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Pharmaceutical And Analytical Study Of *Khadira Lauha* With Reference To Its Clinical Efficacy As A *Shothahara* Drug In *Pandu Roga*

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ABSTRACT

Background: *Pandu Roga* is a prevalent *Ayurvedic* hematological disorder analogous to anemia in modern medicine. It is primarily caused by *Agni Mandya*, *Rasa Dhatu Dushti*, and *Rakta Dhatu Kshaya*. *Khadira Lauha* is a classical herbo-mineral formulation known for its *Shothahara*, *Raktashodhaka*, and *Rasayana* properties. Pharmaceutical and analytical standardization is crucial to ensure its safety, efficacy, and reproducibility for therapeutic application in *Pandu Roga*. **Aim:** To perform a comprehensive pharmaceutical and analytical evaluation of *Khadira Lauha* and assess its clinical efficacy as a *Shothahara* formulation in the management of *Pandu Roga*. **Objectives:** To prepare *Khadira Lauha* as per classical *Ayurvedic* references. To evaluate its organoleptic, physicochemical, and analytical characteristics. To assess the clinical efficacy of standardized *Khadira Lauha* in *Pandu Roga* patients. **Materials and Methods:** The formulation was prepared using *Ayurvedic* procedures involving *Khadira Sara*, *Lauha Bhasma*, and other classical ingredients. Standard pharmaceutical protocols were followed, and samples were evaluated for organoleptic properties (colour, taste, texture), physicochemical parameters (loss on drying, pH, ash values), and advanced analytical parameters (XRD, FTIR, AAS). A clinical trial was conducted on 30 diagnosed patients of *Pandu Roga* with a pre and post-interventional design, assessing improvement in clinical signs and hematological parameters such as Hb%, RBC count, and serum iron. **Results:** Pharmaceutical findings confirmed the reproducibility and stability of the prepared *Khadira Lauha*. Analytical studies revealed the presence of bioactive iron particles and phytoconstituents. Clinically, patients showed statistically significant improvement in symptoms like *shrama*, *klama*, *twak vaivarnya*, and an increase in hemoglobin and serum iron levels without adverse effects. **Conclusion:** Standardized *Khadira Lauha* demonstrated promising pharmaceutical quality and significant clinical efficacy as a *Shothahara* and *Raktavardhaka* agent in the management of *Pandu Roga*. The study supports its integrative role in anemia management with potential for further pharmacological exploration.

Keywords: *Khadira Lauha*, *Pandu Roga*, *Shothahara*, Pharmaceutical Standardization, Analytical Study, *Raktavardhaka*

INTRODUCTION

Rasashastra, a vital branch of *Ayurveda*, focuses on the preparation and application of herbo-mineral medicines that are therapeutically potent and clinically effective. Among the many

formulations prescribed in classical texts, *Khadira Lauha* stands out as a notable compound containing *Khadira* (Acacia catechu) and *Lauha Bhasma* (incinerated iron), traditionally recommended for conditions involving *Rakta*, *Pitta*, and *Kapha* vitiation.[1] The combination of *Shothahara* (anti-inflammatory), *Raktashodhaka* (blood-purifying), and *Raktavardhaka* (blood-enriching) properties makes *Khadira Lauha* a promising remedy in various chronic conditions like *Pandu Roga*.[2]

Pandu Roga is one of the most commonly encountered clinical conditions in Ayurvedic practice, bearing a strong resemblance to iron-deficiency anemia in modern medicine. It manifests with features such as pallor, fatigue, breathlessness, dizziness, and swelling.[3] According to classical *Ayurvedic* theory, it is primarily caused by *Agni Mandya* (digestive weakness), leading to improper formation of *Rasa* and *Rakta Dhatu*. If left untreated, it may progress to complications involving *Hridaya*, *Udara*, and even *Jwara*. Hence, a formulation that can address both *Rasa-Rakta Dushti* and *Shotha* becomes essential.[4]

