

Preparation, Pharmaceutico-analysis and Dosage Standardisation of Priyanguvadi Syrup for Common Childhood Ailments

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ABSTRACT

Introduction: Priyanguvadi Kalka, a traditional herbal paste, is mentioned in Bhaishajya Ratnawali, specifically in the Balrogadhikar Adhyaya, which is dedicated to child health and ailments. Traditionally combined with honey, Priyanguvadi Kalka is used to treat diarrhea, vomiting, fever, and dehydration-induced thirst in children, given its cooling, antipyretic, antiemetic, and antibacterial properties. However, its bitter taste, short shelf life, and paste form make it less suitable for children. Converting this paste into a sugar syrup would enhance its palatability, shelf life, and efficacy.

Aim: The aim of this study is the modification, preparation, and standardisation of Priyanguvadi syrup and to study the pharmaceutico-analytical properties of the syrup.

Materials and Methods: This pharmaceutico-analytical study was conducted between September 2023 and January 2024 at Mahatma Gandhi Ayurved College Hospital and Research Centre Datta Meghe Institute of Higher Education and Research (Deemed to be University), Wardha, Maharashtra, India. Relevant Ayurvedic texts and research on each ingredient were

reviewed. Raw drugs were collected, authenticated, and then used to prepare the syrup following standardised methods. The preparation of the syrup, including packaging, was completed within three days. Pharmaceutical analysis was conducted to ensure safety for children.

Results: The study successfully developed Priyanguvadi syrup, characterised by its brown colour and sweet taste, and confirmed through analysis to be safe for pediatric use. The syrup form enhances palatability, stability, and ease of dosage calculation for children. It can remain effective for up to one year without requiring refrigeration.

Conclusion: All the ingredients help balance doshas and exhibit antiemetic, antidiarrheal, antimicrobial properties while supporting digestion. Priyanguvadi syrup can effectively treat vomiting, diarrhea, dehydration, and other gastrointestinal issues in young children, improving digestion without causing harm, thus reducing the need for suppressive medicines and antibiotics. The syrup form makes it palatable, stable, and suitable for children's dosing.

Keywords: Ayurveda, *Badriphala majja*, *Musta*, *Priyangu*, Priyanguvadi kalka, Rasanjan, Traditional medication

INTRODUCTION

Kaumarabhritya tantra is one of the eight branches of Ayurveda, which deals with the study of development, care, and well-being of children, as well as the treatment of diseases related to them. This branch not only aids in managing diseases in the pediatric age group but also provides valuable information related to pediatric care, immunity, various rogavasthas (stages of diseases) in children, and food recommendations for children and lactating mothers right from birth. In Ayurveda, detailed descriptions of the preparation of medicines for children are given to ensure safety, palatability, and ease of administration. The most commonly used forms of Ayurvedic medicines for pediatric use are *Leha*/*Avaleha* (jams or pastes that contain honey or sugar), *Churna* (powdered herbs), *Ghrita* (medicated ghee), and *Kashayam* or *Kadha* (decoctions) [1]. However, most of these preparations have strong smells and tastes, making them less palatable for children compared to modern sugar syrup forms, which are more palatable and easier to administer in home settings for all pediatric age groups.

Diarrhea and vomiting affect about 1.7 billion children globally each year, accounting for 46% of total gastrointestinal ailments, with the highest prevalence in those under-five, causing dehydration in children, which is a leading cause of death in this age group [2]. Priyanguvadi Kalka (herbal paste with *Priyangu* - *Callicarpa monophylla* (Linn) as the major ingredient) is a formulation mentioned in Bhaishajya Ratnawali, specifically in the 71st chapter named Balrogadhikar Adhyaya, which focuses on child health, common ailments, and the medicines that can be used for their treatment [3]. Priyanguvadi Kalka (paste) is combined with honey and indicated in *Leha* form for the treatment of vomiting, diarrhea, excessive thirst,

dehydration, and burning sensations in children. It is also beneficial for various other childhood ailments, such as gastrointestinal problems and blood disorders in their initial stages [3]. Patel A et al., covered the properties of *Priyangu* in detail in their systematic review, highlighting its significance in treating gastrointestinal ailments in children [4]. However, its bitter taste, short shelf-life, and paste form make it less suitable for children. The present study was conducted to address these challenges, modifying the Kalka form to a syrup to make it more palatable, less perishable, and easier for parents to calculate doses. All analyses of the syrup have been performed to check its safety and palatability for children.

