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ANALYTICAL EVALUATION AND STANDARDIZATION OF BALADI KWATHA: A COMPREHENSIVE PHYSICOCHEMICAL AND CHROMATOGRAPHIC INVESTIGATION

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ABSTRACT

Baladi Kwatha Churna is a classical Ayurvedic polyherbal formulation widely utilized in the management of Vata-dominant disorders, particularly musculoskeletal and neurological conditions. The formulation comprises key ingredients such as Bala (Sida cordifolia) and Saindhava Lavana, known for their Vata-shamaka, Balya, and anti-inflammatory properties.

Despite its therapeutic relevance, systematic standardization remains essential for ensuring batch-to-batch consistency, safety, and global acceptability. The present study undertakes a comprehensive analytical evaluation of Baladi Kwatha through organoleptic characterization, physicochemical profiling, powder microscopy, and Thin Layer Chromatography (TLC).

The physicochemical parameters, including ash values, extractive values, moisture content, and pH, were determined as per standard pharmacopoeia protocols. TLC fingerprinting was performed using ethanol extract using Toluene: Ethyl acetate (9:1) solvent system. The findings revealed that all parameters fall within acceptable pharmacopoeia limits, indicating purity and absence of adulteration. The TLC profile demonstrated multiple distinct spots under UV and visible detection, confirming the presence of diverse phytoconstituents. The study establishes a reproducible analytical profile for Baladi Kwatha, which can serve as a reference for quality control, standardization, and future pharmacological investigations.

KEYWORDS: *Baladi Kwatha, Ayurvedic formulation, TLC profiling, physicochemical analysis, herbal standardization, quality control,Herbal drug evaluation.*

1. INTRODUCTION

Ayurvedic pharmaceutics is grounded in the principle of holistic therapeutics, wherein polyherbal formulations such as Kwathas (decoctions) play a pivotal role in disease management. Baladi Kwatha is a traditionally indicated formulation, particularly in Vata Vyadhi conditions, and is widely prescribed in clinical practice. However, the inherent variability in raw materials, geographical sourcing, and preparation methods necessitates rigorous standardization to ensure reproducibility and therapeutic efficacy.

In recent decades, the integration of traditional medicine with modern analytical science has underscored the importance of physicochemical and chromatographic evaluation as essential tools for herbal drug standardization. Establishing quality control parameters not only ensures safety and efficacy but also facilitates regulatory acceptance and global dissemination of Ayurvedic formulations. In this context, the present study aims to generate a comprehensive analytical profile of Baladi Kwatha through systematic evaluation employing standard pharmacognostical and chromatographic techniques.

2. OBJECTIVES

I. To evaluate organoleptic characters of Baladi Kwatha.
II. To determine physicochemical parameters.
III. To perform powder microscopy.
IV. To develop TLC fingerprint profile.
V. To standardize Baladi Kwatha formulation.

3. METHODOLOGY

3.1 Drug Composition (Table-1)

SL NO.	INGREDIENTS	BOTANICAL NAME	FAMILY	PARTS USED
1.	Bala	Sida cordifolia	Malvaceae	Panchanga
2.	Saindhava lavana	-----	-----	Lavana

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3.2 PHARMACOLOGICAL PROPERTIES(Table-2)

INGREDIENTS	RASA	GUNA	VEERYA	VIPAKA	DOSHIK KARMA	SANSTHANIK KARMA
1.Bala	Madhura	Snigdha, Guru	Sita	Madhura	Vata Pitta shamaka	Balya Vrisya Brimhana Ojavardhaka
2.Saindhava lavana	Lavana	Snigdha, Laghu	Sita	Madhura	Tridosha shamak	Agnideepana Pachana Vrisya

