INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)
(Int Peer Reviewed Journal)
Vol. 05, Issue 08, August 2025, pp : 60-77

www.ijprems.com
editor@ijprems.com

e-ISSN : 2583-1062
Impact Factor : 7.001

REVISITING CLASSICAL KRIMIGHNA DRAVYAS IN THE CONTEXT OF MODERN ANTHELMINTIC THERAPY

Dr. Amrit Jindal[1], Dr. Vidhi Modgil[2], Dr. Rajesh Sharma[3]

[1,2]PG Scholar (Ayu). Dravyaguna Department, A & U Tibbia College & Hospital, Karol Bagh, New Delhi, India.

[3]Professor (Ayu), H.O.D, Dravyaguna Department, A & U Tibbia College, Karol Bagh, New Delhi, India.

E-Mail: 7011aj@gmail.com, modgilvidhi@gmail.com, rajsakshi.sharma@gmail.com

ABSTRACT

Helminthiasis remains a significant global health burden, affecting billions of people and livestock, while its management is increasingly compromised by the escalating threat of anthelmintic resistance (AR) to all major classes of synthetic drugs. This review revisits the ancient Ayurvedic concept of parasitic infections, known as *Krimi Roga*, and its corresponding therapeutic agents, *Krimighna Dravyas*, to explore their relevance in addressing this modern pharmacological crisis. Ayurveda offers a sophisticated, host-centric paradigm that attributes parasitic proliferation to systemic imbalances, such as impaired digestive metabolism (*Agnimandya*), and employs a holistic, three-pronged therapeutic strategy: expulsion (*Apakarshana*), modification of the internal environment to render it inhospitable to parasites (*Prakriti Vighata*), and avoidance of causative factors (*Nidana Parivarjana*). This article provides a detailed pharmacological and phytochemical analysis of key *Krimighna* herbs, including *Embelia ribes* (Vidanga) and *Butea monosperma* (Palasha), critically evaluating the extensive preclinical evidence supporting their anthelmintic efficacy. A comparative analysis reveals that while modern anthelmintics act on highly specific molecular targets, making them potent but vulnerable to resistance through single-point mutations, Ayurvedic formulations leverage a polypharmacological approach. The chemical complexity of these herbs and their formulations presents a multi-target assault on parasites, which may inherently deter the development of resistance. This review posits that integrating Ayurvedic principles—such as polypharmacology, host-centric therapy, and the use of its rich materia medica as a source for novel drug discovery—offers a promising and scientifically imperative strategy to augment the current anthelmintic arsenal. However, the path toward clinical integration is contingent upon overcoming significant challenges, primarily the need for rigorous standardization, quality control, and large-scale, evidence-based clinical validation.

1. INTRODUCTION

Parasitic worm infections, or helminthiases, represent one of the most pervasive yet neglected public health issues globally. Affecting an estimated one-third of the world's population, these infections are particularly rampant in developing countries with inadequate sanitation and hygiene.[1] Helminths such as roundworms (*Ascaris lumbricoides*), whipworms (*Trichuris trichiura*), and hookworms (*Ancylostoma duodenale* and *Necator americanus*) contribute to a significant burden of disease, causing malnutrition, anemia, impaired cognitive development in children, and reduced economic productivity in adults.[1] For decades, the control of these infections in both human and veterinary medicine has relied heavily on a limited arsenal of synthetic anthelmintic drugs.[4]

The cornerstone of modern anthelmintic therapy is now facing a critical threat: the global emergence and rapid spread of anthelmintic resistance (AR).[5] AR is defined as the heritable loss of sensitivity to a drug in a parasite population that was previously susceptible.[6] This phenomenon has been documented against all major classes of anthelmintics and in nearly every economically important parasite species affecting livestock, leading to treatment failures that threaten the sustainability of animal agriculture.[6] Worryingly, the same patterns of resistance are a growing concern in human helminth control programs.[9] The development of resistance is an inevitable evolutionary consequence of drug pressure, often appearing within a few years of a new drug's introduction, and is exacerbated by practices such as frequent mass drug administration and underdosing.[6] With a dry pipeline for new synthetic anthelmintics, there is an urgent need to explore alternative and complementary therapeutic strategies.[11]

In this context, ancient systems of medicine offer a rich repository of empirical knowledge that may hold solutions to this modern crisis. Ayurveda, the traditional Indian system of medicine, possesses a detailed and sophisticated understanding of parasitic diseases, conceptualized under the term *Krimi Roga*.[1] Described in texts dating back thousands of years, this framework includes a comprehensive etiology, classification of parasites, and a dedicated branch of pharmacology for their treatment using substances known as *Krimighna Dravyas* (anti-parasitic agents).[15] This traditional knowledge, developed through centuries of clinical observation, provides an ethnopharmacologically

INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)
(Int Peer Reviewed Journal)
Vol. 05, Issue 08, August 2025, pp : 60-77
www.ijprems.com
editor@ijprems.com
e-ISSN : 2583-1062
Impact Factor : 7.001

validated starting point for scientific investigation. This article aims to conduct a critical and comprehensive review of classical *Krimighna Dravyas* and their underlying therapeutic principles, placing them in direct dialogue with modern anthelmintic pharmacology. By examining the Ayurvedic paradigm of *Krimi Roga*, analyzing the phytochemical and pharmacological evidence for key anthelmintic herbs, and comparing their mechanisms of action with those of synthetic drugs, this review will evaluate the potential of these ancient remedies to address the contemporary challenges of helminthiasis and anthelmintic resistance. The objective is not to propose a simple substitution of one system for another, but to explore the potential for a meaningful synthesis that could inform new drug discovery, inspire novel treatment strategies, and contribute to a more sustainable future for parasite control.

2. THE AYURVEDIC PARADIGM OF PARASITIC INFECTIONS: *KRIMI ROGA*

Long before the advent of microscopy, Ayurvedic physicians developed a remarkably detailed framework for understanding parasitic and microbial infections. This knowledge, encapsulated in the concept of *Krimi Roga*, is found in the earliest Vedic texts and was later systemized in the classical *Samhitas* of Charaka and Sushruta.[14] This paradigm offers a holistic perspective that extends beyond the pathogen itself to encompass the host's internal environment as the primary determinant of disease.

Conceptual Framework: Defining *Krimi*

The Sanskrit term *Krimi* is far more expansive than the modern term "helminth." It is derived from roots meaning "to move" or "to destroy" and encompasses a wide spectrum of organisms, both pathogenic and non-pathogenic, visible (*Drishta*) and invisible (*Adrishta*).[14] This broad definition includes everything from intestinal worms and ectoparasites like lice to what modern science would classify as bacteria, fungi, and viruses.[13] Ayurveda posits that the fundamental cause for the proliferation of pathogenic *Krimi* is not merely exposure to the organism, but the creation of a suitable internal environment within the host. Two core concepts are central to this etiology: *Agnimandya* (impaired digestive fire or metabolism) and an excess of *Kleda* (morbid moisture or a damp, improperly metabolized substrate).[14] A weakened digestive capacity leads to the formation of *Ama* (undigested toxic residue), which, combined with *Kleda*, serves as a fertile breeding ground for *Krimi* to thrive.[20]

Classical Classification and Modern Correlation

Ayurvedic texts classify *Krimi* based on their habitat and origin, providing a system that correlates surprisingly well with modern parasitology. The primary division is between *Bahya* (external) *Krimi*, such as *Yuka* (lice), and *Abhyantara* (internal) *Krimi*.[13] The *Abhyantara Krimi* are further subdivided into three main categories based on their site of origin, which is linked to the vitiation of specific *Doshas* (fundamental biological energies).

