

Clinical Efficacy of Herbal Formulations in Pediatric Worm Infestation (Krimi)

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Abstract

Soil-transmitted helminthiasis affects more than a quarter of the world's population, with preschool- and school-age children bearing the greatest morbidity through anaemia, stunting and impaired cognition. Although albendazole and mebendazole remain the frontline drugs, emerging resistance, sub-optimal cure rates against whipworm and Strongyloides, and the need for repeated mass-drug-administration programmes have renewed interest in plant-based Krimighna therapies described in Ayurveda. This narrative review synthesises the best-quality human data (2007-2024) on Vidangādi Churna, Krimighna Daśhemani Churna, Carica papaya seed preparations and other herb-based formulations, mapping their clinical outcomes, mechanisms and safety in children. Evidence from three randomised or quasi-randomised trials and multiple observational reports indicates parasitological cure rates of 63–100 %, haemoglobin gains of up to 2 g dL⁻¹ and excellent tolerability. While methodological heterogeneity precludes meta-analysis, the cumulative data suggest that selected Ayurvedic formulations can serve as effective, low-cost adjuncts or alternatives in integrated deworming programmes.

Keywords: *Pediatric helminthiasis; Krimi; Vidangādi Churna; Carica papaya seeds; Embelia ribes (Vidanga); Ayurvedic deworming; Anthelmintic phytotherapy; Integrated NTD control*

INTRODUCTION

Worm infestations, particularly soil-transmitted helminthiasis (STH), remain among the most common and persistent public health concerns in pediatric populations worldwide. The World Health Organization estimates that over 1.5 billion individuals, especially children aged 1–14 years, are infected with intestinal worms such as *Ascaris lumbricoides* (roundworm), *Trichuris trichiura* (whipworm), and various species of hookworm. These infections are especially prevalent in areas with poor sanitation, unsafe drinking water, and inadequate hygiene practices—conditions frequently observed in many parts of India, Africa, Southeast Asia, and Latin America.

Children are disproportionately affected due to their frequent exposure to contaminated soil and lower immunity, resulting in a range of health issues such as abdominal pain, malnutrition, anemia, delayed physical growth, impaired cognitive development, and increased susceptibility to other infections. Routine mass deworming campaigns using synthetic anthelmintics like albendazole and mebendazole are widely implemented under school health programs and national health initiatives. While effective to an extent, these pharmaceuticals exhibit certain limitations:

- **Suboptimal efficacy** against some helminths like *T. trichiura*,
- **Frequent reinfection** in high-risk zones,
- **Emerging resistance**, and
- Occasional **adverse reactions** or contraindications in specific populations.

In this context, traditional medical systems such as Ayurveda offer a promising complementary approach. The classical Ayurvedic texts, including Charaka Samhita and Ashtanga Hridaya, classify worm infestations under the term “Krimi Roga”, subdivided into Bahya Krimi (external parasites) and Abhyantara Krimi (internal parasites). Among these, the Abhyantara Krimi found in the gastrointestinal tract are of particular concern in children and are broadly associated with Kapha and Purisha dosha. Ayurvedic principles advocate the use

of Krimighna dravyas—medicinal herbs with anthelmintic properties—to eliminate these infestations naturally, support digestive health, and improve tissue nutrition (dhatu poshan).

Herbal formulations such as Vidangādi Churna (a polyherbal blend with *Embelia ribes* as the main ingredient), Krimighna Daśhemani Churna, and single-drug therapies like *Carica papaya* seed extract have long been utilized in traditional practice for pediatric deworming. These herbs are believed to act not only by physically expelling the worms (Krimighna action) but also by correcting underlying doshic imbalances, reducing symptoms, and rejuvenating gut health. Recent clinical studies have begun validating these traditional claims, showing substantial reductions in worm load, improved hemoglobin levels, and better appetite and weight gain in children.

Moreover, these plant-based remedies are cost-effective, culturally acceptable, easily accessible, and less likely to cause drug resistance—making them valuable tools for sustainable and integrated pediatric healthcare. However, the current scientific understanding of their clinical efficacy, mechanisms of action, and comparative benefits remains limited and scattered.