3.3 PHARMACODYNAMICS(Table-3)

INGREDIENTS	PHYTOCHEMICAL	PHARMACOLOGICAL ACTION
1.Bala	Ephedrine (Large amount in roots stem, seeds Jeaves) Ephedrine (Large amount in roots ,stem, seeds, leaves, Pseudoephedrine, Malvalic&coronaric Acid (Seed),Fatty acids, Saponine, Betaphenethylamine, Hypaphorine, Ecdysterone, Indole alkaloids, Pseudoephedrine, Sterculic, Saponine, Betaphenethylamine, Hypaphorine, Ecdysterone, Indole alkaloids Palmitic steric &-Setosterol	CNS depressant, Analgesic &Antiinflammatory, Hypotensive, Hepatoprotective, Anti microbial activity, Adaptogenic activity, Anti Parkinson's disease, Wound healing activity, Anti Hypertriglyceridemic activity, Hypoglycemic activity
2.Saindhava lavana	Sodium chloride 62.85%, Calcium chloride 0.53%, Magnesium chloride 0.43%, Sodium bicarbonate 0.74%, Insoluble matter 30-34%	Antioxidant Anti inflammatory Analgesic

3.4 Study Design

Baladi Kwatha (Batch No. 35-BK-26), prepared in coarse powder form, was subjected to analytical evaluation. The study was conducted over a defined period (28/02/2026 to 20/03/2026) under controlled laboratory conditions. All procedures adhered to standard guidelines prescribed in the Ayurvedic Pharmacopoeia of India (API) and WHO protocols for herbal drug standardization.

3.5 Organoleptic Evaluation

Organoleptic assessment was performed to evaluate macroscopic characteristics such as colour, odour, taste, and texture, which serve as preliminary indicators of drug identity and quality.

3.6 Physicochemical Analysis

The following parameters were analysed using standard pharmacopoeia procedures:

Total Ash Value: Indicator of total inorganic content

Acid Insoluble Ash: Reflects siliceous matter and contamination

Loss on Drying: Determines moisture content and stability

Extractive Values: Indicates the presence of active phytoconstituents

PH Determination: Assesses compatibility for internal use

Particle Size Analysis: Evaluates uniformity and extraction efficiency

3.7 Powder Microscopy

Microscopic analysis was carried out to identify diagnostic cellular structure such as fibers, Vessels, starch grains, and other histological features characteristic of the constituent drugs.

Microscopic examination of Baladi Kwatha powder revealed the presence of several characteristic diagnostic features confirming the authenticity of the ingredients.

- ✓ Cork Layer Fragments

Fragments of cork cells were observed in surface view. The cork cells appeared polygonal to rectangular in shape with thick walls and brownish coloration. These compactly arranged cells serve as protective tissue and are characteristic features of root drugs.

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✓ Wavy Parenchyma

Fragments of parenchymatous cells with wavy walls were observed. The cells appeared thin-walled, irregular to polygonal in shape, and loosely arranged. Such wavy parenchyma is characteristic of storage tissue commonly present in root material.

✓ Parenchymatous Cells

Numerous parenchymatous cells were observed, appearing thin-walled, rounded to polygonal in shape with intercellular spaces. These cells represent fundamental tissue involved in storage and metabolic functions of the plant.

✓ Spiral Vessels

Spiral xylem vessels were distinctly observed showing spiral thickening along the vessel walls. These elongated tubular structures are characteristic conducting elements responsible for water transport in vascular tissues.

✓ Fibres

Fibres were observed as elongated, thick-walled, lignified structures with tapering ends. The fibres appeared yellowish to brown in colour and were found either singly or in groups. The lumen was narrow with prominent thick walls, indicating strong lignification. These characteristic fibres serve as important diagnostic features confirming the presence of Bala (Sida cordifolia) in the formulation.

✓ Pitted Xylem Vessels

Pitted xylem vessels were observed with distinct pits distributed along the vessel walls. These vessels appeared thick-walled and elongated, serving as efficient conducting elements. The presence of pitted vessels confirms the vascular origin of the powdered drug material.

✓ Starch Grains

Starch grains were observed as small, simple, rounded to oval structures distributed within parenchymatous cells. The grains appeared translucent with well-defined boundaries and showed variable sizes. Most of the starch grains were simple and occasionally clustered, indicating storage tissue characteristics typical of root drugs. The presence of starch grains supports the identification of Bala (Sida cordifolia) as one of the major constituents of the formulation.

