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Development of a Validated Method for the Oral Dosage and Bulk Quantification of Pantoprazole and Cinitapride using RP-HPLC and Spectrophotometry

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Abstract: Drugs are very important as they are raw materials which need to be quantitatively analyzed to make sure they meet certain standards and to find out how much of each part has to be used in medicine. None of the pharmacopoeias have standard ways to test medicines that were recently made or synthesized. Because of this, it is necessary to come up with new, more accurate, focused, simple, doable, reliable, and cost-effective ways to analyze new medicines. It is not possible to estimate pantoprazole and cinitapride because there is no data to confirm this. It was found that the RP-HPLC and UV-visible methods were simple, quick, accurate, and exact for analyzing pantoprazole and cinitapride in both their prescription dosage form and their pure form. In this study, spectrophotometric methods have been tested, which are clear, simple, quick, accurate, cheap, and quick to use for figuring out pantoprazole and cinitapride in bulk and combination oral dosage form.

Keywords: Cinitapride, Pantoprazole, Oral dosage, Quantitative analysis, RP-HPLC

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Introduction

Cinitapride (Fig. 1) is a substituted benzamide drug that moves food through the digestive tract. It works on serotoninrgic 5-HT2 and 5-HT4 receptors as well as dopaminergic D2 receptors in the myenteric plexus's neuronal synapses in a way that is complicated but works well with each other (Lahari *et al*., 2012). Adults usually eat or drink 1 mg of cinitapride three times a day, 15 min before each meal. In certain circumstances, the physician may opt to reduce the dosage in accordance with the patient's age and presenting symptoms (Patel *et al*., 2011). Due to the absence of a highly

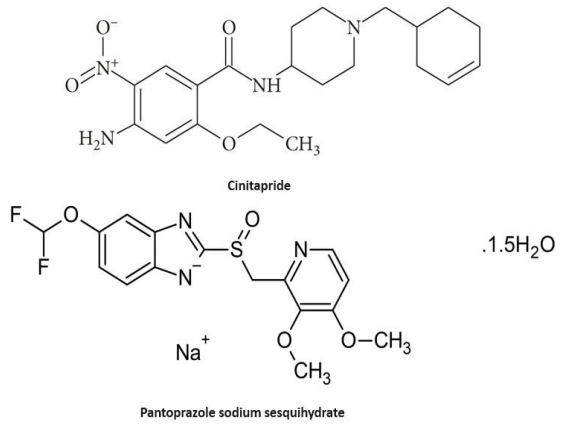

Fig. 1: Structure of Cinitapride and Pantaprazole.

sensitive analytical technique for detecting plasma concentrations of cinitapride at extremely low doses, investigations of its pharmacokinetics following oral and intramuscular administration have been conducted using dosages far exceeding the therapeutic dose (Siddartha *et al*., 2014). When 12 mg of cinitapride was taken by mouth, it was quickly absorbed, and high levels were reached 2 h after the dose (Hamed Bellah *et al*., 2020). When cinitapride was injected into the muscle, it was absorbed even faster. One hour after treatment, peak levels were reached, which were 50% higher than levels taken by mouth (Shende *et al.*, 2013).

Pantoprazole (Fig. 1) is a drug that stops the production of acid in the stomach. It is used to treat esophageal erosion and ulceration caused by gastroesophageal reflux disease in the short term. Like other medicines in the same family, it lowers stomach acid production by blocking a part of the parietal cells (Keservani *et al*., 2016).

Pantoprazole sodium salt is a powder that is solid and varies in colour from almost white to off-white. It doesn't mix with chloroform or carbon tetra chloride, but it does mix with methanol, water, and acetone to a lesser extent. The melting point of pantoprazole sodium can not be found because it gets worse over time when heated (Nair *et al.*, 2021).

