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ORIGINAL ARTICLE

Pharmaceutical Development and Analytical Standardisation of *Triphaladi Kashaya* for the Management of *Mukhapaka*.

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Abstract

Background: *Triphaladi Kashaya* is a classical Ayurvedic formulation indicated for the management of *Mukhapaka* and other oral disorders. Although it has been used in Ayurvedic practice for many years, published data on its pharmaceutical standardisation are limited.

Objective: To prepare *Triphaladi Kashaya* according to classical Ayurvedic procedures and to establish reference quality parameters through pharmaceutical and analytical evaluation.

Materials and Methods: *Triphaladi Kashaya* was prepared using *Terminalia chebula* Retz. (*Haritaki*), *Terminalia bellirica* (Gaertn.) Roxb. (*Vibhitaki*), *Phyllanthus emblica* Linn. (*Amalaki*), *Cissampelos pareira* Linn. (*Patha*), *Vitis vinifera* Linn. (*Mrdwika*), and *Jasminum grandiflorum* Linn. (*Jati*), with *Madhu* (honey) as an adjuvant. The raw drugs were authenticated and evaluated using pharmacognostical and physicochemical methods. The finished formulation was analysed for its organoleptic characters, physicochemical properties, phytochemical profile, total phenolic content, microbial quality, heavy metal content, and pesticide residues using standard analytical procedures.

Results: The prepared *Triphaladi Kashaya* was light brown in colour with a characteristic odour and a bitter-astringent taste. The formulation showed a pH of 3.92, specific gravity of 1.0358, total solids of 11.3397%, refractive index of 1.349, and 10°Brix. The total phenolic content was found to be 0.38% w/w (tannic acid equivalent). Qualitative phytochemical screening confirmed the presence of carbohydrates, tannins, phenols, flavonoids, terpenoids, and saponins. Microbial counts were well within the prescribed limits, while pathogenic microorganisms, heavy metals, and pesticide residues were absent or within permissible limits.

Conclusion: The study generated a pharmaceutical and analytical profile for *Triphaladi Kashaya* that may serve as reference data for quality control and standardisation. These findings provide a basis for maintaining the consistency of the formulation and support further pharmaceutical and clinical investigations.

Introduction

Kashaya is one of the most widely used liquid dosage forms described in Ayurveda. Owing to its simple method of preparation, rapid extraction of water-soluble phytoconstituents, and broad therapeutic utility, it continues to occupy an important place in Ayurvedic clinical practice. Classical Ayurvedic texts describe numerous *Kashaya* formulations for the management of different disease conditions and emphasise strict adherence to pharmaceutical procedures to ensure optimum therapeutic effectiveness. Despite their long history of clinical use, many of these formulations have not undergone systematic evaluation using contemporary analytical techniques. Consequently, establishing quality standards has become necessary to ensure their safety, consistency, reproducibility, and wider scientific acceptance.

Ayurveda describes several local therapeutic procedures and herbal formulations for the management of *Mukharoga*. Among these, *Triphaladi Kashaya* is a classical formulation advised as *Gandusha*, an oral retention therapy indicated for *Mukahapaka*(Aphthous ulcer). It is described in *Ashtanga Hridaya*,[1] *Charaka SamhitA*,[2] *Bhaishajya Ratnavali*,[3] and *Chakradatta*[4] under *Mukharoga Chikitsa*. The formulation comprises *Haritaki* (*Terminalia chebula* Retz.), *Vibhitaki*

(Terminalia bellirica (Gaertn.) Roxb.), *Amalaki (Phyllanthus emblica Linn.)*, *Patha (Cissampelos pareira Linn.)*, *Mrdwika (Vitis vinifera Linn.)*, *and Jati (Jasminumgrandiflorum Linn.)*, with *Madhu* (honey) used as an adjuvant. According to Ayurvedic literature, these ingredients possess properties such as *Vrana Ropana*, *Shothahara*, *Krimighna*, and *Tridosha Shamaka*, supporting their use in promoting healing and maintaining the health of the oral mucosa.

Experimental studies on the individual ingredients of *Triphaladi Kashaya* have demonstrated a variety of pharmacological activities, including antioxidant, anti-inflammatory, antimicrobial, immunomodulatory, and wound-healing effects. These activities have been largely attributed to the presence of tannins, phenolic compounds, flavonoids, and other bioactive phytochemicals. However, the chemical composition of polyherbal formulations can vary depending on the quality of raw materials, geographical source, and manufacturing process. Therefore, comprehensive pharmaceutical and analytical evaluation is essential to establish quality standards and ensure batch-to-batch uniformity.

With the growing integration of Ayurveda into evidence-based healthcare, scientific standardisation of classical formulations has gained increasing importance. Evaluation of organoleptic characteristics, physicochemical parameters, and phytochemical constituents provides objective quality benchmarks and strengthens the scientific credibility of traditional formulations. Accordingly, *Triphaladi Kashaya* was prepared following standard classical Ayurvedic pharmaceutical procedures and subjected to organoleptic evaluation, physicochemical analysis, and phytochemical screening. The data generated through this study provide reference quality parameters that may facilitate routine quality control, support future pharmaceutical development, and serve as a basis for further research on this classical Ayurvedic formulation.

MATERIALS AND METHODS

The study was undertaken to prepare and standardise *Triphaladi Kashaya* according to classical Ayurvedic procedures. The materials and methods adopted for the preparation and pharmaceutical evaluation of the formulation are described below.

1. Review of *Triphaladi Kashaya*
2. Collection and Authentication, Quality Evaluation of Raw Materials
3. Preparation of *Triphaladi Kashaya*
4. Organoleptic Evaluation of *Triphaladi Kashaya*
5. Physicochemical Evaluation of *Triphaladi Kashaya*
6. Preliminary Phytochemical Screening of *Triphaladi Kashaya*
7. Heavy Metal Analysis of *Triphaladi Kashaya*
8. Microbial Analysis of *Triphaladi Kashaya*
9. Pesticide Residue Analysis of *Triphaladi Kashaya*

i. REVIEW OF *TRIPHALADI KASHAYA*

A. Classical reference

Triphaladi Kashaya is a classical Ayurvedic polyherbal formulation indicated for the management of *Mukharoga*. The formulation is described in *Ashtanga Hridaya*,[1] *Charaka Samhita*,[2] *Bhaishajya Ratnavali*,[3] and *Chakradatta*[4] under *Mukharoga Chikitsa*. Traditionally, it is administered locally as *Gandusha* (*Mukha Dhavana*), *Nishteevana*, and orally as *Bhakshana*.

B. Composition of *Triphaladi Kashaya*

The ingredients used for the preparation of *Triphaladi Kashaya* are presented in Table 1.

Table No. 1: Ingredients of Triphaladi Kashaya

Drug	*Botanical Name*	Family	Part Used
Haritaki	*Terminalia chebula* Retz.	Combretaceae	Fruit rind
Vibhitaki	*Terminalia bellirica* (Gaertn.) Roxb.	Combretaceae	Fruit rind
Amalaki	*Phyllanthus emblica* Linn.	Combretaceae	Fruit rind
Patha	*Cissampelos pareira* Linn.	Menispermaceae	Root
Mrdwika	*Vitis vinifera* Linn.	Vitaceae	Fruit
Jati	*Jasminum grandiflorum* Linn.	Oleaceae	Leaf
Madhu (Adjuvant)	*Apis* species	Apidae	Honey

C. Mode of Administration in *Mukhapaka*

Local Use:

Mukha dhavana (*Gandusha*)– cleansing of oral ulcers

Nishteevana(Chewing and spitting out)

Bhakshana(Internal administration)[1]

D. Phytopharmacological Profile of the Ingredients

Haritaki

Table No.2: Classical and Pharmacological Profile of *Haritaki* (*Terminalia chebula* Retz.)

Parameter	*Details*
Rasapanchaka	*Rasa: Lavana-varjita Pancharasa (Kashaya predominant); Guna: Laghu, Ruksha (Sara* according to *Sushruta Samhita* and *Ashtanga Hridaya); Virya: Ushna; Vipaka: Madhura.*[5]
Major Ayurvedic actions	*Jwaraghna, Kushtaghna, Tridoshahara, Anulomana, Vatahara, Pittahara, Rasayana, Dipaniya, Medhya, Pramehaghna, Vayasthapana, Ayushya, Netrahitakara.*[6]
Major phytoconstituents	Hydrolysable tannins (chebulagic acid, chebulinic acid, gallic acid, ellagic acid, corilagin), phenolic compounds, flavonoids (quercetin and related derivatives), triterpenoids, and ascorbic acid.[7]
Reported pharmacological activities	Antioxidant, anti-inflammatory, antimicrobial, antibacterial, angiogenic, collagen-promoting, wound-healing, and tissue regenerative activities.[7]
Contemporary evidence	Experimental studies have demonstrated that tannin-rich extracts of Haritaki significantly enhance wound contraction, granulation tissue formation, collagen deposition, VEGF-mediated angiogenesis, and antibacterial activity against common wound pathogens. Additional studies have reported potent antioxidant and anti-inflammatory effects, supporting its traditional use in *Vrana Ropana* and the management of oral ulcers.[8]
Dose (Churna)	*3–6 g.*[9]

● *Vibhitaki*

Table No.3: Classical and Pharmacological Profile of *Vibhitaki (Terminalia bellirica (Gaertn.)* Roxb.)

