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Validation and Development of UV spectroscopy method for the Estimation of Diclofenac sodium in Bulk and dos protected mode interface

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ABSTRACT:

There are presently four direct, speedy, delicate, and exact UV spectroscopic methods accessible for assessing how much diclofenac sodium in drug dosage forms and bulk. A clear UV spectroscopic strategy was made and confirmed to gauge the centralization of Diclofenac sodium utilizing a 20:40 dissolvable combination of acetonitrile and ethanol. Diclofenac sodium was found to have a linearity scope of 2-12 µ g/ml with a location frequency of 276 nm. The ICH rules were utilized to approve the methodology. It is not difficult to utilize, delicate, trustworthy, and produces repeatable outcomes. so supportive for the ordinary assessment of diclofenac sodium.

Key Words: Diclofenac sodium, acetonitrile, methanol, linearity, validation Parameter

1.0 Introduction:

A subordinate of benzene-acidic corrosive is diclofenac sodium (diclofenac sodium intestinal covered tablets). For oral use, Voltaren comes as 75 mg light pink postponed discharge (intestinal covered) tablets. 2-[(2,6-dichlorophenyl) amino] benzene acidic corrosive, monosodium salt is the synthetic name. 318.14 is the sub-atomic weight. Its primary formula is as per the following, and its sub-atomic formula is C14H11Cl2NO2.(T. R. Bhardwaj 2022) It can likewise be utilized related to other circulatory strain drugs.

Voltaren contains the accompanying dormant fixings: lactose, magnesium stearate, hydroxypropyl methylcellulose, iron oxide, microcrystalline cellulose, polyethylene glycol, povidone, propylene glycol, sodium hydroxide, sodium starch glycolate, powder, and titanium dioxide. (El-Shafei RA 2016)

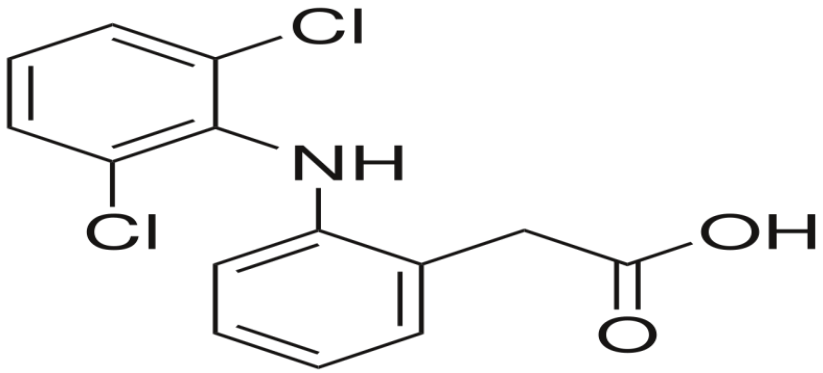

Figure 1 Diclofenac sodium $C_{14}H_{11}Cl_2NO_2$

Urine recovery indicates that oral delivery of diclofenac sodium results in 100% absorption as opposed to ingested administration. Nevertheless, only roughly 50% of the absorbed dosage is systemically accessible because of first-pass metabolism (Janićijević J, Krajišnik 2015). Food has no discernible impact on how much diclofenac is absorbed. In any case, there is ordinarily a 1 to 4.5-hour postpone in the beginning of retention and a decline in the pinnacle plasma levels of the essential objective of the examination is to make and approve an UV method to gain an exact, precise, and delicate quantitative estimation of diclofenac sodium. (Li L, Rossoni G 2006)

Diclofenac is utilized to ease pain related with gallstones, kidney stones, rheumatic diseases, dysmenorrhea, joint pain, and other incendiary problems (Boelsterli, U.A.(2003). Treating intense headaches is another sign. Diclofenac is habitually used to reduce gentle to direct pain following a medical procedure or injury, particularly related to irritation. (Brune, K. and J. Lindner.(1992)

Diclofenac has likewise been viewed as supportive for osteoarthritis, yet not so much for different forms of constant musculoskeletal pain. It is a topical medication. Additionally, actinic keratosis and acute pain from small sprains, contusions, and strains may benefit from the usage of diclofenac. (Hussain, I.M., Z. Khan 2008)