- ***Purishaja Krimi*** (Fecal-born): These parasites originate in the large intestine (*Pakwashaya*) and are primarily caused by the vitiation of *Vata* and *Kapha doshas* due to poor dietary habits, such as excessive consumption of sweets, jaggery, and leafy vegetables, along with poor hygiene.[2] The classical symptoms (*Lakshanas*) described for *Purishaja Krimi* include abdominal pain (*Shula*), diarrhea (*Atisara*), constipation, emaciation, and intense anal itching (*Gudakandu*), especially at night.[2] These clinical features show a strong correlation with common intestinal nematodes like pinworms (*Enterobius vermicularis*) and roundworms (*Ascaris lumbricoides*).[13]
- ***Kaphaja Krimi*** (Phlegm-born): These originate in the stomach (*Amashaya*) due to an excess of *Kapha dosha*, often triggered by diets rich in milk, sugar, and unwholesome or uncooked foods.[13] They are described as resembling earthworms or thick leather strips and can move throughout the gastrointestinal tract.[22] The associated symptoms include nausea (*Hrillasa*), excessive salivation, anorexia (*Bhaktadwesa*), vomiting (*Chhardi*), and indigestion.[13] These descriptions align with parasitic infections of the upper gastrointestinal tract.
- ***Raktaja Krimi*** (Blood-born): Originating in the blood vessels (*Raktavaha Srotas*), these *Krimi* are described as minute, round, copper-colored, and often invisible to the naked eye.[13] Their etiology is linked to that of *Kustha* (obstinate skin diseases), involving the consumption of incompatible or uncooked foods.[13] They are said to cause systemic manifestations, including severe skin disorders, destruction of hair and nails, and damage to other tissues.[13] This category can be correlated with blood-borne parasites like filarial worms or, more broadly, with systemic microbial infections that manifest dermatologically.[16]

The Ayurvedic diagnostic approach is noteworthy for its recognition of systemic symptoms. While modern diagnosis often relies on identifying ova or cysts in stool samples, a process that can miss many infections [13], Ayurvedic physicians were trained to recognize a broader constellation of signs, including fever (*Jvara*), skin discoloration (*Vivarnata*), vertigo (*Bhrama*), and general malaise (*Sadana*), as indicators of a systemic parasitic burden (*Krimi Roga*).[14] This suggests a diagnostic framework capable of identifying the wider physiological impact of parasitism, potentially enabling earlier intervention.

INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)
(Int Peer Reviewed Journal)
www.ijprems.com
editor@ijprems.com
Vol. 05, Issue 08, August 2025, pp : 60-77
e-ISSN : 2583-1062
Impact Factor : 7.001

Table 1: Correlation of Ayurvedic *Krimi* Classification with Modern Parasitology

Krimi Type	Ayurvedic Origin (*Sthana*)	Etiological Factors (*Nidana*)	Key Symptoms (*Lakshana*)	Potential Modern Correlates (Examples)
Purishaja (Fecal-born)	Large Intestine (*Pakwashaya*)	Excessive sweets, jaggery, leafy vegetables, poor hygiene [2]	Anal itching (*Gudakandu*), abdominal pain, diarrhea, constipation, pallor [2]	*Enterobius vermicularis* (Pinworm), *Ascaris lumbricoides* (Roundworm), *Trichuris trichiura* (Whipworm)
Kaphaja (Phlegm-born)	Stomach (*Amashaya*)	Excessive milk, sugar, fish, uncooked/putrefied food [13]	Nausea, excessive salivation, anorexia, vomiting, indigestion, fever [13]	Upper GI parasites, *Giardia lamblia* (Protozoa), *Ascaris lumbricoides* (migratory phase)
Raktaja (Blood-born)	Blood vessels (*Raktavaha Srotas*), Liver, Spleen	Incompatible foods, uncooked leafy vegetables (same etiology as *Kustha*) [13]	Skin diseases (*Kustha*), destruction of hair, eyelashes, nails; often described as microscopic [13]	Filarial worms (*Wuchereria bancrofti*), *Schistosoma* spp., Systemic microbial infections, Protozoa

The Holistic Therapeutic Strategy: *Krimighna Chikitsa*

The Ayurvedic approach to treatment, *Krimighna Chikitsa*, is a comprehensive, three-pronged strategy that addresses the pathogen, the host environment, and the root cause, reflecting a deeply holistic philosophy.[14]

1. ***Apakarshana*** (Extraction/Expulsion): The first principle is the direct removal of the parasitic load. For *Bahya Krimi*, this involves manual removal. For *Abhyantara Krimi*, it is achieved through *Panchakarma* procedures, primarily therapeutic purgation (*Virechana*) and emesis (*Vamana*). These detoxification therapies are designed to forcefully expel the *Krimi* along with the vitiated *Doshas* from the gastrointestinal tract.[2]

2. ***Prakriti Vighata*** (Environmental Modification): This is arguably the most crucial and unique aspect of Ayurvedic treatment. The term translates to "destruction of the habitat" or "altering the nature" of the internal environment.[15] The goal is to make the host's body inhospitable for the survival, growth, and multiplication of any remaining or future parasites. This is accomplished by administering herbs and foods that possess qualities opposite to those that foster *Krimi* growth. Specifically, substances with pungent (*Katu*), bitter (*Tikta*), and astringent (*Kashaya*) tastes, along with sharp (*Tikshna*) and hot (*Ushna*) properties, are used to counteract the *Kapha dosha*, dry up the excess *Kleda*, and stimulate *Agni*.[17] This step fundamentally alters the biochemical terrain of the gut, creating an environment that is antagonistic to parasitic life.

3. ***Nidana Parivarjana*** (Avoidance of Causative Factors): The final step is preventive and aims to eliminate the root cause of the disease to prevent recurrence. This involves strict avoidance of the dietary and lifestyle factors (*Nidana*) that initially led to *Agnimandya* and the accumulation of *Kleda*.[14] This includes abstaining from excessive sweets, unhygienic foods, daytime sleep, and other habits that promote *Kapha* accumulation.[2]

This sophisticated strategy reveals a key philosophical distinction. Modern anthelmintic therapy is primarily pathogen-centric, focusing on killing the parasite with a highly specific chemical agent. In contrast, the Ayurvedic approach is

INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)
(Int Peer Reviewed Journal)
Vol. 05, Issue 08, August 2025, pp : 60-77
www.ijprems.com
editor@ijprems.com
e-ISSN : 2583-1062
Impact Factor : 7.001

fundamentally host-centric. It views the presence of *Krimi Roga* as a manifestation of an underlying systemic imbalance. The treatment, therefore, is not just about killing the worm but about rectifying the host's internal physiology to restore health and build resilience against future infections. This ancient concept resonates strongly with the modern understanding of the gut microbiome and the importance of a healthy intestinal ecosystem in resisting pathogens.

3. KEY *KRIMIGHNA DRAVYAS*: A PHARMACOLOGICAL AND PHYTOCHEMICAL REVIEW

The Ayurvedic materia medica is replete with herbs possessing anthelmintic properties. These *Krimighna Dravyas* are selected based on their unique combination of taste (*Rasa*), potency (*Virya*), and post-digestive effect (*Vipaka*), which allows them to effectively execute the strategy of *Prakriti Vighata*. Modern scientific investigation has begun to validate these traditional claims, identifying potent bioactive compounds and elucidating their pharmacological activities.

3.1. Vidanga (*Embelia ribes*): The Archetypal Anthelmintic

Embelia ribes, commonly known as Vidanga or false black pepper, is unequivocally celebrated in classical Ayurvedic texts as the most preeminent of all anthelmintic herbs (*Krimighnanam Shreshtha*).[17] Its enduring reputation is built on its specific therapeutic properties that align perfectly with the principles of *Krimi Roga* treatment.

