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SIMULTANEOUS ESTIMATION AND VALIDATION OF MULTIPLE COMPOUND FORMULATIONIN TABLET BY SPECTROPHOTOMETRY METHOD

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ABSTRACT

Spectrophotometry is a widely used analytical technique for simultaneous estimation of multiple compounds in pharmaceutical formulations. This review focuses on the application of spectrophotometry for simultaneous estimation and validation of multiple compound formulationsin tablets.

Method Development

1. Selection of analytical wavelength
2. Optimization of instrumental parameters
3. Development of calibration curves
4. Selection of chemometric techniques (e.g., PCA, PLSR)

Validation Parameters

1. Linearity
2. Precision (repeatability, intermediate precision)
3. Accuracy (recovery studies)
4. Robustness (ruggedness)
5. Limit of Detection (LOD) and Limit of Quantitation (LOQ)

Chemometric Techniques

1. Principal Component Analysis (PCA)
2. Partial Least Squares Regression (PLSR)
3. Artificial Neural Networks (ANN)
4. Support Vector Machines (SVM)
2. Interference from excipients
3. Development of robust and transferable methods
4. Integration with other analyticaltechniques (e.g., HPLC, MS)

KEYWORDS: spectrophotometry, simultaneous estimation, tablets, validation.

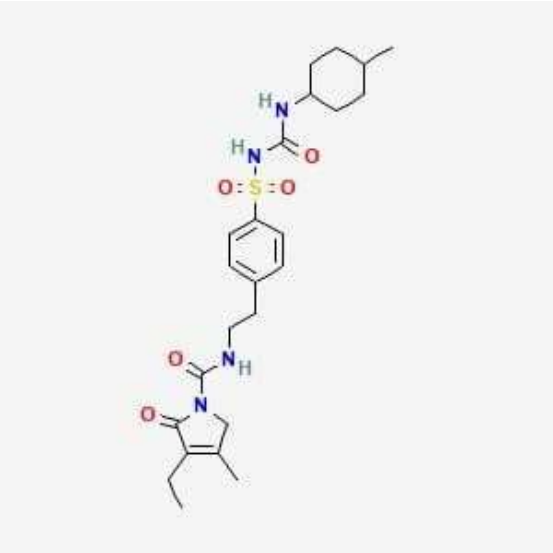
INTRODUCATION

In terms of its chemical composition, atorvastatin calcium is [R-(R*,R*)-2-(4- fluorophenyl)-β -dihydroxy-5-(1-methylethyl)- 3-phenyl-4-quinoline [(Phenylamino)carbonyl]-1H-pyrrole-1- heptonic acid- can be restated as acid derived from 1H-pyrrole-1-heptonic with the phenylamino carbonyl group attached. 2:1 calcium salt trihydrate employed as an artificial cholesterol agent used to reduce. Glimepiride is a medication used to treat diabetes from the sulfonylurea class. The substance is a drug that is chemically 3-ethyl- 2,5-dihydro-4-methyl-N-[2-[4-[[[(trans-ethyl 2- oxo-ethyl-[4 (cyclohexylamino)sulfonylaminocarbonyl]amin e. 1H-pyrrole-1-carboxamide Metformin hydrochloride is a medication. chemical compound known as N, N-dimethyl and used as an oral medication to treat diabetes. Analytical techniques like imidodicarbonimidic diamide analysis. Reverse phase high performance liquid chromatography[1] have been documented for the determination of atorvastatin calcium in its various preparations. UHPLC-MS/MS technique for analyzing atorvastatin reportedly, calcium levels in human blood are also noted[2] The mixture consists of atorvastatin calcium, glimepiride, and metformin hydrochloride is sold commercially. accessible in the form of tablets. Literature indicates that there There is no method for analyzing these three medications. simultaneous combination using spectrophotometry. So we are required to ... deliver fast and affordable quality assurance here tool for regular numerical examination of the three medications determining the combined dosage forms using spectrophotometry.[3] Because of Please provide the text you would like me to paraphrase. There is no documented spectrophotometric technique available for. simultaneous determination of paracetamol, aceclofenac this is why they are combined in the present moment an effort has been made to calculate successfully. These medications can be administered at the same time using basic UV method using a spectrophotometer.[4] A review of literature shows that both HPLC and HPTLC techniques are commonly used. has also been noted in the determination of Rabeprazole Different types of pharmaceutical forms are available. Techniques such as UV spectrophotometry for Rabeprazole. found to be entirely satisfactory. accessible that relies on calculating Rabeprazole levels. Domperidone is simultaneously analyzed by UV absorption ratio. method that uses spectrophotometry. The objective of the current study was to create a straightforward and accurate... precise and cost-effective spectrophotometric techniques for the concurrent detection of two drugs rephrasing the text using the same input language and keeping the same amount of words: development. The suggested approach was fine-tuned

