DEVELOPMENT AND VALIDATION OF A STABILITY-INDICATING REVERSED-PHASE HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY (RP-HPLC) METHOD FOR ASSAY OF PRUCALOPRIDE DRUG SUBSTANCE

Ms. Priya Chidrewar*[1], Mr. Arun Sathe[1], Mrs. Prapti Desai [2]

[1]*Assistant Professor, Department of pharmacy, Asian college of Pharmacy, Dhayari-Narhe Rd, Tal-Haveli, Dhayari, Pune, Maharashtra, India.*

[2]*Principal, Asian college of Pharmacy, Dhayari-Narhe Rd, Tal-Haveli, Dhayari, Pune, Maharashtra, India.*

Address for Correspondence: Ms. Priya Chidrewar, Asian college of Pharmacy, Dhayari-Narhe Rd, Tal-Haveli, Dhayari, Pune, Maharashtra, India.

ABSTRACT
A reverse phase-high-performance liquid chromatography method can measure tablet Prucalopride content. This procedure is simple, accurate, economical, reliable, and powerful, and it may be repeated. The amount of Prucalopride in a pharmaceutical was previously determined using UV spectroscopy and a few HPLC methods (4.73 minutes' retention time). New RP-HPLC technique can evaluate bulk and prescription Prucalopride drugs with a shorter retention duration than existing methods. The separation employed RP-HPLC with a mobile phase of 30% Orthophosphoric acid and 70% methanol (v/v). The mobile phase was moved at 1 mL/min, and UV was measured at 225 nm. Prucalopride retained 1.5 minutes under chromatographic conditions. This method was evaluated against ICH standards to assure accuracy, consistency, and reliability. In stress testing, various breakdown products were created. This comprised acid, alkali, boiling water, hydrogen peroxide, dry heat, and UV light. Prucalopride tablets and mass may be evaluated using the specified chemical method.

KEYWORDS: *Prucalopride, RP-HPLC, Spectrophotometry, ICH, UV*
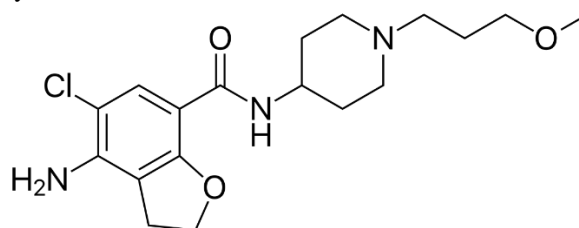
1   INTRODUCTION
In high performance liquid chromatography, often known as HPLC, the separation of compounds may be accomplished by using a stationary solid phase in conjunction with a mobile liquid phase. This technique also goes by the name of high pressure liquid chromatography (HPLC), which is another term for it. The speed, specificity, accuracy, precision, and automation-feasibility of the HPLC technique make it an excellent choice for the analysis of a wide range of multicomponent dosage forms. This is because the HPLC method may be used to separate out individual components of the dose. The time-consuming processes of extracting and separating chemicals may be avoided with the use of a technique known as high-performance liquid chromatography (HPLC), which is an analytical technique. Prucalopride, a pharmacological medication, has been given the green light for use in the treatment of persistent constipation in female patients. Prucalopride is the medication of choice for the treatment of chronic idiopathic constipation (CIC), a functional gastrointestinal disorder that lasts for an extended period of time (1, 2).

Prucalopride acts as a selective agonist of serotonin receptors. This is what it does. It's probable that this compound is a dihydrobenzofuran carboxamide of a very high purity. This procedure enhances the motility of the colon, which in turn improves bowel function. The production of acetylcholine is boosted all the way through the gastrointestinal tract. In the evaluation of the literature about Prucalopride, there were only a few UV spectroscopy methods and one High Performance Liquid Chromatography (HPLC) technique mentioned. As was noted in the introductory materials, the primary objective of this research was to investigate strategies to reduce the amount of time that subjects were had to wait before being processed. The RP-HPLC technique of liquid chromatography served as the primary means of chemical differentiation throughout this investigation. For the purpose of treating Prucalopride, the chemical compound known as 4-amino-5-chloro-2, 3-dihydro-N-[1-(3-methoxypropyl)-4-piperidinyl] (PRU) is used (3).

According to the drug's chemical nomenclature, it is possible that the compound in question may be identified as 7-benzofurancarboxamide butanedioate. This substance is a member of the benzofuran family of chemicals. The pharmacological effects of the compound under investigation are brought about through enterokinetic regulation of the 5-HT4 receptor. The

compound under investigation is a derivative of dihydro benzofuran carboxamide. The abdominal muscles are significantly affected as a result of this. As a result, it facilitates the restoration of normal function to the digestive system. Even while the amount of time spent in the stomach remained basically the same, there was an increase in the number of times that bowel motions occurred (4, 5).