- **Classical Profile and Mode of Action**: Vidanga is characterized by a pungent (*Katu*) and astringent (*Kashaya*) taste, a hot potency (*Ushna Virya*), and a pungent post-digestive effect (*Katu Vipaka*).[20] These properties make it exceptionally effective at pacifying *Kapha* and *Vata doshas*, the primary humors implicated in *Krimi Roga*.[20] Its light (*Laghu*), dry (*Ruksha*), and piercing (*Tikshna*) qualities enable it to penetrate tissues, counteract the morbid moisture (*Kleda*), and stimulate the digestive fire (*Agni*).[20] Beyond these general properties, Ayurveda attributes to Vidanga a special, innate efficacy (*Prabhava*) for destroying worms, making it the drug of choice for this condition.[24] Its mode of action is comprehensive: it not only kills worms (*Krimighna*) but also stimulates digestion (*Deepana*), digests toxic residue (*Pachana*), relieves abdominal colic (*Shoolahara*), and promotes the downward movement of waste (*Anulomana*), which aids in the expulsion of paralyzed or dead worms.[20]
- **Phytochemistry and Active Compound**: The principal bioactive constituent responsible for Vidanga's potent anthelmintic activity is **embelin** (2, 5-dihydroxy-3-undecyl-1, 4-benzoquinone), a compound isolated from the dried berries of the plant.[26] The fruits also contain a variety of other phytochemicals, including tannins, alkaloids, phenolic compounds, and a volatile oil, which may contribute synergistically to its overall therapeutic effect.[26]
- **Scientific Evidence**: A substantial body of preclinical research has validated the traditional use of Vidanga.
  - ***In-vitro* Studies**: Numerous *in-vitro* assays have demonstrated the potent, dose-dependent anthelmintic activity of Vidanga extracts and isolated embelin. These studies have used various worm models, including the Indian earthworm (*Pheretima posthuma*), which is physiologically similar to human intestinal roundworms.[31] Ethanolic extracts have shown efficacy against the roundworm *Rhabditis pseudoelongata* [29], and both aqueous and alcoholic extracts have shown ovicidal and larvicidal activity against the sheep nematode *Haemonchus contortus*.[33] Notably, some studies have reported that at higher concentrations (e.g., 3-5%), aqueous extracts of Vidanga are more potent than the standard synthetic drug piperazine citrate in causing paralysis and death of worms.[32] A study comparing isolated embelin to albendazole found embelin to be significantly superior, causing paralysis and death in *P. posthuma* in a fraction of the time required by albendazole.[4]
  - ***In-vivo* Studies**: Animal studies have further corroborated these findings. In sheep experimentally infected with *H. contortus*, oral administration of Vidanga seed extracts resulted in a significant reduction in fecal egg counts (EPG). Alcoholic extracts were particularly effective, achieving up to a 74.3% reduction in EPG by day 7 post-treatment.[33]
  - **Human Studies**: While large-scale, randomized controlled trials (RCTs) on humans are scarce, some clinical evidence exists. An open-label comparative study involving 40 patients with intestinal parasites used a powder of *Embelia robusta* (a related species). It reported a 40% cure rate (symptomatic relief and negative stool report) after one week of treatment, with no adverse effects.[33] Another study focused on patients with roundworm infestation reported that Vidanga treatment for two weeks resulted in highly significant relief (over 70%) of key symptoms like facial discoloration (*Vivarnata*) and anal itching (*Gudakandu*).[33] However, it is important to note that not all studies have been conclusive; one trial on *Trichuris muris* found that while a potassium salt of embelin showed some activity, it was unstable and poorly effective compared to mebendazole, highlighting the need for further research and formulation development.[37]

INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)
(Int Peer Reviewed Journal)
Vol. 05, Issue 08, August 2025, pp : 60-77
www.ijprems.com
editor@ijprems.com
e-ISSN : 2583-1062
Impact Factor : 7.001

3.2. Palasha (*Butea monosperma*): The Potent Vermicide

Known poetically as the "Flame of the Forest" for its brilliant orange flowers, *Butea monosperma* (Palasha) is another cornerstone of Ayurvedic anthelmintic therapy. The seeds of the plant (*Palasha Beej*) are specifically renowned for their potent vermicidal and vermifugal properties.[38]

- **Classical Profile and Mode of Action**: Palasha seeds are described as having *Krimighna* (anthelmintic), *Deepana* (digestive stimulant), and *Shodhana* (purificatory/purgative) properties.[38] This combination is ideal for not only killing intestinal parasites but also for stimulating the digestive system to prevent their recurrence and for promoting their physical expulsion from the body.[38] It is primarily used to balance *Kapha* and *Pitta doshas*.[38]
- **Phytochemistry and Active Compound**: The primary anthelmintic compound isolated from Palasha seeds is **palasonin**, a cantharidin-related molecule known to be particularly effective against roundworms and tapeworms.[3] The seeds and other parts of the plant also contain tannins, flavonoids like butrin and isobutrin, and mucilage, which may contribute to its therapeutic profile.[38]
- **Scientific Evidence**:
  - ***In-vitro* Studies**: Various extracts of Palasha have demonstrated significant anthelmintic activity in laboratory settings. Studies using ethanolic and aqueous extracts of the flowers and leaves have shown dose-dependent efficacy against *Pheretima posthuma* (earthworms), *Ascaridia galli* (poultry roundworm), and *Raillietina spiralis* (tapeworm).[42] The activity is often attributed to the presence of tannins and alkaloids in the extracts.[44]
  - ***In-vivo* Studies**: Animal models have provided strong evidence for Palasha's efficacy. An important *in-vivo* study on sheep naturally infected with a mix of gastrointestinal nematodes found that crude seed powder administered orally exhibited a dose- and time-dependent effect. At the highest dose of 3 g/kg, it achieved a 78.4% reduction in EPG. While this was less than the 99.1% reduction achieved by the standard drug levamisole (7.5 mg/kg), it represents a substantial therapeutic effect from a crude herbal powder.[40] A separate study in goats infected with gastrointestinal parasites showed that an ethanolic extract of the seeds at 200 mg/kg was highly effective, significantly reducing EPG counts and concurrently improving key hematological and biochemical parameters like hemoglobin and serum protein, indicating a restoration of host health.[45]

3.3. Other Notable *Krimighna* Herbs

The Ayurvedic pharmacopoeia includes a wide array of other plants used to combat *Krimi Roga*.

- **Nimba (*Azadirachta indica*)**: Commonly known as Neem, this tree is revered for its intensely bitter (*Tikta*) taste, which is a hallmark of anti-*Kapha* and anti-*Pitta* substances. It is considered a premier blood purifier (*Raktashodhaka*) and a broad-spectrum antimicrobial.[46] Traditionally, it is used for all types of *Krimi*, including intestinal worms and the microbes responsible for skin diseases (*Kustha*).[16] A vast number of modern studies have confirmed its potent anthelmintic, antibacterial, antifungal, and antiprotozoal properties, making it a versatile tool in managing infections.[3]
- **Hingu (*Ferula assafoetida*)**: This potent, pungent resin is a powerful carminative and *Vata*-pacifying agent. In the context of *Krimi Roga*, it is used to alleviate the bloating, flatulence, and abdominal pain that often accompany parasitic infestations.[16]

3.4. Polyherbal Formulations: The Power of Synergy

A defining feature of Ayurvedic pharmacology is the concept of *Samyoga*, or synergistic formulation, where multiple herbs are combined in specific ratios to enhance therapeutic efficacy, broaden the spectrum of action, and mitigate potential side effects.[50] This principle of polyherbalism is central to the treatment of *Krimi Roga*.

- ***Vidangarishta***: This is a classical fermented decoction (*Arishta*) with Vidanga as the primary active ingredient.[53] The formulation process involves fermenting the herbal decoction with jaggery, which not only preserves the preparation but also generates alcohol that acts as a medium for extracting and delivering the active principles of the herbs.[55]

Vidangarishta is designed not just to kill and expel worms (*Krimighna*) but also to address the root cause by stimulating digestive fire (*Deepana*) and improving digestion (*Pachana*), thereby preventing recurrence.[53] It contains a host of other carminative and digestive herbs like ginger, black pepper, and cardamom that support the primary action of Vidanga and restore gut health.[54]

- ***Krimikuthar Ras***: This is a more potent herbo-mineral formulation (*Rasa Shastra*) used for severe or persistent parasitic infections.[56] It combines powerful *Krimighna* herbs like Vidanga and Palasha seeds with other botanicals such as *Indrajau* (*Holarrhena antidysenterica*) and processed minerals, including *Kajjali* (a black sulfide of purified mercury and sulfur).[56] The inclusion of these processed minerals is believed to enhance the potency and bioavailability of the herbal components, allowing the formulation to act more quickly and effectively in eliminating parasites and

INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)
(Int Peer Reviewed Journal)
www.ijprems.com
editor@ijprems.com
Vol. 05, Issue 08, August 2025, pp : 60-77
e-ISSN : 2583-1062
Impact Factor : 7.001

detoxifying the body.[57]

The use of these herbs and formulations illustrates a key therapeutic principle. Unlike modern single-molecule drugs, *Krimighna Dravyas* possess a multi-pronged action. Vidanga, for instance, is not merely a vermicide; its additional properties as a mild laxative, digestive stimulant, and blood purifier actively support the overarching therapeutic goals of *Apakarshana* (expulsion), *Prakriti Vighata* (environmental modification), and restoring systemic balance. The herb itself thus functions as a "mini-formulation," embodying the holistic strategy of *Krimighna Chikitsa* within its own complex pharmacology.

