WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.453
Volume 14, Issue 3, 1424-1428. Review Article ISSN 2277–7105

ROLE OF RAMAN SPECTROSCOPY IN AYURVEDIC RAS-SHASTRA

Dr. Austluxmi*

Assistant Professor, RSBK Dept. SBMN Ayurvedic College, Baba Mastnath University, Rohtak, Haryana.

Article Received on
19 December 2024,

Revised on 09 Jan. 2025,
Accepted on 29 Jan. 2025

DOI: 10.20959/wjpr20253-35386

***Corresponding Author**
Dr. Austluxmi
Assistant Professor, RSBK Dept. SBMN Ayurvedic College, Baba Mastnath University, Rohtak, Haryana.

ABSTRACT

This paper discusses the advantages of Raman spectroscopy in Ras-Shastra, highlighting its ability to provide non-destructive, precise, and real-time molecular analysis of Ayurvedic medicines. Ayurvedic Ras Shastra, an ancient Indian branch of medicine, integrates metals, minerals, and herbal components into therapeutic formulations. Modern analytical techniques like Raman spectroscopy have revolutionized the understanding, standardization, and safety assessment of these formulations.

KEYWORDS: *Ras Shastra, Raman Spectroscopy.*

INTRODUCTION

Ras Shastra is a traditional Ayurvedic practice involving the preparation of mineral- and metal based formulations like bhasmas (calcined ashes). Ensuring the safety, efficacy, and quality of these formulations is paramount. Raman- Effect was discovered by Prof. C.V. Raman in 1928. “Raman is a spectroscopic technique, has emerged as a powerful tool for the analysis of complex materials. By using the scattering of monochromatic light, it provides molecular-level insights, making it particularly suited for the study of Ayurvedic formulations. It is a light scattering technique, where by a molecule scattered irradiant light from a source laser. Most of the scattered light is at the same wavelength as a laser source and does not provide useful information, but a small amount of light is scattered at different wavelength. The different wavelength of light is derived from the interaction of light with the sample material. Hence a C-C bond will produce a certain Raman band, a metal-O bond another or a C-H, S-S yet further bonds etc.

RAMAN SPECTROSCOPY

Raman Spectroscopy is a technique that uses the interaction of energy with a sample to characterize it in order to get the analysis. There are several instruments that are used to perform a spectroscopic analysis. Among them Raman Spectroscopy is most common.

When a monochromatic radiation or radiation of very narrow frequency band is scattered by a solid then the scattered light not only consists of the radiation of incident frequency but also the radiations of frequencies above and below the incident beam frequency. This form of scattering in which frequency of incident beam undergoes a definite change was observed and studied by Raman in 1928 and is called Raman Effect.

Hence, when a beam of intense monochromatic radiation passes through a sample consisting of molecules a portion of this radiation undergoes shift in the original frequency by the vibration of the molecules. Such a change in the frequency of the radiation is indicative of the composition and molecular structure of the sample and is called Raman Effect.

The instrument used in Raman Spectroscopy to obtain Raman Spectra, is Micro Raman Spectrometer. The function of this spectrometer is rejection of the Rayleigh scattering and detection of Raman shifted component.

General Advantages of Raman Spectroscopy

- It offers many benefits to the analysts as it is a non-destructive and non-invasive technique, with no need for sample preparation.
- The laser energy is generally low so the sample remains intact.
- It gives high resolution.
- It is relatively unaffected by strong IR observers like water, carbon and glass (silica).
- No special accessories are needed for aqueous solution because water is a weak scatter.
- Fiber optics of varying lengths can be used to transmit the excitation laser light and collect back the scattered light for remote analysis.
- Properties of laser sources make it relatively easy to use micro-samples, surfaces, films, powders, solutions, gases and many other sample types.

Advantages of Raman Spectroscopy in Ras-Shastra

1. Non-Destructive Analysis

Raman spectroscopy allows the examination of bhasmas and other formulations without altering their structure or composition. This is crucial for preserving the integrity of precious samples during analysis.

2. Molecular-Level Insights

It provides detailed information about the molecular structure and bonding of compounds present in Ayurvedic formulations, helping to verify their chemical identity and purity.