Figure 1 Structure of Prucalopride

Only a few number of analytical techniques that can be used for the purpose of quantitatively analyzing pharmaceutical formulations have been published in the relevant body of academic research. A few examples of such techniques are UV-spectrophotometry, high-performance liquid chromatography, and ultra-high-performance liquid chromatography–mass spectrometry. Since there is little evidence supporting the HPTLC method's reliability, its application is limited. The primary objective of this study was to develop and verify a novel HPTLC technique for assessing the stability of Prucalopride in pharmaceutical goods. This objective was one of the key goals of this research. This technique was developed to provide a straightforward, fast, and selective approach to evaluating the drug's long-term stability (6-8).

The stability-indicating reversed-phase high-performance liquid chromatography (RP-HPLC) approach for routine analysis of Prucalopride in either bulk or pharmaceutical (tablet) forms is not included in any of the world's pharmaceutical databases. In order to effectively mitigate the quality-related issues that are associated with pharmaceutical companies engaged in the production of Prucalopride, it is essential to develop an analytical methodology that is capable of consistently evaluating the quality characteristics of both tablet formulations containing Prucalopride and Prucalopride in its bulk form. This study is devoted to the systematic development of a validated reversed-phase high-performance liquid chromatography (RP-HPLC) technique for the detection of Prucalopride concentrations in tablet formulations and commercially made items. This approach will be used in this research. This approach is differentiated from others by its user-friendliness, its cheap cost, its great precision and accuracy, its high robustness, and its high repeatability (9).

2   MATERIALS AND METHODS
2.1   Chemical and Reagents
Prucalopride was provided in its original form by Alkem laboratories in Mumbai, India. In this analysis, researchers employed the medication Prudac 1 (Zydus Cadila, India). The pills, which were purchased from a local vendor, were confirmed to contain 1 milligram of Prucalopride each. The research made use of AR-grade acids and toxins. (Merck Specialties Private Limited's headquarters are located in Mumbai, India.)

2.2   Chromatographic Conditions and Equipment
The study was done with a UV monitor built into a Shimadzu LC_2010 CHT HPLC. The signal at the output was watched and changed with the help of the LC solution program. The C18 (150mm × 4.6mm, 5μ) chromatographic column was used. Gradient filtration was used to do the study. As the mobile phase, 85:15% v/v ACN was mixed with ammonium acetate, which had its pH changed to 5.0 with glacial acetic acid (10).

2.3   Instrumental Parameters
The gradient's mobile phase flow rate was held constant at 1 ml/min. 20 μL were injected. The sample was run for 10 minutes at 215 nm under close observation. The sample was held for a total of around 2.519 minutes.

2.4   Determination of Wavelength
The standard stock solution (B) was diluted many times using a diluent, and the spectrum analysis was performed from 400 to 200 nm. Absorbance's of note at 227 nm, 254 nm, 277 nm, 296 nm, and 309 nm were used to construct the spectra.

2.5   Preparation of Standard and Test Solutions
2.5.1   Preparation of Stock Solution
A stock solution of 1000μg/ml was prepared by adding 100 mg of Prucalopride to 100 ml of methanol and shaking the vial (11).

EPRA International Journal of Research and Development (IJRD)

2.5.2   Preparation of Working Standard Solutions

After transferring the standard stock solution into 10 volumetric containers at intervals of 0.25, 0.50, 0.75, 1.0, 1.25, and 1.5 ml each, a working standard solution was created. Due to the fact that the volume was set aside for the mobile phase, the resultant concentration was anywhere between 25-150 ug/ml.

2.5.3   Preparation of Sample Solutions

Take 20 tablets (20 mg) of the commercial preparation and determine the weight of the average content. A weight equal to 20 mg prucalopride was transferred to a 100 ml volumetric flask and dissolved in methanol. The solution was sonicated and filtered through Whitman filter paper. Average tablet weight was calculated as 113.2 mg.

2.6   Forced degradation study (12-15)

Forced degradation studies of these chemicals were carried out under acidolysis, alkaline, neutral, oxidation, thermal and photolysis degradation conditions.

2.6.1   Acid Hydrolysis

Use 2 ml of prucalopride stock solution in a 10 ml volumetric flask and force it to degrade in an acidic environment. Add 2 ml of 2N HCl to the beaker and leave at 80°C for 30 minutes. Then neutralize with 2N NaOH and dilute to volume with mobile phase. Solution is 100 µg/ml.

2.6.2   Alkali Hydrolysis

Transfer 2 ml of prucalopride stock solution to a 10 ml volumetric flask to force degradation in alkaline media. Add 2 ml 2N NaOH to the beaker and store at room temperature. 2 hours at 80°C. Then neutralize with 2N HCl and dilute to volume with mobile phase. Solution is 100 µg/ml.