Pantoprazole, a proton pump inhibitor, halts the final stage of gastric acid synthesis in the stomach. This is achieved through the establishment of a covalent bond with two specific locations within the (H^+, K^+)-ATPase enzyme system located on the secretory surface of the stomach parietal cell (Nair *et al*., 2020). This dose-dependent mechanism inhibits both regular and heightened gastric acid secretion, regardless of the stimulus. Analysis is a big part of creating new medicines, making them, and using them in therapy (Salem *et al*., 2020). The raw materials and the end product need to be quantitatively analyzed to make sure they meet certain standards and to find out how much of each part is in the whole. None of the pharmacopoeias have standard ways to test medicines that were recently made or synthesized (Ahire *et al*., 2020). Because of this, it is necessary to come up with new, more accurate, focused, simple, doable, reliable, and cost-effective ways to analyze new medicines (Abbas and Marihal, 2014). A careful study of the research shows that first derivative and HPTLC are the only ways that have been reported for finding pantoprazole and cinitapride. It is not possible to figure out how much pantoprazole and cinitapride are in a mixture tablet (Formica *et al.*, 2022). In the present study, spectrophotometric methods have been tested which are clear, simple, quick, accurate, cheap, and

quick to use for figuring out pantoprazole and cinitapride in bulk and combination oral dosage form (Patil *et al*., 2023).

Materials and Methods

Selection of solvent:

Based on Indian Pharmacopoeial standards, the ability of cinitapride and pantoprazole to dissolve in water was studied. Both polar and non-polar liquids were used to test how well the medicines mixed (Surana *et al*., 2022). It was found that both medicines could be dissolved easily in methanol. Methanol was selected as the solvent for further investigation into the effects of pantoprazole and cinitapride by UV spectroscopy (Singh *et al*., 2017).

Preparation of Standard Stock Solutions:

Two distinct 50 ml volumetric flasks were meticulously weighed, with each flask containing 50 mg of standard pantoprazole and ciprofloxacide. The stock solutions containing 1000 µg/ml of cinitapride and pantoprazole, were prepared by adding methanol (Furquan *et al*., 2023).

Maxima absorption selection:

The stock solutions of pantoprazole and cinitapride were diluted to a concentration of 10 µg/ml. A methanol blank was utilized to compare the dilutions in the ultra violet (200–400 nm) range. The highest absorption was observed at 263 nm for cinitapride and 292 nm for pantoprazole. Consequently, the lamba max values for cinitapride and pantoprazole were determined to be 292 nm and 263 nm, respectively (Fakir *et al*., 2023). These values were subsequently employed forfurther investigation to determine the quantity of each compound using UV spectrophotometry (Bhandari *et al*., 2022).

Standard absorbance method :

Cinitapride:

A precise measurement of twenty cinitapride pills was employed in the production of a fine powder. A 100 ml volumetric flask was utilized to combine tablet powder containing 10 mg of cinitapride with an appropriate quantity of methanol (Aher *et al*., 2023). The mixture was stirred for 30 min. Subsequently, methanol was introduced into the mixture to achieve its maximum capacity. After thorough mixing, Whatmann filter paper No.41 was employed to screen the mixture (Sonawane *et al*., 2023). Upon disposing of the initial ml of the filter, a minor quantity was diluted till the ultimate concentration of cinitapride reached 10 µg/ml. The new solution's absorbance was measured at a wavelength of 263 nm in comparison to a methanol blank (Pardeshi *et al*., 2024).

Pantoprazole:

The tablets of Pantoprazole were accurately measured and pulverized into a fine powder. In a 100 ml volumetric flask, tablet powder containing 10 mg of pantoprazole was measured, subjected to vigorous agitation with an appropriate amount of methanol for 30 min, and subsequently filled to the desired volume using methanol. Subsequently, the blended solution underwent filtration employing Whatmann filter paper No. 41. Once the initial milliliters of the filtrate were disposed away, an appropriate amount of filtrate was diluted using methanol in order to get a final concentration of 10 µg/ml of pantoprazole. The absorbance of the resulting solution was measured at a wavelength of 292 nm, relative to a methanol blank (Beg *et al*., 2017).

Formulation analysis:

A total of twenty cinitapride tablets were meticulously weighed and thereafter finely pulverized. A precise measurement of tablet powder containing 25 mg of cinitapride was taken and combined with 10 ml of methanol. Subsequently, the solution was supplemented with water in order to achieve a concentration of 250 µg/ml. Whatmann filter paper No. 41 was employed for the purpose of segregating the constituents inside the combination. Following the initial disposal of a few milliliters, 6 ml of the filtrate was transferred to a 50 ml volumetric flask. The sample solution was diazotized and then

connected to ethyl acetoacetate using the same techniques as for normal cinitapride. The absorbance of the synthesized chromogen was observed at a wavelength of 392.5 nm (Ayad *et al.*, 2017).