Parameter	Details
Rasapanchaka	*Rasa*: *Kashaya* (with *Amla*, *Katu*, *Tikta*, and *Madhura* mentioned in different classics); *Guna*: *Laghu*, *Ruksha* (*Guru* according to *Ashtanga Hridaya*); *Virya*: Predominantly *Ushna* (*Sheeta* according to *Ashtanga Hridaya*); *Vipaka*: Predominantly *Madhura* (*Katu* according to some texts).[10]
Major Ayurvedic actions	*Kaphapittahara*, *Kasaghna*, *Bhedana*, *Krimighna*, *Netrahita*, *Keshya*, *Mukharoganashana*, *Kantharoganashana*, *Swarabhedahara*, *Chardihara*, *Atisarahara*.[11]
Major phytoconstituents	Gallic acid, ellagic acid, chebulagic acid, chebulinic acid, flavonoids, polyphenols, lignans, glycosides, and ascorbic acid.[12]
Reported pharmacological activities	Antioxidant, anti-inflammatory, antimicrobial, astringent, wound-healing, collagen-promoting, and epithelial regenerative activities.[12]
Contemporary evidence	Experimental studies using ethanolic fruit extract in excision and incision wound models demonstrated enhanced wound contraction and improved wound healing, supporting the traditional use of *Vibhitaki* in *Vrana Ropana* and *Mukharoga*[13].
Dose (*Churna*)	3–6 g.[14]

● *Amalaki*

Table No.4: Classical and Pharmacological Profile of *Amalaki (Phyllanthus emblica* Linn.)

Parameter	Details
Rasapanchaka	*Rasa:* Predominantly *Amla (Lavana-varjita Pancharasa* according to *Bhavaprakasha Nighantu); Guna: Laghu*, *Ruksha*, *Sara*; *Virya: Sheeta*; *Vipaka: Madhura.*[5]
Major Ayurvedic actions	*Rasayana*, *Tridoshaghna*, *Raktapittaghna*, *Pramehaghna*, *Vrishya*, *Hridya*, *Jvaraghna*, *Vataghna*, *Kaphaghna*.[15]
Major phytoconstituents	Vitamin C (ascorbic acid), emblicanin A and B, gallic acid, ellagic acid, flavonoids (quercetin), phenolic compounds, tannins, and polysaccharides.[16]
Reported pharmacological activities	Antioxidant, anti-inflammatory, antimicrobial, collagen-promoting, immunomodulatory, wound-healing, and tissue-regenerative activities.[16]
Contemporary evidence	Experimental studies have demonstrated potent antioxidant and anti-inflammatory activities through inhibition of oxidative stress and inflammatory mediators. Wound-healing studies have shown accelerated wound contraction, enhanced collagen synthesis and cross-linking, increased cellular proliferation, improved tensile strength, and faster epithelialization, supporting the traditional use of *Amalaki* in *Vrana Ropana* and oral ulcer management.[17]
Dose	Fresh fruit: 10–20 g; Fresh juice: 5–10 mL; Powder (*Churna*): 3–6 g.[18]

● *Patha*

Table No.5: Classical and Pharmacological Profile of *Patha (Cissampelos pareira* Linn.)

Parameter	Details
Classical varieties	Classical texts describe two varieties of *Patha*: ***Laghu Patha*** (*Cissampelos pareira* Linn.) and ***Raja Patha*** (*Cyclea peltata* (Lam.) Hook.f. & Thomson), with *Stephania hernandifolia* Willd. used as a substitute in certain regional traditions. *Laghu Patha* is considered therapeutically superior for *Mukharoga* and *Vrana Ropana* owing to its *Tikta–Katu Rasa*, *Laghu–Ruksha Guna*, and *Ushna Virya*.[19]
Rasapanchaka	*Rasa***:** Predominantly *Tikta* and *Katu*; *Guna***:** *Laghu*, *Ruksha*, *Tikshna* (Guru according to *Raja Nighantu*); *Virya***:** *Ushna*; *Vipaka***:** *Katu*.[19]
Major Ayurvedic actions	*Jvaraghna*, *Atisaraghna*, *Gulmaghna*, *Shulaghna*, *Chardighna*, *Kushtaghna*, *Kandughna*, *Shwasaghna*, *Krimighna*, *Hridrogaghna*, *Vrana Ropana*, *Raktatisaranashana*.[20]
Major phytoconstituents	Bisbenzylisoquinoline alkaloids (cissampeline, hayatine, hayatinine, pareirine, cycleanine), tetrahydropalmatine, flavonoids (quercetin, kaempferol), phenolic compounds, tannins, glycosides, β-sitosterol, quercitol, and carbohydrates.[21]
Reported pharmacological activities	Anti-inflammatory, antioxidant, antimicrobial, wound-healing, analgesic, immunomodulatory, and tissue regenerative activities.[21]
Contemporary evidence	Experimental studies have demonstrated significant anti-inflammatory activity of the ethanolic root extract in acute, subacute, and chronic inflammatory models, with a favourable safety profile. These findings support the traditional use of *Patha* in *Shotha*, *Vrana Ropana*, and inflammatory disorders of the oral cavity.[22]
Dose (*Churna*)	3–6 g.[23]

- ***Mrdwika***

Table No.6: Classical and Pharmacological Profile of *Mrdwika* (*Vitis vinifera* Linn.)

Parameter	Details
Rasapanchaka	*Rasa*: Predominantly *Madhura* (with *Kashaya* and *Amla* mentioned in some references); *Guna*: *Snigdha*, *Sara*, *Guru*; *Virya*: *Sheeta*; *Vipaka*: *Madhura*.[24]
Major Ayurvedic actions	*Brimhana*, *Vrishya*, *Balya*, *Kandya*, *Shramahara*, *Santarpana*, *Snehana*, *Raktapittahara*, *Panduhara*, *Kshayahara*, *Svarabhedahara*, *Swarya*, *Netrya*, *Ruchikaraka*, *Rechana*.[24]
Major phytoconstituents	Glucose, fructose, resveratrol, gallic acid, flavonoids, anthocyanins, phenolic acids, tannins, proanthocyanidins, catechins, phytosterols, vitamin E, vitamins, minerals, pectin, and organic acids.[25]
Reported pharmacological activities	Antioxidant, anti-inflammatory, antimicrobial, collagen-promoting, wound-healing, cardioprotective, and tissue regenerative activities.[25]
Contemporary evidence	Experimental studies have demonstrated that grape seed extract accelerates wound contraction, epithelialization, collagen synthesis, hydroxyproline content, and tensile strength through antioxidant and anti-inflammatory mechanisms. Additional studies have confirmed significant antioxidant and anti-inflammatory effects mediated by polyphenols, particularly proanthocyanidins and resveratrol, supporting the traditional use of *Mrdwika* in tissue repair and ulcer healing.[26]
Dose	5–10 g.[27]

- ***Jati***

Table No.7: Classical and Pharmacological Profile of *Jati* (*Jasminum grandiflorum* Linn.)

Parameter	Details
Rasapanchaka	*Rasa*: *Tikta*, *Kashaya* (*Tuvara* according to *Bhavaprakasha Nighantu*); *Guna*: *Laghu*; *Virya*: *Ushna*; *Vipaka*: *Katu*.[28]
Major Ayurvedic actions	*Mukharogahara*, *Mukhapakahara*, *Vranahara*, *Vrana Ropana*, *Kaphapittahara*, *Kushtaghna*, *Shirorogahara*, *Akshirogahara*, *Dantashulahara*, *Vishaghna*, *Anilarogahara*, *Chakshushya* (flower buds and flowers).[28]
Major phytoconstituents	Phenolic compounds, tannins, triterpenoids (oleanolic acid and ursolic acid), saponins, β-sitosterol, sterols, and essential oils containing aromatic constituents.[29]
Reported pharmacological activities	Antioxidant, anti-inflammatory, antimicrobial, immunomodulatory, wound-healing, tissue-regenerative, and membrane-stabilising activities.[29]
Contemporary evidence	Experimental studies have demonstrated significant wound contraction and accelerated epithelialization following topical application of *Jati* leaf extract. Additional studies have reported potent anti-inflammatory activity through inhibition of inflammatory cell infiltration and suppression of COX-2, IKK, and NF-κB signalling pathways, supporting the traditional use of *Jati* in *Mukhapaka*, *Vrana Ropana*, and inflammatory oral disorders.[30]
Dose	10–20 g of leaf powder for decoction.[31]

- ***Honey***

Table No. 8:Classical and Pharmacological Profile of *Madhu* (Honey)

Parameter	Details
Zoological origin	Honeybees (*Apis* spp.); Family: Apidae. Common honey-producing species include *Apis cerana indica*, *Apis mellifera*, *Apis dorsata*, and *Apis florea*.
Classical types	*Pauttika*, *Bhramara*, *Kshaudra*, and *Makshika* are described in all major classics, while *Chhatra*, *Arghya*, *Auddalaka*, and *Dala* are additionally described in *Sushruta Samhita* and later *Nighantus*.[32]
Rasapanchaka	*Rasa*: Predominantly *Madhura* with *Kashaya Anurasa*; *Guna*: *Laghu*, *Ruksha*, *Vishada*, *Sukshma* (Guru in some classics); *Virya*: *Sheeta*; *Vipaka*: *Madhura*; *Dosha Karma*: *Kapha–Pittahara* with mild *Vata* aggravating property.[33]
Major Ayurvedic actions	*Vrana Shodhana*, *Vrana Ropana*, *Sandhanakara*, *Lekhana*, *Agnideepana*, *Medohara*, *Hridya*, *Swarya*, *Sangrahi*, *Chakshushya*, *Varnya*, *Sukshma Marganusari*, *Kaphahara*, *Pittahara*.[33]
Major phytoconstituents	Fructose, glucose, enzymes, amino acids, proteins, vitamins, minerals, phenolic acids, flavonoids, organic acids, and antioxidant compounds.[34]
Reported pharmacological activities	Antioxidant, antimicrobial, anti-inflammatory, wound-healing, immunomodulatory, tissue regenerative, and bioadhesive activities.[34]
Contemporary evidence	Clinical and experimental studies have demonstrated that topical honey accelerates wound contraction, enhances granulation tissue formation, promotes epithelialization, reduces microbial load, and exerts significant anti-inflammatory activity. These findings support its traditional use as a *Vrana Shodhana* and *Vrana Ropana* agent and justify its inclusion in formulations for managing oral ulcers.[34]
Dose	1–10 mL.[35]