2.6.3   Neutral Hydrolysis

For forced degradation of neutral hydrolysis, take 2 ml of prucalopride stock solution into a 10 ml volumetric flask. Add 2 ml of HPLC grade water to the vial and leave at 80°C for 2 hours. Dilute to volume with mobile phase. The solution is 100 µg/ml.

2.6.4   Oxidative Degradation

Place 2 ml of prucalopride stock solution into a 10 ml volumetric flask and force degradation under oxidative conditions. Add 2 ml 10% H2O2 to the bottle and let sit at 80°C for 30 minutes. Dilute to volume with mobile phase and shake well. Solution strength is 100µg/ml.

2.6.5   Thermal Degradation

For forced degradation during thermal degradation, weigh 10 mg prucalopride and place at 70 °C for 8 hours. After exposure, mix the powder and transfer to a 10 ml volumetric vial, dissolve in methanol and dilute to the mark with diluent. Make final dilution with standard diluent to obtain a final concentration of 100 µg/ml.

2.6.6   Photolytic Degradation

Photolytic error degradation, 10 mg prucalopride is weighed and exposed to 254 nm for 24 hours. After exposure, mix the powder and transfer to a 10 ml volumetric vial, dissolve in methanol and dilute to the mark with diluent. Make final dilution with standard diluent to obtain a final concentration of 100 µg/ml. Inject 20 µl of the above solution into the HPLC system and analyze according to the specified chromatography conditions.

2.7   Method Validation (16-18)

2.7.1   Linearity and Range

The experiment included adding various volumes of standard solution to volumetric flasks of 10 ml: 0.25, 0.50, 0.75, 1.0, 1.25, and 1.5 ml. Concentrations of 25-150µg/ml were achieved by diluting the contents of the flasks with methanol. Three separate 20-l aliquots of each solution were analyzed by chromatography, and a more refined procedure was used each time. By plotting the average area of the Prucalopride peak vs drug concentration, a regression equation may be generated.

2.7.2   Precision

2.7.2.1   Intra-day Precision

We analyzed standard solutions of Prucalopride at 50, 75, and 100 µg/ml to determine the precision of measurements made within a single day.

2.7.2.2   Inter-day Precision
The accuracy across days was determined by testing SAR reference solutions from 50 to 100 µg/ml on three separate occasions. Prucalopride RSD was calculated to be a certain proportion.

2.7.3   Accuracy
The degree to which a measurement or computation is correct is referred to as its precision (2.7.3). It quantifies how The reliability of the experiment was evaluated by determining how much Prucalopride was recovered using the standard addition method. Prucalopride 100 µg/ml standard solutions were made by adding 4.0, 5.0, and 6.0 ml of a known volume to a 2 ml sample solution of Prucalopride of the same concentration. The resultant solution was diluted with methanol to the 10-milliliter mark in a volumetric flask. Each solution was injected three times, and recovery was calculated by inspecting the slope and intercept of the calibration curve's regression equation at their respective peaks.

2.7.4   Limit of Detection and Limit of Quantification
n order to determine the drug's LOD and LOQ, the recommended formulae from the International Council for Harmonization of Technical Requirements for Pharmaceuticals for Human Use (ICH) were used.

$$\text{LOD} = 3.3\ \sigma/s \text{ and LOQ} = 10\ \sigma/s \text{ were found.}$$

Where, σ is the SD of the response, S is the slope of the calibration curve.

2.7.5   Robustness
Robust studies have been conducted to evaluate the effects of small but intentional changes in chromatographic conditions. Power is controlled by the difference of four small variables such as flow rate (1.0 ± 0.2 ml/min), organic level (70 ± 5 ml), injection volume (20 ± 5µL) and pH (5.0 ± 0.5). was done. Check the area, HETP, tail factor, and retention time after injecting each sample. A 20 µL aliquot of the sample drug was injected under chromatographic conditions, the peak area was measured, and the % content was calculated according to the regression equation. Response is average of six determinations.

