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Research Article

UV – Spectroscopic Analysis of Curcumin in Bulk & Nano Formulations

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A B S T R A C T

Fast, precise, simple, specific and selective method by using application of UV-Visible Spectrophotometry are been derieved for the analysis of pharmacological ingredient called Curcumin in nano and bulk formulations. The analysis by using UV- Spectroscopy and it was carried out by sampling sample by using ethanol as a solvent and at a lambda maximum of around 420 nm. Various methodology were been validated for different validation parameters. The range for linearity was found as 5-25µg/ml with the coefficient of correlation of 0.9997. The ranges for accuracy were resulted in limit. The results for limit of quantification and limit of detection were observed to be 0.4 and 1.21µg/ml; respectively. The obtained results explained that this methodology can be used for regular testing of quality control and quality assurance parameters for Curcumin in nano as well as bulk in formulations.

Keywords: Curcumin, UV spectroscopy, Bulk formulation, Nano formulation, Analysis

Introduction:

Curcumin which is obtained from curcuma longa belongs to family Zingiberaceae. The Curcumin is obtained from rhizome of curcuma longa which is modified shoot or stem, the rhizome from which we get turmeric is either dried or fresh. The major known use of turmeric is as a flavoring agent which adds a color to food. The active pharmaceutical ingredient which one gets from curcuma longa is turmeric, which contain about 3-7%. The Curcumin is

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insoluble in the water whereas it is soluble in solvents like methanol, ethanol, acetone and chloroform. Curcumin also inhibits the inflammation activity which is one of important pharmacological activity of Curcumin besides this Curcumin also protects the skin from harmful UV radiation as well. The numbers of different analytical methodologies are developed by the research worker which reflects their use for quality control analysis of various formulations of herbal drugs which includes various chromatographic and spectroscopic methods. Besides this ICH guidelines highlights that there is a need to develop a analytical method which is fast, precise, simple, specific and selective for the analysis of formulations of herbal drugs. So the main goal of this work was to demonstrate and validate the suitable methodology for the analysis of formulation of turmeric by applying the principle of UV- visible spectroscopy which will be helpful for regular quality checking of Curcumin.

Materials & Methods:

Extract of Curcumin obtained from curcuma longa. Chemicals ranked as analytical grade.

Preparation of extract of Curcumin:

The Curcumin was collected from curcuma longa and the application of unit operation called drying is applied by keeping for 3 days in sunlight for drying. Then to obtain a fine powder it was crushed by using mortar and pestle and to obtain uniform size it was passed from sieve number 60. Then powder was subjected with a ethanol in the iodine flask for the maceration process. To obtain pure and clear liquid the extract was decolorized by using activated charcoal and filtered. Then to obtain semisolid mass obtained extract is kept for evaporation and finally subjected to the vacuum drier to obtain powder.

Development of Curcumin Formulations:

Nano precipitation methodology was used for the preparation of the nano particles of Curcumin. The sample of Curcumin for analysis by UV spectroscopy was prepared by addition of ethanol as a solvent. By the use of β-cyclodextrin with the aqueous phase under the Sonication for about 15 minutes which resulted in the formation of nano particles. The continuation of Sonication procedure for about an hour resulted in the removal of the extra organic solvent present in nano formulation.

Development of Methodology:

Instrumentation:

Shimadzu UV-Visible Spectrophotometer was used to carry out spectroscopic analysis of Curcumin.

Standard and stock solution preparations:

Curcumin stock solutions containing API Curcumin 10µg/ml were prepared by using ethanol and to prepare different samples of different concentrations the aliquots were transferred in the differential volumetric flasks.

Optimization and selection of solvents:

Various solvents were optimized for the procedure but among them ethanol qualified all the conditions required to be as ideal solvents at a specific wavelength.

Wavelength selection:

Wavelength for the maximum absorption was selected at 420 nm.

Validation methodology:

As per the available guidelines 8-10 validation methods were carried out. Limit of detection and limit of quantification were also quantified by using suitable experimental methodologies. More specifically LOQ & LOD were verified by dilution of Curcumin sample till the aggregate results were about 2-10 times the standard deviations for six different determinations.

Linearity Range:

Various concentrations of turmeric were formulated by using ethanol as solvent. To obtain linearity range least square analysis were carried out and same methodology was applied for this formulation too.

Precision:

Repetitions of the same results were done my analyzing the ethanol in a same day. Same methodology is repeated for the analysis of the same concentrations in the 3 different days. Along with this percentage standard deviations were carried out for every set of data.

Accuracy:

Three different concentrations of standard Curcumin in ethanol were prepared for independent stock solutions and by using the standard curve strengths of prepared solutions were estimated. A standard addition methodology was carried out to support the accuracy by the addition of three different standard Curcumin concentrations to gain pre analyzed solutions of Curcumin.