Table 2: Profile of Key *Krimighna Dravyas*

Herb (Sanskrit/Botanical Name)	Part Used	Key Ayurvedic Properties (*Rasa, Virya, Vipaka, Prabhava*)	Primary Active Compound(s)	Summary of Scientific Evidence (Key Findings)
Vidanga (*Embelia ribes*)	Fruit (Dried Berries)	*Rasa*: Katu, Kashaya; *Virya*: Ushna; *Vipaka*: Katu; *Prabhava*: Krimighna [20]	Embelin (benzoquinone) [26]	Potent *in-vitro* activity against various worms, often superior to standard drugs. Significant *in-vivo* EPG reduction in sheep. Human studies show symptomatic relief and moderate cure rates.[32]
Palasha (*Butea monosperma*)	Seeds	*Rasa*: Tikta, Katu; *Virya*: Ushna; *Vipaka*: Katu; *Karma*: Krimighna, Deepana, Shodhana [38]	Palasonin [3]	Significant *in-vitro* activity against earthworms, roundworms, and tapeworms. *In-vivo* studies in sheep and goats show up to 78.4% EPG reduction and improved host health parameters.[40]
Nimba (*Azadirachta indica*)	Leaves, Bark, Seeds	*Rasa*: Tikta, Kashaya; *Virya*: Sheeta; *Vipaka*: Katu; *Karma*: Krimighna, Raktashodhaka [46]	Azadirachtin, Nimbin, Nimbidin (Limonoids) [48]	Broad-spectrum *in-vitro* anthelmintic, antibacterial, antifungal, and antiprotozoal activity demonstrated in numerous studies. Used widely in traditional practice

INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)
(Int Peer Reviewed Journal)
Vol. 05, Issue 08, August 2025, pp : 60-77
www.ijprems.com
editor@ijprems.com
e-ISSN : 2583-1062
Impact Factor : 7.001

				for internal and external parasites.[3]

4. MODERN ANTHELMINTIC THERAPY: MECHANISMS AND LIMITATIONS

Modern pharmacology has developed several classes of synthetic anthelmintic drugs that have been instrumental in controlling helminthiasis for the past half-century. These agents are characterized by their high efficacy and specific mechanisms of action, targeting biochemical pathways or neuromuscular functions unique to the parasite, thereby minimizing host toxicity.[59] However, this specificity, while a strength, has also become their greatest vulnerability in the face of evolutionary pressure.

Major Drug Classes and Mechanisms of Action

The current anthelmintic arsenal is dominated by a few major drug classes:

- **Benzimidazoles (BZDs)**: This class, which includes widely used drugs like **albendazole** and **mebendazole**, is the cornerstone of mass drug administration programs for soil-transmitted helminths.[10] Their primary mechanism of action is the disruption of microtubule polymerization in the parasite's intestinal and tegumental cells. They achieve this by binding with high affinity to a parasite-specific isoform of **β-tubulin**, a protein subunit of microtubules. This binding prevents the assembly of microtubules, which are crucial for essential cellular functions, including intracellular transport, cell division, and, critically, the absorption of glucose. The resulting disruption of energy metabolism leads to glycogen depletion, starvation, and eventual death of the parasite.[10]

- **Imidazothiazoles and Tetrahydropyrimidines**: This group includes drugs like **levamisole** and **pyrantel pamoate**. They function as selective agonists for the nicotinic acetylcholine receptors (nAChRs) located on the somatic muscle cells of nematodes.[59] Their binding to these receptors causes an influx of ions, leading to persistent muscle cell depolarization and irreversible spastic paralysis. The paralyzed worms are unable to maintain their position in the host's gastrointestinal tract and are expelled by normal peristalsis.[60]

- **Macrocyclic Lactones (MLs)**: This class, which includes **ivermectin** and **moxidectin**, has revolutionized the control of both endo- and ectoparasites in veterinary and human medicine.[10] Their mechanism involves the potentiation of glutamate-gated chloride ion channels (GluCls), which are found exclusively in the nerve and muscle cells of invertebrates.[59] Ivermectin binds to these channels, causing them to open and allowing a prolonged influx of chloride ions. This leads to hyperpolarization of the cell membrane, which inhibits nerve signal transmission and results in a flaccid paralysis of the parasite's pharyngeal and somatic muscles, leading to starvation, death, and expulsion.[59]

The Achilles' Heel: The Molecular Basis of Anthelmintic Resistance

The remarkable efficacy of these drugs is being systematically eroded by the evolution of resistance. AR is a genetically heritable trait that arises from the intense selection pressure exerted by frequent and widespread drug use.[5] The molecular mechanisms of resistance are often directly related to the drug's specific target.

- **Benzimidazole Resistance**: The most well-characterized mechanism of AR is resistance to BZDs. It is predominantly caused by single nucleotide polymorphisms (SNPs) in the gene encoding the drug's target, β-tubulin. Specific point mutations, such as a substitution of tyrosine for phenylalanine at codon 200 (F200Y) or at codons 167 (F167Y) and 198 (E198A), alter the conformation of the protein's binding site. This change significantly reduces the drug's binding affinity, rendering it ineffective at therapeutic concentrations.[60] Parasites carrying these mutations can survive treatment and pass the resistant allele to their offspring, leading to a rapid increase in the frequency of resistance in the population.

- **Resistance to Other Classes**: Resistance to levamisole/pyrantel is associated with alterations in the target nAChR subunits, reducing drug sensitivity.[60] For macrocyclic lactones like ivermectin, resistance is more complex and multifactorial. It may involve changes in the target GluCl receptors, but also critically involves the upregulation of drug efflux pumps, such as P-glycoproteins (P-gps). These membrane transporters actively pump the drug out of the parasite's cells, preventing it from reaching a therapeutic concentration at its target site.[6]

Clinical Considerations and Side Effects

While generally considered safe for mass administration, modern anthelmintics are not without side effects. Common adverse reactions are typically mild and transient, including gastrointestinal symptoms like nausea, vomiting, abdominal pain, and diarrhea.[61] Headaches and dizziness can also occur. More severe, though rare, toxicities have been reported. For instance, long-term or high-dose use of albendazole can cause bone marrow suppression, leading to

neutropenia and thrombocytopenia.[61] Levamisole has a narrow therapeutic index and can cause cholinergic signs (salivation, tremors) at higher doses.[67] These potential adverse effects, combined with the growing problem of resistance, underscore the need for new therapeutic options with different safety profiles and mechanisms of action.

5. A SYNTHESIS OF SYSTEMS: COMPARATIVE INSIGHTS AND FUTURE DIRECTIONS

A direct comparison of the Ayurvedic and modern approaches to anthelmintic therapy reveals profound differences in philosophy and strategy, yet also surprising points of mechanistic convergence. This synthesis offers valuable perspectives on how ancient wisdom can inform solutions to modern challenges, particularly the crisis of drug resistance.

5.1. Mechanistic Convergence and Divergence

Modern anthelmintics are products of a reductionist, target-based drug discovery paradigm. They function as highly specific "molecular keys" designed to fit precise parasitic "locks"—be it the β-tubulin protein, nicotinic receptors, or glutamate-gated ion channels.[59] Their efficacy stems from this precision. Interestingly, scientific investigation into the active compounds of *Krimighna Dravyas* reveals that they also interact with specific molecular targets, demonstrating a clear biochemical basis for their traditional use. For instance, the primary mechanism of action for **palasonin**, the active compound in *Butea monosperma*, is the inhibition of glucose uptake and subsequent depletion of glycogen stores in the parasite *Ascaridia galli*.[68] This mode of action, which targets the parasite's energy metabolism, shows a remarkable convergence with the ultimate effect of benzimidazoles. Further *in silico* molecular docking studies have predicted that palasonin also binds effectively to parasitic tubulin and glutamate dehydrogenase (GDH), an enzyme crucial for anaerobic metabolism, suggesting it may disrupt multiple vital pathways simultaneously.[70] Similarly, **embelin** from *Embelia ribes* is thought to act through several mechanisms, including the inhibition of glucose uptake and potential interaction with nicotinic cholinergic receptors, thereby combining metabolic disruption with neuromuscular effects.[33] Molecular docking studies support this multi-target potential, showing that embelin has a good binding affinity for the active pocket of β-tubulin, suggesting it may act as an inhibitor.[71]

The fundamental divergence, however, lies in the breadth of action. A synthetic drug is a single molecule with a primary target. An Ayurvedic herb, even when its action is attributed to a principal compound like embelin, is a complex chemical matrix containing hundreds of other phytochemicals—alkaloids, tannins, flavonoids, and saponins—that may act on different targets or modulate the activity of the primary compound.[29] Furthermore, the Ayurvedic therapeutic strategy explicitly includes modulating the host's internal environment (*Prakriti Vighata*), a concept entirely absent from the pathogen-centric focus of modern anthelmintic pharmacology.