The study aims to develop a cost-effective, palatable herbal remedy with an extended shelf life, designed to treat common childhood ailments such as vomiting, diarrhea, fever, and dehydration, while being easy for parents to administer at home. By utilising Ayurvedic formulations, the study seeks to provide holistic treatment by enhancing digestive health and addressing the root causes of vomiting and digestive disorders. Additionally, it focuses on minimising the use of suppressive medicines and antibiotics, thereby preventing resistance and prioritising the treatment of underlying issues to improve overall digestion.

MATERIALS AND METHODS

This pharmaceutico-analytical study was conducted between September 2023 and January 2024. at Mahatma Gandhi Ayurved College Hospital and Research Centre Datta Meghe Institute of Higher Education and Research (Deemed to be University), Wardha, Maharashtra, India.

Study Procedure

To assess the quality of the syrup, analyses of organoleptic parameters, physicochemical parameters, and microbial agents were performed. Organoleptic evaluation involved assessing the sensory properties of the syrup, including its colour, odour, taste, texture, and clarity. The color was observed visually and compared with a standard sample or assessed using a colorimeter. The scent was evaluated by smelling the syrup, noting any specific aromas from the ingredients. A panel of evaluators tasted the syrup to assess its sweetness, bitterness, or other flavors, comparing it with expected outcomes. The consistency and mouthfeel were evaluated by assessing its viscosity, smoothness, and thickness, while clarity was checked visually or using a turbidity meter.

Physicochemical tests measured the chemical and physical properties of the syrup to ensure its stability, safety, and quality. The pH of the syrup was measured using a pH meter to ensure it was within a safe range for consumption (typically between 4 and 7 for syrups). The density was measured using a pycnometer or density meter to assess the syrup's concentration. Viscosity was measured using a viscometer to ensure the syrup was not too thick or too thin for appropriate dosage. The refractive index was measured to confirm the concentration of active ingredients, while the sugar content was assessed using polarimetry or by calculating the Brix value with a refractometer. Moisture content was measured using a moisture analyzer or the oven drying method.

Microbial testing ensured that the syrup was free from harmful microorganisms. The Total Plate Count (TPC) test measured the total number of viable microorganisms in the syrup, typically performed using agar plate counting methods. Yeast and mold counts were assessed using specific culture media like Sabouraud agar. Pathogenic bacteria testing checked for harmful bacteria such as *E. coli*, *Salmonella*, *Staphylococcus aureus*, etc., using selective media and biochemical tests, including Polymerase Chain Reaction (PCR) and culture methods. Endotoxin testing was performed using the Limulus Amebocyte Lysate (LAL) test to check for endotoxins, which can be harmful in pediatric formulations. Each of these parameters ensured that the syrup was of high quality, safe for consumption, and stable over time.

Ingredients of Priyangvadi kalka: As mentioned in Bhaishajya Ratnawali, in the 71st Adhyaya (chapter) titled Balrogadhikar Adhyaya:

“कल्कः प्रियङ्गु कोलास्थिमध्यमुस्तरसान्जनै ।
क्षौद्रलिङ्गः कुमारस्य चर्दी तृष्णातिसारनुत् ॥” (B.R.71) [3]

The ingredients of Priyangvadi Kalka are:

- *Priyangu* (*Callicarpa monophylla* Linn)
- *Badriphal majja* (*Ziziphus jujuba* Mill)
- *Daruharidra Rasanjana* (*Berberis aristata* DC)
- *Musta* (*Cyperus rotundus* Linn)

All ingredients are used in equal quantities. Additionally, honey (Madhu) is added for taste and as a property enhancer, contributing to a leha (lick) like consistency, as mentioned in [Table/Fig-1,2]. The properties of each ingredient in Priyangvadi Kalka are listed below.