E.Rasapanchaka of Triphaladi Kashaya

Table No.9:Inferred *Rasapanchaka* of *Triphaladi Kashaya* Based on Its Constituent Drugs

Parameter	Rasapanchaka	Constituent Basis and Potential Synergistic Effect
Rasa	*Kashaya Pradhana*, *Tikta*, *Madhura*, *Amla (Anurasa)*	Predominantly contributed by *Triphala*, *Patha*, *Jati*, *Mrdwika* and *Madhu*. The predominance of *Kashaya Rasa*, together with the complementary *Tikta* and *Madhura* components, may provide a synergistic basis for the formulation's *Shodhana*, *Ropana* and *Dosha* balancing actions.
Guna	*Laghu*, *Ruksha*	Predominantly contributed by *Haritaki*, *Vibhitaki*, *Patha* and *Jati*, with the properties of the remaining ingredients providing complementary effects. The interaction of these properties may contribute synergistically to reducing *Kapha* and supporting local wound-healing activity.
Virya	*Ushna* (predominant)	The overall *Ushna Virya* is inferred from the predominance of *Haritaki*, *Patha* and *Jati*, despite the *Sheeta Virya* of *Amalaki*, *Mrdwika* and *Madhu*. The coexistence of opposing *Virya* attributes may provide a complementary balance within the formulation rather than an isolated action of individual drugs.
Vipaka	*Madhura* (predominant)	Majority of the ingredients possess *Madhura Vipaka*.
Dosha Karma	*Tridosha Shamaka* (predominantly *Kapha–Pitta Shamaka*)	Based on the classical *Dosha Karma* of *Triphala*, *Patha*, *Jati* and *Madhu*, with their complementary pharmacodynamic properties potentially producing a synergistic *Tridosha Shamaka*, particularly *Kapha–Pitta Shamaka*, effect.

ii. COLLECTION, AUTHENTICATION AND QUALITY EVALUATION OF RAW MATERIALS

A. Procurement of raw drugs

The herbal raw materials required for the preparation of *Triphaladi Kashaya* were procured from the Ambuja Institute of Ayurvedic Research and Documentation (AIARD), Udayamperoor, Ernakulam; a crude drug supplier from Thrissur; and a supplier from Thiruvananthapuram, Kerala, India. Following preliminary physicochemical evaluation, the samples of the four herbal ingredients obtained from AIARD were found to comply with the specified quality parameters, including loss on drying, total ash, acid-insoluble ash, water-soluble extractive, alcohol-soluble extractive, and foreign matter, as applicable to the respective ingredients, and were therefore selected for the study. *Patha* (*Cissampelos pareira* Linn.) was procured from Hamirpur, Himachal Pradesh, India. Fresh *Jati* (*Jasminum grandiflorum* Linn.) leaves were obtained from an authorised crude drug dealer in Thammanam, Ernakulam. At the same time, AGMARK-certified *Madhu* (honey) was procured from Vanasree, Forest Department, Rajamala, Munnar, Kerala.

All herbal raw materials were botanically identified and authenticated by an expert from the Department of Dravyaguna Vijnana, Government Ayurveda College, Tripunithura. The authenticated specimens were subsequently taxonomically verified, and voucher specimens were deposited in the Department of Botany, St. Albert's College, Ernakulam, for future reference(Herbarium Voucher Specimen Number: SAC/BOT/HER/01/2026). Microscopic evaluation of the raw drugs was carried out at the Research and Development Laboratory, Nupal Remedies Pvt. Ltd., Ernakulam, to confirm their diagnostic anatomical characteristics.

Physicochemical quality evaluation of all raw herbal ingredients was performed at the Analytical Laboratory, Department of Rasashastra and Bhaishajya Kalpana, Government Ayurveda College, Tripunithura, following standard analytical procedures. The quality of honey was assessed at the Analytical Laboratory, Department of Rasashastra and Bhaishajya Kalpana, Government Ayurveda College, Tripunithura, and the Research and Development Laboratory, Nupal Remedies Pvt. Ltd., Ernakulam. Preliminary phytochemical screening of honey was conducted at CARe Keralam Ltd., Koratty, Thrissur, before its incorporation into the formulation.

B. Macroscopic evaluation of raw drugs

The identity of the raw drugs was initially established through macroscopic examination, including assessment of their colour, odour, taste, texture, shape, and other characteristic morphological features.

C)Microscopic Evaluation of Raw Drugs:

Microscopic examination of the individual raw drugs *Haritaki*, *Vibhitaki*, *Amalaki*, *Patha*, *Mrdwika*, and *Jati* was performed at the Quality Assurance Laboratory of Nupal Remedies, Kadavanthra, Ernakulam. All powdered drug samples were subjected to detailed microscopic examination to identify characteristic cellular structures and diagnostic features. The analysis included observation of lignified fibres, stone cells (sclereids), vessels, trichomes, starch grains, calcium oxalate crystals, and other specific anatomical markers indicative of the respective plant parts. All features were cross-checked with standard pharmacognostical references as per the quality standards of Indian medicinal plants published by the Medicinal Plant Division, ICMR, to confirm botanical identity and detect any possible adulteration or substitution.

D. Physicochemical Parameters of Raw Drugs Used in the Formulation as per API Standards.

Physicochemical evaluation of the raw drugs was carried out by determining parameters such as loss on drying, total ash, acid-insoluble ash, water-soluble extractive, and alcohol-soluble extractive following standard pharmacopoeial procedures.

E. Analysis of Honey

Table No.10:Analytical parameters of honey

Sl. No.	Analysis	Parameters Evaluated
1	Organoleptic and physicochemical analysis	Colour, odour, appearance, consistency, weight per mL, pH, moisture, reducing sugars, sucrose, fructose–glucose ratio, ash, acidity, HMF, Fiehe's test, and aniline chloride test
2	Preliminary phytochemical screening	Qualitative screening for major phytoconstituents
3	Microbial analysis	Total bacterial count, total fungal count, and specified pathogenic microorganisms
4	Heavy metal analysis	Lead, cadmium, arsenic, and mercury
5	Pesticide residue analysis	Organochlorine, organophosphorus, carbamate, and pyrethroid pesticide residues

iii. PREPARATION OF *TRIPHALADI KASHAYA*

A. Pre-processing of Raw Drugs

The raw drugs, namely *Haritaki*, *Vibhitaki*, *Amalaki*, *Patha*, *Mrdwika*, and *Jati* leaves, were manually cleaned to remove foreign matter, including dust, soil, and other extraneous materials. The drugs were washed, initially shade-dried and subsequently dried in a hot-air dryer to achieve uniform drying and reduce residual moisture. The dried drugs were then subjected to size reduction. Hard drugs were crushed before pulverisation. The raw materials were processed into coarse powder following standard guidelines recommended for *Kwatha Kalpana*, such that the powder completely passed through a 710 µm IS sieve (sieve no. 22) and not more than 10% passed through a 355 µm IS sieve (sieve no. 44).

✷ Specification of Dryer

Drying Equipment: Hot air dryer

- Type: Tray-type hot air dryer
- Temperature range: Ambient to 60°C
- Drying temperature used: 40–45°C
- Air circulation: Forced air circulation
- Control: Digital temperature controller
- Purpose: Uniform drying of raw drugs and reduction of moisture content without affecting thermolabile constituents.

B. Weighing and Mixing of Ingredients

The coarsely powdered drugs were weighed accurately in equal proportions, 8 g each of *Haritaki*, *Vibhitaki*, *Amalaki*, *Patha*, *Mrdwika* and *Jati* leaves, to obtain a total weight of 48 g. The weighed ingredients were mixed thoroughly to achieve a homogeneous drug mixture.

C. Decoction Process (*Kwathana*)

The coarsely powdered drug mixture (48 g) was transferred to a mud vessel and mixed with 768 mL of demineralised water (obtained by ion-exchange purification to remove dissolved inorganic ions and mineral impurities; the water obtained was utilised for the *Kashaya* preparation). The contents were heated mildly and then boiled until the volume was reduced to one-eighth of the initial volume, yielding 96 mL of *Triphaladi Kashaya*. The vessel was kept uncovered during boiling, and excessive stirring was avoided throughout the process.

D. Filtration (*Parisechana*)

After attaining the desired reduction, the decoction was filtered through a clean 4-layered muslin cloth while still warm to remove the marc and obtain a clear filtrate.

E. Cooling and Storage

After filtration, the Kashaya was left undisturbed until it reached room temperature. The decoction was used fresh for further pharmaceutical processing. Reheating or further concentration of the prepared Kashaya was not carried out.