3   RESULTS AND DISCUSSION
3.1   Determination of Wavelength
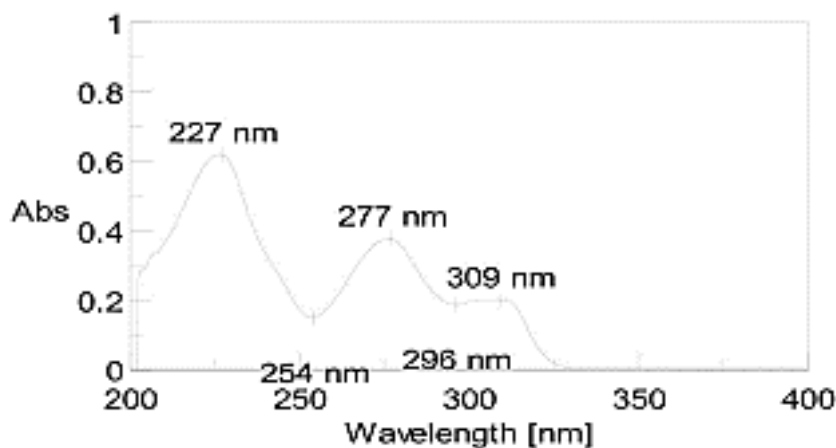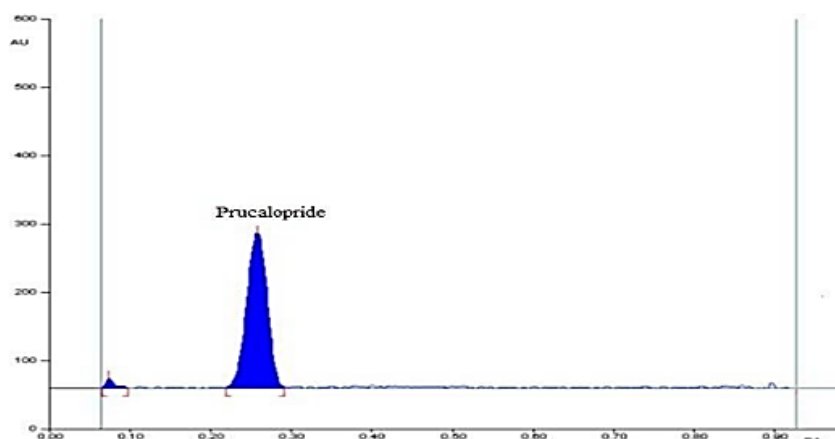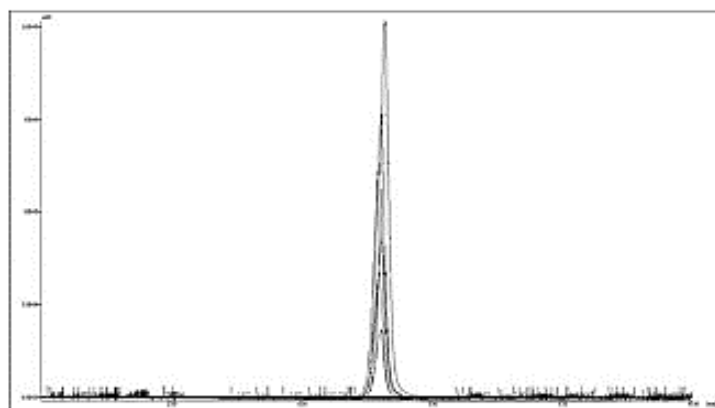Maximum absorbance (λmax) at a wavelength of 277 nm was used to choose the drug for the investigation.

Figure 2 UV spectrum of Prucalopride

EPRA International Journal of Research and Development (IJRD)

Figure 3 Densitogram of standard solution of Prucalopride

3.2 Method Development and Optimization of Chromatographic Conditions

The new research was developed through much trial and error and eventually Grace selected the most suitable cell (acetonitrile: 0. 02 M potassium dihydrogen phosphate at a 20:80 v/v ratio) for 10 min chromatography at ambient temperature on C18. temperatu re (30 °C), the chromatography column (diameter 250×4.6 mm, particle size 5 μm) is used at a flow rate of 1 mL/min, and the de tection wavelength is 277 nm. The selection of the C18 line was inspired by previous research. Elution was reached after (on aver age) 5,416 min for several consecutive experiments in isocratic mode (Figure 3).

Figure 4 Chromatogram of Prucalopride obtained from multiple sampling

A low pH for the mobile phase is preferred because it lowers the peak, prevents breakdown of the silica reverse phase column, and increases the strength of the process. The pH value is similar to the pKa value to determine whether the solvent is in an ionized st ate, which is important to achieve high solubility. Therefore, it is necessary to choose pH = pKa up to 2 units. Short runs have ma ny advantages in terms of solvent and time. The capsule sample measured a mean recovery of 99.17% with a %RSD value of 1.17 2 (Table 1). The chromatographic method facilitates routine analysis of large quantities of drugs and is precise, accurate and robus t.

Table 1 Assay performed for tablet formulation sample of Prucalopride

S. No.	Peak area (4 μg/mL)	Amount recovered (μg/mL)	% Recovery
1	136135	4.060	101.500
2	132914	3.958	98.943
3	133381	3.973	99.314
4	132193	3.935	98.371
5	133565	3.978	99.460
6	135158	4.029	100.724
Mean	133891	3.989	99.719
SD	1472.75	0.047	1.169
% RSD	1.09996	1.172	1.172

EPRA International Journal of Research and Development (IJRD)