3. Real-Time Monitoring

Raman spectroscopy facilitates real-time monitoring of the preparation of bhasmas, ensuring adherence to traditional processing techniques like incineration cycles (puta).

4. Detection of Impurities

The technique can detect trace levels of impurities, including heavy metals or un-reacted starting materials, ensuring the safety of Ayurvedic medicines.

5. Characterization of Crystalline and Amorphous Phases

Raman spectroscopy distinguishes between crystalline and amorphous phases of minerals and metals, aiding in the identification of correctly prepared bhasmas.

6. Standardization of Formulations

By providing a molecular fingerprint, Raman spectroscopy helps establish quality standards for Ayurvedic formulations, ensuring reproducibility across batches.

7. Compatibility with Complex Matrices

Ayurvedic formulations often contain a mix of organic and inorganic components. Raman spectroscopy effectively analyzes such complex matrices without requiring extensive sample preparation.

8. Portable and In-Situ Applications

Portable Raman devices allow on-site analysis of raw materials and finished products, supporting quality control at various stages of production.

9. Green Technology

The technique does not require the use of harmful chemicals or solvents, aligning with the eco-friendly principles of Ayurveda.

10. Validation of Traditional Knowledge

Raman spectroscopy bridges ancient Ayurvedic practices with modern science, validating the therapeutic properties of Ras-Shastra formulations through empirical data.

Raman Spectroscopy- Uses

Raman Spectroscopy is very widely used in diverse fields of science, research and industries. Its application involves both the pure conceptual scientific development and industrial production. It is used in the following areas

a) **Forensic**: to identify illicit drugs and narcotics etc.
b) **Art and Culture**: to identify minerals, pigments, bio-deterioration etc.
c) **Pharmaceutical**: for understanding compound present and distribution in tablets high scattering raw material verification, polymorphism phases, chemistry, infection etc.
d) **Biological and biomedical**: to distinguish between cancerous, pre-cancerous and normal tissues and its sensitivity to change in cell metabolites and protein structures.
e) **Semiconductors**: for enhancing sensitivity, to investigate stress, infection, super lattice structure etc.
f) **In Planetary Science**: for getting information on compositional and structural information of extra terrestrial samples. To identify rare mineral species.
g) **In polymer science**.
h) **In life-science**: for DNA analysis, drug interaction etc.
i) **In environmental study**.

Uses of Raman Spectroscopy in Ayurvedic Ras Shastra

1. Analysis of Bhasmas

Raman spectroscopy has been used to characterize the chemical composition and phase of bhasmas like Swarna (gold), Tamra (copper), and Vanga (tin).

2. Identification of Raw Materials

It ensures the authenticity of raw materials like minerals and herbal components before they are used in formulations.

3. Quality Control

By detecting deviations in preparation methods, Raman spectroscopy helps maintain the quality and efficacy of formulations.

4. Safety Assessment

It aids in identifying toxic contaminants or unprocessed materials that could pose health risks.

Limitations and Future Prospects

While Raman spectroscopy offers numerous advantages, its application in Ayurvedic research is still in its nascent stage. High costs and the need for specialized expertise may limit widespread adoption. However, advances in technology and increasing awareness of its benefits are expected to drive its integration into Ayurvedic medicine.

Future prospects include the development of portable, cost-effective Raman devices tailored for Ayurvedic laboratories and the creation of comprehensive spectral libraries for Ras Shastra formulations.

CONCLUSION

Raman spectroscopy has immense potential to enhance the understanding and standardization of Ayurvedic formulations in Ras Shastra. By offering precise, non-destructive, and eco-friendly analysis, it ensures the safety and efficacy of traditional medicines while bridging the gap between ancient wisdom and modern science.

REFERENCES

1. Ayurvedic Pharmacopeia of India (API).
2. Smith, E., & Dent, G. (2013). Modern Raman Spectroscopy: A Practical Approach.
3. Sharma, R. K., & Dash, B. (2007). Rasashastra: The Mercury Science of Ayurveda.
4. Suryawanshi, A., et al. (2020). Application of Spectroscopic Techniques in Standardization of Ayurvedic formulations. Journal of Ayurveda and Integrative Medicine.