Fig. 1: Coarse powder of the ingredients-48gm



Fig. 2: 768 ml of water



Fig.3: 96 ml of water added to the powder



Fig. 4: The 96 ml water level was marked



Fig. 5: Cooking of *Kashaya* in *Mrdu Agni*



Fig.6: *Kashaya* reduced up to 96ml



Fig.7: Filtration of the prepared *Kashaya*



Fig.8: Filtered *Kashaya*

3. RESULT

I). Macroscopic evaluation of raw drugs

The macroscopic characteristics of all raw drugs were found to be in accordance with the standard diagnostic features described in the Ayurvedic Pharmacopoeia of India.

a)Ingredients of *Triphaladi kashaya*



Fig.9:*Terminalia chebula* Retz (Dried fruit)



Fig.10:*Terminalia bellirica*(Garetn)Roxb (Dried fruit)



Fig.11: *Phyllanthus emblica* Linn. (Dried fruit)



Fig.12: *Cissampelos pareira* Linn. (Dried root)



Fig.13: *Vitis vinifera* Linn. (Dried fruit)



Fig. 14: *Jasminum grandiflorum* Linn. (Leaf)

II)Microscopic Evaluation of Raw Drugs:

1. Powder Microscopy of *Terminalia chebula* Retz. fruit pericarp.

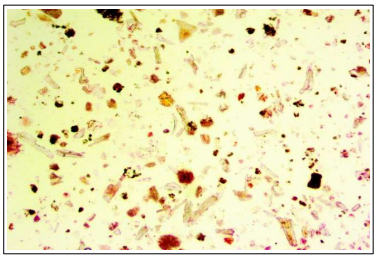


Fig.15 Powder microscopy showing mixed tissue fragments

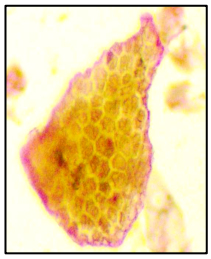


Fig.16:Epidermal cells

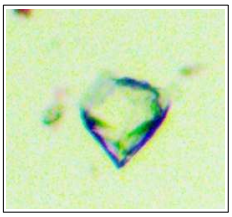


Fig.17:Calcium oxalate crystal

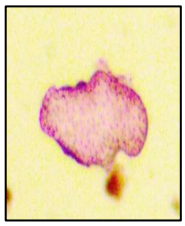


Fig.18 Stone cell

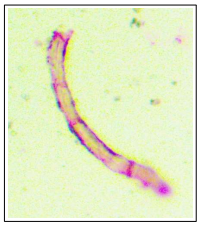


Fig.19: Lignified Fibre



Fig 20: Elongated sclereids

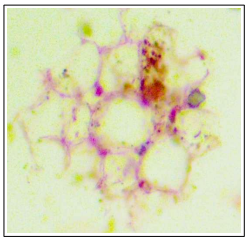


Fig. 21: Parenchymal cells containing starch grains

The powder microscopy of fruit rind revealed the presence of characteristic microscopic elements such as epidermal cell fragments with polygonal thick-walled cells, calcium oxalate crystals, stone cells (sclereids), elongated lignified fibres, irregular sclereids, and parenchymatous cells containing starch grains. These diagnostic features confirm the identity and purity of the *Haritaki*.

2.Powder microscopy of *Terminalia bellirica*(Gaertn).Roxb.

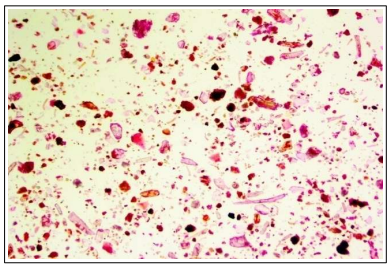


Fig.22 Powder microscopy showing mixed tissue fragments.



Fig. 23 Stone cell.



Fig.24 Epidermal hair

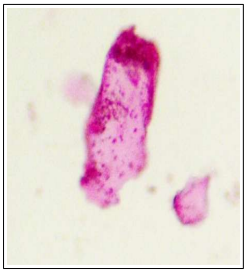


Fig.25 Rosette crystal of calcium oxalate

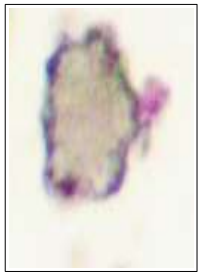


Fig.26 Irregular sclereid

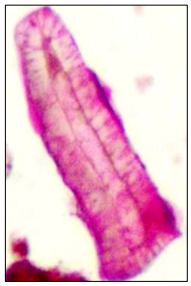


Fig.27 Pitted vessel element

Powder microscopy shows characteristic mixed tissue fragments. Diagnostic features include stone cells (sclereids) with thick lignified walls, epidermal hairs, rosette crystals of calcium oxalate, irregular sclereids, and pitted vessel elements. These features confirm the identity of the drug *Vibhitaki*.

3. Powder Microscopy of *Phyllanthus emblica* Linn.

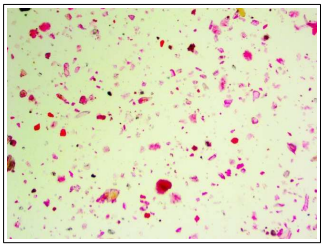


Fig.28 Powder microscopy showing mixed tissue fragments.

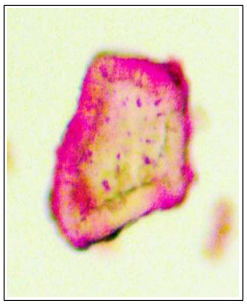


Fig.29 Stone cells (Scleride)



Fig.30: Fibre

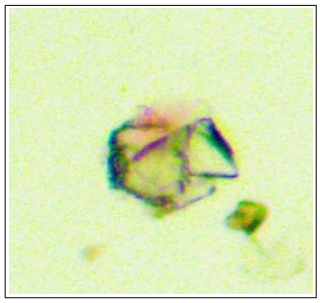


Fig.31 Prismatic crystal

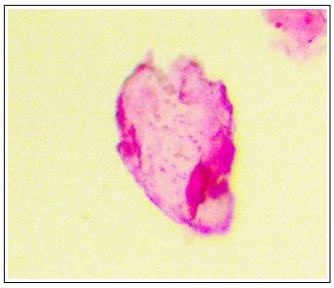


Fig.32 Pitted parenchyma

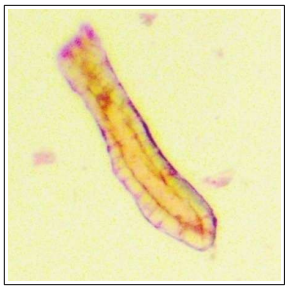


Fig.33 Sclereid fragment

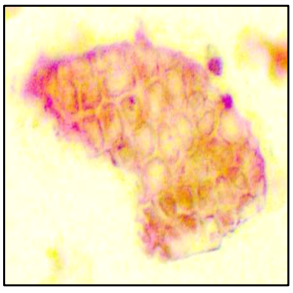


Fig.34 Epidermal cells

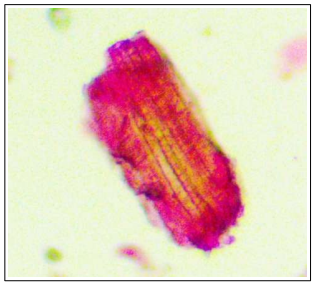


Fig.35 Scleride from endocarp

Revealed fragments of polygonal epidermal cells, parenchymatous mesocarp cells, elongated fibres, sclereids, vascular elements with characteristic wall thickenings, and aggregates of silica crystals. These features are in agreement with the microscopic description provided in the Ayurvedic Pharmacopoeia of India (API), thereby confirming the identity and authenticity of the crude drug *Amalaki*.

3. Powder microscopy of the dried root of *Cissampelos pareira* Linn.

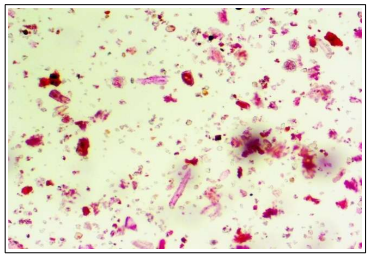


Fig.36 Powder microscopy showing mixed tissue fragments.

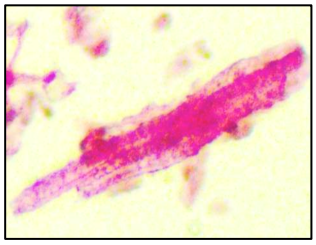


Fig.37 Xylem vessel

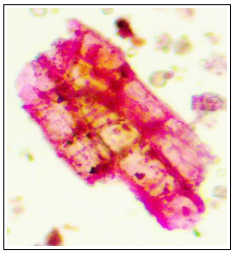


Fig.38 Tracheid

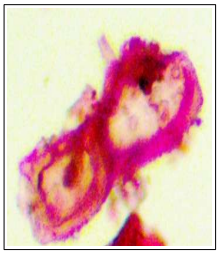


Fig.39 Stone cells

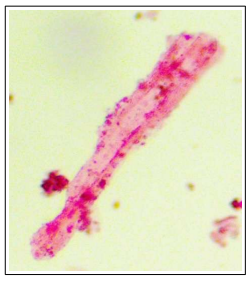


Fig. 40: Xylem fibre

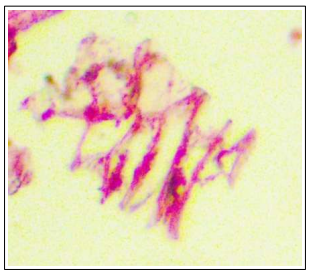


Fig.41 Cork in sectional view

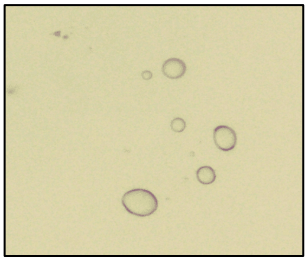


Fig.42 Starch grain

Revealed fragments of cork cells, stone cells with simple pits, F elements including vessels and tracheids, xylem fibres, ray parenchyma and numerous starch grains. These diagnostic microscopic features are consistent with the standard description provided in the Ayurvedic Pharmacopoeia of India (API), thereby confirming the identity and authenticity of the crude drug *Patha*.

