



REVIEW ARTICLE

A REVIEW ON DIFFERENT TYPES OF ANALYTICAL METHODS

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Abstract - Selection of suitable analytical method play an essential role in the discovery, development and manufacturing of pharmaceuticals. Every year, number of drugs entered into the market; hence it is mandatory to select suitable analytical methods for such drugs. After the development, it becomes necessary to validate the new analytical method. Method development is the process which proves that the analytical method is acceptable for use. Validation should be done as per regulatory guidelines such as ICH guidelines. This article was pre-pared with an aim to review different analytical method available for analysis of the drugs.

Keywords: Analytical method, Spectroscopy, UV-VIS spectroscopy, Chromatography, HPLC

INTRODUCTION

Analytical chemistry is a branch of chemistry which deals with identification of components (qualitative) and determination of quantity of components (quantitative) of substances or samples or mixture. There are two types of analysis, one is qualitative analysis and another one is quantitative analysis. In qualitative analysis, there is identification of components or analyte of mixture or sample is carried out.¹ In quantitative analysis, there is determination of amount of components or analyte of mixture or sample is carried out. Analytical data is required not only in chemistry but also in other sciences like biology, zoology, arts such as painting and sculpture, archaeology, space exploration and clinical diagnosis. Important areas of application of analytical chemistry are quality control in manufacturing industries, monitoring and control of pollutants, clinical and biological studies, geological assays, fundamental and applied research.^{2,3}

Analytical method includes use of a specified technique and detailed-stepwise instructions which are used in qualitative, quantitative or structural analysis of a sample for one or more

analytes. Analytical methods are mainly classified into two types: Classical methods and Instrumental methods. A method in which the signal is proportional to the absolute amount of analyte is called classical method. A method in which the signal is proportional to the analytes concentration is called instrumental method.^{4,5}

Classical methods are divided into 3 main types are: a) Separation of analyte, b) Qualitative analysis and c) Quantitative analysis. Separation of analyte includes extraction, distillation, precipitation and filtration. Qualitative analysis includes boiling point, freezing point, colour, odour, density, reactivity and refractive index. Quantitative analysis includes gravimetric analysis and volumetric analysis. Instrumental methods are divided into four main types are: a) spectroscopic methods, b) electrochemical methods, c) chromatographic methods and d) other techniques. Spectroscopic methods include ultraviolet-visible spectroscopy, infrared spectroscopy, Raman spectroscopy, atomic absorption spectroscopy and atomic emission spectroscopy, x-ray spectroscopy and nuclear magnetic spectroscopy. Electrochemical methods include Potentiometry, Coulometry and Voltametry.^{6,7}

SPECTROSCOPY

Spectroscopy is the study of interaction of electromagnetic radiation with matter. These interactions involve absorption and emission of radiation (energy) by the matter.⁸ Spectroscopy are of two types, absorption spectroscopy and emission spectroscopy. The study of electromagnetic radiation absorbed by the sample, in the form of spectra is called absorption spec-troscopy (UV-visible, IR, NMR, microwave and Radiowave spectroscopy). The study of electromagnetic radiation emitted by the sample, in the form of spectra is called emission spec-troscopy (flame photometry and fluorimetry). Spectroscopy is useful for the study of atomic and molecular structure and used in the analysis of a wide range of samples. Atomic spectroscopy is the study of interaction of

electromagnetic radiation with atoms, changes in energy takes place at atomic level (e.g. atomic absorption spectroscopy and flame photometry).⁹ Molecular spectroscopy is the study of interaction of electromagnetic radiation with molecules, changes in energy takes place at molecular level (e.g. ultraviolet and infrared spectroscopy). UV-VIS spectroscopy In UV-visible spectroscopy, the amount of light absorbed at each wave-length of UV and visible region of electromagnetic spectrum is measured.¹⁰ This absorption spectroscopy uses electromagnetic radiations between 200 nm to 800 nm and is divided into the ultraviolet (UV, 200-400 nm) and visible (VIS, 400-800 nm) regions. The principle of UV-Visible spectroscopy is based on the absorption of ultraviolet light or visible light by sample or chemical substance which results in the production of different spectra.¹¹ When a molecule absorbs UV radiation, the electron present in that molecule undergo excitation, this causes transition of electron within a molecule from a lower level to a higher electronic energy level and the ultraviolet emission spectra arise from the reverse type of transition. Most commonly used solvents in UV spectroscopy are water, methanol, ethanol, ether, chloroform, carbon tetrachloride, cyclohexane and dichloroethane. Applications of UV spectroscopy are detection of functional groups, detection of conjugation, detection of geometrical isomers and detection of impurities.^{12,13}

CHROMATOGRAPHY

Chromatography is a physicochemical method for separation of mixture of compounds. Chromatography is a method of separation of mixture of compounds into individual components between two phases, a stationary phase and a mobile phase (Luxminarayan L, et al., 2017). Chromatography is classified as follows:^{14,15}