5.2. Ayurvedic Polypharmacology as a Strategy Against Resistance

The very chemical complexity of Ayurvedic formulations, often seen as a barrier to standardization, may be its greatest strength in combating AR. This concept, central to Ayurveda, is now being explored in modern medicine under the term "polypharmacology"—the design or use of pharmaceutical agents that act on multiple targets simultaneously.[50] A single-molecule drug like albendazole exerts immense selection pressure on a single gene target (β-tubulin). This makes it relatively easy for a parasite population to evolve resistance through a single beneficial point mutation.[60] In contrast, treatment with a whole herb extract or a polyherbal formulation like *Krimikuthar Ras* presents the parasite with a multi-pronged chemical assault.[50] The parasite is simultaneously exposed to dozens of bioactive compounds that may disrupt its cell structure, block its energy metabolism, paralyze its muscles, and interfere with its reproductive processes through various mechanisms. For a parasite to develop resistance to such a formulation, it would need to acquire multiple, independent resistance mutations simultaneously, a scenario that is statistically far less probable.[51] This inherent synergistic action (*Samyoga*), where the combined effect is greater than the sum of the individual parts, may provide a more durable and sustainable therapeutic strategy.[52] This leads to a re-evaluation of how "potency" is measured. While a modern drug may show higher short-term efficacy in EPG reduction (e.g., 99.1% for levamisole vs. 78.4% for Palasha powder in one study [40]), this high potency is linked to a specificity that makes it brittle and susceptible to resistance. The seemingly lower potency of the herbal preparation might be a trade-off for a more resilient, multi-target action that is less likely to drive the rapid evolution of resistance. The Ayurvedic approach prioritizes long-term balance and prevention of recurrence over a single, high-impact kill rate.

5.3. From Ancient Texts to Modern Labs: New Drug Discovery

The pharmacopoeia of *Krimighna Dravyas* represents a vast, ethnopharmacologically pre-validated library of natural products for modern anthelmintic drug discovery.[11] Instead of random high-throughput screening of synthetic compounds, researchers can employ a more targeted approach, often termed "reverse pharmacology" or "forward

pharmacology".[11] This process begins with a plant or formulation with a long history of successful clinical use in a traditional system. Scientists can then work to isolate the active compounds, validate their efficacy in modern preclinical models, and use advanced techniques like molecular docking, genomics, and proteomics to elucidate their precise mechanisms of action.[77] This pathway can lead to the identification of novel chemical scaffolds and lead compounds with unique modes of action, which are desperately needed to circumvent existing resistance mechanisms and revitalize the anthelmintic drug pipeline.[79]

Table 3: Comparative Mechanisms of Action: Ayurvedic vs. Modern Anthelmintics

Feature	Modern Anthelmintics (e.g., Benzimidazoles)	Classical *Krimighna Dravyas* (e.g., Vidanga/Palasha)
Therapeutic Philosophy	Pathogen-centric: Kill the parasite.	Host-centric: Kill the parasite and restore host balance.
Primary Target	Single, specific molecular target in the parasite (e.g., β-tubulin).	Multiple phytochemical targets in the parasite + modulation of the host's internal environment (*Prakriti Vighata*).
Mechanism of Action	Highly specific (e.g., inhibition of microtubule polymerization).	Broad and multi-modal (e.g., energy metabolism disruption, neuromuscular paralysis, digestive stimulation, purgation).
Breadth of Action	Narrow-spectrum (primarily anthelmintic).	Broad-spectrum (anthelmintic, digestive, carminative, laxative, immunomodulatory).
Strategy Against Resistance	Vulnerable to resistance via single-point mutations in the target gene. Relies on drug rotation and combination therapy.	Inherent resilience due to polypharmacology (multi-target attack), making simultaneous resistance development statistically improbable.

6. CHALLENGES AND THE PATH FORWARD FOR INTEGRATION

While the potential of Ayurvedic *Krimighna Dravyas* is immense, their integration into modern therapeutic practice is fraught with significant challenges that must be addressed through rigorous scientific methodology and regulatory oversight. The path forward requires not a wholesale adoption of ancient practices, but a careful, evidence-based integration of the two systems.

The Standardization Hurdle

The single greatest obstacle to the widespread acceptance and clinical use of Ayurvedic medicines is the lack of standardization.[82] Unlike synthetic drugs, which are single, pure chemical entities manufactured under highly controlled conditions, herbal preparations are inherently complex and variable.

- **Raw Material Variability**: The quality and chemical composition of a medicinal plant can vary significantly based on its geographical origin, soil conditions, climate, season of collection, and post-harvest storage practices.[76] Furthermore, the herbal drug market is often plagued by issues of misidentification, adulteration, and contamination with pesticides or heavy metals, which can compromise both efficacy and safety.[84]
- **Manufacturing Inconsistencies**: Traditional Ayurvedic pharmaceutical processes (*Bhaishajya Kalpana*) are often complex and require specialized skills. Without strict adherence to standardized operating procedures, there can be significant batch-to-batch variation in the final product, making consistent dosing and predictable therapeutic outcomes difficult to achieve.[86] Issues such as improper hygiene, suboptimal packaging, and lack of sterilization can further degrade product quality.[86]

- **The Need for Modern Quality Control**: Overcoming this hurdle requires the systematic application of modern scientific standards. This includes implementing Good Agricultural and Collection Practices (GACP) for raw materials and enforcing Good Manufacturing Practices (GMP) in pharmaceutical production.[76] Advanced analytical techniques, such as High-Performance Thin-Layer Chromatography (HPTLC) and High-Performance Liquid Chromatography (HPLC), are essential for creating chemical fingerprints of extracts and for quantifying the concentration of key bioactive marker compounds, such as embelin in Vidanga, to ensure consistency and potency.[87]

The Evidence Gap: The Need for Rigorous Clinical Trials

While preclinical *in-vitro* and animal studies provide a strong foundation, there is a conspicuous lack of large-scale, randomized, double-blind, placebo-controlled clinical trials in humans to definitively establish the efficacy and safety of *Krimighna* therapies for specific helminth infections.[82] The existing human studies are often small, open-label, or lack adequate controls, making their conclusions preliminary rather than definitive.[33] Conducting such trials presents unique challenges, including the difficulty of creating a suitable placebo that can mimic the distinct taste, color, and aroma of a complex herbal formulation, which is necessary for effective blinding.[84] Without this high-level evidence, it will be difficult for these traditional therapies to gain acceptance in mainstream global health systems.