4. Powder microscopy of the dried fruit of *Vitis vinifera* Linn

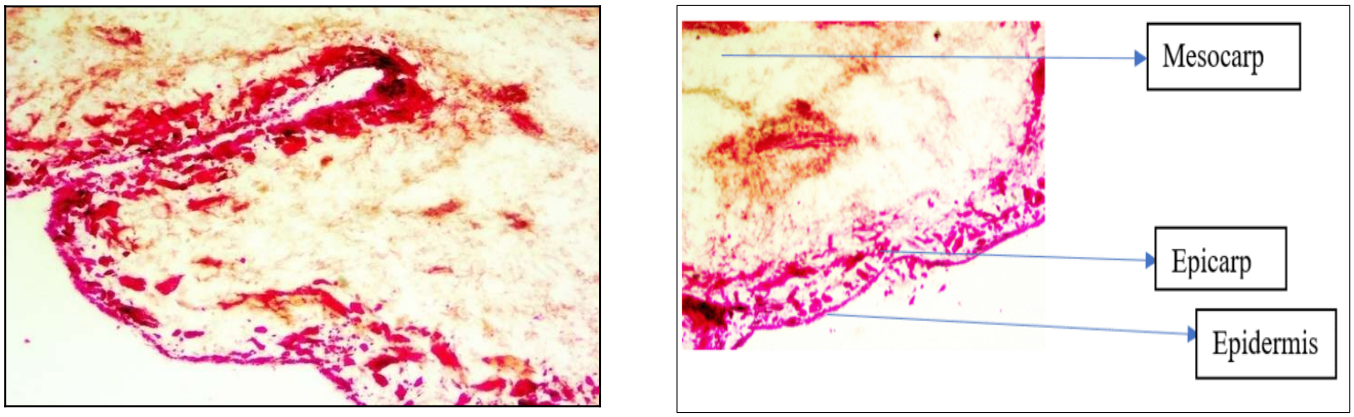


Fig.43 Longitudinal section (L.S.) of *Vitis vinifera* fruit

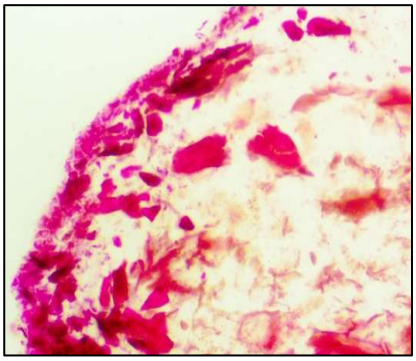
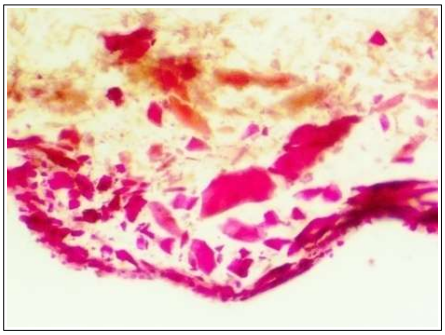


Fig.44 Epidermis filled with reddish-brown contents.



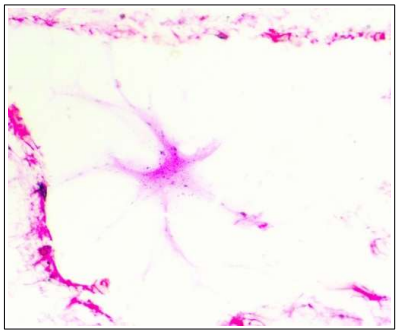


Fig.45 Endocarp region

Microscopic examination of the longitudinal section of *Vitis vinifera* fruit revealed a single-layered epidermis containing reddish-brown pigments, a pulpy mesocarp composed of thin-walled parenchymatous cells with prismatic calcium oxalate crystals, and scattered fibrovascular bundles. The seed consists of a thick-walled testa and an endosperm composed of angular parenchymatous cells containing oil globules and cluster crystals of calcium oxalate. These features are consistent with the microscopic description provided in the Ayurvedic Pharmacopoeia of India (API), confirming the identity and authenticity of the crude drug *Mrdwika*.

5. Microscopical evaluation of the *Jasminium grandiflorum*. Linn

a).Cross-section (c.s) of the *Jasminium grandiflorum*. Linn

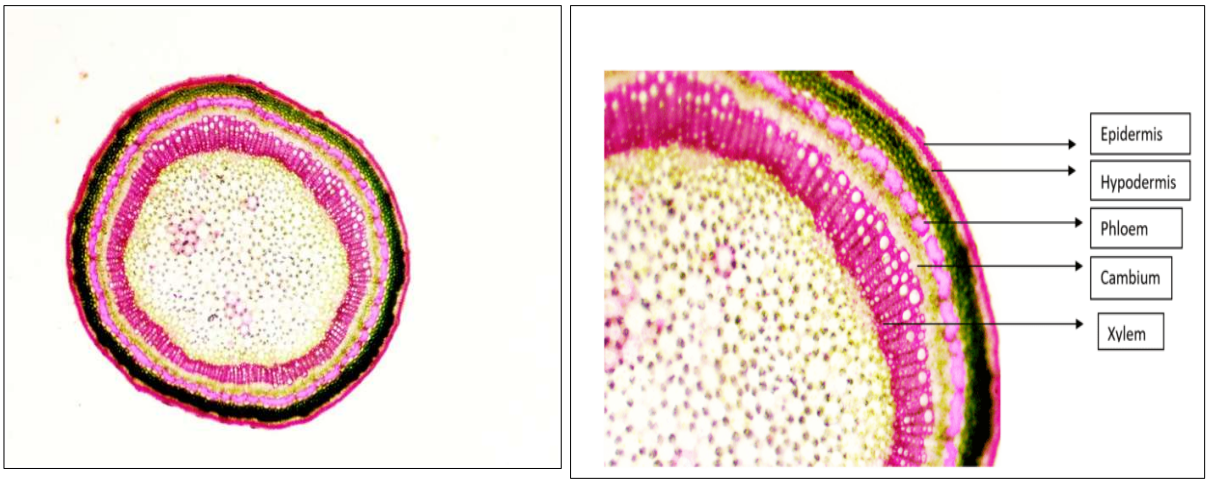


Fig.46: Cross-section (c.s.) of the stem of *Jasminum grandiflorum*. Linn

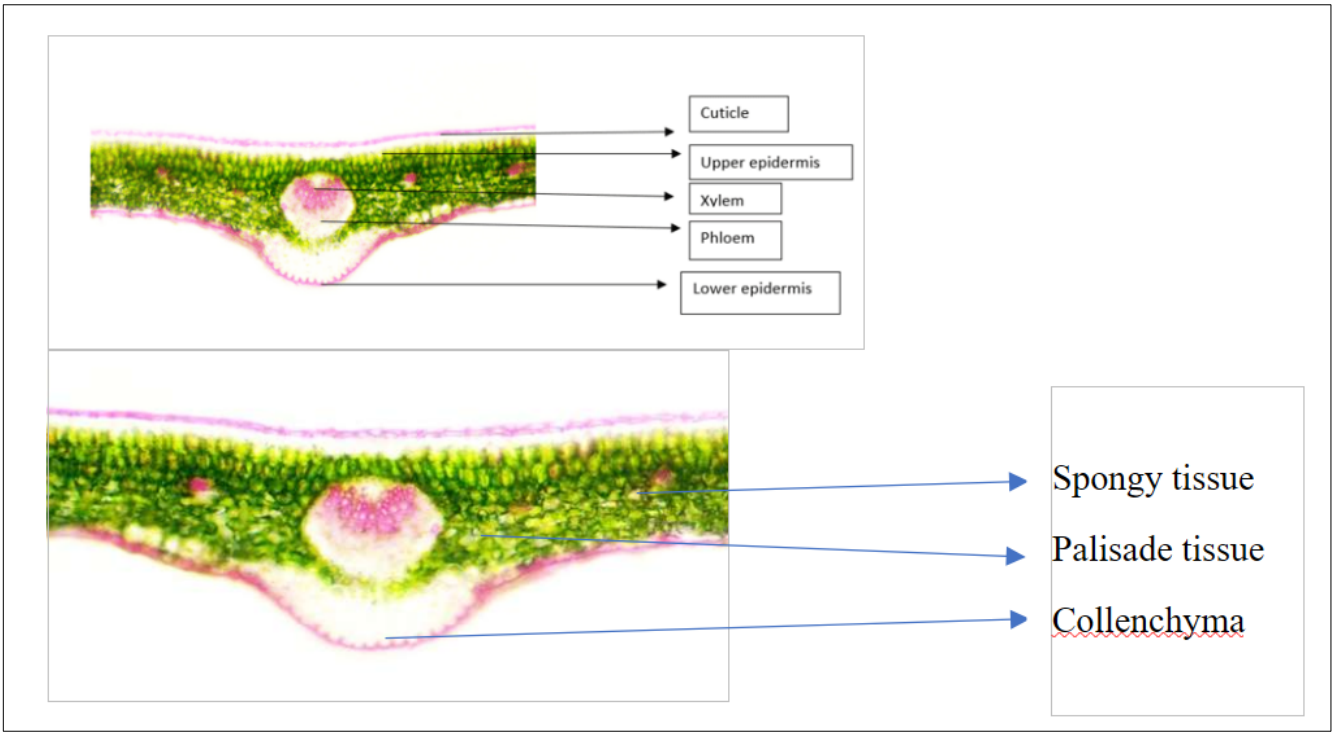


Fig.47: Cross-section of the leaf of *Jasminum grandiflorum* Linn

b). Powder microscopy of the leaf of *Jasminum grandiflorum* Linn.