and improved. confirmed in compliance with International Conference on.[5]

Experimental: for atorvastatin calcium, glimepiride and metformin.

Structure: atorvastatin[6]



Structure: Glimepiride[7]

Structure: Metformin[8]

Material for atorvastatin calcium, glimepirideand metformin

Shimadzu UV-visible dual beam spectrophotometer. model 1700 with a spectral bandwidth of 1 nm, with an accuracy of ± 0.3 nm accuracy of the wavelength and two 10 mm aligning quartz cell utilization occurred. The tablet that is available for purchase. cdpro 2 contains 10 mg of atorvastatin calcium as stated on the label. 2 mg of glimepiride and 500 mg of metformin hydrochloride were administered. obtained from the nearby market.[9]

Preparation of standard stock solution andcalibration curves

Atorvastatin calcium's standard stock solutions. glimepiride, and metformin hydrochloride were formulated by mixing 10 mg of each medication in 10 mL of methanol in 10 mL measuring 1000 in the volumetric flask to achieve a solution containing 1000 Concentration of each drug is expressed in micrograms per milliliter. A 0.1 ml solution was obtained from the solution mentioned above. was then mixed with methanol and reduced to 10 ml volume to create a mixture with a concentration of 10 micrograms per milliliter. 10 µg/mL standard solutions were scanned during work. the full spectrum of UV light from 400 to 200 nm in order to identify the maximum wavelength, λmax. these medications. The highest absorption wavelength of atorvastatin calcium, glimepiride, and metformin hydrochloride wasdetermined to have a measurement of 247.2 nm. 224.8 nm and 236 nm are shown in Figure-1. Six individuals currently employed conventional remedies for three medications with a dosage of 5 concentrations 10, 15, 20, 25, 30 µg/mL were dissolved in methanol to create the solution. solution in stock. The absorbance of solutions obtained as a result The respective λmax of three drugs were measured. A graph was created by plotting the calibration curve against concentration. the linear relationship and regression formula of three medications.[3]

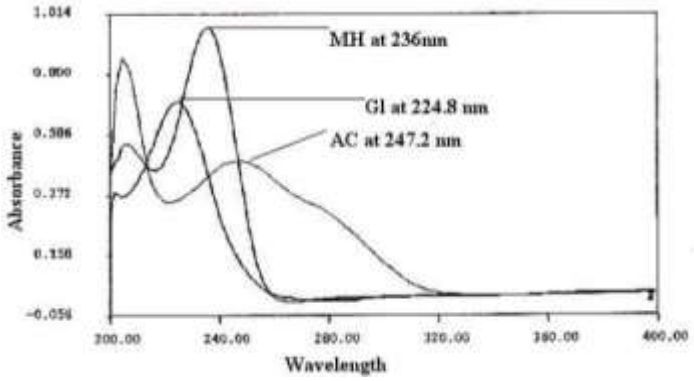
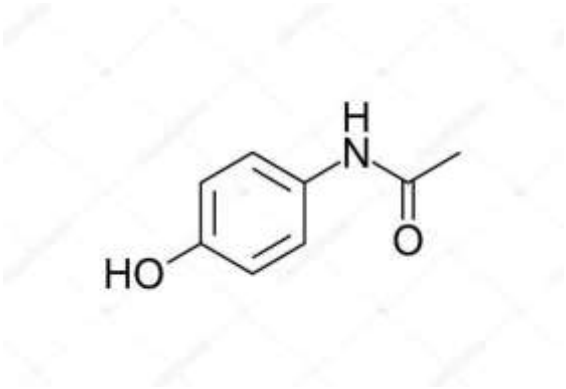
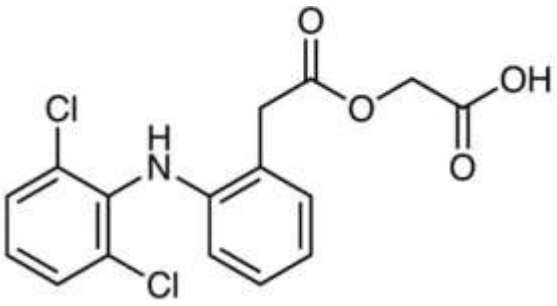