CINITAPRIDE

Standard solution preparation and linearity establishment:

A precise measurement of 10 mg of standard cinitapride was taken and added to a 25 ml volumetric flask. The flask was then mixed with methanol and filled with more methanol to achieve a concentration of 0.6 mg/ml of cinitapride. The solution was employed subsequent to undergoing filtration using a 0.2º membrane filter. The concentration range of 5 µg/ml to 30 µg/ml was achieved by repeatedly diluting a small quantity of the standard solution of cinitapride with the mobile phase. The dilutions were sequentially introduced into the 20 µl loop, with approximately 20 µl of each dilution. The wavelength of the eluate was determined to be 263 nm, and a chromatogram was generated. Regression analysis was employed to examine the linearity of the peak area plotted against concentration (Emad *et al*., 2021).

Formulation Analysis:

A total of twenty cinitapride pills from the formulation were accurately weighed. The cinitapride tablet powder, with a precise measurement of 6 mg, was dissolved in methanol for a duration of 15 min utilizing ultrasonic waves. Subsequently, additional methanol was introduced until the target volume of 10 ml was achieved. By introducing the mobile phase, the concentration of the solution was further decreased to 0.12 mg/ml. After traversing a 0.2º membrane filter, the fluid was subsequently injected into the column. The presence of the eluate was observed at a wavelength of 263 nm, and the chromatogram was documented (Surana *et al*., 2023).

Study of Percentage Recovery:

A total volume of 25 ml was prepared by combining two different stock solutions, into a volumetric flask. The response was inserted into the column subsequent to undergoing filtration. The wavelength of the eluate was determined to be 263 nm, and a chromatogram was generated (Nguyen *et al*., 2022).

PANTOPRAZOLE

Standard solution preparation and linearity establishment:

100 mg of standard pantoprazole was measured and thereafter transferred into a 50 ml volumetric flask. Next, we combined it with the mobile phase and continued adding more mobile phase until the flask reached its maximum capacity. The obtained concentration of pantoprazole was 2 mg/ml. The solution was subjected to filtration using a 0.2° membrane filter in order to facilitate its reuse. The standard solution of pantoprazole, with a concentration of 10 mg, was repeatedly diluted with the mobile phase until the concentration reached a range of 5 µg/ml to 25 µg/ml. The dilutions were sequentially applied. The eluate was subsequently quantified at a wavelength of 292 nm, and the chromatograms were recorded. The relationship between the peak area and the quantity was graphed, and regression analysis was employed to assess the degree of linearity (Keservani *et al*., 2017).

Formulation Analysis:

100 mg of pantoprazole was transferred into a 50 ml volumetric flask. The substance was dissolved in the mobile phase for a duration of 15 min using ultrasonication. Subsequently, the mobile phase was added to achieve a concentration of 2 mg/ml. It was further diluted, the concentration was then decreased to 0.2 mg/ml. The final dilution was introduced onto the column at a volume of 20 µl after being filtered through a 0.2º membrane. The eluate was detected at a wavelength of 292 nm and the chromatogram was recorded (Keservani *et al.,* 2023).

Table 1: Cinitripride's absorbance at a wavelength of 263 nm

S. No.	Concentration (µg/ml)	Absorbance
1	5	0.232
2	10	0.452
3	15	0.579
4	20	0.688
5	25	0.885
6	30	1.132

Table 2: Absorbance of pantoprazole at 292 nm

S. No.	Concentration (µg/ml)	Absorbance
1	5	0.196
2	10	0.391
3	15	0.581
4	20	0.771
5	25	1.151

Study of Percentage Recovery:

2 mg/ml preanalyzed sample stock solution was mixed with 5 ml solution. 2.5 ml of the standard stock solution (2 mg/ml) was introduced into a volumetric flask, and the volume was subsequently raised to 50 ml. Once the filtration process was completed, the solution was introduced into the column. The eluate was detected at a wavelength of 292 nm, and the chromatogram was recorded (Behera *et al*., 2010).