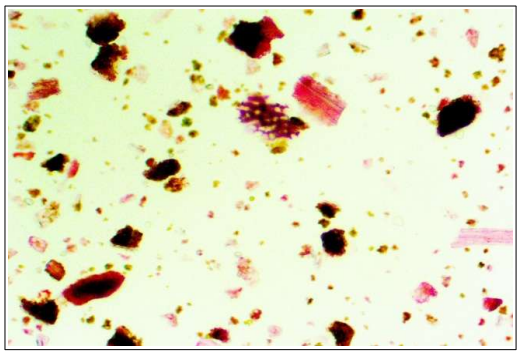


Fig.48 Powder microscopy showing mixed fragments.

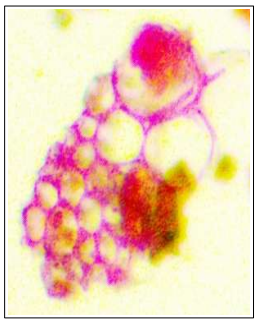


Fig.49 Upper epidermis

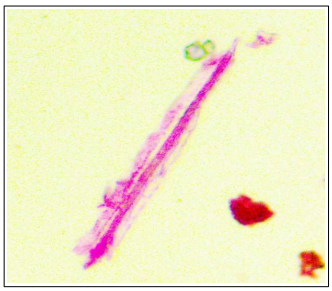


Fig.50 Fragments of fibres

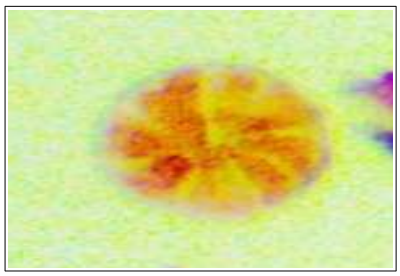


Fig.51 Sessile peltate glandular trichome

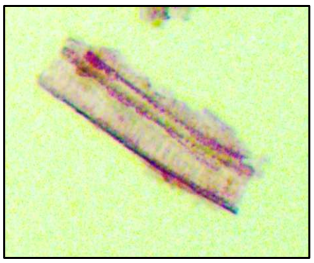


Fig.52 Pitted vessel

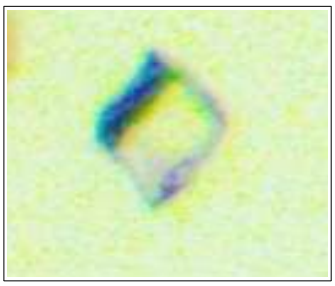


Fig.53 Lower epidermis

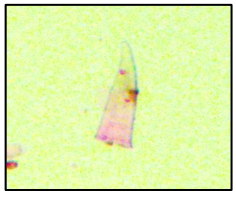


Fig.54 Prismatic crystal

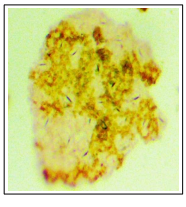


Fig.55 Unicellular trichome



Fig.56 Spiral vessels

Microscopic evaluation of *Jasminum grandiflorum* Linn. leaf showed characteristic anatomical features consistent with its pharmacognostical identity. The rachis exhibited lateral wings with a single-layered epidermis covered by a thick cuticle, along with unicellular trichomes and underlying collenchymatous tissue. The lamina displayed a typical dorsiventral arrangement comprising palisade and spongy parenchyma, with anomocytic stomata observed on the lower epidermis. Powder microscopy revealed diagnostic elements including fragments of palisade and spongy parenchyma, unicellular trichomes, fibres, polygonal epidermal cells with anomocytic stomata, and spiral vessels. These observed features were comparable with the standard description given in the Ayurvedic Pharmacopoeia of India, thereby confirming the identity of the leaf of *Jati*.

III. PHYSICOCHEMICAL PARAMETERS OF RAW DRUGS USED IN THE FORMULATION AS PER API STANDARDS.

The physicochemical parameters of all the raw drugs were found to comply with the standards prescribed in the Ayurvedic Pharmacopoeia of India (API), indicating their acceptable quality and suitability for use in the preparation of *Triphaladi Kashaya*.

Table No:11 Physicochemical Evaluation of Individual Ingredients

Drug	Foreign Matter	Moisture / LOD (%)	Total Ash (%)	Acid-Insoluble Ash (%)	Alcohol-Soluble Extractive (%)	Water-Soluble Extractive (%)
Haritaki	API: ≤1%Obs: **0.62%**	**4.81%**	API: ≤5%Obs: **3.84%**	API: ≤5%Obs: **4.80%**	API: ≥40%Obs: **66.53%**	API: ≥60%Obs: **61.25%**
Vibhitaki	API: ≤2%Obs: **0.96%**	**5.62%**	API: ≤7%Obs: **5.03%**	API: ≤1%Obs: **0.45%**	API: ≥8%Obs: **38.76%**	API: ≥35%Obs: **49.51%**
Amalaki	API: ≤2%Obs: **0.54%**	**6.49%**	API: ≤7%Obs: **3.12%**	API: ≤2%Obs: **0.20%**	API: ≥40%Obs: **49.31%**	API: ≥50%Obs: **69.16%**
Patha	API: ≤2%Obs: **0.48%**	**4.33%**	API: ≤7%Obs: **6.77%**	API: ≤1%Obs: **0.57%**	API: ≥11%Obs: **15.36%**	API: ≥13%Obs: **15.29%**
Mrdwika	API: ≤2%Obs: **0.59%**	API: ≤15%Obs: **3.73%**	API: ≤3%Obs: **2.02%**	API: ≤0.2%Obs: **0.17%**	API: ≥25%Obs: **85.02%**	API: ≥70%Obs: **73.81%**
Jati	API: ≤2%Obs: **0.73%**	**6.67%**	API: ≤6%Obs: **5.82%**	API: ≤0.5%Obs: **0.42%**	API: ≥18%Obs: **20.43%**	API: ≥25%Obs: **26.01%**

IV. ANALYSIS OF HONEY



Fig.57 Honey

a)Organoleptic and physicochemical analysis of honey

Table No.12: Organoleptic and Physicochemical Analysis of Honey.

Parameter	Obtained Value	Standard Limit	Result
Description	Yellowish-brown coloured semisolid with a characteristic odour	—	Complies
Weight per ml	1.4361 g/ml	NLT 1.35 g/ml	Within limit
P^H	4	NMT 4.5	Within limit
Moisture	17.1344 %	NMT 25 %	Within limit
Reducing sugar	54.7024 %	NMT 65 %	Within limit
Sucrose	2.5 %	NMT 5 %	Within limit
Fructose–Glucose ratio	1.2	NLT 1	Within limit
Ash	0.3449 %	NMT 0.50 %	Within limit
Acidity (as formic acid)	0.0120 %	NMT 0.2 %	Within limit
Hydroxymethylfurfural (HMF)	Nil	Should be absent	Complies
Fiehe's test	Negative	Should be negative	Complies
Aniline chloride test	Negative	Should be negative	Complies

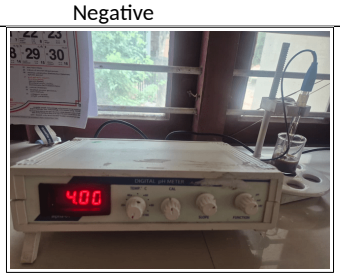


Fig.58 P^H of honey

b)Phytochemical screening of honey



Fig.59. Biuret test showing the presence of proteins in honey. The formation of a violet-to-purple colouration upon addition of Biuret reagent indicates a positive protein reaction, confirming the presence of peptide bonds in the honey sample.

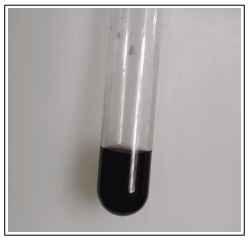


Fig.60. Positive Ferric Chloride Test for Phenolic Compounds in Honey. Formation of a dark blue-black colouration upon addition of ferric chloride reagent indicates the presence of phenolic compounds in the honey sample.

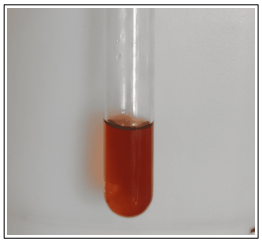


Fig.61 Positive Shinoda Test for Flavonoids in Honey. Development of a characteristic pink colouration following the addition of magnesium turnings and concentrated hydrochloric acid confirms the presence of flavonoids in the honey sample.