3.3   Method Validation
The method was validated in compliance with ICH guidelines.

3.3.1   Linearity and Range:
Linearity Plot the calibration curve of 6 standard solutions with concentrations of 5-30 μg/mL. Each dilution is repeated over time, location is on the Y-axis and concentration is the amount on the X-axis. Linearity is measured by horizontal analysis as shown in Figure 5.
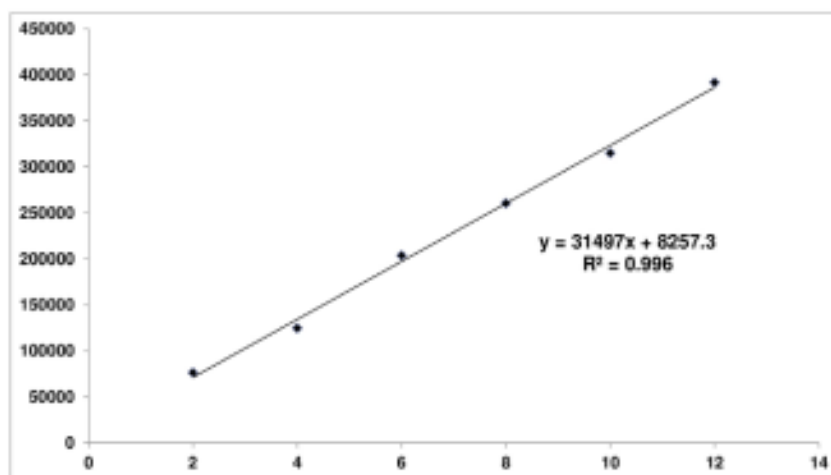

Figure 5 Linearity of Prucalopride

Table 2 Linearity study of Prucalopride

Conc. (μg/mL)	Replicates	Area	Mean	SD	% RSD
2	1	74890	76462	1369.939	1.792
	2	78630			
	3	75895			
	4	76530			
	5	76365			
4	1	123367	124788.6	2346.6	1.880
	2	125193			
	3	122465			
	4	128564			
	5	124354			
6	1	200993	203675	3026.817	1.486
	2	204564			
	3	201468			
	4	202865			
	5	208485			
8	1	265148	260540	4327.437	1.661
	2	262489			
	3	256412			
	4	255460			
	5	263191			
10	1	318986	315075.2	5707.997	1.812
	2	322102			
	3	307409			
	4	312564			
	5	314315			

EPRA International Journal of Research and Development (IJRD)

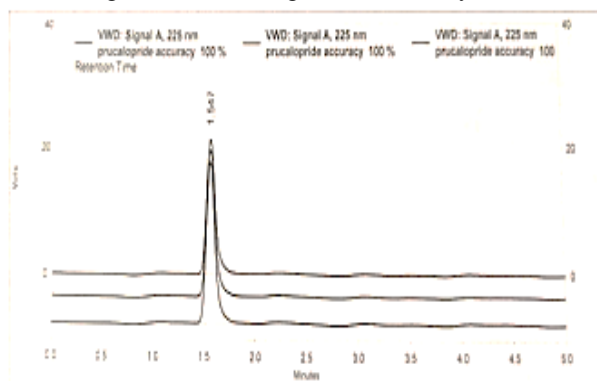|					
	1	398410			
	2	385272			
12	3	391456	391874.2	6438.445	1.643
	4	385823			
	5	398410			

3.3.2   Accuracy
The estimation of the proportion of Prucalopride recovered by the chromatographic technique was derived from the created calibration curve, using the slope and Y-intercept of the graph, both of which have significant importance. The percentage relative standard deviation (RSD) values of 0.755%, 0.588%, and 0.482% conform to the permissible range of ± 2% as specified by the United States Pharmacopeia (USP) Pharmacopoeia.

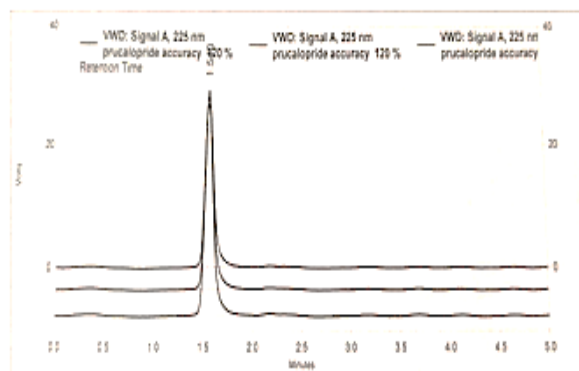**Table 3 Recovery for accuracy studies for Prucalopride**

Level	Conc. of sample solution (µg/mL)	Conc. of standard solution spiked (µg/mL)	Area	Amount recovered (µg/mL)	% recovery (mean ± % RSD)
50%	4	2	195951	5.959	100.173 ± 0.755
			198666	6.045	
			198080	6.027	
100%	4	4	257427	7.911	99.077 ± 0.588
			259554	7.978	
			256740	7.889	
150%	4	6	317558	9.820	98.575 ± 0.482
			320423	9.911	
			318236	9.842	

Figure 6 Chromatogram of accuracy 50%

Figure 7 Chromatogram of accuracy 100%

Figure 8 Chromatogram of accuracy 150%

3.3.3   Precision

The examination of intra- and inter-day variation for Prucalopride within the range of 6-10 g/mL shown a high degree of accuracy. There was agreement between the sample solution and the standard solution in terms of peak area, and the RSD stayed below 2%. For the purpose of analyzing daily fluctuations, the percentage relative standard deviations (RSDs) are listed in Table 4. The measured RSDs were 0.754, 1.032, and 0.482. Table 5 displays the findings of the investigation into the variability experienced across days, with the relative standard deviations (RSDs) coming in at 0.797, 0.559, and 0.524 percent. According to the results, the chromatographic method delivered a high degree of accuracy with a small margin of error.

