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APPLICATIONS OF HIGH-PERFORMANCE THIN-LAYER CHROMATOGRAPHY (HPTLC) IN STANDARDIZATION OF HERBAL FORMULATIONS

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ABSTRACT

In the herbal formulations qualitative and qualitative research work most commonly High-Performance Thin-Layer Chromatography (HPTLC) used in traditional and modern technology, but still the developed herbal products need to validate the therapeutic efficacy which are depends on proper standardization and quality control. HPTLC technology is used as a powerful analytical tool especially for the identification, quantification, and fingerprint of key chemical constituents. In this review article covered the applications of HPTLC in the standardization of herbal formulations, ensuring quality, safety, and reproducibility of herbal products.

KEYWORDS: High-Performance Thin-Layer Chromatography, standardization and quality control, identification, quantification.

1. INTRODUCTION

HPTLC technology is emerging trends to use for the validation and standardization of herbal products due to growing global demand. Standardized herbal products are globally acceptable for herbal medicines necessitate stringent quality control measures. In modern times it has been seen that synthetic drugs, herbal dosage formulations having complex mixtures of bioactive compounds, making their standardization challenging. HPTLC technology used to

provides consistent, quick, and low cost methods for determination of herbal drug quality.[1-3] An HPTLC used in herbal products is shown in Fig 1.

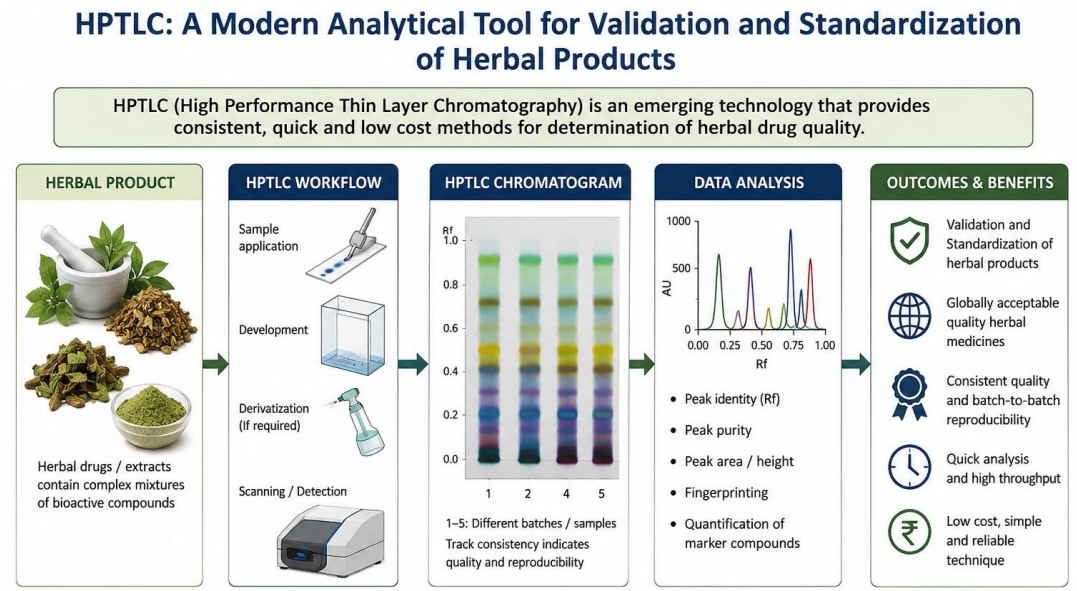

Fig. 1: HPTLC used in herbal products.

2. Principle of HPTLC

HPTLC technology is a sophisticated form of Thin-Layer Chromatography (TLC). It offers better resolution, excellent sensitivity, and reproducibility properties. It consists:

1. In first step develop in a suitable solvent system for test sample analysis
2. In second step apply the test samples on precoated plates
3. In third step detect the applied sample through the UV/visible light
4. Finally densitometric scanning technique used in HPTLC for quantification.[4-6]

3. Role of HPTLC in Herbal Standardization

3.1 Fingerprint Profiling

HPTLC chromatogram provides characteristic fingerprints of respective test components that represented that

3.1.1 Identify and validated the plant species and their bioactive components

3.1.2 Detect the presence of adulteration and substitution in test sample

3.1.3 HPTLC chromatogram results validated the quality and assurance batch-to-batch consistency.[7-9]

3.2 Quantitative Estimation of Marker Compounds[10-13]

HPTLC used to quantify of bioactive markers components such as

3.2.1 Alkaloids

3.2.2 Flavonoids

3.2.3 Glycosides

3.2.4 Terpenoids

Results of HPTLC represented that the therapeutic efficacy of formulations.