Eye drops are offered in a few nations to treat nonbacterial irritation of the front district of the eyes, both intense and persistent (e.g., postoperative conditions). (Aydin, G., A. Gõkçimen) Traumatic corneal abrasion pain has also been treated using the eye drops. (Naidoo V, Duncan N, Bekker L2007)

Diclofenac is frequently used to treat cancer-related chronic pain, particularly when inflammation is present. Diclofenac gel usage shouldn't go beyond 32 g (32,000 mg) each day. (P. W. Elsinghorsta, M. Kinziga 2011)

The method involved with checking that the scientific procedure utilized for a specific test is suitable for its planned use is known as validation. Analytical results' consistency, quality, and dependability can all be assessed using technique validation results. It is a crucial component of all sound analytical procedures. (Ambrogi V., Perioli L 2011) Diclofenac sodium dissolves in one part ethanol to thirty parts.Many nations sell commercially available oral liquid forms of prednisolone, prednisolone sodium phosphate, and diclofenac sodium. Prednisone solutions have a pH of 2.6 to 3.6 and include 4-6% ethanol, while suspensions typically have a pH of 3 to 4.5 and contain 2 to 5% ethanol. Numerous techniques, including UV, colorimetry, and HPLC, have been developed to determine the dose form of diclofenac sodium. [Cassano R., Trombino S 2010] Particular guidelines for method validation for chemical evaluation have been released by the USP. Eight steps are defined by USP for validation: Specificity, precision, accuracy, quantitation limit, linearity and range, robustness, robustness, and robustness(Rao S.P. 2003)

Since the process of quality control is dynamic, some kind of validation or verification must go on until the approved procedure is being used. It shouldn't be the case that a method is designed and validated, then forgotten about. (Marco-Urreaa E 2009)

The most common problems are related to the stomach. Diaclofenac medication must be stopped right away if ulceration and/or bleeding occur. During long-term treatment, most of patients are

regulated a gastro-defensive prescription as a preventive measure (misoprostol, ranitidine 150 mg at sleep time, or omeprazole 20 mg at sleep time. [Cheng G., An F 2004]

2.0 EXPERIMENTAL SECTION Materials and Methods:

Diclofenac sodium in bulk and pharmaceutical formulation in acetonitrile and methanol was created using a UV technique.

2.1 Reagents and chemicals:

Diclofenac sodium: Isolate medication.

Using ethanol and acetonitrile as diluents at a 20:40 ratio .

Making a standard stock solution with 1000 µg/ml of Diclofenac sodium:

Precisely weighing 100 mg of unadulterated prescription into a 100 ml volumetric jar, the stock arrangement of Diclofenac sodium was made by dissolving the medication in a 30:70 proportion of acetonitrile to methanol, yielding a centralization of 1 mg/ml.

Planning of working standard arrangement of Diclofenac sodium (100µg/ml):

Diclofenac sodium working arrangement was made by fittingly weakening the stock arrangement with methanol to accomplish a centralization of 100µ g/ml.

2.2 Instrument:

Using matching quartz cuvettes of one centimeter, all tests were conducted on a Perkin Elmer Lambda 850 UV-Visible Spectrophotometer.

Parameter fixation: Determination of λmax:

At what wavelength does maximal absorption occur? This is known as an absorption maximum, or λmax.

Diclofenac sodium's λmax when diluted:

After diluting the Diclofenac sodium solution appropriately, it was tested to determine its λmax. as shown in image 2.