1. Based on interaction of solute to stationary phase
 - Adsorption chromatography
 - Partition chromatography
 - Ion exchange chromatography
 - Molecular exclusion chromatography
2. Based on chromatographic bed shape
 - Column chromatography
 - Planar chromatography
 - Paper chromatography
 - Thin layer chromatography
 - Displacement chromatography
3. Techniques by physical state of mobile phase
 - Gas chromatography
 - Liquid chromatography
 - Affinity chromatography

HPLC

HPLC stands for high performance liquid chromatography or high-pressure liquid chromatography. HPLC can separate, identify and quantify the compounds present in any sample which can be dissolved in liquid.¹⁶ The main principle of liquid chromatography is adsorption. It is a chromatographic technique in which mobile phase is liquid. Sample is in the form of liquid solution. Sample is injected into a column of a porous material (stationary phase) and a liquid phase (mobile phase). Sample move through the column with mobile phase by high pressure delivered by a pump. Sample components travel according to their affinity towards the stationary phase. The component which has more affinity towards the stationary phase travels slower. The component which has less affinity towards the stationary phase travels faster. The components are separated from each other. The most common solvents used for HPLC are n-hexane, methylene chloride, chloroform, methyl-t-butyl ether, Tetrahydrofuran (THF), Isopropanol (IPA), Acetonitrile (MeCN or CAN), Methanol (MeOH) and water. Fundamental chromatographic parameters are efficiency (number of theoretical plates), retention factor, selectivity, resolution and pressure. Applications of HPLC are chemical separation, purification and identification. Other applications of HPLC include pharmaceutical applications, environmental applications, forensics, clinical, food and flavor.^{17,18}

CONCLUSION

This article gives an idea about the different type of analytical method used for Qualification and Quantifications of Pharmaceuticals. The primary objectives of development of analytical methods are for identification, purification and eventually to qualification any necessary drug etc. The selection of suitable analytical methods helps in understanding the critical process parameters and to reduce their effects on precision and accuracy. Chromatography and Spectroscopy are the necessary technique in the Pharma sector and that used to ensure that quality work is done in the process which supports the development of medicine and products.

REFERENCES

1. Ravisankar P, Navya CN, Pravallika D, Sri DN. A review on step-by-step analytical method validation. IOSR J Pharm. 2015; 5(10): 7-19.
2. Jeffery GH. Textbook of quantitative chemical analysis. Longman. 1989.
3. Chatwal GR, Anand SK. Instrumental Methods of Chemical Analysis. Himalaya Publishing House. 2002.
4. Phaneendra D, Venkatesh V, Ramarao N, "Simultaneous Estimation Of Simvastatin And Sitagliptin By Using Different Analytical Methods" Int. j. in Adv. in PharmaAnal., 2012,2(1),19-23



5. Tijare LK, Rangari NT, Mahajan UN. A review on bioanalytical method development and validation. *Asian J Pharm Clin Res* 2016;9:6-10.
6. Tiwari G, Tiwari R. Bioanalytical method validation: an updated review. *Pharm Methods* 2010;1:25-8.
7. Pasbola K, Chaudhary M. Updated review on analytical method development and validation by HPLC. *World J Pharm Pharm Sci* 2017;6:1612-30.
8. Geetha G, Raju KN, Kumar BV, Raja MG. Analytical method validation: an updated review. *Int J Pharm Biol Sci* 2012;1:64-1.
9. Shrivastava A, Gupta VB. Methods for the determination of limit of detection and limit of quantitation of the analytical methods. *Chron Young Sci* 2011;2:21.
10. Ravichandran V, Shalini S, Sundram KM, Harish R. Validation of analytical methods—strategies and importance. *Int J Pharm Pharm Sci* 2010;2:18-2.
11. Shweta K, Anita S. A review on analytical method validation. *Int J Pharm Res Rev* 2016;5:30-6.
12. Boque R, Maroto A, Riu J, Rius FX. Validation of analytical methods. *GrasasAceites* 2002;53:128-43.
13. PushpaLatha E, Sailaja B. Bioanalytical method development and validation by HPLC: a review. *J Med Pharm Innov* 2014;1:1-9.
14. Gupta V, Jain AD, Gill NS, Gupta K. Development and validation of HPLC method—a review. *Int Res J Pharm Appl Sci* 2012;2:17-5.
15. Sahoo PK, Sharma R, Chaturvedi SC. Simultaneous estimation of metforminhydrochloride and pioglitazone hydrochloride by RPHPLC method from combinedtablet dosage form. *Indian J Pharm Sci.* 2008;70(3):383-386.
16. Jain AK, Agrawal RK. Simultaneous estimation of Gliclazide and Metforminhydrochloride in combined dosage forms. *Indian J Pharm Sci.* 2002;64(1):88-91.
17. Mahar P, Verma A. Pharmaceutical process validation: an overview. *Int J Pharm Res Biosci* 2014;3:243-62.
18. Lavanya G, Sunil M, Eswarudu MM, Eswaraiah MC, Harisudha K, Spandana BN, et al. Analytical method validation: an updated review. *Int J Pharm Sci Res* 2013;4:1280.