3.3 Detection of Adulterants and Contaminants

HPTLC is successful used for identifying of synthetic drug adulteration, heavy metal-associated compounds and pesticide residues (Hyphenated technology at very low quantity)

3.4 Stability Studies

HPTLC is successful used for Degradation of bioactive compounds and their **s**helf-life analysis of herbal formulations.

3.5 Standardization of Polyherbal Formulations

HPTLC is successful used for polyherbal formulations and their complexity study through the simultaneous analysis of multiple constituents and development of multi-component fingerprints.

4. Advantages of HPTLC[15-16]

It is very simple, cost-effective and globally acceptable

It is requires least sample preparation

HPTLC having ability to check multiple samples simultaneously

HPTLC having high throughput screening

HPTLC having visual documentation and digital data storage

5. Limitations[17]

HPTLC having lower sensitivity compared than HPLC in some cases

HPTLC not handle by simple person, it requires skilled technician

HPTLC limited automation compared to advanced chromatographic techniques

6. Recent Advances

Modern HPTLC systems integrate with

6.1 Auto sampler

6.2 Densitometric scanners

6.3 Hyphenation with spectroscopic techniques (HPTLC-MS)

These advancements Hyphenation techniques enhance accuracy and increase its applications in herbal drug analysis.[18] Applications of HPTLC in standardization of herbal formulations are shown in diagrammatic presentation in Fig 1.

Fig 1: Applications of HPTLC in standardization of herbal formulations.

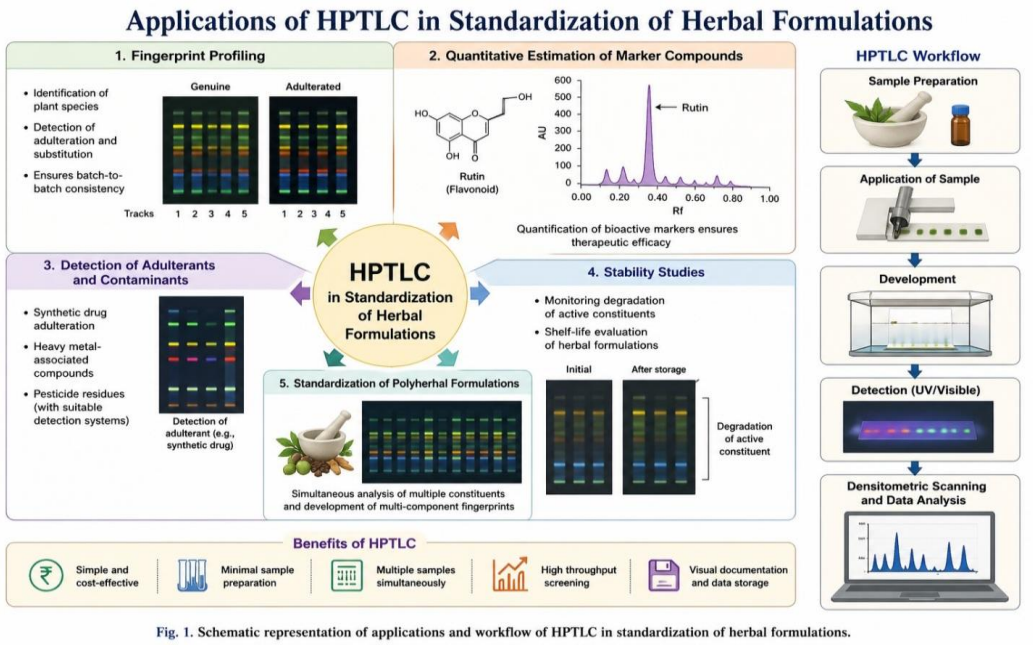

Fig. 1. Schematic representation of applications and workflow of HPTLC in standardization of herbal formulations.

Fig 2: Applications of HPTLC in standardization of herbal formulations.

7. CONCLUSION

HPTLC is a versatile and indispensable tool for the standardization of herbal formulations. Its ability to provide qualitative and quantitative analysis, along with fingerprint profiling, makes it highly suitable for ensuring the quality, safety, and efficacy of herbal medicines. With ongoing technological advancements, HPTLC will continue to play a crucial role in herbal drug research and regulatory compliance.

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