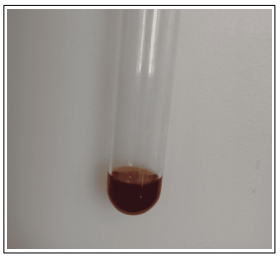


Fig.62 Positive Salkowski Test for Terpenoids in Honey. The development of a reddish-brown colouration at the interface upon addition of concentrated sulphuric acid indicates the presence of terpenoid compounds in the honey sample.

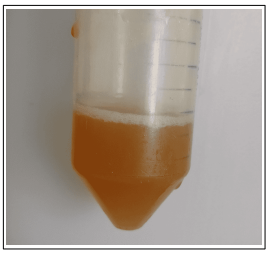


Fig.63 Positive Foam Test for Saponins in Honey. Formation and persistence of a stable froth layer after vigorous shaking indicate the presence of saponins in the honey sample.

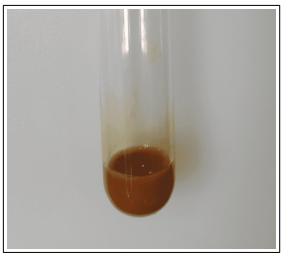


Fig.64 Positive Benedict's Test for Carbohydrates in Honey. Formation of an orange to brick-red precipitate upon heating with Benedict's reagent indicates the presence of reducing sugars and confirms the presence of carbohydrates in the honey sample.

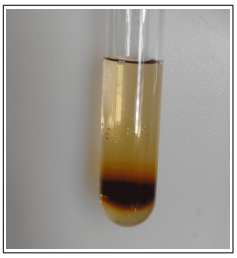


Fig.65 Positive Keller–Killiani Test for Glycosides in Honey. Formation of a distinct reddish-brown ring at the interface between the two liquid layers indicates a positive reaction for glycosides in the honey sample

c)Microbial analysis of honey

Table No.13: Microbiological Analysis of Honey

Parameter	Obtained Value	Permissible Limit	Result
Total bacterial count	100 cfu/ml	NMT 100000 cfu/ml	Within limit
Yeast & mould	<10 cfu/ml	NMT 1000 cfu/ml	Within limit
E. coli	Absent	Absent in 1 ml	Complies
Salmonella	Absent	Absent in 10 ml	Complies
Pseudomonas	Absent	Absent in 1 ml	Complies
Staphylococcus aureus	Absent	Absent in 1 ml	Complies

d)Heavy metal analysis of honey

Table No.14: Heavy Metal Analysis of Honey

Metal	Result	Limit	Interpretation
Lead	Nil	NMT 10 ppm	Within limit
Arsenic	Nil	NMT 3 ppm	Within limit
Mercury	Nil	NMT 1 ppm	Within limit
Cadmium	Nil	NMT 0.3 ppm	Within limit

e) Pesticide residue analysis of honey

Table No.15: Pesticide Residue Analysis of Honey

Parameter	Result	Limit	Interpretation
Total organochlorine	Nil	NMT 1 ppm	Within limit
Total organophosphorus	Nil	NMT 1 ppm	Within limit

V. ANALYSIS OF *TRIPHALADI KASHAYA*



Fig. 66 Triphaladi Kashaya

A. Organoleptic evaluation of *Kashaya*

Table No:16 Organoleptic Evaluation of the Finished Kashaya

Parameter	Observation
Colour	Light brown
Odour	Characteristic
Taste	Bitter, Astringent
Turbidity	Slightly turbid
Suspended particles	Little

B. Physicochemical Parameters of the Finished *Kashaya*

Table No.17: Physicochemical parameters of Kashaya

Sl. No.	Parameter	Result
1	pH	3.92
2	Specific gravity / Density (g/mL)	1.0358
3	Total solids / % Dry residue (w/w)	11.3397
4	Refractive index	1.349
5	Brix (°Bx) / Soluble solids (%)	10degree



Fig.67: P^{H} of the *Triphaladi kashaya*

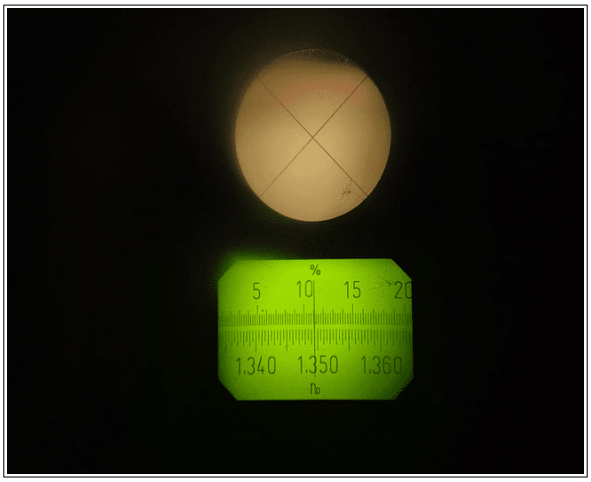


Fig.68:Refractive index of *Triphaladi kashaya*

C. Total Phenolic Content Evaluation

Total Phenol = (Calculated concentration / Sample concentration) × 98

= (7.97 / 2073.9) × 98

= 0.38 % w/w

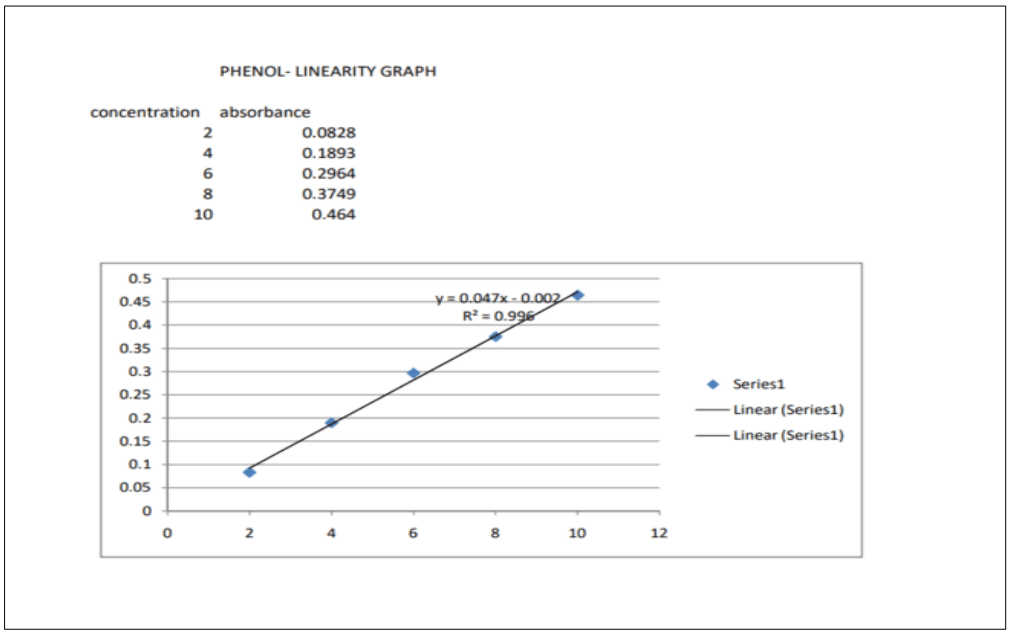


Fig.69 Phenol - Linearity graph

The total phenolic content of the sample was 0.38% w/w, expressed as tannic acid equivalents. This level can be considered moderate for *Triphaladi Kashaya*. It indicates the presence of sufficient phenolic constituents that contribute to antioxidant and therapeutic activity.

D. Phytochemical screening of *Triphaladi kashaya*

Present: Carbohydrates, tannins, phenols, saponins, terpenoids, flavonoids

Absent: Alkaloids, glycosides, steroids, sterols, proteins, anthraquinones.



Fig. 70: Positive Salkowski test indicating the presence of terpenoids in *Triphaladi Kashaya*, evidenced by the formation of a reddish-brown ring at the interface after the addition of concentrated sulphuric acid.

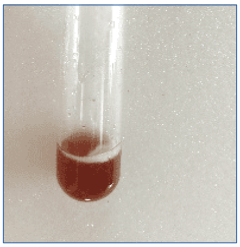


Fig.71: Positive Shinoda test indicating the presence of flavonoids in *Triphaladi Kashaya*, evidenced by the development of characteristic pinkish-red colouration following the addition of magnesium ribbon and concentrated hydrochloric acid.



Fig. 72: Positive lead acetate test indicating the presence of tannins in *Triphaladi Kashaya*, evidenced by the formation of a whitish precipitate due to the formation of an insoluble lead tannate complex.



Fig.73: Positive ferric chloride test indicating the presence of phenolic compounds in *Triphaladi Kashaya*, evidenced by the development of a characteristic dark blue to blackish colouration after addition of ferric chloride solution.



Fig.74: Positive Molisch's test indicating the presence of carbohydrates in *Triphaladi Kashaya*, evidenced by the formation of a characteristic violet ring at the junction after addition of Molisch reagent and concentrated sulphuric acid.



Fig.75. Saponin Test (Foam Test) of *Triphaladi Kashaya*. The test solution showed the formation of a stable persistent froth/foam layer upon vigorous shaking, indicating the presence of saponins in the sample.