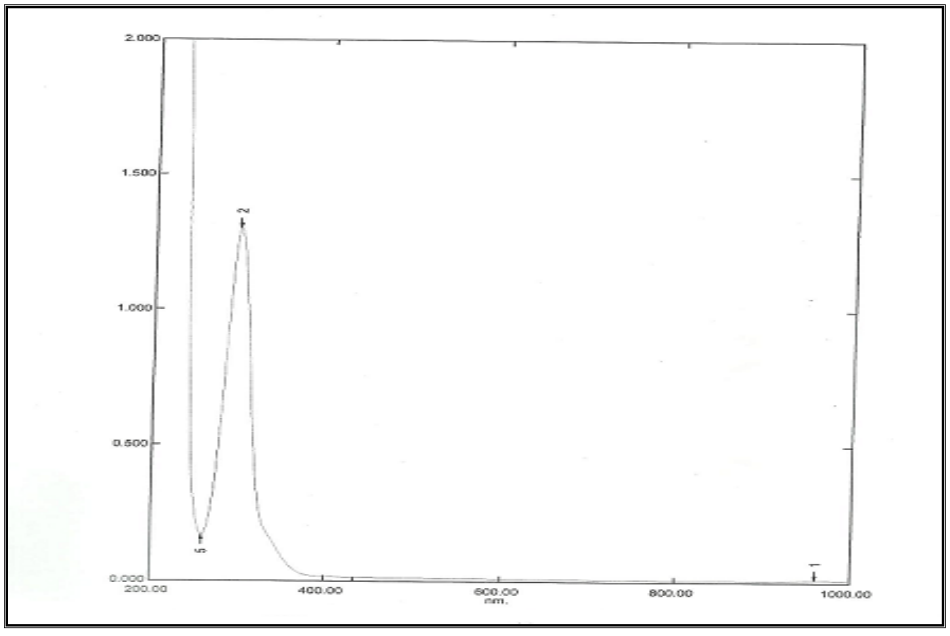

Figure (2) UV spectra of Diclofenac sodium

Stability of sample:

The medication arrangement test containing 3µ g/ml was created by weakening with proper diluents, and absorbance estimations were made at 276 nm in contrast with a clear. It was discovered that the sample was stable for more than ten hours. As seen in Figure 3 and Table No. 1 that follow.

Table 1: stability of sample

Absorbance at 276 nm	Time (min)	Concentration of drug solution (mg/L)	Sr. No.
0.1	0	3	1
0.2	30	3	2
0.3	60	3	3
0.4	90	3	4
0.5	120	3	5
0.6	240	3	6
0.7	360	3	7
0.8	480	3	8
0.9	600	3	9

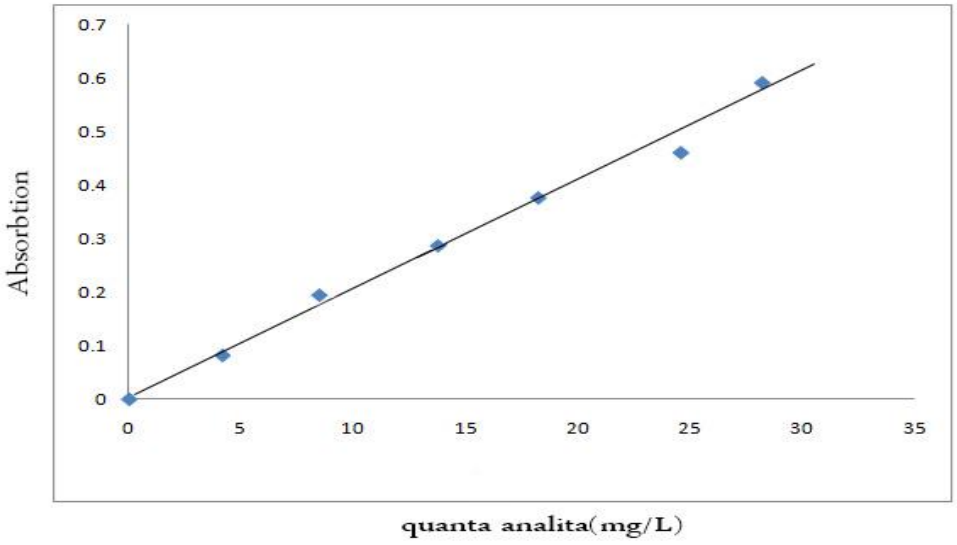

Figure 3: stability of sample

Linearity of samples:

Utilizing the functioning norm, six particular 10 ml volumetric jars containing 0.4, 0.6, 0.8, 1, 1.2, and 1.4 ml of medication arrangement were filled to the proper level utilizing a 30:70 acetonitrile: methanol blend. The absorbance of each example was then estimated at 276 nm against the relating reagent clear, and the outcomes are displayed in Table No. 2 and Figure No. 4. The prescription's straight reaction inside the scope of 2-12µ g/ml of the concentration.