Table 4 Precision data of intra-day variability.

Concentration (µg/mL)	Area	% recovery	SD	% RSD
6	198331	101.442	0.765	0.754
	201079			
	200485			
8	257518	99.919	1.031	1.032
	262707			
	259859			
10	321415	99.804	0.481	0.482
	324315			
	322102			

Table 5 Precision data of inter-day variability

Concentration (µg/mL)	Area	% recovery	SD	% RSD
6	198485	100.337	0.800	0.797
	198988			
	196155			
8	260529	100.758	0.563	0.559
	263191			
	262707			
10	318986	99.240	0.520	0.524
	322102			
	321415			

3.3.4   Robustness

The retention time of the chromatogram (shown in Figure 9) did not vary visibly when the flow rate, frequency, and composition of the mobile phase were altered. When the settings were altered, there was a marginal change in the amount of time it took to hold. High peak area, more than 2000 theoretical plates, and a tailing factor of 2% were all determined to be in compliance with the requirements of the USP pharmacopeia. The investigation confirmed the validity of the developed chromatographic technique.

EPRA International Journal of Research and Development (IJRD)
Volume: 8 | Issue: 10 | October 2023   - Peer Reviewed Journal

Figure 9 Robustness studies of Prucalopride: (a) Flow rate at 0.9 mL/min; (b) Flow rate at 1.1 mL/min; (c) Wavelength at 275 nm; (d) Wavelength at 279 nm; (e) Mobile phase composition 18:82 v/v; and (f) Mobile phase composition 22:78 v/v
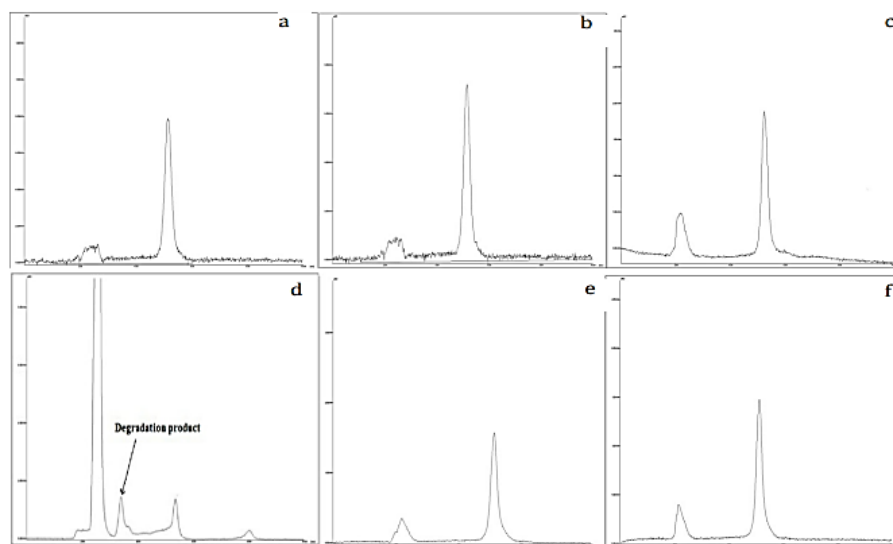
3.3.5   Limit of Detection and Quantification
It was determined that 0.36 µg/mL was the LOD for Prucalopride and that 1.111 µg/mL was the LOQ. According to the results, the chromatographic method discussed in this paper can identify solutes with amazing sensitivity. The method has the capacity to identify huge volumes or very low concentrations of Prucalopride inside formulations.