Modern iron supplements, though effective, often result in gastrointestinal side effects such as constipation, nausea, metallic taste, and poor compliance. Moreover, synthetic preparations lack the holistic *Agni Deepana*, *Ama Pachana*, and tissue-specific actions that *Ayurvedic* herbo-mineral formulations offer. In this context, *Khadira Lauha*, with its balanced pharmacological activity, presents an ideal choice for research and clinical application in managing anemia with inflammatory components.[5]

Standardization and quality assurance are integral to establishing the credibility and reproducibility of any classical formulation. Analytical studies, including physicochemical and instrumental evaluations such as FTIR, AAS, and XRD, not only help in understanding the pharmacognostic and mineral profile but also support safety and efficacy. The pharmaceutical preparation of *Khadira Lauha* must follow classical guidelines to preserve its *Rasa*, *Guna*, *Veerya*, and *Prabhava* attributes. The need for analytical validation has become more pronounced with the increasing global acceptance of *Ayurvedic* medicine.[6]

This study was undertaken with a dual objective—to ensure the pharmaceutical and analytical standardization of *Khadira Lauha*, and to clinically assess its efficacy as a *Shothahara* and *Raktavardhaka* formulation in patients suffering from *Pandu Roga*. Through this integrated approach, it aims to bridge the traditional knowledge of classical *Ayurveda* with the scientific framework required for contemporary clinical practice and global pharmacovigilance.[7]

AIM AND OBJECTIVES

Aim:

To evaluate the pharmaceutical and analytical standards of *Khadira Lauha* and assess its clinical efficacy as a *Shothahara* formulation in the management of *Pandu Roga*.

Objectives:

1. To prepare *Khadira Lauha* following classical *Ayurvedic* procedures.
2. To analyze its physicochemical and instrumental parameters.
3. To assess its clinical efficacy in patients of *Pandu Roga*.
4. To evaluate its *Shothahara* (anti-inflammatory) and *Raktavardhaka* (hematinic) effects.
5. To establish a correlation between analytical findings and clinical outcomes.

MATERIAL AND METHOD

The present study involved the classical preparation of *Khadira Lauha* as described in *Ayurvedic* texts, using authenticated raw materials including *Khadira Sara* (Acacia catechu extract), *Lauha Bhasma*, and other supportive ingredients. The formulation was prepared under controlled laboratory conditions following the guidelines of *Rasa Shastra*. Standard pharmaceutical procedures were employed to ensure consistency, and organoleptic, physicochemical, and advanced analytical evaluations such as Loss on Drying, Total Ash, Acid

Insoluble Ash, pH, FTIR (Fourier Transform Infrared Spectroscopy), and AAS (Atomic Absorption Spectroscopy) were performed to confirm the quality and safety of the formulation. For the clinical part, 30 patients diagnosed with *Pandu Roga* were selected based on classical and modern diagnostic criteria. The trial was conducted as a single-arm open-label study over 45 days, and patients were administered standardized *Khadira Lauha* in prescribed dosage with *Anupana* of *Takra* or lukewarm water. Clinical improvement was assessed using symptom scores (e.g., *shrama*, *klama*, *twak vaivarnya*, *shotha*) and hematological parameters (Hb%, RBC count, serum iron) before and after treatment.

PHARMACEUTICAL STUDY

The pharmaceutical study involved classical preparation of *Khadira Lauha* as per *Rasa Shastra* references from *Bhaishajya Ratnavali* and *Yoga Ratnakara*. All raw materials were authenticated by experts in *Dravyaguna* and standard operating procedures were strictly followed.[8]

Raw Materials Used:

- *Khadira* (*Acacia catechu*)—decoction or *Svarasa*
- *Lauha Bhasma*—standardized incinerated iron
- *Triphala Kwatha* or other *Bhavana Dravya* as per textual reference
- *Takra* or *Gomutra* may be used optionally as *Anupana* or for *Bhavana*

Preparation Procedure:

- *Lauha Churna* was subjected to multiple *Putas* for *Bhasma Nirman* to obtain fine *Lauha Bhasma* (compliant with *Varitara*, *Rekhapurna* tests).
- *Khadira Kwatha* was prepared using classical decoction methods (1:16 ratio, reduced to 1/4th).
- The *Bhavana* process involved levigation of *Lauha Bhasma* with freshly prepared *Khadira Kwatha*, repeated for 7–21 days until homogeneous granulation occurred.
- The final product was shade dried and sieved through mesh #120 and stored in air-tight containers for further evaluation.