E. Microbial analysis of *Triphaladi Kashaya*

Table No.18: Microbial analysis result of *Triphaladi Kashaya*

Sl. No.	Parameter	Result	Specification (Limit)
1	Total bacterial count (cfu/g)	20	NMT 100000
2	Total yeast and mould count (cfu/g)	30	NMT 1000
3	*Escherichia coli*	Absent	Should be absent in 1 g
4	*Salmonella typhi*	Absent	Should be absent in 10 g
5	*Pseudomonas aeruginosa*	Absent	Should be absent in 1 g
6	*Staphylococcus aureus*	Absent	Should be absent in 1 g

F. Heavy Metal Analysis (ICP-OES) of the Kashaya

Table No.19:Heavy metal analysis results of Kashaya

Sl. No.	Parameter	Result	Specification (Limit)
1	Arsenic (ppm)	Nil	NMT 3
2	Cadmium (ppm)	0.01	NMT 0.3
3	Lead (ppm)	Nil	NMT 10
4	Mercury (ppm)	Nil	NMT 1

4. DISCUSSION

Triphaladi Kashaya is a classical Ayurvedic polyherbal formulation indicated for the management of *Mukharoga*. Although it has been used in clinical practice for centuries, comprehensive pharmaceutical quality data on the formulation are limited. Establishing standard quality parameters is therefore essential to ensure consistency, safety and reproducibility, while also facilitating its acceptance in evidence-based research and pharmaceutical practice.

The quality of a herbal formulation begins with the quality of its raw materials. Factors such as botanical identity, geographical origin, harvesting season, processing methods and storage conditions can influence the phytochemical composition of medicinal plants and, consequently, the quality of the finished product. For this reason, authentication and quality assessment of every ingredient were carried out before the preparation of *Triphaladi Kashaya*. This ensured that only genuine raw materials complying with recognised quality standards were used for pharmaceutical processing.

Particular attention was given to the selection of *Laghu Patha* (*Cissampelos pareira* Linn.), as more than one botanical source has traditionally been used under the name *Patha*. Correct identification of this drug is important for preserving the classical composition of the formulation and maintaining uniformity in its phytochemical profile. Fresh *Jati* leaves and quality-tested natural honey were also selected to maintain the integrity of the formulation and to provide phytoconstituents known to possess wound-healing, antimicrobial and anti-inflammatory activities.

The systematic evaluation of the raw materials provided a sound foundation for the pharmaceutical preparation of *Triphaladi Kashaya*. Careful selection, authentication and quality assessment of each ingredient reduced the likelihood of variation in the finished product and contributed to the development of a formulation with consistent pharmaceutical quality. These observations also provide baseline information that can be used for routine quality control and future standardisation of this classical Ayurvedic formulation.

The quality of any polyherbal formulation depends largely on the identity and purity of its constituent raw materials. Therefore, pharmacognostical evaluation was undertaken as an essential step to ensure that each ingredient used in the preparation of *Triphaladi Kashaya* was genuine and free from adulteration. The macroscopic characteristics observed for all the raw drugs corresponded with the descriptions provided in the *Ayurvedic Pharmacopoeia of India*. Likewise, microscopic examination revealed characteristic anatomical features such as sclereids, lignified fibres, vessel elements, calcium oxalate crystals, starch grains, epidermal cells and trichomes, which served as reliable diagnostic markers for confirming the botanical identity of the respective plant materials. These findings confirmed that the crude drugs used in the present study were authentic and suitable for pharmaceutical processing.

Physicochemical evaluation further supported the quality of the selected raw materials. All the analysed drugs complied with the limits prescribed in the *Ayurvedic Pharmacopoeia of India* for parameters including foreign matter, total ash, acid-insoluble ash, alcohol-soluble extractive and water-soluble extractive. The low foreign matter content indicates proper collection, cleaning and handling of the crude drugs, while the acceptable moisture content suggests adequate drying, thereby reducing the possibility of microbial growth and deterioration during storage. Similarly, the ash values indicate minimal contamination with inorganic impurities such as soil and siliceous matter, reflecting the good quality of the plant materials used in the formulation.

Extractive values are important indicators of the amount of soluble phytoconstituents present in crude drugs and are commonly used to assess their quality and consistency. The satisfactory water- and alcohol-soluble extractive values obtained for all the ingredients suggest the presence of adequate quantities of extractable bioactive constituents. Since *Triphaladi Kashaya* is a water-based decoction, the favourable water-soluble extractive values are particularly relevant, as they indicate efficient extraction of therapeutically important constituents during the preparation of the formulation. Overall, the pharmacognostical and physicochemical findings confirm that all the raw materials met the required quality standards and provided a dependable basis for the preparation and analytical standardisation of *Triphaladi Kashaya*.

The pharmaceutical process adopted for *Triphaladi Kashaya* was based on the classical principles of *Kwatha Kalpana*, where the extraction of therapeutic constituents depends on careful control of each processing step. Uniformity in particle size, quantity of water, duration of heating and method of filtration is essential for obtaining a decoction with consistent composition and reproducible quality.

Preparation of the ingredients as coarse powder was an important pharmaceutical step. Coarse particles allow better diffusion of soluble constituents into the aqueous medium during boiling while preventing the excessive release of fine plant debris into the final decoction. Controlled drying before pulverisation also reduced the moisture content of the crude drugs without exposing them to excessive heat, thereby helping preserve constituents susceptible to thermal degradation. These measures contribute to the stability and uniformity of the finished preparation.

The classical reduction of the decoction to one-eighth of its original volume concentrates the soluble constituents extracted from the herbal ingredients. Gentle heating facilitates gradual extraction while limiting undesirable changes that may occur at higher temperatures. Filtration of the warm decoction removed coarse insoluble material, yielding a preparation suitable for pharmaceutical evaluation. Avoiding reheating after preparation further minimised changes in the chemical composition of the decoction.

The sensory characteristics of the finished *Triphaladi Kashaya* reflected the nature of its herbal constituents. The light brown colour is consistent with the extraction of polyphenols and tannins from the formulation, whereas the bitter and astringent taste corresponds to the predominance of *Tikta* and *Kashaya Rasa* of the constituent drugs. Slight turbidity is commonly observed in freshly prepared herbal decoctions because of naturally occurring colloidal substances and suspended phytoconstituents and does not necessarily indicate poor quality.

Physicochemical evaluation generated objective quality parameters that can serve as reference standards for future batches. The acidic pH may be attributed to the presence of naturally occurring organic acids, and tannins contributed mainly by the *Triphala* ingredients. Measurements such as specific gravity, total solids, refractive index and °Brix reflect the concentration of dissolved constituents extracted during decoction and provide useful indicators for monitoring consistency during pharmaceutical production.

The presence of measurable phenolic content further supports the chemical profile of the formulation. Phenolic compounds are recognised for their free radical scavenging ability and their contribution to anti-inflammatory, antimicrobial and tissue repair mechanisms.[36] Since several ingredients of *Triphaladi Kashaya* are naturally rich in polyphenols, the observed phenolic content is consistent with the expected composition of the formulation and may contribute to its therapeutic activity.

Phytochemical screening demonstrated the presence of tannins, phenols, flavonoids, terpenoids, saponins and carbohydrates. Rather than acting independently, these constituents are likely to exert complementary pharmacological effects. Tannins possess astringent properties that promote tissue contraction, flavonoids and phenolic compounds help counter oxidative stress, while terpenoids and saponins have been associated with antimicrobial and anti-inflammatory activities. The coexistence of these phytochemical groups supports the concept of synergism that underlies many classical polyherbal formulations.[37]

Microbiological examination confirmed that the microbial load remained well within the prescribed limits and that common pathogenic organisms were absent, indicating satisfactory hygienic conditions during preparation. Heavy metal analysis likewise demonstrated compliance with permissible limits, with arsenic, lead and mercury not detected and cadmium present only in trace amounts. These findings establish the microbiological and toxicological safety of the formulation and strengthen its suitability for pharmaceutical use.

Overall, the pharmaceutical procedure yielded a decoction that satisfied the essential quality requirements with respect to identity, physicochemical characteristics, phytochemical composition and safety. The data generated in this study provide practical reference values for routine quality control and support the standardisation of *Triphaladi Kashaya* for future pharmaceutical and clinical investigations.

The findings of this study provide pharmaceutical quality data for *Triphaladi Kashaya* through the application of classical Ayurvedic pharmaceutical methods together with modern analytical techniques. The use of authenticated raw materials, a standardised method of preparation, and evaluation of organoleptic, physicochemical, phytochemical and safety parameters ensured the quality and consistency of the formulation. The values generated in this study can be used as baseline quality standards for routine quality control and for maintaining batch-to-batch consistency during pharmaceutical preparation. These observations also add to the available scientific information on *Triphaladi Kashaya* and may support future pharmaceutical and clinical research on this classical formulation.

Conclusion

The pharmaceutical evaluation of *Triphaladi Kashaya* generated a set of quality parameters that can serve as reference standards for this classical Ayurvedic formulation. Careful authentication of the raw materials, adherence to the classical method of preparation, and systematic analytical evaluation ensured the consistency and quality of the finished *Kashaya*. The observed organoleptic characteristics, physicochemical properties and phytochemical profile reflected the expected composition of the formulation, while microbiological, heavy metal and pesticide residue analyses confirmed its safety for pharmaceutical use. These observations provide a scientific basis for the quality assessment of *Triphaladi Kashaya* and may facilitate its routine standardisation in pharmaceutical practice. The data generated may also support future pharmacological investigations, dosage form development and well-designed clinical studies, thereby contributing to the broader scientific validation of this classical Ayurvedic formulation.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest.

GUARANTOR

The guarantor of this article and its content is the corresponding author.

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