Table 6 Validation Parameter of Prucalopride

Sr. No.	Parameter	Prucalopride
1.	Linearity Range	30 µg/mL
2.	Regression Line equation	Y=27691x+ 914034
3.	Correlation co-efficient	0.996
4.	Precision (%RSD)	
	Intra-day Precision	0.754, 1.032, and 0.482
	Inter-day Precision	0.797, 0.559, and 0.524
5.	Accuracy (%Recovery)	0.755, 0.588, and 0.482,
6.	Limit of Detection(µg/ml)	0.367 µg/mL
7.	Limit of Quantification(µg/ml)	1.111 µg/mL
8.	% Assay	101.1
9.	Robustness (% RSD of Assay)	0.85

3.4   Forced Degradation Studies
Others, such as photolytic action, peroxide treatment, neutral pH, temperature variations, acidic treatment, and base therapy, produced a deteriorated product between 2.1 and 3.4 minutes. A peak with distortion was seen around 2.1–2.3 minutes. However, the acidic and basic regimens' forced degradation chromatograms showed no significant peaks. However, the chromatograms of materials without oxidation, heat treatment, or UV radiation exhibited a clear peak with a retention time of 2.148 minutes. Figure 7 shows that the system deteriorated most when subjected to oxidative stress, as seen by the Rt values of 2.148 and 3.43 minutes. Acidic and basic therapeutic processes are well-studied. However, the mechanisms of oxidative stress, the main cause of deterioration, remain unclear. Despite this, oxidative stress may rupture weak connections and quickly remove protons from the therapeutic material.

EPRA International Journal of Research and Development (IJRD)

Figure 10 Force degradation studies of Prucalopride: (a) Acidic condition; (b) Alkaline condition; (c) Neutral hydrolysis; (d) Oxidative condition; (e) Dry heat condition; and (f) UV-light

Table 7 Result of Forced Degradation Study of Prucalopride

Sr. No.	Stress type	Condition	No. of peaks	% Degradation
1	Acid Hydrolysis	2 N HCl at 80ºC for 30 min.	1	7.25
2	Alkali Hydrolysis	2 N NaOH at 80ºC for 2 hr.	-	-
3	Neutral Hydrolysis	H2O at 80ºCfor 2 hr.	-	-
4	Oxidative Degradation	10% H2O2 at 80ºC for 30 min.	1	5.24
5	Thermal Degradation	At 70ºC for 8 hr.	-	-
6	Photolytic Degradation	UV 254 nm for 24 hr.	-	-

3.5   Comparison with Other Methods for Estimation of Prucalopride

Comparison of properties such as accuracy, robustness, reproducibility, precision, and linearity is not possible because no reverse phase stability-indicating HPLC method has previously been developed or reported on the prediction of Prucalopride in bulk and tablet formulations. We have developed a method that can be called the "exponential RP-HPLC method" to estimate Prucalopride. A few years ago, researchers used tandem mass spectrometry and ultrahigh-performance liquid chromatography to measure Prucalopride levels in rat plasma (19). It has been determined that acetonitrile-water (containing 0.1% formic acid) solution, which is the mobile phase drug used in the selection process, has many uses in rapid, accurate and sensitive pharmacokinetics. The method developed by our group to estimate Prucalopride in bulk can also be used to estimate Prucalopride in biological samples (especially plasma), although the detection ability may be lower than in our body.

4   CONCLUSION

We found that the created strategy was basic, touchy and particular for Prucalopride investigation. Prucalopride debases somewhat in acidic and oxidative conditions and has been appeared to be steady in all other conditions. The percent corruption is calculated by comparing the debasement crest region in each corruption condition with the crest range of the medicate in non-degradation conditions. Within the think about, a safety-informed RP-HPLC strategy for Prucalopride estimation was created and approved agreeing to ICH rules. We created and approved a vigorous HPTLC procedure that does not depend on added substances or corruption items to gauge Prucalopride substance in tablet materials (20). The results appear that the method is exceptionally particular and the medicate and its corruption items are well isolated. The built up chromatographic strategy can be utilized by examiners for every day item security to gauge Prucalopride in bulk and tablet details and to screen the least due to its tall affectability, vigor, repeatability, accuracy and linearity (key ICH-Q2A and Q2B necessities). USP monograph is required for following, RSD and hypothetical plates. Considers on stretch (corrosive, oxidative, UV-induced, dry warm, impartial and antacid) appear degraders that offer assistance increment the sum (21).