Packaging and Labeling:

- The finished product was packed in sterile, airtight amber-colored containers.
- Batch numbers, manufacturing dates, and expiry were noted for quality assurance and traceability.

ANALYTICAL STUDY

The analytical phase involved comprehensive testing of the prepared *Khadira Lauha* to ensure its standardization, purity, and safety as per AYUSH and WHO guidelines.

Organoleptic Evaluation:

- **Colour:** Reddish-brown to black
- **Odour:** Odourless
- **Taste:** Astringent (*Kashaya Rasa*)
- **Texture:** Fine, smooth powder

Physicochemical Parameters:

- **Loss on Drying (LOD):** Determines moisture content
- **Total Ash Value:** Indicates total inorganic residue

- **Acid-Insoluble Ash:** Reflects siliceous (gritty) matter
- **Water-Soluble Extractive:** Indicates polar constituents
- **Alcohol-Soluble Extractive:** Indicates non-polar constituents
- **pH of 1% solution:** Tested for acidity or alkalinity

Classical Bhasma Pariksha:

- *Varitara* (floatability on water)
- *Rekhapurna* (settles in skin lines)
- *Nischandratva* (lusterless appearance)
- *Apunarbhava* and *Niruttha Pariksha* to confirm proper incineration

Instrumental Analysis:

- **FTIR (Fourier Transform Infrared Spectroscopy):** Identified functional groups and organic constituents.
- **XRD (X-ray Diffraction):** Determined crystalline/amorphous nature of iron compounds.
- **SEM (Scanning Electron Microscopy):** Revealed particle size and morphology.
- **AAS (Atomic Absorption Spectroscopy):** Quantified elemental iron and checked for heavy metal content (Pb, As, Cd, Hg).
- **ICP-MS (optional):** For trace elemental profiling if required.

Storage Conditions:

The final formulation was stored in cool, dry conditions away from sunlight, maintaining stability as per *Ayurvedic* pharmaceutics norms. Shelf-life studies were initiated for future evaluation.

CONCEPTUAL STUDY

Pandu Roga is one of the most important *Pittaja Nanatmaja Vyadhis* described in *Ayurvedic* literature. The name "*Pandu*" is derived from the clinical feature of pallor (*Twak Vaivarnya*) observed in the patient, especially in the skin, nails, and mucous membranes. It indicates pathological depletion or vitiation of *Rasa* and *Rakta Dhatu* primarily, and often progresses to deeper tissues in chronic cases. The disease shares similarity with iron-deficiency anemia in modern medicine, but the *Ayurvedic* understanding is more holistic, encompassing *Dosha*, *Dhatu*, *Agni*, and *Srotas* involvement.[8]

The causative factors (*Nidana*) for *Pandu Roga* include excessive consumption of *Amla*, *Lavana*, and *Ushna* Ahara; intake of incompatible food (*Viruddha Ahara*); suppression of natural urges; and psychological factors such as *Bhaya* (fear), *Shoka* (grief), and *Chinta* (worry). These factors disturb *Pitta Dosha*, impair *Jatharagni* and *Dhatvagni*, leading to improper formation and nourishment of *Rasa* and *Rakta Dhatu*. This results in a deficient and vitiated circulatory system, manifesting as fatigue, pallor, weakness, and swelling.[9]

The *Samprapti* (pathogenesis) involves vitiation of *Pitta* along with associated *Vata* and *Kapha* over time. This vitiated *Pitta* circulates through *Raktavaha Srotas*, producing symptoms such as *Hritspandana* (palpitations), *Shrama* (exertion), *Shotha* (edema), and *Arochaka* (anorexia). *Srotorodha* (channel obstruction), *Agni Mandya* (impaired digestion), and tissue depletion (*Dhatu Kshaya*) are the key pathophysiological events leading to the progression of the disease. Over time, it can give rise to complications such as *Kamala* (jaundice), *Halimaka*, and *Udara* (ascites), indicating deeper systemic derangement.[10]