Table 2: Beer's law-compliant absorbance of various concentrations of Diclofenac sodium

Absorbance At 276 nm	Concentration Range (mg/L) in 10 ml	Concentration of drug taken (100 mg/L)	Sr. No
0.172	4 µ g	0.4 ml	1
0.27	6 µ g	0.6 ml	2
0.342	8 µ g	0.8 ml	3
0.439	10 µ g	1 ml	4
0.536	12 µ g	1.2 ml	5
0.638	14 µ g	1.4 ml	6

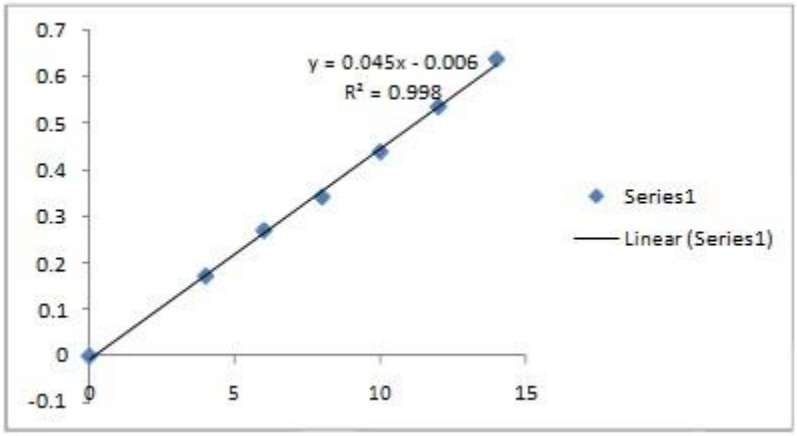

Figure 4: sample's linearity

Analysis of formulation:

Wyeth Limited of Verna, Goa, India, produced the 5-milligram tablets of diclofenac sodium that were purchased from the local market and sold under the brand name WYSOLONE 5.

Preparation of solution:

A mortar and pestle were utilized to gauge and pound twenty pills precisely. Subsequent to gauging the powder to determine its identical load of 100 mg, it was moved to a 100 ml volumetric cup and broke down in a combination of acetonitrile and methanol in a 20:40 proportion. The combination was then sifted through Whatmann channel paper into one more 100 ml volumetric carafe and leaving up to imprint utilizing similar diluents, yielding an answer of 1 mg/ml conc. Extra weakening was then completed to get a centralization of 100µ g/ml. Table 3 contains the level of diclofenac sodium.

Table 3: Assay Findings for Sold Formulation

% Diclofenac sodium	Amount obtained of Diclofenac sodium (mg/L)	Actual concentration of Diclofenac sodium (mg/L)	Formulation
96 %	5.9	4	Tablet

3.0 Validation parameter:

3.1 Linearity:

It is important to assess a linear relationship throughout the analytical process. By diluting a normal stock solution, it was proven directly on the medication material while utilizing the suggested approach. The brew lambert regulation is trailed by this methodology in the fixation scope of 4-12 µ g/ml. as indicated by table no. 2.

3.2 Accuracy:

Throughout the designated range of the analytical process, accuracy was proven. The proportion of precision is the manner by which intently the test discoveries delivered by the strategy match the real worth. Twenty tablets were weighed, pulverized, and analyzed in order to investigate the accuracy. In order to conduct recovery tests, standard drugs were introduced to the sample at three different concentration levels while accounting for the bulk drug samples' percentage purity. Table 4 presents the accuracy determination results.

Table 4: Assessment of Accuracy

% Recovery Diclofenac sodium %	Amt. of drug recovered Diclofenac sodium mg/L	Amt. of drug added Diclofenac sodium mg/L	Amt of sample Diclofenac sodium mg/L
-	9.91	0	10
99.8	3.99	4	10
99.3	5.93	6	10
99.13	7.87	8	10

3.3 Repeatability:

Diclofenac sodium standard arrangements (4, 6, 8, 10, 12, and 14 µ g/ml) were made, and a spectra was recorded. At 276 nm, the combination of water and ammonium molybdate was utilized as the clear to gauge absorbance. Six estimations of a similar focus arrangement's absorbance were made, and the RSD was processed. Tables 5 and 6 contain repeatability data for Diclofenac sodium and a sample of Diclofenac sodium.