Fig. Overlain spectra of atorvastatin calcium, glimepiride and metformin hydrochloride.[10]

Experimental for paracetamol, aceclofenacand tizanidine



Structure: paracetamol[11]



Structure: Aceclofenace[12]

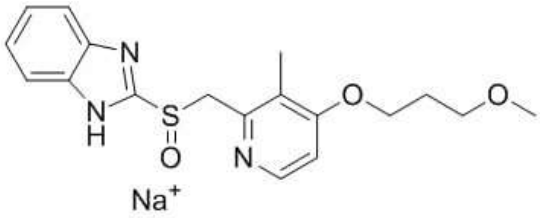
Structure: tizanidine[13]

Apparatus, substance and materials. A spectrophotometer for recording UV-Visible spectra made by Shimadzu. (Model-UV 1601) equipped with silica cells measuring 1 cm in length. utilized in spectrophotometric testing. Acetaminophen, commonly known as Paracetamol. aceclofenac and tizanidine bulk drugs were procured. a complimentary gift from Alpa Laboratories Ltd., located in Indore. India, IPCA Laboratories Ltd. in Ratlam, India and Unichem Laboratories Ltd. is located in Roha, India. Formulation of tablet containing a combined dose (Zerodol-MR) produced by IPCA Laboratories Ltd., based in India, was obtained from a nearby pharmacy in Indore, India. Every additional The chemicals utilized were of high quality for analysis.[14]

Preparation of stock solution

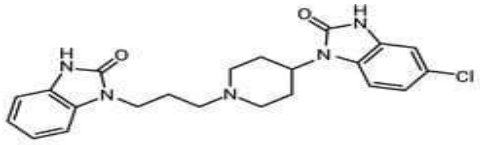
Creating a solution for future use. Administered in the form of a standard drug, consisting of ten milligrams of paracetamol. precisely measured and moved into a 10 ml container flask that measures volume. To this, an adequate quantity of 95% methanol was poured and the flask was agitated to dissolve the medication. The volume was increased to the maximum. Prepare a 1 mg/ml stock solution of aceclofenac by marking it with methanol in a similar manner. Tizanidine was formulated.[15]

Experimental for Rabeprazole and Domperidone



Structure: rabeprazole[16]

Method I: Simultaneous equation method



Structure: Domperidone[17]

A Jasco UV-2075 double-beam spectrophotometer for UV-visible analysis. 2nm spectral bandwidth spectrophotometer wavelength precision of ± 0.5 nm and two 1-cm items A set of quartz cells that matched each other was utilized to determine the absorbance of. the solution that is produced as a result.[18]

Examples

Samples of Rabeprazole and Domperidone were of standard quality. acquired.

Rabeprazole and Domperidone doses combined. Rabeprazole & Domperidone tablets are available in 20 mg and 10 mg strengths. produced by Stedman pharmaceuticals Pvt. Ltd. captured. Liquid that dissolves a solid, liquid, or gaseous solute.