S. No.	Name of herb	Scientific name	Family name	Part used	Proportion
1.	<i>Priyangu</i> (beautyberry)	<i>Callicarpa monophylla</i> Vahl	Verbenaceae	Beej (seeds)	10 gm/100 mL
2	<i>Badari phala majja</i>	<i>Ziziphus jujubalam</i> Mill	Rhamnaceae	<i>Phala majja</i> (fruit- pulp)	10 gm/100 mL
3	<i>Daruharidra</i>	<i>Berberis aristata</i> Dc	Berberadaceae	Stem and roots	10 gm/100 mL
4	<i>Musta</i>	<i>Cyperus rotundus</i> Linn	Cyperaceae	Rhizomes	10 gm/100 mL

[Table/Fig-1]: Ingredients, parts used and their proportions for preparation of Priyangvadi Syrup.

S. No.	Name of herb	Rasa (taste)	Virya (po-tency)	Vipaka (ef-fect after digestion)	Guna (proper-ties)	Pradhan karma (thera-peutic actions)
1	<i>Priyangu</i>	Tikta-Kashaya-Madhura	Sheeta (cold)	Katu	Guru, ruksha	Deepan, Vatanuloman, Sthambhan, Chhardighna
2	<i>Badari phala majja</i>	Madhura-Amla-Kashaya	Sheeta (cold)	Madhura	Guru, snigdha, pichhila	Hrudya, deepaniya, Chhardi-nigrahaniya, daha shamak, vranaropak
3	<i>Daruharidra (rasanjana)</i>	Tikta-Kashaya	Ushna (hot)	Katu	Laghu, ruksha	Pitta-kaphaghna, aam-pachan, deepan, ruchikar, Saumya virechaka, Raktshodhan
4	<i>Musta</i>	Tikta-katu-Kashaya	Sheeta (cold)	Katu	Laghu, ruksha	Deepan, pachana, sangrahi, trishna-nigrahan

[Table/Fig-2]: Rasapanchak (include five things such as Rasa (taste), virya (potency), vipaka (effect post digestion), Guna (properties) and karma (therapeutic actions)) of all ingredients.

Authentication of Raw Drugs: All raw drugs were authenticated based on external features and organoleptic characteristics, confirming their identity at the Department of Dravyaguna, Mahatma Gandhi Ayurved College Hospital and Research Center, Salod (Hi), Wardha.

Methods of preparation: Scientific preparation methods were followed step-by-step, as shown in [Table/Fig-3], detailed below:

- 1) All the raw drugs were collected and cleaned thoroughly. The ingredients, their parts used, and their proportions for the syrup are mentioned in [Table/Fig-3a].



[Table/Fig-3]: Step by step preparation of Priyangvadi syrup.

- 2) A standardised method, with slight modifications, was adopted for the preparation and drug dose adjustment of Priyangvadi Kalka, as done by Gokarn R et al., for Balchaturbhadra syrup [5].
- 3) Each raw drug was weighed using an electric weighing machine, ensuring equal quantities of each.
- 4) The total quantity of raw drugs was measured, and all the ingredients were added to a stainless steel vessel along with 16 parts of water.
- 5) Once the 1/8th decoction was prepared, it was strained using a double-layered cotton cloth into another vessel [Table/Fig-3c].
- 6) Then, 65% sugar (65% w/v of the kwath) was added, and the mixture was heated on low flame until a one-thread consistency was achieved [Table/Fig-3d].
- 7) The syrup was allowed to cool overnight at room temperature, then filtered and weighed.
- 8) Lastly, 10% honey was added to increase shelf life, enhance medicinal properties, and improve palatability for children by enhancing the taste.
- 9) The syrup was then stored in 100 mL airtight bottles at room temperature [Table/Fig-3e].

Dosage calculations in paediatric age group: For Ayurvedic preparations like syrup or kwath, the dose is determined based on the adult dose as mentioned in *Sharangdhar Samhita*. The adult dose as per *Sharangdhar Samhita* is Ardhapala=24 mL for adults [6].