Results and Discussion

Comparison of standard method:

The solubility of cinitapride in methanol was demonstrated to be high. The highest level of absorbance was seen in methanol at a wavelength of 263 nm. A study was conducted to investigate the linearity of the reference medication within the concentration range of 2 to 100 µg/mL. A calibration chart consisting of five points was constructed by graphing absorbance on the Y-axis and concentration on the X-axis. The applicability of Beer's law to cinitapride within the concentration range of 5 to 30 µg/ml was demonstrated. Table 1 displays the relationship between absorbance and concentration. At concentrations beyond 30 µg/ml, a negative deviation from Beer's rule was observed.

It was found that the correlation value, which was 1, was within a good range. It was possible to measure the mixture. It was also found that pantoprazole mixed very easily with methanol. At 292 nm, pantoprazole was found to absorb the most light. Absorbance increasewd with increased quantity (Table 2). The medicine followed Beer's law when the concentration was between 5 and 30 µg/ml, as shown on the five-point calibration chart. The calibration chart shows that regression analysis was used to find the uniformity. It was found that the correlation value, which was 1, was within a good range.

Sample Analysis:

Table 3: Cinitapride Assay Results

S. No.	Claim	Concentration (mg ± SD)	RSD	Purity (%) ± SD	RSD
1	3 mg	2.90 ± 0.0050	0.151	102.69 ± 0.152	0.00151
2		3.01 ± 0.0020	0.061	99.52 ± 0.061	0.00061
3		2.99 ± 0.0030	0.091	98.89 ± 0.086	0.00091

Table 4: Pantoprazole Assay Results

S. No.	Claim	Concentration (mg ± SD)	RSD	Purity (%) ± SD	RSD
1	40 mg	40.1 ± 0.0040	0.0921	98.99 ± 0.0810	0.00090
2		41.6 ± 0.0030	0.0701	101.31 ± 0.070	0.00070
3		41.7 ± 0.0050	0.127	102.20 ± 0.125	0.00120

Table 5: Cinitapride Recovery Studies Results

% Recovery	Concentration (mg)		Total Conc. (mg)	Amount recovered (mg)	Evaluated % Recovery	Recovery in % ± S.D	RSD
	Sample	Std					
25%	3	0.7	4.11	0.71	21.25	100.98± 0.21	0.0091
50%		1.4	5.01	1.32	41.36	101.81± 0.51	0.0123
100%		3.1	6.17	3.51	102.2	102.11± 0.71	0.0070

Table 6: Pantoprazole Recovery Studies Results

% Recovery	Concentration (mg)		Total Conc. (mg)	Amount recovered (mg)	Evaluated % Recovery	Recovery in % ± S.D	RSD
	Sample	Std					
25%	40	9	49.42	9.11	21.36	100.70± 0.41	0.030
50%		18	57.23	16.35	41.35	101.25± 0.26	0.020
100%		82	80.62	40.41	98.22	100.58 ± 0.75	0.010

Cinitapride and pantoprazole are both available as separate tablets in the capsule dose form. In this case, the drugs are valued as different things.

Assay of Cinitapride:

Cinitapride content was determined in the mixture. The sample's value was set so that it falls within the linearity range of 5–30 µg/ml of standard cinitapride. The samples were analyzed three times, and the average of these three estimations were determined. The accuracy of the new method is shown by the fact that the purity percentage consistently obtain within the 98.89–102.69 % range. The sample analysis findings are shown in Table 3.

Assay of Pantoprazole:

The amount of Pantoprazole in the combination

was measured. The linearity range of 5-30 µg/ml of standard pantoprazole was used to set the sample's value. We averaged the results from our three separate analyses of the samples. The new method's accuracy is demonstrated by the fact that the purity percentage constantly falls within the range of 98.99-102.20%. The results of the statistical analysis are displayed in Table 4.

Recovery Studies:

Cinitapride:

The formulation containing Cinitapride was measured. The sample concentration was selected to align with the normal Cinitapride linearity range of 5–30 µg/ml. Three triplicate assessments of the data were performed, and the calculation was based on the average of the three studies. Calculations were conducted to ascertain the quantity and purity %. The purity was found to range from 100.98% to 102.11%. Table 5 presents the results of the sample analysis.

Pantoprazole:

The formulation including pantoprazole underwent measurement. The sample's concentration was selected to lie between the 5 and 30 µg/ml conventional linearity ranges for pantoprazole. The computation was based on the average of the three experiments, which involved three duplicate assessments of the data. To ascertain the quantity and purity percentage, calculations were performed. The purity was found to vary between 99.70% and 101.58%. The results of the sample analysis are shown in Table 6.