Table 5: Data on Diclofenac sodium's repeatability at 278 nm

12 mg/L	10mg/L	8mg/L	6mg/L	4mg/L	2mg/L	Concentration
0.638	0.536	0.439	0.342	0.27	0.172	Absorption
0.637	0.538	0.438	0.34	0.27	0.17	
0.638	0.544	0.435	0.342	0.273	0.17	
0.639	0.543	0.436	0.344	0.273	0.172	
0.635	0.534	0.435	0.345	0.269	0.173	
0.639	0.537	0.439	0.336	0.274	0.169	
0.637	0.538	0.437	0.341	0.271	0.171	Mean.
0.001506	0.003983	0.001897	0.003209	0.002074	0.001549	Std. Dev.
0.0023	0.0074	0.0043	0.0094	0.0076	0.0090	Coefficient
0.23	0.74	0.43	0.94	0.76	0.90	% RSD

n = 4 determination

Table 6: Repeatability of Diclofenac sodium sample application data

Diclofenac sodium 5 mg/L	Concentration
0.224	Absorption
0.221	
0.220	
0.221	
0.222	
0.224	
0.222	Mean.
0.001673	Std. Dev.
0.0075	Coefficient variation
0.75	% RSD

n = 4 determinations

3.4 Limit of detection (LOD) & limit of quantitation (LOQ):

Standard deviation and slop were utilized to compute the medication's furthest reaches of recognition and quantitation. Table 7 portrays its worth.

$$LOD = \frac{3\sigma}{S}$$

$$LOQ = \frac{10\sigma}{S}$$

σ= standard deviation

s= slope of the calibration curve

Table 7: LOD AND LOQ

LOQ	LOD
0.48	0.12

3.5 Specificity and selectivity:

Table 8 indicates the specific and selective nature of diclofenac sodium.

Table 8: Study of Selectivity and Specificity

Diclofenac sodium	Study
Specific	Specificity
Selective	Selectivity

3.6 Reproducibility:

To evaluate reproducibility, an interlaboratory trial is used. Another spectrophotometer was used to measure the absorbance readings at 276 nm in a different lab, and the results were analyzed using the t-test to confirm their Table 9 contains the reproducibility information for Diclofenac sodium at 276 nm.

Table 9: Diclofenac sodium reproducibility data at 276 nm

Inference	Result of t test*	Instrument 2 JASCO	Instrument 1 SIMADZU
Not significant difference	0.98	0.171 ± 0.001648	0.170 ± 0.001550

* At 96 % confidence interval

3.7 Intra and inter day precision:

Variations in the results between days (inter-day) and within the day (intraday) were examined. Diclofenac sodium was analyzed three times at 276 nm on the same day to assess the intraday precision. By testing the medication at 276 nm on three separate days, the interday precision was ascertained. Table 10 provides precision values for prednisolone at 276 nm.

Table 10: Diclofenac sodium precision measurements at 276 nm

% RSD	CV	Intraday (n=3)	Conc. mg/L
0.91	0.0091	0.170 ± 0.001550	10
0.76	0.0076	0.271 ± 0.002074	20
0.94	0.0094	0.341 ± 0.003209	30

% RSD	CV	Inter day (n=3)	Conc. m g/L
0.89	0.0089	0.169± 0.001520	10
0.69	0.0069	0.269 ± 0.001870	20
0.91	0.0091	0.340 ± 0.003100	30

An ultraviolet spectroscopic approach was used in the procedure to estimate the amount of Diclofenac sodium. The technique's wavelength of detection was 276 nm, and it followed Beer-Lambert's law in the concentration range of 2–12 µ g/ml. Ultimately, research on recovery was started. Table 11 lists the quantitative factors used to determine the amount of diclofenac sodium in a pharmaceutical dosage form.

Table 11: The numerical parameters used to calculate the sodium diclofenac content

Result	Parameter
276.0	λmax (nm)
2-12	Beer's law limits (m g/L)
4.366 x 10 4	Molar absorptivity
Y= 0.044+-0.0065 0.044 -0.0065	Regression equation (y=bc+a) Slope (b) Intercept (a)
0.998	Correlation coefficient (r)
0.66	Relative standard deviation (%)
4	n

4.0 CONCLUSION:

The suggested approach is straightforward, sensitive, and selective. The acquired statistical parameters for prednisolone measurement by the suggested UV spectrophotometry approach are straightforward, precise, quick, and accurate. The accuracy and linearity of the procedure were

satisfactory. Because of its excellent sensitivity, the suggested method might be used with ease to the routine examination of pure medications and their container forms.

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Conflicts of Interest Statement……

Manuscript title:

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Mohammed R . Abdul – Azeez	*mohammed*	20/3/2025