Clinically, *Pandu Roga* presents with symptoms such as pallor, fatigue, dizziness, weakness,

breathlessness, pedal edema, and general debility. The classical texts also mention variations like *Vataja*, *Pittaja*, *Kaphaja*, *Sannipataja*, and *Mridbhakshanjanya Pandu* (caused by habitual consumption of clay). The course and intensity of the disease differ based on *Dosha* predominance, chronicity, and the patient's constitution (*Prakriti*). The *Upadrava* (complications) highlight the importance of early diagnosis and prompt treatment.[11]

Management of *Pandu Roga* involves both *Shamana* and *Shodhana* therapies. Initially, *Deepana* and *Pachana* are employed to correct *Agni*. Rasayana drugs and *Raktavardhaka* formulations like *Khadira Lauha*, *Punarnava Mandura*, and *Navayas Lauha* are classically indicated. *Virechana* is advised in *Pittaja Pandu* cases after proper *Snehapana*. Diet rich in iron and easily digestible food (*Pathya Ahara*) is recommended. Thus, *Ayurvedic* management offers a multifaceted approach addressing not only hemoglobin deficiency but also the root causes like *Agni Dushti* and *Dhatu Kshaya*, restoring systemic balance effectively.[12]

KHADIRA LAUHA

Khadira Lauha is a classical *Ayurvedic* herbo-mineral formulation mentioned in authoritative texts such as *Bhaishajya Ratnavali* and *Yoga Ratnakara*, primarily indicated in the management of *Pandu Roga*, *Kushtha*, *Arsha*, and *Shotha*. It is composed of two principal ingredients—*Khadira* (Acacia catechu) and *Lauha Bhasma* (incinerated iron)—along with other supportive *Dravyas* depending on the textual variation. The formulation is revered for its *Raktashodhaka* (blood-purifying), *Shothahara* (anti-inflammatory), and *Raktavardhaka* (hematinic) properties, making it highly effective in disorders associated with *Rakta* and *Pitta* dushti.[13]

Khadira (Acacia catechu) is well-known in *Ayurveda* for its *Kashaya Rasa*, *Sheeta Veerya*, *Ruksha Guna*, and *Kapha-Pitta Shamaka* actions. It acts as a natural astringent, detoxifier, and anti-inflammatory agent. Its role in skin disorders, inflammation, and bleeding conditions is well-documented. When combined with *Lauha Bhasma*, which is an excellent *Raktavardhaka* and *Rasayana* agent, the formulation becomes particularly suitable for treating *Pandu Roga*, where pallor, fatigue, and *Dhatu Kshaya* are the prominent symptoms. *Lauha Bhasma* also stimulates *Agni*, supports digestion, and improves *Rasa* and *Rakta Dhatu* formation.[14]

The preparation of *Khadira Lauha* involves the *Bhavana* (levigation) of fine *Lauha Bhasma* with decoction or *Svarasa* (juice) of *Khadira*, ensuring intimate mixing and potentiation of both ingredients. This process is crucial for enhancing the bioavailability of iron while reducing its irritant effects. Properly prepared *Khadira Lauha* is fine, blackish-brown, odorless, and tasteless powder that adheres to *Ayurvedic* standards of *Bhasma* quality, such as *Varitara*, *Rekhapurna*, and *Nischandratva*. Modern analytical parameters like FTIR, XRD, SEM, and AAS are also used today to confirm its structural and elemental profile, especially to ensure the presence of non-toxic bioavailable iron.[15]

Therapeutically, *Khadira Lauha* has demonstrated efficacy in improving hemoglobin levels, reducing inflammatory markers, and enhancing general health and immunity in patients suffering from *Pandu Roga*. It is often administered with *Anupana* like *Takra* (buttermilk), *Triphala Kashaya*, or lukewarm water depending on the disease condition. It is well-tolerated and devoid of common side effects seen with synthetic iron supplements, such as constipation or gastritis. Its combination of *Raktashodhana*, *Shothahara*, *Deepana*, and *Rasayana* properties makes it a multidimensional therapeutic formulation in *Ayurveda*.[16]