Methanol was chosen as the solvent for creating spectral. attributes of medication. The choice

was finalized following evaluating the ability of both drugs to dissolve in various substances liquid used to dissolve other substances.[19]

Preparation of stock solution for Rabeprazole and Domperidone: 10mg of both Rabeprazole and Domperidone (RAB and DOM). were precisely measured and dissolved individually in order to create a stock solution (100 µg/ml), dissolve in 100ml of methanol.[20,21]

- **Analysis**

atorvastatin calcium, glimepiride and metformin hydrochloride

The analysis was conducted using the simultaneous equation method. uptake of medications (atorvastatin calcium, glimepiride, and metformin hydrochloride) at the peak wavelength one another. Three wavelengths chosen for advancement. The wavelengths of the simultaneous equations were 247.2 nm, 224.8 nm, and 236 nanometer maximum wavelength of atorvastatin calcium, glimepiride, and respectively metformin hydrochloride[22] Three medications were assessed at wavelengths of 247.2 nm, 224.8 nm, and 236 nm. nautical mile Absorptivity values were measured at 247.2 nm and 224.8 nm. Absorbance values for atorvastatin were 0.0457 (ax1) at 280 nm and 0.0342 at 236 nm. (ax2), 0.0418 (ax3); for glimepiride 0.0142 (ay1), 0.0633 (ay2), 0.0409 (ay3); for metformin hydrochloride 0.0438 (az1), 0.0621 (az2), and 0.0931 (az3) are the values in question. These values represent averages of six approximations.[23]

Method II: Multiwavelength Spectroscopy

In this technique, the tool is programmed in advance to gather data. gather the spectral data obtained from scanning the samples of standards and combine it achieves the outcome through matrix computations. Five different types of things combined together criteria for atorvastatin calcium, glimepiride and concentrations of metformin hydrochloride measured in µg/mL 0.5:0.1:25, the products offer an increasing rate of return for every five units. 25 solutions were diluted in methanol with a ratio of 0.5:0.1. adequate quantities of standard stock solutions and The area scanned ranged from 400 nm to 200 nm. Selecting frequencies to measure 247.2 nm, 224.8 nm, 236 nm, and 240nm were chosen from the options. the method of experimentation and mistakes. Each person's focus or attention drugs were administered to the multi-component system. tool. The tool gathers and organizes the data. analyzing spectral data from a combination of standards to determine the concentration of. Every part was derived from the spectral information of the sample. solution involving five different mixed

standards. Elaborated on Method I involved the preparation of a solution using a tablet sample. The text should contain the same number of words in the paraphrased version. The resulting solution was analyzed using spectrophotometry. performed utilizing the multifaceted method of the tool.[24]

Paracetamol, Aceclofenac and Tizanidine Multicomponent mode of analysis

Five solutions of paracetamol of mixed standards were prepared. aceclofenac and tizanidine were combined in a specific proportion. with concentrations of 1, 1, and 5 µg/ml, respectively Analyzed were 2:2:10, 3:3:15, 4:4:20, 5:5:25, and 6:6:30. in multi- component mode at their individual λmax positions 248, 276, and 319 nanometers in order. The focus the person was given a dose of the mixed medication. manner in which the instrument is used. Gathers data. gathers the spectral information from various mixed samples and combines them. the focus on the different elements of the formulation is immediately documented upon sampling The resolution is analyzed. The examination was conducted five times. occasions. Spectra of paracetamol with multiple components overlaid in the analysis.[25]

Absorbance Ratio Method Rabeprazole and Domperidone

During the overlap in the absorbance ratio process, the spectrums of both medications, with a wavelength of 280.0 nm (Iso-). absorption peak) and 291.0 nm (maximum wavelength of Rabeprazole) were chosen for examination. The graphs used for calibration. Both Rabeprazole and Domperidone were graphed on the chart. concentration levels between 5 to 25 µg/ml and 5 to 25 µg/ml respectively both the wavelengths, each of them. The abilities to absorb values were established for both drugs at both the frequencies of light.[26]

Validation parameters

Atorvastatin Calcium, Glimepiride and Metformin Hydrochloride

Accuracy: The validity of the established method was confirmed through testing. performing a replicate analysis with 80%, 100%, and 120% configurations (n= 3) conducting research on retrieval in accordance with ICH standards at three separate locations the act of focusing one's mind on something; several levels of focus. Common pharmaceutical treatment There were solutions presented for a pre-examined specimen. The answer and subsequently the amount of drug content were determined. computed. The findings of precision were revealed study. findings indicated a positive outcome. This technique is highly precise for measuring quantities. calcium atorvastatin, metformin and glimepiride hydrochloride provided in a tablet form for statistical analysis. findings fell within the acceptable range (S.D. < 2.0).[27]