3.8 Thin Layer Chromatography (TLC)

Thin Layer Chromatography (TLC) of Baladi Kwatha was performed using ethanol extract as the sample. The chromatographic separation was carried out using Toluene: Ethyl acetate (9:1) as the mobile phase.

The developed TLC plates were observed under visible light, UV 254 nm, and UV 366 nm wavelengths for detection of separated phytoconstituents.

Distinct spots were observed at different Rf values under various detection conditions, indicating the presence of multiple phytochemical constituents.

4. RESULTS

ORGANOLEPTIC EVALUATION

Table 4.1Parameter evaluated(Table -4)

Colour	Greyish
Odour	Characteristic
Taste	Astringent
Texture	Coarse powder

PHYSIOCOCHEMICEL ANALYSIS

Table:4.2 Physiocochemical Parameter (Table-5)

Total Ash	4.5%
Acid Insoluble Ash	2%
Loss on Drying	6.1%04.4%
Water Extractive Value	04.4%
Alcohol Extractive Value	1.2%
pH	6.9
Particle Size	355 µm-250 µm

TLC PROFILE OF BALADI KWTHA(Table-6)

Table:4.3

Extract	Ethanol
Mobile phase	Toluene: Ethyl acetate (9:1)

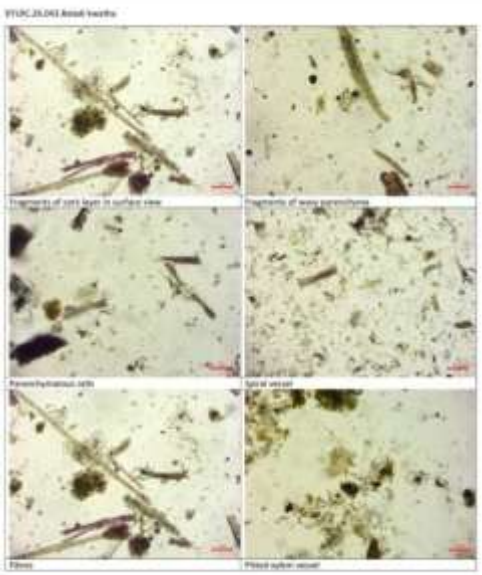
Detection Mode	Rf Values
Visible Light	0.56, 0.67
UV 254 nm	0.11, 0.20, 0.50, 0.56, 0.67
UV 366 nm	0.11, 0.20, 0.37, 0.44, 0.50, 0.56, 0.67

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ANALYTICAL STUDY REPORT



MICROSCOPY REPORT



5. DISCUSSION

The physicochemical parameters obtained in the present study fall within acceptable limits, indicating the absence of significant inorganic contamination and optimal processing conditions. The low moisture content (6.1%) suggests enhanced shelf stability and reduced susceptibility to microbial degradation. Extractive values indicate the presence of water- and alcohol-soluble bioactive constituents, which are likely responsible for the therapeutic efficacy of the formulation.

The near-neutral pH (6.9) suggests suitability for oral administration without causing mucosal irritation. Particle size distribution within the specified range ensures efficient extraction during decoction preparation, thereby influencing bioavailability.

TLC fingerprinting revealed multiple distinct bands under different wavelengths, indicating a complex phytochemical composition. The reproducibility of Rf values confirms the reliability of the chromatographic profile as a standard reference. Such fingerprinting serves as an essential tool for detecting adulteration, substitution, and batch variability.

Overall, the integration of classical organoleptic evaluation with modern analytical techniques provides a robust framework for the standardization of Ayurvedic formulations.

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Overall, the integration of classical organoleptic evaluation with modern analytical techniques provides a robust framework for the standardization of Ayurvedic formulations.

6. CONCLUSION

The present study successfully establishes a comprehensive analytical profile for Baladi Kwatha, encompassing organoleptic, physicochemical, microscopic, and chromatographic parameters. The findings confirm that the formulation meets standard quality requirements and exhibits consistency suitable for therapeutic application. The developed TLC fingerprint and physicochemical benchmarks can serve as reference standards for quality control, ensuring reproducibility and regulatory compliance. Further studies involving advanced chromatographic techniques and pharmacological validation are recommended to substantiate its clinical efficacy.

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