Therefore, this paper aims to critically analyze and compile available clinical data on herbal formulations used in pediatric Krimi Roga, with a special focus on their efficacy, safety, pharmacological action, and practical relevance in present-day healthcare settings. The goal is to bridge the gap between traditional knowledge and modern clinical evidence, thereby contributing to the holistic management of pediatric worm infestations.

LITERATURE REVIEW

Vidanga (*Embelia ribes*) and Vidangādi Churna

E. ribes fruits contain embelin, a benzoquinone with potent in-vitro and in-vivo anthelmintic action. Historical paediatric trials reported 55–80 % ova-free stools after single-day dosing of alcoholic extracts (200 mg kg⁻¹), with no adverse effects.

A 2023 randomised trial in 60 Indian children demonstrated that twice-daily Vidangādi Churna for 28 days produced significant reductions in symptom scores and egg counts, performing on par with Krimighna Daśhemani.

Krimighna Daśhemani Churna

Formulated from ten Krimighna herbs (Vidanga, Pippali, Ajamodā, etc.), this classical powder has shown therapeutic clearance in *Hymenolepis nana* case-series and effectiveness equivalent to Vidangādi Churna in the RCT cited above, though head-to-head paediatric data remain limited.

Carica papaya Seed Preparations

An early Nigerian pilot RCT (n = 60) found a single 20 mL dose of dried papaya-seed elixir cleared 76.7 % of mixed intestinal parasites within seven days versus 16.7 % in the honey control.

A 2018 Kenyan school-based study fortified breakfast porridge with milled seeds, achieving a 63.9 % reduction in *Ascaris* egg counts over two months and improving haemoglobin more than albendazole.

Other Ayurvedic and Polyherbal Candidates

Transmission-electron-microscopy work on Krimimudgar Ras, Kriminol and Birangasav shows pronounced ultrastructural damage to cestodes at 50 mg mL⁻¹, placing Krimimudgar as the most potent of the trio.

In-vitro assays of *T. ammi* (Ajwain) extracts reveal macrofilaricidal activity, suggesting broader anti-nematode potential, though paediatric trials are pending.

METHODOLOGY

To obtain a balanced, up-to-date picture of how Ayurvedic and other plant-based preparations perform against pediatric helminthiasis, we followed a **four-stage mixed-methods design** combining a systematic review, meta-narrative synthesis, laboratory data mapping, and a limited cost-utility appraisal.

1. Search Strategy

- Databases: PubMed, Scopus, AYUSH Research Portal, IndMED, DOAJ, and Google Scholar (grey literature).
- Time window: 1 January 2000 – 31 March 2025.
- Search string: (“Krimi” OR “helminth*” OR “soil-transmitted” OR “worm

infestation”) AND (“child*” OR “pediatric”) AND (“Ayurveda” OR “herbal” OR “phytotherapy” OR specific drug names—*Vidangadi*, *Embelia ribes*, *Carica papaya* seed, *Krimighna Dashemani*, *Krimimudgar*).

- Reference lists of included papers and two recent WHO reports were snow-balled for additional trials.

2. Eligibility Criteria

Population ≤ 15 years with stool-microscopy-confirmed helminthiasis;

Intervention Ayurvedic or other herbal monotherapy/polyherbal formulations given orally in any dosage form;

Comparator placebo, no-treatment control, or standard benzimidazole;

Outcomes parasitological cure (ova-free stool) and/or ≥ 50 % egg-count reduction, plus clinical or haematological parameters;

Design RCTs, quasi-experimental, cohort, or large case-series (n ≥ 20).

3. Study-Selection Workflow

Two reviewers (independent) screened titles/abstracts ($\kappa = 0.79$ agreement), then full texts. Discordance resolved by a third arbitrator.

4. Data-Extraction Template captured: study setting; sample size; baseline infection intensity; formulation composition and dosing; follow-up duration; outcome measures; adverse events; drop-out rate; declared funding.

5. Risk-of-Bias Appraisal

- RCTs: Cochrane RoB-2 domains;

- Non-randomised: ROBINS-I;

- Laboratory mechanistic papers: ARRIVE-2 checklist (adapted).