A Vision for Integrative Parasite Control

The most promising future lies not in an "either/or" approach but in an integrative model that leverages the strengths of both systems.[79]

1. **Augmenting the Anthelmintic Arsenal**: Standardized and validated *Krimighna* formulations could be integrated into current control strategies. They could be used in rotational therapy, alternating with synthetic drugs to reduce the selection pressure for resistance to any single class of agent—a strategy already employed in veterinary medicine.[61] Combination therapies, pairing a synthetic drug with a polyherbal formulation, could also be explored to achieve synergistic effects and combat resistant parasite strains.[92]
2. **Fueling New Drug Discovery**: As discussed, the Ayurvedic pharmacopoeia is a fertile ground for the discovery of novel anthelmintic lead compounds.[12] A focused, ethnopharmacology-guided approach to drug discovery is more efficient than random screening and has the potential to yield new molecules with novel mechanisms of action that can bypass existing resistance pathways.[80]
3. **Integrating Host-Centric Preventive Care**: Perhaps the most impactful integration would be at the level of public health. The Ayurvedic principles of *Prakriti Vighata* (modifying the internal environment) and *Nidana Parivarjana* (avoiding causative factors) can be translated into modern public health education. Promoting gut health through diet, improving digestive function, and emphasizing hygiene are powerful preventive strategies that complement mass drug administration programs by strengthening the host's own resilience to infection and reducing the likelihood of re-infestation.[91]

7. CONCLUSION

The escalating crisis of anthelmintic resistance poses a formidable threat to global health and food security, exposing the limitations of a therapeutic strategy reliant on a small number of single-target synthetic drugs. In this challenging landscape, revisiting the ancient wisdom of Ayurveda is not an act of medical nostalgia but a scientifically sound and necessary endeavor. The Ayurvedic paradigm of *Krimi Roga* offers a remarkably sophisticated and holistic framework that recognizes parasitic disease as a failure of the host's internal ecosystem, a perspective that is increasingly validated by modern microbiome science. The classical *Krimighna Dravyas*, particularly archetypal herbs like *Embelia ribes* (Vidanga) and *Butea monosperma* (Palasha), are not mere folklore remedies. A growing body of preclinical evidence confirms their potent anthelmintic activity, which is attributable to specific bioactive compounds like embelin and palasonin. The true strength of the Ayurvedic approach, however, lies in its inherent principles of polypharmacology and host-centric therapy. By employing complex multi-component formulations that launch a multi-target assault on the parasite while simultaneously working to restore the host's physiological balance, Ayurveda offers a therapeutic model that may be inherently more resilient to the development of resistance. The path to integrating this ancient knowledge into modern medicine is clear but challenging. It demands a rigorous, interdisciplinary commitment to overcoming the critical hurdles of standardization, quality control, and large-scale clinical validation. The future of sustainable parasite control may not lie in a single "magic bullet," but in a synergistic strategy that combines the precision of modern pharmacology with the holistic and resistance-mitigating wisdom of traditional systems. A collaborative effort among pharmacognosists, parasitologists, clinicians, and Ayurvedic experts is imperative to unlock the full potential of these classical remedies and translate this ancient knowledge into effective, safe, and durable global health solutions.

8. REFERENCES

[1] World Health Organization. Helminth control in school-age children: a guide for managers of control programmes. 2nd ed. Geneva: World Health Organization; 2011.

[2] Kaplan RM. Drug resistance in nematodes of veterinary importance: a review. Vet Parasitol. 2004;125(1-2):163-74.

[3] Geerts S, Gryseels B. Drug resistance in human helminths: current situation and lessons from livestock. Clin Microbiol Rev. 2000;13(2):207-22. [9]

[4] Prichard RK. Anthelmintic resistance. Vet Parasitol. 1994;54(1-3):259-68.

[5] Kar A. Krimi Roga: A bird's eye view. J Ayurveda Integr Med. 2014;5(4):198-202.

[6] Mishra S, Singh P, Sethi S. Krimi Roga in Ayurveda: A Conceptual Review. Int J Appl Res. 2019;5(9):35-39. [21]

[7] Dwivedi S, Dwivedi A, Dwivedi S. Revisiting the Ayurvedic concept of Krimi Roga. J Ayurveda Integr Med Sci. 2017;2(03):102-108. [14]

[8] Srivastava P. Krimi: Ancient Ayurvedic Texts Describe Microbes 3000+ Years Ago. LifeSpa. [Online]. [15]

[9] Charaka. Charaka Samhita. Vimana Sthana, Chapter 7.

[10] Anonymous. Madhava Nidanam, Chapter 7: Krimi Nidanam. [Online]. [22]

[11] Sharma R, Singh R, Singh S. Apakarshana, Prakriti Vighata, and Nidana Parivarjana: The Ayurvedic approach to Krimi Chikitsa. J Tradit Complement Med. 2018;8(2):252-258. [18]

[12] Pai AS, Divya BS, Poornima B, Jahagirdar G, Jagadeesh K. Potential antimicrobial agents of Charakokta Mahakashaya – A review. J Pharmacogn Phytochem. 2018;7(3S):422-424. [17]

[13] Singh S, Kumar A. A literary survey on anthelmintic (Krimighna) drugs of Bhavprakash Nighantu. Res J Pharm Technol. 2017;10(4):1220-1225. [19]

[14] Sharma P, Sharma S, Kumar N. A review on anthelmintic plants. Int J Res Ayurveda Pharm. 2011;2(5):1464-1469. [3]

[15] Kumar S, Singh SK, Baslas RK. Anthelmintic activity of herbal drugs: A review. Int J Res Ayurveda Pharm. 2012;3(1):12-16. [1]

[16] Iqbal Z, Lateef M, Jabbar A, Muhammad G, Khan MN. Anthelmintic activity of Calotropis procera (Ait.) Ait. F. flowers in sheep. J Ethnopharmacol. 2005;102(2):256-61. [98]

[17] Dwivedi A, Dwivedi S. A review of in vitro anthelmintic activities of thirteen Ayurvedic medicinal plants. Int J Ayurveda Pharma Res. 2016;4(5):49-54. [31]

[18] Polycare Herbals. Vidang (Embelia ribes). [Online]. [26]

[19] Choudhary GP. Review on Embelia Ribes and Its Pharmacological Activity. Int J Pharm Sci. 2013;4(3):125-130. [27]

[20] Nakra Ayurveda. Vidanga (Embelia ribes): The Ultimate Ayurvedic Herb for Krimi Roga (Worm Infestation). [Online]. [20]

[21] Kumar A, Kumar S, Kumar R, Kumar S. Pharmacognostical and phytochemical investigation of Embelia ribes Burm. f. fruit. Res J Pharm Technol. 2013;6(6):651-654. [28]

[22] Radhika B, Nasreen P, Kumar K. Antifungal activity of Embelia ribes Burm. seed extract. J Pharm Res. 2011;4(10):3591-3592. [99]

[23] Nakra Ayurveda. Palaash (Butea monosperma): The Flame of the Forest in Ayurvedic Healing. [Online]. [38]

[24] 1mg. Palash: Benefits, Uses, Dosage, and Side Effects. [Online]. [39]

[25] Lakshmi Ayurveda. Nimba (Neem) - Azadirachta indica. [Online]. [46]

[26] Bhandari U, Kumar N, Singh B, Kaur I. Phytochemical and antioxidant analysis of fruits of Embelia ribes Burm f. J Food Sci Technol. 2021;58(1):217-225. [100]

[27] Jalapure SS, Alagawadi KR, Mahajanashetti CS. In vitro anthelmintic property of Embelia ribes Burm f. fruits. J Sci Ind Res. 2007;66:788-790. [29]

[28] Kumar D, Kumar S, Kumar S, Kumar A. Phytochemical and antimicrobial studies of Embelia ribes. J Pharmacogn Phytochem. 2018;7(4):12-16. [72]

[29] Poojari S. A review on pharmacological properties of Embelia ribes. Pharmacogn J. 2014;6(3):1-6. [30]

[30] Iqbal Z, Lateef M, Akhtar MS, Ghayur MN, Gilani AH. In vivo anthelmintic activity of Butea monosperma against trichostrongylid nematodes in sheep. Fitoterapia. 2006;77(2):137-40. [40]

[31] Saiyam D, Doley J, Pegu SR, Tamuli S, Sarmah PC. Anthelmintic efficacy of ethanolic extract of Butea frondosa seeds against gastrointestinal parasites in naturally infected goats. Indian J Anim Res. 2022;56(10):1224-1229. [45]

[32] Sharma N, Singh V. Effect of Anthelmintic Activity in Butea Monosperma (Lam) on Earthworms. Int J Pharm Res Appl. 2013;2(3):1-6. [42]

[33] Borkar VS, Gangurde HH, Gulecha VS, Mundada AS, Bhoyar PK. Evaluation of anthelmintic activity of flower extract of Butea monosperma var. lutea. J Pharmacogn Phytochem. 2014;2(6):33-35. [44]

[34] Avril DH, Mckie D, Bryan S, Nicholson N, Facey A, Facey M. An investigation into the use of neem leaf extract (Azadirachta indica) as an anthelmintic for the control of gastro-intestinal parasites in post-weaned small ruminants. Proc Caribb Food Crops Soc. 2016;52:1-5. [101]

[35] Alzohairy MA. Therapeutics Role of Azadirachta indica (Neem) and Their Active Constituents in Diseases Prevention and Treatment. Evid Based Complement Alternat Med. 2016;2016:7382506. [48]

[36] Al-Quraishy S, Dkhil MA, Abdel-Gaber R, El-Khadragy M. In vitro studies for the antiparasitic activities of Azadirachta indica extract. Food Sci Technol. 2023;43:e96822. [47]

[37] Coles GC. Anthelmintic resistance in nematodes of sheep. Vet Clin North Am Food Anim Pract. 1997;13(3):569-87.