Conclusion

For the dosage form and bulk estimate of cinitapride and pantoprazole, simple, exact, quick, and reliable methods have been set up. The UV spectrophotometric approach employs the utilization of the solubility of pantoprazole and cinitapride in methanol. The λmax of pantoprazole is 293 nm in methanol and that of cinitapride is 263 nm. The correlation value for both medicines was found to be 1. The following three methods were used to figure out how much of each drug dosage was present. In the method, the normal absorbance method is used. The absorption of the standard and sample were used to figure out how much of the analyte there was. There were three spiking levels of the usual addition method used in the recovery tests. The RSD shows that the method can be used again and again, which means that the created method is accurate. It can be said that the new RP-HPLC and UV-visible methods were quick, easy, accurate, and specific ways to look at both pantoprazole and cinitapride in their pure form and in their medicine dosage form. Because of this, all of the above methods can be used to effectively analyze cinitapride and pantoprazole in pharmaceutical dosage form on a daily basis.

References

Abbas Z and Marihal S. (2014) Gellan gum-based mucoadhesive microspheres of almotriptan for nasal administration: Formulation optimization using factorial design, characterization, and in vitro evaluation. J Pharma Bioallied Sci. 6(4): 267.

Aher P, Surana K, Ahire E, Patil D, Sonawane D and Mahajan S. (2023) Development and validation of RP-HPLC method for quantitative determination of 4-amino benzene sulphonamide in sulphonamide hydrochloride. Trends Sci. 20(6): 5209-5209.

Ahire ED, Surana KR, Patil CD, Shah HS, Sonwane GB and Talele SG. (2020) Role of omega-3 fatty acids in different neurodegenerative disorders. In: Applied Pharmaceutical Science and Microbiology, (eds.) Mahapatra D.K., Talele S.G. and Haghi A.K., Apple Academic Press, pp. 173-194.

Ayad M, El-Balkiny M, Hosny M and Metias Y. (2017) Isocratic HPLC method for simultaneous determination of Tramadol hydrochloride and Pantoprazole sodium synthetic mixture in pure forms and injection formulations. J Pharma Res. 11(3): 210-219.

Beg AE, Bushra R, Ashfaq M, Zafar F, Ali H and Rizvi M. (2017) Development and validation of stability indicating assay method for cinitapride in bulk and tablets. Pakistan J Pharmaceut Sci. 2: 30.

Behera J, Keservani RK, Yadav A, Tripathi M and Chadoker A. (2010) Methoxsalen loaded chitosan coated microemulsion for effective treatment of psoriasis. Int J Drug Deliv. 2: 1.

Bhandari M, Rasool N and Singh Y. (2022) Polymeric lipid nanoparticles for donepezil delivery. In: Polymeric Biomaterials and Bioengineering: Select Proceedings of APA Bioforum 2021 Singapore: Springer Nature Singapore, pp. 51-63).

Emad NA, Ahmed B, Alhalmi A, Alzobaidi N and Al-Kubati SS. (2021) Recent progress in nanocarriers for direct nose to brain drug delivery. J Drug Deliv Sci Technol. 64: 102642.

Fakir J, Surana KR, Patil DM and Sonawane DD. (2023) Survey based assessment of adverse effect in Covid-19 vaccination breakthrough infections. Asian J Res Pharmaceut Sci. 13(3): 195-200.

Formica ML, Real DA, Picchio ML, Catlin E, Donnelly RF and Paredes AJ. (2022) On a highway to the brain: A review on nose-to-brain drug delivery using nanoparticles. Appl Materials Today 29: 101631.

Furquan A, Hafeez A and Rahman MA. (2023) Brain targeting of drugs via intranasal route in conjunction with nanoparticle-based systems: an updated review. J Nanoparticle Res. 25(11): 233.

Hamed Bellah AM, Mohamed AM and Mohamed NA. (2020) Development and validation of RP-HPLC method for simultaneous determination of ondansetron hydrochloride and granisetron hydrochloride in their admixtures with pantoprazole sodium. Thai J Pharmaceut Sci. 44(2): 82-90.