Precision

By studying repeatability and intermediateprecision, precision was determined.[28]

Repeatability

The outcome of consistency shows the precision regarding a. short-term and intra- assay accuracy within the same timeframe conditions under which operations are performed. variation, and interquartile range are all measures of dispersion or variability in a dataset. Three medications had their variance and standard error computed. Repeatable tablet formulation tests werecarried out six times. occasions.[29]

Limit of Detection (LOD) and Limit ofQuantitation (LOQ)

The limits of detection and quantification for metformin hydrochloride using suggested techniques were obtained determined by utilizing calibration standards. Limits of detection (LOD) and limits of quantification (LOQ) were determined. measured standarddeviation. The gradient of the calibration curve and σ is the standard deviation. Of reply.[30]

Table 1: standard deviation, COV: Coefficient of variation, * Average of six determination.[31]

Parameters	Values		
	AC	GI	MH
Maximum absorbance (λ max)	247.2nm	224.8nm	236nm
Beer's law limit (µg/ml)	5-30	5-30	5-30
Absorptivity*	0.0457	0.0633	0.0931
Correlation coefficient*	0.997	0.983	0.986
Intercept*	0.048	0.106	0.059
Slope*	0.042	0.056	0.088
LOD* (µg/ml)	0.1278	0.4532	0.0241
LOQ*(µg/ml)	1.6587	0.7354	0.5781
Intra-Day* (Precision) (% COV)	0.4581	0.3562	0.7845
Inter-Day (Precision) (% COV) n=3	0.8650	0.5874	0.6521

Paracetamol, Aceclofenac and Tizanidine

Intermediate precision: The precision within and between days was determined by analysis of the sample solution on the same day and at the same time Various days at various time intervals, respectively.[32]

Limit of detection and limit of quantitation(LOD) and (LOQ): The detection limit and quantitation limit were determined. computed using the formula provided LOD equals 3.3 multiplied by the average standarddeviation divided by the slope of the curve.

LOQ is equal to 10 times the average standard deviation divided by the slope of the curve.[33]

Table 2: Validation parameter.[34]

Parameters		Observation of multicomponent analysis		
		PCM	ACE	TIZA
Linearity		2-14 µg/ml	5-40 µg/ml	5-25 µg/ml
Accuracy	80 %	101.35±1.52	101.38±1.4	101.38±1.4
	100 %	100.76±0.45	100.75±0.45	100.75±0.456
	120 %	102.07±1	102.26±0.82	102.2±0.82
Precision	Intraday	99.6±0.35	99.4±0.76	99.6±0.35
	Interday	99.7±0.31	100.23±0.471	99.3±0.31
LOD		0.05 µg/ml	0.114 µg/ml	0.104 µg/ml
LOQ		0.153 µg/ml	0.34 µg/ml	0.31 µg/ml
Analysis of tablet		100.02±1.4	100.62±1.97	100.64±1.9

Rabeprazole and Domperidone Linearity

Linear response was achieved within the specified concentration range. 5-25 µg/ml of Rabeprazole and 5-25 µg/ml of Rabeprazole. Domperidone is used in both methods as prescribed. Law of Beer-Lambert.[35]

Accuracy

In order to verify the validity of the suggested techniques, Standard addition was utilized to conduct recovery experiments. approach, technique.[36]

Limit of Detection (LOD) and Limit of Quantitation (LOQ)

The LOD and LOQ were established using the proposed methods. utilizing calibration references. LOD and LOQ were computed. at rates of 3.3 units per second and 10 units per second, where S represents the slope of the calibration curve and s represents the standard deviation of rewrite.[37]

Table 3: validation parameter[38]

Drug	Label Claim (µg/ml)	Amount Taken (mg/tab)	Amount Found (mg)	% Recovery	S.D	S.E	C.V	LOD (µg/ml)	LOQ (µg/ml)
RAB	20	10	9.91	99.1	0.251	0.1454	0.25	0.8311	0.251
			9.88	98.8					
			9.93	99.3					
DOM	10	5	4.95	99	0.2	0.1156	0.23	0.6606	0.2
			4.94	98.8					
			4.96	99.2					

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