5   REFERENCES

1. Deodhe S, Dhabarde DM, Kamble MA, Mahapatra DK. Development and validation of a novel stability indicating RP-HPLC method for the estimation of entecavir in tablet formulation. Eur J Anal Chem. 2017;12(3):223-235.
2. Deodhe S, Dhabarde DM, Kamble MA, Mahapatra DK. Novel stability indicating RP-HPLC method for the estimation of pinaverium bromide in tablet formulation: Assay development and validation. Eur J Anal Chem. 2017;12(2):3-16.
3. Kanthale SB, Thonte SS, Mahapatra DK. Development of validated stability indicating RP-HPLC method for the estimation of glecaprevir and pibrentasvir in bulk and pharmaceutical dosage form. J Appl Pharm Sci. 2019;9(6):52-60.
4. Sabale PM, Bhagwat D, Sabale VP, Mahapatra DK. Development and validation of RP-HPLC method for simultaneous estimation of esomeprazole and domperidone in capsule formulation. Eur J Anal Chem. 2018;13(6):57-66.
5. Jha SK, Bhaskaran S, Kamble MA, Mahapatra DK. A novel RP-HPLC based assay for the estimation of Tramadol HCl content in tablets: Development and Validation. Inventi Impact Pharm Anal Quality Assur. 2017; 2017(4):142-146.
6. Prakash O, Mahapatra DK, Singh R, Singh N, Verma N, Veda A. Development of a new isolation technique and validated RP-HPLC method for quercetin and kaempferol from Azadirachta indica leaves. Asian J Pharm Anal. 2018;8(3):164-168.
7. Sawale V, Dhabarde DM, Mahapatra DK. Development and validation of UV spectrophotometric method for simultaneous estimation of olmesartan medoxomil and chlorthalidone in bulk and pharmaceutical dosage form. Eur J Anal Chem. 2017;12(1): 55-66.
8. Dr. G. Abirami, Dr. T. Vetrichelvan, M. Raman, Method development and validation of Prucalopride succinate in bulk and tablet dosage form by RP-HPLC method, Journal of Innovations in Pharmaceutical and Biological Sciences Vol. 7 (3): 07-12, Jul-Sep, 2020.
9. Vaibhavi N. Akhani, Mrs. Khushbu K. Patel, Ms. K. S. Patel, Dr. L.M. Prajapati and Dr. C. N. Patel, Development and validation of RP-HPLC method for estimation of Prucalopride succinate in pharmaceutical dosage form world Journal of pharmacy and pharmaceutical sciences, Volume 9, Issue 6, 1112-1122.
10. Ashwini S. Chawathe, Purnima D. Hamrapurkar, Implementation of Quality by Design Approach for Analytical method development and validation for estimation of Prucalopride succinate in the Bulk and Solid Dosage Form, IJPQA, Volume 11 Issue 4 October 2020 – December 2020, 510-517.
11. R. S. Sakhare, S. S. Pekamwar, T. V. Gitte, Stability indicating high performance thin-layer chromatography method for simultaneous estimation of ambroxol hydrochloride and loratadine in pharmaceutical dosage form, Indian Drug, August 2018, 55(8); 44-51.
12. Patel SK, development and validation of analytical method for estimation of Leflunomide in bulk and their pharmaceutical dosage Form, Austin Journal of Analytical and pharmaceutical chemistry, ISSN: 2381-8913, Volume 2 Issue 4 - 2015, Page No 01-10.
13. Emmanuel AV, Roy AJ, Nicholls TJ, Kamm MA. Prucalopride, a Systemic Enterokinetic, for the Treatment of Constipation. Alim Pharmacol Therapeut. 2002;16(7):1347-1356.
14. Zhi Sun1, Lihua Zuo1, Jian Kang, Lin Zhou, Mengmeng Jia, Zeyun Li, Zhiheng Yang, Xiaojian Zhang, Zhenfeng Zhu, development and validation of a sensitive UHPLC– MS/MS method for Quantitation of Prucalopride in Rat Plasma and its application to pharmacokinetics study, Page No. 328-333, 2016.
15. Baira Shandilya, Mahamuni Anupama, Jajula Atul, Awasthi Pradipbhai D. Kalariya M.V.N. Kumar Talluri, selective separation and characterisation of stress degradation products and process impurities of Prucalopride succinate by LCQTOF-MS/MS 22, 2016.
16. Virag Gophane, Ravi A Thakur, Development, Validation and Stability Indicating RP-HPLC Method for estimation of Prucalopride Formulation, 2016.
17. Dr. G. Abrami, Dr. T. Vetrichelvan, Method development and validation of Prucalopride Succinate in bulk and tablet dosage form by RP-HPLC Method. Journal of innovations in Pharmaceutical and biological sciences (JIPBS) ISSN: 2349-2759, vol-7, page no. 07-12, 2020.
18. Sangameshwar B. Kanthale, Sanjay S. Thonte, Sanjay S. Pekamwar, Debarshi K. Mahapatra development and validation of a Stability Indicating RP-HPLC Method for the Determination of Prucalopride succinate in Bulk and Tablet, International Journal of Pharmaceutical Sciences and Drug Research vol-12(2), 2020, Page No.166-174
19. Bhosale AC, Bhagat VC, Kunjir VV, Kardile DP, Shete RV. Analytical method development and validation of Prucalopride Succinate in bulk and formulation by UV-Visible spectrophotometry. Res J Pharm Technol 2021;14(8):4189-1.
20. Bojja GDA, Annapurna MM. Development and Validation of New Analytical Methods for the Quantification of Prucalopride Succinate. Acta Scientific Pharmaceutical Sciences (2020);4(5):74- 77.
21. Kanthale SB, Thonte SS, Pekamwar SS, Mahapatra DK. Development and validation of a stability indicating Rp-Hplc method for the determination of Prucalopride succinate in bulk and tablet. Int J Pharm Sci Drug Res 2020;12(2):166-74.