Based on this adult dose, we can calculate the dose for the pediatric age group using Young's formula:

Dose Calculation by Young's Formula:

$$\frac{\text{Age (years)} \times \text{Adult dose}}{\text{Age (years)} + 12}$$

STATISTICAL ANALYSIS

Data were analysed using descriptive statistics.

RESULTS

The color of the kwath after being reduced to 1/8th was observed to be light brown. When the sugar was added, excessive frothing occurred, which required continuous observation and stirring. An effervescence was noted in the decoction upon the addition of sugar, but this disappeared with persistent stirring. The syrup gradually thickened, achieving a thread-like consistency and beginning to stick to the spoon. As the moisture content in the syrup reduces, the cohesive force increases, and the further application of heat imparts kinetic movement to the sugar molecules, causing them to coalesce. This explains the thickening of the syrup as it cools. When the Paka (syrup) reaches one-thread consistency, it is considered a sign of completion of the process (siddhi lakshanas). The color of the syrup was observed to be dark brown, and it had a sweet taste.

The formulation was analysed using various analytical parameters, including organoleptic characteristics [Table/Fig-4], physicochemical parameters [Table/Fig-5], and microbiological growth parameters [Table/Fig-6]. The analytical results of Priyangvadi syrup are as follows:

DISCUSSION

This study focuses on developing a palatable, long-lasting Ayurvedic syrup form of *Priyangvadi Kalka* to treat common pediatric ailments such as vomiting, diarrhea, and dehydration. Traditional Ayurvedic formulations for children, like *Leha* (pastes), *Churna* (herbal powders), *Ghrita* (medicated ghee), and *Kashayam* (decoctions), often have strong flavors and aromas that reduce their acceptability among children. While these forms are effective, they generally have short shelf lives, making them challenging for home use. By modifying *Priyangvadi Kalka* into a syrup, the study aims to

S. No.	Test parameters	Test results
1	Colour	Dark brown
2	Odour	Sweet odour
3	Taste	Sweet

[Table/Fig-4]: Organoleptic parameters.

S. No.	Test parameters	Test results
1	Brix0	720
2	Specific Gravity	1.14 g/mL
3	Ph	5.3

[Table/Fig-5]: Physicochemical parameters.

S. No.	Test parameters	Test results
1	Total viable count	Absent
2	Enterobacteriaceae	Absent
3	Total fungus count	Absent
4	<i>E-coli</i>	Absent
5	<i>Salmonella</i>	Absent
6	<i>Staphylococcus aureus</i>	Absent
7	<i>Pseudomonas aeruginosa</i>	Absent

[Table/Fig-6]: Microbiological parameters.

create an effective, easy-to-administer herbal remedy that retains the therapeutic benefits of the original formulation. This modified form not only improves the ease of administration for parents but also minimises the use of conventional suppressive medications by addressing the root causes of ailments. This aligns with Ayurvedic principles of holistic health while addressing the need for improved pediatric compliance.

Probable Mode of Action of All Ingredients with Respect to Common Childhood Ailments:

1. **Priyangu- Priyangu** is renowned for its therapeutic properties, particularly its tikta (bitter) rasa and sheeta veerya (cooling potency) [7]. Gangola S et al., studied the antimicrobial properties of *Priyangu* against important pathogens affecting the gastrointestinal tract, especially [8]. These attributes make it particularly effective in managing conditions such as diarrhea, vomiting, fever, burning sensations, thirst, headache, and *raktapitta* (bleeding disorders). The text highlights its specific actions on balancing doshas, particularly in conditions aggravated by Pitta and Vata doshas [7].

Its proven antibacterial, antimicrobial, and anti-inflammatory properties also help control underlying infections associated with various childhood ailments. Yadav V et al., studied the anti-inflammatory and antimicrobial properties of *Priyangu* [9]. Its *deepan* (appetizer) properties stimulate digestive fire (*Agni*) and address vomiting caused by weak digestion (*Agnimandya*). Additionally, *Priyangu*'s ability to relieve thirst aids in controlling dehydration due to diarrhea and vomiting. In a systematic review by Paprikar M et al., the phytochemistry, active ingredients, mechanism of action, and clinical uses of *Priyangu* are discussed [10].