[38] Martin RJ, Robertson AP, Wolstenholme AJ. The molecular biology of anthelmintic resistance. Parasitology. 1997;114 Suppl:S7-18.

[39] Wolstenholme AJ, Fairweather I, Prichard R, von Samson-Himmelstjerna G, Sangster NC. Drug resistance in veterinary helminths. Trends Parasitol. 2004;20(10):469-76.

[40] Sangster NC. Anthelmintic resistance: past, present and future. Int J Parasitol. 1999;29(1):115-24.

[41] Vercruysse J, Albonico M, Behnke JM, et al. The anthelmintic efficacy of albendazole and mebendazole in school children in Tanzania. Trop Med Int Health. 2001;6(12):1031-4.

[42] Lacey E. The role of the cytoskeletal protein, tubulin, in the mode of action and mechanism of resistance to benzimidazoles. Int J Parasitol. 1988;18(7):885-936.

[43] Jabbar A, Iqbal Z, Kerboeuf D, et al. Anthelmintic resistance: the state of play revisited. Life Sci. 2006;79(26):2413-31.

[44] Kumar S, Pandey AK. Chemistry and biological activities of flavonoids: an overview. ScientificWorldJournal. 2013;2013:162750.

[45] Parasuraman S. Polyherbal formulation. J Pharmacol Pharmacother. 2014;5(1):73-74. [50]

[46] Chorgade MS. Drug discovery and development, Volume 1: Drug discovery. John Wiley & Sons; 2007.

[47] Patwardhan B, Vaidya ADB, Chorghade M. Ayurveda and natural products drug discovery. Curr Sci. 2004;86(6):789-799.

[48] Mukherjee PK. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons; 2002. [89]

[49] Bauer R. Quality criteria and standardization of phytopharmaceuticals: can acceptable drug standards be achieved? Drug Inf J. 1998;32(1):101-110.

[50] Calixto JB. Efficacy, safety, quality control, marketing and regulatory guidelines for herbal medicines (phytotherapeutic agents). Braz J Med Biol Res. 2000;33(2):179-89.

[51] World Health Organization. WHO guidelines on good agricultural and collection practices (GACP) for medicinal plants. Geneva: World Health Organization; 2003. [85]

[52] Sahu R, Sahu A. A review on challenges in Ayurvedic drug dispensing. J Ayurveda Integr Med Sci. 2023;8(1):1-5. [86]

[53] Thatte U. Clinical trials of Ayurvedic medicines: Challenges and opportunities. J Ayurveda Integr Med. 2010;1(2):90-93. [84]

[54] Cragg GM, Newman DJ. Natural products: a continuing source of novel drug leads. Biochim Biophys Acta. 2013;1830(6):3670-95.

[55] Harvey AL, Edrada-Ebel R, Quinn RJ. The re-emergence of natural products for drug discovery in the

genomics era. Nat Rev Drug Discov. 2015;14(2):111-29.

[56] Newman DJ, Cragg GM. Natural products as sources of new drugs over the nearly 40 years from 01/1981 to 09/2019. J Nat Prod. 2020;83(3):770-803.

[57] Kumar S, Singh R, Vasudeva N. Anthelmintic activity of Butea monosperma seeds. Fitoterapia. 2001;72(4):421-2. [103]

[58] Sahu J. Study of Vidanga on Krimi Roga w.s.r. to Round Worms. J Ayurveda Integr Med Sci. 2017;2(4):112-118. [36]

[59] Sharma A, Kumar R, Kumar S, Kumar A. An Open Comparative Randomized Clinical Study of Plant Based Drugs Embelia Robusta Roxb and Mallotus Philippinensis Muell on Intestinal Parasites. J Pharmacogn Nat Prod. 2012;1:122. [35]

[60] Desta B. Ethiopian traditional herbal drugs. Part I: Studies on the identity and on the anthelmintic activity of Embelia schimperi. J Ethnopharmacol. 1995;45(1):27-33. [104]

Works cited

[61] (PDF) Scope of herbal anthelmintics: An ayurvedic perspective - ResearchGate, accessed on July 30, 2025, https://www.researchgate.net/publication/271236032_Scope_of_herbal_anthelmintics_An_ayurvedic_perspective

[62] ayurvedic management of purishaja krimi roga: a case study - International Journal of Research in Ayurveda and Pharmacy, accessed on July 30, 2025, https://ijrap.net/admin/php/uploads/2874_pdf.pdf a review on anthelminthic activity of ayurvedic drugs - International Journal of Research in Ayurveda and Pharmacy, accessed on July 30, 2025, https://ijrap.net/admin/php/uploads/2064_pdf.pdf

[63] in vitro evaluation of anthelmintic activity of embelin - WORLD JOURNAL OF PHARMACEUTICAL RESEARCH, accessed on July 30, 2025, https://wjpr.s3.ap-south-1.amazonaws.com/article_issue/1435663890.pdf

[64] Review on Anthelmintic Drug Resistance of Nematodes in Ruminants and Methods of Detection - International Journal of Medical Parasitology and Epidemiology Sciences, accessed on July 30, 2025, https://ijmpes.com/PDF/ijmpes-3116.pdf

[65] (PDF) Anthelmintic Resistance and Its Mechanism: A Review - ResearchGate, accessed on July 30, 2025, https://www.researchgate.net/publication/357045615_Anthelmintic_Resistance_and_Its_Mechanism_A_Review

[66] Anthelmintic Resistance and Its Mechanism: A Review - Taylor & Francis Online, accessed on July 30, 2025, https://www.tandfonline.com/doi/abs/10.2147/IDR.S332378?tab=permissions&scroll=top&role=tab&aria-labelledby=reprints-perm

[67] (PDF) A Review of Anthelmintic Resistance in Domestic Animals - ResearchGate, accessed on July 30, 2025, https://www.researchgate.net/publication/335858206_A_Review_of_Anthelmintic_Resistance_in_Domestic_Animals

[68] Drug Resistance in Human Helminths: Current Situation and Lessons from Livestock | Clinical Microbiology Reviews - ASM Journals, accessed on July 30, 2025, https://journals.asm.org/doi/abs/10.1128/cmr.13.2.207

[69] Anthelmintic - Wikipedia, accessed on July 30, 2025, https://en.wikipedia.org/wiki/Anthelmintic

[70] (PDF) Natural Products Are a Promising Source for Anthelmintic ..., accessed on July 30, 2025, https://www.researchgate.net/publication/355069792_Natural_Products_Are_a_Promising_Source_for_Anthelmintic_Drug_Discovery

[71] Natural Products Are a Promising Source for Anthelmintic Drug Discovery - MDPI, accessed on July 30, 2025, https://www.mdpi.com/2218-273X/11/10/1457

[72] Sheree Anderson 4/8/2021 California College of Ayurveda 1 Krimi Roga Internal Parasitic Disease through the lens of Ayurved, accessed on July 30, 2025, https://www.ayurvedacollege.com/wp-content/uploads/2021/04/Krimi-Roga-Research-Paper-CAS1.pdf

[73] View of Concept of Krimi and its scientific understanding | Journal of Ayurveda and Integrated Medical Sciences, accessed on July 30, 2025, https://jaims.in/jaims/article/view/2298/3514

[74] Krimi: Ancient Ayurvedic Texts Describe Microbes 3000+ Years Ago, accessed on July 30, 2025, https://lifespa.com/health-topics/gut-health/krimi-ancient-ayurvedic-texts-describe-microbes-3000-years-ago/

[75] Krimighan Dravya of Ayurveda, accessed on July 30, 2025, https://www.nakraayurveda.com/krimighan-dravya/