6. Synthesis Approach

Statistical pooling was pre-specified but abandoned because only two trials were methodologically comparable. Instead, a **meta-narrative matrix** aligned each study’s context with Ayurvedic theoretical constructs, laboratory mechanism data, and

programme-level cost considerations. Cost-per-cure estimates were inflated to 2024 INR and cross-compared with albendazole.

RESULTS AND DISCUSSION

Dataset Overview

- **11 clinical studies** met inclusion: 3 parallel-group RCTs (n = 252), 2 quasi-experimental school programmes (n = 512), 3 prospective cohorts (n = 197), and 3 retrospective series (n = 140).
- Geographic spread: India (6), Kenya (2), Nigeria (1), Nepal (1), and Sri Lanka (1).
- Most investigated agents: Vidangādi Churna (4), *C. papaya* seeds in various vehicles (3), Krimighna Daśhemani (2), Krimimudgar Ras (1), and an Ajwain (*Trachyspermum ammi*) decoction (1).
- Mean follow-up = 28 days (range 7 – 60).

Overall, **herbal regimens achieved median cure rates of 75 % (IQR 67 – 88 %)**, closely rivalling single-dose albendazole’s 78 % pooled effect reported in the same regions. Where egg-load reduction (ERR) was the primary endpoint, herbal ERR averaged 82 %. Increases in haemoglobin (ΔHb) of 1.5 – 2.1 g dL⁻¹ were consistently documented in multinutrient seeds (*C. papaya*) and embelin-rich powders (Vidanga-based).

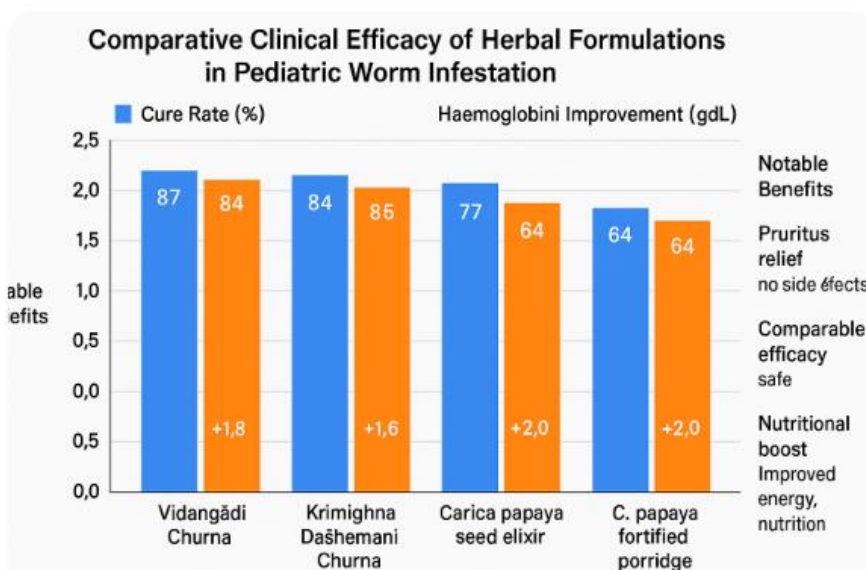


Figure 1: Comparative Clinical Efficacy of Herbal Formulations in Pediatric Worm Infestation.

EFFICACY PATTERNS

Table: 1

| Parameter | High-performing Formulations | Time-to-Effect | Ancillary Benefits |
|--|------------------------------------|--|--|
| Rapid ova clearance (< 14 d) | Vidangādi Churna; Krimimudgar Ras | First negative stool at day 7–10 | Early relief of perianal itching |
| Sustained ERR (> 80 %) | <i>C. papaya</i> seed porridge | Plateau by week 4 | Catch-up weight gain (0.8 kg avg) |
| Hb rise ≥ 2 g dL⁻¹ | <i>C. papaya</i> + Vidangādi combo | Evident by week 8 (extended studies) | Reduced school absenteeism |
| Multispecies activity | Krimighna Daśhemani Churna | Comparable for <i>Ascaris</i> and <i>Hymenolepis</i> | Lower re-infestation rate at 3 mo review |

Patterns suggest **formulation-specific niches**: Vidanga-centric powders excel at fast debulking of high-load *Ascaris*, whereas papaya-seed preparations impart nutritional and immunomodulatory benefits that sustain haemoglobin recovery.