Priyangu's *raktasthambak* (hemostatic) action helps control any bleeding associated with vomiting, while its *shulaghna* (pain-relieving) effect reduces discomfort, making it suitable for children experiencing these symptoms [11]. King CK et al., in their studies related to managing acute gastroenteritis among children, mentioned various complications that may arise in children and the need to tackle these problems with a holistic approach [12].

2. **Badariphala majja- Badariphala majja** (the pulp of *Ziziphus jujuba*, or jujube) is highly beneficial for children suffering from vomiting, dehydration, and lack of appetite associated with

fever due to its unique combination of therapeutic properties. Acharya Charak mentioned *Badar as hrudya*, *virechanopaga*, and *chhardi nighrahaniya* [13]. Being *madhura rasatmaka*, guru, and *snigdha*, it helps to balance Vata and Pitta doshas without aggravating Kapha. Its *dahashamak* action helps relieve the burning sensation often associated with hyperacidity, acid reflux, and vomiting, while its *bruhana* (nourishing) quality aids in restoring strength and vitality, which is important for children recovering from common ailments. Ahmad Rajaei et al., in their study, demonstrated that jujube pulp is a rich source of phenolic compounds. The extracts from the pulp exhibited strong antioxidant activity and were somewhat effective in inhibiting the growth of both Gram-negative and Gram-positive bacteria. The study also showed that the pulp had no cytotoxic effects on human cells [14]. Additionally, *Badariphala majja's* *deepana* (digestive strength enhancer) and *grahi* (absorbent) properties help prevent dehydration and support digestion. Moreover, its *ruchya* (appetizer) effect also helps children regain their interest in food, aiding recovery from digestive imbalances. Agrawal P et al., studied the phytochemical properties of *Badar*, noting the antioxidant, antimicrobial, and anti emetic properties of the *Badar* fruit [15].

3. **Daruharidra-** *Daruharidra* (*Berberis aristata*), with its *katu* and *tikta rasa*, *katu vipaka*, and *ushna veerya*, offers a variety of therapeutic benefits for children. Its deepan action stimulates appetite and enhances the digestive fire (*Agni*), addressing weak digestion (*Agnimandya*) and preventing the accumulation of undigested food or Aam, a common cause of diseases in children. Additionally, *Daruharidra's* *shothahara* (anti-inflammatory) and *rakta shodhaka* (blood purifying) properties help reduce inflammation and cleanse the blood, which is beneficial in cases linked to infections, liver dysfunction, or other digestive disturbances. Joshi PV et al., in her study on *Berberis aristata* and its active ingredients, reported the absorbent, anti emetic, anti-diarrheal, anti-inflammatory, and antimicrobial properties of *Daruharidra* [16]. The presence of berberine, a key component of *Daruharidra*, plays a crucial role in reducing inflammation of liver tissues and regulating bile production, making it particularly useful for managing hepatitis, jaundice, or digestive disorders. Kulkarni SK studied the antimicrobial and anti-inflammatory properties of berberine [17].
4. **Musta-** *Musta* (*Cyperus rotundus*) is a widely used Ayurvedic herb known for its effectiveness in managing gastrointestinal symptoms in children. It is considered the best *sangrahi* (absorbent) of all herbs. Imam H et al., studied the phytochemical properties of *Musta*, which also demonstrate its absorbent action [18]. Additionally, its primary qualities include *deepana* (digestive stimulant), *rechana* (aids digestion), *trushnanighrahaniya* (curbs excess thirst), and *jantughna* (anti-parasitic). These properties, along with its *tikta*, *kashaya*, and *katu rasa*, make it ideal for treating digestive imbalances [7]. *Musta* is considered one of the best anti-pyretic herbs by Acharya Vagbhat and treats all types of fever in children [19]. Its *deepana* and *pachana* properties enhance digestive fire (*Agni*), improve appetite, and assist in the digestion of *Ama* (undigested toxins) in children [20]. Additionally, *Musta* has antiparasitic properties, making it effective against worm infestations commonly observed in children. Pavithra PS et al., studied the antimicrobial and antioxidant properties of *Musta* [21]. Its *sheeta veerya* helps in balancing *Pitta dosha*, offering relief from fever and hyperacidity. Its ability to quell thirst (*Trushna Nighrahani*) and prevent dehydration further supports faster recovery. Overall, *Musta* is a holistic remedy for pediatric fever, dehydration, loose stools, vomiting, and hyperacidity, targeting both the root causes and associated symptoms. Venkatasubramanian P's study considered *Musta*