Keservani RK, Kesharwani RK, Sharma AK, Gautam SP and Verma SK. (2017) Nutraceutical formulations and challenges. In: Developing New Functional Food and Nutraceutical Products, (eds.) Bagchi D. and Nair S., Academic Press, pp. 161-177.

Keservani RK, Sharma AK and Kesharwani RK. (2016) Medicinal effect of nutraceutical fruits for the cognition and brain health. Scientifica (Cairo) 2016: 3109254.

Keservani RK, Tung BT, Singh S and Kesharwani RK. (2023) Nutraceuticals in Cancer Prevention, Management, and Treatment. CRC Press.

Lahari K, Kumari KS, Meghana D and Prakash K. (2012) Development and validation of RP-HPLC method for simultaneous estimation of rabeprazole and cinitapride in both bulk and solid dosage forms. Pharm Analysis Quality Assurance 2(4): 1-4.

Nair AB, Al-Dhubiab BE, Shah J, Jacob S, Saraiya V, Attimarad M, SreeHarsha N, Akrawi SH and Shehata TM. (2020) Mucoadhesive buccal film of almotriptan improved therapeutic delivery in rabbit model. Saudi Pharmaceut J. 28(2): 201-209.

Nair AB, Shah J, Jacob S, Al-Dhubiab BE, Patel V, Sreeharsha N and Shinu P. (2021) Development of mucoadhesive buccal film for rizatriptan: In vitro and in vivo evaluation. Pharmaceutics 13(5): 728.

Nguyen TT, Nguyen TT, Tran NM and Van Vo G. (2022) Lipid-based nanocarriers via nose-to-brain pathway for central nervous system disorders. Neurochem Res. 1:1-22.

Pardeshi VN, Lokhande T, Mahajan SK and Surana KR. (2024) Novel applications of functional foods in brain health. In: Applications of Functional Foods in Disease Prevention, Apple Academic Press, pp. 71-88.

Patel GH, Prajapati ST and Patel CN. (2011) HPTLC method development and validation for simultaneous determination of cinitapride and Pantoprazole in capsule dosage form. Res J Pharm Technol. 4(9): 1428-1431.

Patil SJ, Surana KR and Mahajan SK. (2023) In vitro antimicrobial and antifungal activity of *Mentha piperita* active phytoconstituents. Res J Agricult Sci. 14(6): 1875-1877.

Salem LH, El-Feky GS, Fahmy RH, El Gazayerly ON and Abdelbary A. (2020) Coated lipidic nanoparticles as a new strategy for enhancing nose-to-brain delivery of a hydrophilic drug molecule. J Pharmaceut Sci. 109(7): 2237-2251.

Shende MD, Dighade NR and Kasture AV. (2013) Simultaneous estimation of cinitapride hydrogen tartrate (CNT) and pantoprazole sodium sesquihydrate (PNP) in capsule by Q-analysis UV-spectrophotometric method. Asian J Res Chem. 6: 911-915.

Siddartha B, Babu IS, Gupta CR and Panigrahy UP. (2014) Analytical method development and validation for simultaneous estimation of mosapride and pantoprazole in bulk and pharmaceutical dosage form by RP-HPLC method. J Adv Pharm Edu Res. 4(2): 186-192.

Singh P, Kesharwani RK and Keservani RK. (2017) Antioxidants and vitamins: Roles in cellular function and metabolism. In: Sustained energy for enhanced human functions and activity, Academic Press, pp. 385-407.

Sonawane VN, Suryawanshi KG, Wagh KH, Sonawane SL, Sonar AD, Sakle SJ and Sonawane DD. (2023) A comparative study of dissolution profiles on various brands of diclofenac sodium prolonged release tablet formulation. Prog Chem Biochem Res. 6(4): 341-355.

Surana K, Ahire ED, Pawar R, Khairnar R, Mahajan S, Kshirsagar S and Keservani RK. (2022) Oral health and prebiotics. In: Prebiotics and Probiotics in Disease Regulation and Management. https://doi.org/10.1002/9781394167227.ch11

Surana K, Bhawar S, Sonawane V, Patil D, Sonawane D and Mahajan S. (2023) Tap water and RO outlet water a novel greener route to catechol synthesis in H_2O_2. Asian J Green Chem. 7:189-98.