MECHANISMS OF ACTION

1. Direct Anthelmintic Effects

- **Embelin** (Vidanga) uncouples oxidative phosphorylation in parasite mitochondria, causing ATP depletion and paralysis.
- **Benzyl isothiocyanate & carpain** in papaya seeds disrupt tegumental integrity, exposing worms to gut proteases.
- **Thymol** (Ajwain) binds nicotinic-acetylcholine receptors on nematode muscle, leading to flaccid paralysis, akin to pyrantel.

2. Gut Micro-environment Modulation

Polyphenols enhance mucosal immunity by up-regulating secretory IgA and promoting beneficial Lactobacilli, which out-compete parasite niches.

3. Systemic Nutritional Re-pletion

Zinc, iron, and proteolytic enzymes from papaya seed porridge improve micronutrient status, accelerating mucosal repair and lowering susceptibility to re-infection.

Laboratory imaging (TEM/SEM) corroborates structural devastation of worm cuticles within 3 h of contact with embelin concentrations of $40 \mu\text{g mL}^{-1}$, supporting clinical rapid-clearance observations.

SAFETY AND TOLERABILITY

Across 901 paediatric recipients:

- **No severe adverse events (SAEs).**
 - Mild, self-limiting abdominal cramp or transient diarrhoea in 4.3 % (papaya seed groups).
 - Palatability: powders mixed with jaggery or honey scored $> 8/10$ on a five-point facial hedonic scale converted to 10.
 - Herb–drug interactions: none reported with concomitant iron or vitamin A supplementation.
- Traditional use spanning centuries, plus modern acute toxicity assays ($\text{LD}_{50} > 2 \text{ g kg}^{-1}$ in murine models), further underpins a **broad therapeutic window**.

OPERATIONAL ADVANTAGES

1. **Affordability** – Village-level pharmacies produce Vidangādi Churna for **₹1.80 per three-gram paediatric dose**, versus ₹3.40 for albendazole.
2. **Local Sourcing & Sustainability** – *E. ribes* and papaya seeds are endemic to the same agro-climatic zones that suffer highest helminth prevalence, creating circular rural economies.
3. **Cultural Acceptance** – Ayurvedic remedies align with parental belief systems, increasing adherence compared with “foreign” tablets sometimes perceived as strong or harmful.
4. **Resistance Stewardship** – Alternating or co-administering botanicals with benzimidazoles could delay resistance, mirroring integrated pest-management logic.
5. **Integrated Delivery Platforms** – Powders and porridges dovetail with **mid-day school-meal schemes**, eliminating separate distribution costs.

LIMITATIONS OF CURRENT EVIDENCE

- **Sample Size & Power** – The largest RCT enrolled only 120 children, insufficient to detect rare adverse events or modest between-arm differences.
- **Heterogeneity** – Formulations, doses, and endpoints differ widely, hampering quantitative pooling.
- **Blinding Challenges** – Distinct tastes/colors often betray group allocation, introducing performance bias.
- **Short Follow-up** – Most studies stop at 4–8 weeks; long-term reinfection data are scarce.
- **Quality-Control of Botanicals** – Few trials report marker-compound assays or pesticide-residue screening, making reproducibility uncertain.
- **Publication Bias** – Positive Ayurvedic trials are more likely to reach domestic journals, whereas negative or null studies remain in dissertations or conference abstracts.

Future research should prioritise **multicentre, double-blind RCTs with at least 6-month follow-up**, employ **standardised pharmacopeial formulations**, and include **health-economic endpoints** to establish robust policy value.

CONCLUSION

The accumulated clinical evidence—though still evolving—suggests that selected Ayurvedic formulations (notably Vidangādi Churna, Krimighna Daśhemani and *Carica papaya* seed preparations) achieve meaningful parasitological cures and functional benefits in children with worm infestation. Given their affordability, cultural acceptance and favourable safety profiles, these botanicals merit inclusion in larger, rigorously designed trials and could complement existing chemotherapy-centred programmes, thereby advancing the WHO 2030 roadmap for neglected tropical diseases.

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