to be the nearest substitute for *Ativisha* in alleviating childhood ailments [22].

Overall Effect: Priyngvadi syrup, with its blend of *Priyangu*, *Musta*, *Daruharidra*, and *Badariphalmajja*, is an effective remedy for managing many childhood ailments. This formulation works holistically by calming the digestive system, improving digestion, enhancing appetite, and addressing underlying causes such as *Mandagni* and *Ama*. Its antimicrobial properties help manage underlying infections and inflammation. It regulates digestive imbalances, reduces the frequency of vomiting and loose stools, curbs dehydration, alleviates fever and indigestion, and supports overall recovery, making it a gentle yet powerful solution for children's digestive issues.

Properties of Syrup: *Priyngvadi kalka*, having all the above ingredients, is modified into syrup form, which has a brown color, sweet taste, pH of 5.3, specific gravity of 1.14 g/mL, Brix value of 720, and shows no microbiological growth. Intense care is needed during the preparation of *Priyngvadi* syrup, as excess temperature or duration of heating may destroy some active constituents and affect the physicochemical properties. This syrup formulation will have a longer shelf life than *kalka* (paste), making it easier to calculate dosages and administer to children. It is sweet in taste, as it is a sugar syrup and contains honey, which enhances both the properties and taste, making it more palatable for children. With the beneficial actions of all the ingredients, the formulation proves to be useful in addressing various ailments in children at an early stage. It can be used for gastrointestinal disorders that are common in the childhood age group, such as vomiting, diarrhea, bloody dysenteries, worm infestations, dehydration, excess thirst, and burning sensations.

Limitation(s)

The study has a few limitations. Microbial testing may not cover all potential pathogens or environmental factors, and more extensive testing under varied conditions is needed. Herbal variability could affect the syrup's consistency and potency due to variations in ingredient sources and preparation methods. Standardising these processes could improve reliability. Lastly, bias in pharmaceutical analysis may influence safety and palatability assessments, and independent evaluations would help ensure more objective results.

CONCLUSION(S)

The analytical study of the *Priyngvadi* syrup formulation concludes that modifying *Priyngvadi Kalka* into a syrup form results in a highly palatable, stable, and effective remedy for managing common childhood ailments, particularly gastrointestinal issues like vomiting, diarrhea, dehydration, and indigestion. The syrup form enhances shelf life, improves dosage calculation, and simplifies administration, which is essential for pediatric use. With ingredients like *Priyangu*, *Musta*, *Daruharidra*, and *Badariphala*, the syrup addresses both symptoms and root causes, promotes digestive balance, reduces infections, and supports overall recovery. The syrup's antimicrobial, anti-inflammatory, and digestion-enhancing properties align with Ayurvedic principles of holistic health, offering a gentle yet potent solution for pediatric gastrointestinal issues while minimising the need for conventional suppressive medications. This formulation provides a cost-effective, practical, and palatable option for home use, making it an invaluable addition to pediatric Ayurvedic treatments.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]

- Plagiarism X-checker: Jun 26, 2024
- Manual Googling: Mar 29, 2025
- iThenticate Software: Mar 31, 2025 (4%)

ETYMOLOGY: Author Origin

EMENDATIONS: 8

AUTHOR DECLARATION:

- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? No
- Was informed consent obtained from the subjects involved in the study? No
- For any images presented appropriate consent has been obtained from the subjects. No

Date of Submission: Jun 19, 2024

Date of Peer Review: Oct 30, 2024

Date of Acceptance: Apr 02, 2025

Date of Publishing: Oct 01, 2025