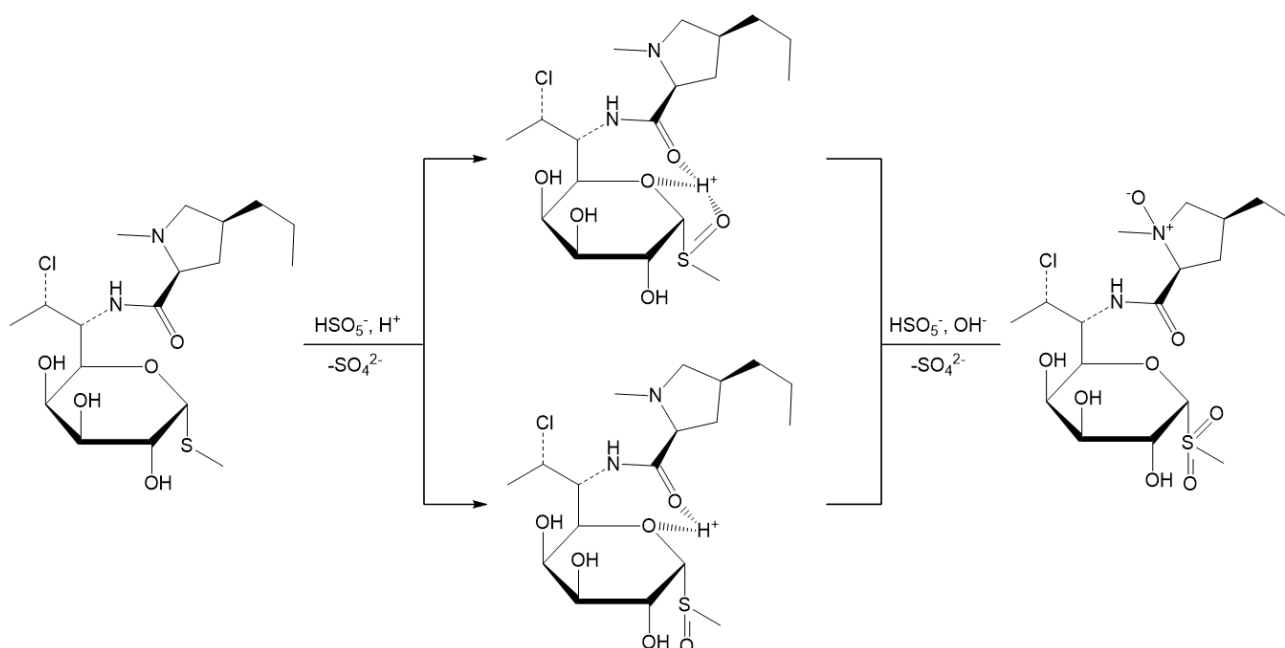


Fig. 5. Scheme of the oxidation process of CLN using hydrogen peroxomonosulfate.

The quantitative analysis results for CLN and CLN-P are presented in Table 1. and Table 2. The relative standard deviation (RSD) was less than 1.07%, and the “ δ ” ranged from 0.41% to 0.61%.

Assay of Clindamycin Phosphate in a solution of 150 mg/ml for injection DALACIN® and Clindamycin hydrochloride in capsules “Clindamycin hydrochloride” 0.150 g are given in Table. 3. $\text{RSD} = 1.64 - 1.71\%$. $\delta < t_{\alpha} \times \text{RSD}/\sqrt{n}$.

Conclusions

The pH-dependent kinetics of the oxidation of clindamycin hydrochloride (CLN) by potassium peroxymonosulfate (KHSO_5) were investigated. The results indicate that the reaction follows the general principles of specific acid-base catalysis.

In alkaline medium at pH 8.0–9.0, peroxy-monosulfate reacts stoichiometrically with CLN to yield the corresponding sulfone-N-oxide. The reaction proceeds in a 1:3 molar ratio, with 1 mole of CLN consuming 3 moles of KHSO_5 .

A new oxidimetric analytical method has been developed for the determination of CLN and clindamycin phosphate (CLN-P), using KHSO_5 in the form of the stable potassium triple salt, oxone ($2\text{KHSO}_5 \cdot \text{KHSO}_4 \cdot \text{K}_2\text{SO}_4$), as the oxidizing reagent. The method employs iodometry through a back-titration approach.

The proposed method has successfully demonstrated quantitative determination of Clindamycin hydrochloride and Clindamycin phosphate as substances and in capsule and injection dosage forms. RSD does not exceed 1.7%. $(\bar{x} - \mu) \times 100/\mu < t_{\alpha} \times \text{RSD}/\sqrt{n}$.

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Ethical approval

Not applicable.

Conflict of interest

No conflict of interest is associated with this work.

Authors' contribution

We declare that this work was done by the authors named in this article, and all liabilities pertaining to claims relating to the content of this article will be borne by the authors. The work was conceived by Blazheyevskiy M. Ye. Alfred-Ugbenbo D., Diadchenko V. V., Moroz V. P. and Kryskiv O. S. made substantial contributions to design, analysis and interpretation of data. All authors reviewed the manuscript and approved the submitted version.

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