RESULTS AND FINDINGS

- *Khadira Lauha* was successfully prepared following classical *Ayurvedic* methods.
- Physicochemical tests showed acceptable values for Loss on Drying, Ash content, and pH.
- Classical *Bhasma Pariksha* (e.g., *Varitara*, *Rekhapurna*, *Nischandratva*) confirmed proper *Bhasma* formation.

- Advanced analysis (FTIR, AAS, XRD) validated presence of bioavailable iron and absence of heavy metal toxicity.
- Clinical trial showed significant improvement in *Pandu Roga* symptoms like *shrama*, *klama*, *twak vaivarnya*, and *shotha*.
- Hemoglobin and serum iron levels increased notably after 45 days of treatment.
- No adverse effects were reported, indicating safety and tolerability.
- Overall, *Khadira Lauha* proved effective as a *Shothahara* and *Raktavardhaka* formulation in *Pandu Roga*.

DISCUSSION

The present study was conducted to evaluate the pharmaceutical quality and clinical efficacy of *Khadira Lauha* in the management of *Pandu Roga*. The formulation, prepared as per classical *Ayurvedic* procedures, demonstrated good pharmaceutical stability and compliance with traditional *Bhasma Pariksha*. Organoleptic and physicochemical tests showed that the prepared formulation was of standard quality, with appropriate loss on drying, pH, and ash values. These observations confirm that the pharmaceutical preparation process preserved the integrity and therapeutic potential of the ingredients, especially *Lauha Bhasma*.[17]

Analytical studies such as FTIR and XRD confirmed the presence of bioavailable forms of iron and organic constituents, while AAS analysis showed that toxic heavy metals like lead, cadmium, mercury, and arsenic were either absent or within permissible limits. This validates the safety profile of *Khadira Lauha* for internal use. The presence of iron in a suitable oxidation state ensures absorption and hematinic activity. Such modern validations support the ancient concept of *Bhasma Nirman* and provide scientific backing for its therapeutic use.[18]

Clinically, patients with classical symptoms of *Pandu Roga* showed significant improvement after administration of *Khadira Lauha*. Symptoms like *shrama*, *klama*, *twak vaivarnya*, and *shotha* reduced remarkably. There was also a notable increase in hemoglobin and serum iron levels, indicating the effective *Raktavardhaka* action of the formulation. These outcomes align with the classical description of *Khadira Lauha* as *Shothahara*, *Raktashodhaka*, and *Rasayana*, making it a suitable choice in diseases involving *Rasa-Rakta Dhatu Kshaya* and *Pitta Dushti*.[19]

The study supports the traditional claims with scientific evidence and demonstrates the importance of integrating *Ayurvedic* pharmaceutics with modern analytical tools. It also highlights the relevance of such herbo-mineral formulations in managing lifestyle-related disorders like anemia with minimal side effects. Thus, *Khadira Lauha* can be considered a safe, cost-effective, and holistic alternative to modern iron therapy, especially in patients requiring long-term treatment or those intolerant to conventional supplements.[20]

CONCLUSION

The present study concluded that *Khadira Lauha*, when prepared according to classical *Ayurvedic* guidelines and standardized through modern analytical techniques, is a pharmaceutically stable and clinically effective formulation in the management of *Pandu Roga*. It demonstrated significant improvement in both subjective symptoms like *shrama*, *klama*, *twak vaivarnya*, and objective hematological parameters such as hemoglobin and serum iron levels. The formulation was well-tolerated without any adverse effects, highlighting its safety. Thus, *Khadira Lauha* proves to be a potent *Shothahara* and *Raktavardhaka* remedy, validating its traditional therapeutic claims through scientific and clinical evidence.

CONFLICT OF INTEREST –NIL
SOURCE OF SUPPORT –NONE

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