Analysis of Curcumin nano formulation:

Amount of turmeric encapsulated in the nano particles was carried out indirectly by measuring the available free turmeric in the nano formulations. The centrifugation was carried out at 20,000 revolutions per minute and for 45 minutes which were followed by separation of supernatant. In 1 mL of a supernatant extract the equal volume of ethanol were added and was sonicated which was followed by the filtration via 0.20 µm membrane & were analyzed by use of same developed methodology.

Stability studies:

To study the formulation and the drug stability, the stability studies were carried out as per the guidelines issued by ICH. The humidity was maintained at 30 ± 2 °C/ 65 ± 5 % & 40 ± 2 °C / 75 ± 5 % relative humidity for 2 months. After the end of study period sample analysis were carried out for estimation of drug content.

Results and discussions:

The methodology elaborated above was found to be sensitive, simple, accurate, precise, fast and economical for the regular estimation of turmeric in the bulk and nano formulations of pharmaceutical dosage form.

Analysis of drug sample:

The spectral analysis of Curcumin resulted into lambda maximum of 420 nm.

Method Validation:

The methodology demonstrated above were validated by using the different validation parameters and results obtained were as follows,

Parameters	**Value**
Absorption Maximum (nm)	420
Linearity Range (µg/ml)	5 – 25µg/ml
Correlation Coefficient	0.999
Accuracy (%)	99.33%
Precision (% RSD)	0.2-0.4
LOD (µg/ml)	0.444
LOQ (µg/ml)	1.211
Assay (%)	99.78%

Linearity & Range:

Excellent linear relationships were resulted among the concentrations and absorbance in the specified range of 5 – 25µg/ml & with a coefficient of correlation of 0.999.

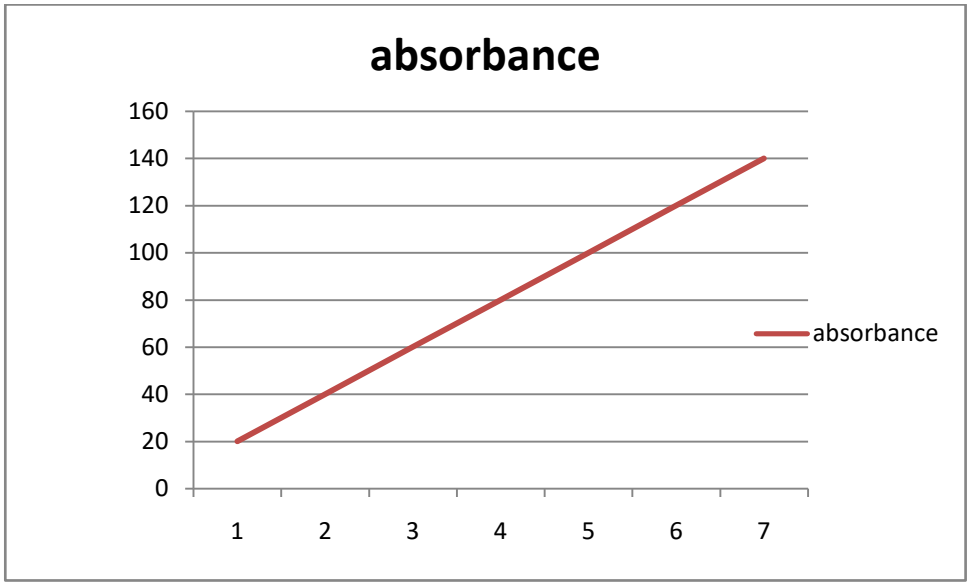

Fig 1: Linearity graph

Precision:

Intraday precision states the application of analytical methodology for a short time in a laboratory with the same parameters like same equipment and same operator. Intraday precision includes the determination of differences in the analysis when the methodology is used on a different days in a laboratory. Repeatability was studied by analyzing the different concentrations at a different interval of time. The percentage of RSD during the experimentation was found within a specified range. The obtained data confirms better precision of demonstrated method.

Accuracy:

Percentage recovery for all the concentrations ranged from 99.3 % to 101.22 % which indicates any minute change in the concentration of drug can be determined with great accuracy by demonstrated methodology.

Specificity:

Excipients are the agents which are added in pharmaceutical formulations for better stability. The presence of excipients in the sample does not show interference with the peak of drug. This indicates the demonstrated methodology was found to be selective and specific for the drug.

Limit of Detection:

The limit of detection (LOD) was found to be 0.444

Limit of Quantification:

The limit of quantification was found to be 1.211

Application of the Validated UV-Visible Spectrophotometer Method on the Formulation:

The prepared formulation of Curcumin was analyzed by using above demonstrated methodology. The results for assay value of Curcumin formulation was resulted to 99.78%

Conclusion:

Demonstrated methodology by the use of UV- Visible spectrophotometer was fast, simple and accurate. By using application of UV spectrophotometry the method was validated successfully and can be used for regular quality assurance and quality control analysis of turmeric in the bulk and nano drug formulations without any spectral interference from added excipients.

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Declaration of competing interest

All authors report no conflicts of interest relevant to this article.

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Consent statement/Ethical approval:

Not applicable

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