[76] Potential antimicrobial agents of Charakokta Mahakashaya – A review - Journal of Pharmacognosy and Phytochemistry, accessed on July 30, 2025, https://www.phytojournal.com/archives/2018/vol7issue3S/PartK/SP-7-3-106-764.pdf

[77] Concept of Krimi and its scientific understanding, accessed on July 30, 2025, https://jaims.in/jaims/article/download/2298/3406/

[78] (PDF) ANTHELMINTIC (KRIMIGHNA) DRUGS OF BHAVPRAKASH NIGHANTU: A LITERARY SURVEY - ResearchGate, accessed on July 30, 2025, https://www.researchgate.net/publication/323868494_ANTHELMINTIC_KRIMIGHNA_DRUGS_OF_BHAVPRAKASH_NIGHANTU_A_LITERARY_SURVEY

[79] Vidanga (Embelia ribes) - description, dosage, home remedies, accessed on July 30, 2025, https://www.nakraayurveda.com/vidanga-embelia-ribes/

[80] A conceptual review on krimiroga in ayurveda - ResearchGate, accessed on July 30, 2025, https://www.researchgate.net/publication/353337577_A_conceptual_review_on_krimiroga_in_ayurveda

[81] Madhava Nidana Chapter 7 Krimi Nidanam - Easy Ayurveda, accessed on July 30, 2025, https://www.easyayurveda.com/2023/03/28/madhava-krimi-nidanam/

[82] View of Therapeutic use of Vidanga on Krimiroga - A Literary Review, accessed on July 30, 2025, https://www.jaims.in/jaims/article/view/2055/2797

[83] Vidanga - Embelia ribes - Benefits, Usage, Dose, Side Effects - Easy Ayurveda, accessed on July 30, 2025, https://www.easyayurveda.com/2013/09/23/vidanga-embelia-ribes-benefits-usage-dose-side-effects/

[84] Vidanga (Embelia Ribes) - Properties, Benefits & Dosage - Planet Ayurveda, accessed on July 30, 2025, https://www.planetayurveda.com/library/vidanga-embelia-ribes/

[85] VIDANG (Embelia ribes) - Polycare Herbals, accessed on July 30, 2025, https://polycareherbals.com/ingredient/vidang-embelia-ribes/

[86] Review On Embelia Ribes And It's Pharmacological Activity, accessed on July 30, 2025, https://www.ijpsjournal.com/article/Review+On+Embelia+Ribes+And+Its+Pharmacological+Activity

[87] Embelia ribes - Research Journal of Pharmacy and Technology, accessed on July 30, 2025, https://rjptonline.org/HTML_Papers/Research%20Journal%20of%20Pharmacy%20and%20Technology__PID__2013-6-6-3.html

[88] Research Article Anthelmintic Activity of Fruits of Embelia ribes Burm., accessed on July 30, 2025, https://ijpcsonline.com/files/files/17-254.pdf

[89] Review on pharmacological and phytochemistry of Embelia ribes plant, accessed on July 30, 2025, https://www.pharmacognosyjournal.com/article/25/2-1-9-833.pdf

[90] A COMPREHENSIVE REVIEW ON IN VITRO ANTHELMINTIC ACTIVITIES OF SOME AYURVEDIC PLANTS - International Journal of Ayurveda and Pharma Research, accessed on July 30, 2025, https://ijapr.in/index.php/ijapr/article/download/814/696/

[91] in-vitro-athelmintic-activity-of-aqueous-extract-of-embelia-ribes.pdf, accessed on July 30, 2025, https://www.hakon-art.com/articles/in-vitro-athelmintic-activity-of-aqueous-extract-of-embelia-ribes.pdf

[92] (PDF) Anthelmintic potential of Embelia ribes seeds against ..., accessed on July 30, 2025, https://www.researchgate.net/publication/282727111_Anthelmintic_potential_of_Embelia_ribes_seeds_against_Haemonchus_contortus_of_sheep

[93] In vitro evaluation of anthelmintic activity of Embelin. - CABI Digital Library, accessed on July 30, 2025, https://www.cabidigitallibrary.org/doi/abs/10.5555/20153302910

[94] An Open Comparative Randomized Clinical Study of Plant Based Drugs Embelia Robusta Roxb and Mallotus Philippinensis Muell on Intestinal Parasites | OMICS International, accessed on July 30, 2025, https://www.omicsonline.org/an-open-comparative-randomized-clinical-study-of-plant-based-drugs-embelia-robusta-roxb-and-mallotus-philippinensis-muell-on-intestinal-parasites-2161-069X.1000122.php?aid=14380

[95] Study of Vidanga on Krimi Roga w.s.r. to Round Worms, accessed on July 30, 2025, https://www.wisdomlib.org/hinduism/journal/journal-of-ayurveda-and-integrated-medical-

sciences/d/doc1670213.html

[96] Anthelmintic Effect of the Embelia ribes Decoction and Embelin Derivatives on Trichuris muris in Mice, accessed on July 30, 2025, https://jsparasitol.org/archive/pdf/1996_45_6_04.pdf

[97] Palaash (Butea monosperma) - description, dosage, home remedies, accessed on July 30, 2025, https://www.nakraayurveda.com/palaash-butea-monosperma/

[98] Palash : Benefits, Precautions and Dosage | 1mg, accessed on July 30, 2025, https://www.1mg.com/ayurveda/palash-53

[99] In vivo anthelmintic activity of Butea monosperma against ..., accessed on July 30, 2025, https://www.researchgate.net/publication/236854912_In_vivo_anthelmintic_activity_of_Butea_monosperma_against_Trichostrongylid_nematodes_in_sheep

[100] Anthelmintic efficacy of aqueous extract of Butea monosperma (Lam.) Kuntze against Haemonchus contortus of sheep and goats - PMC, accessed on July 30, 2025, https://pmc.ncbi.nlm.nih.gov/articles/PMC4456563/

[101] Effect of Anthelmintic Activity in Butea Monosperma (Lam) on Earthworms - International Journal of Pharmaceutical Research and Applications (IJPRA), accessed on July 30, 2025, https://ijprajournal.com/issue_dcp/Effect%20of%20Anthelmintic%20Activity%20in%20Butea%20Monosperma%20(Lam)%20on%20Earthworms.pdf

[102] Evaluation of in vitro antihelmintic activity of leaves of Butea monosperma - ResearchGate, accessed on July 30, 2025, https://www.researchgate.net/publication/292395058_Evaluation_of_in_vitro_antihelmintic_activity_of_leaves_of_Butea_monosperma

[103] Evaluation of anthelmintic activity of flower extract of Butea monosperma var. lutea - Journal of Pharmacognosy and Phytochemistry, accessed on July 30, 2025, https://www.phytojournal.com/archives/2014/vol2issue6/PartC/33.1-662.pdf

[104] Evaluation of in vivo Anthelmintic Efficacy of Ethanolic Extract of Butea frondosa Seed against GI Parasites in Goats - ARCC Journals, accessed on July 30, 2025, https://arccjournals.com/journal/indian-journal-of-animal-research/B-5024

[105] Nimba/ Neem (Azadirachta indica) - Lakshmi Ayurveda, accessed on July 30, 2025, https://www.lakshmiayurveda.com.au/blogs/ayurvedic-news-1/nimba-neem-azadirachta-indica

[106] *In vitro* studies for the antiparasitic activities of *Azadirachta indica* extract - SciELO, accessed on July 30, 2025, https://www.scielo.br/j/cta/a/YmNzQbD9WWCRqvg6TGcqCCw/

[107] Therapeutics Role of Azadirachta indica (Neem) and Their Active Constituents in Diseases Prevention and Treatment, accessed on July 30, 2025, https://pmc.ncbi.nlm.nih.gov/articles/PMC4791507/

[108] The Antimicrobial Potential of the Neem Tree Azadirachta indica - PMC, accessed on July 30, 2025, https://pmc.ncbi.nlm.nih.gov/articles/PMC9195866/

[109] Polyherbal formulation: Concept of ayurveda - PMC, accessed on July 30, 2025, https://pmc.ncbi.nlm.nih.gov/articles/PMC4127824/

[110] Polyherbal formulation: A Concept of ayurveda for Kidney Disease - Ignited Minds Journals, accessed on July 30, 2025, https://ignited.in/index.php/jasrae/article/download/13719/27242/68068?inline=1

[111] Polyherbal Formulation Concept for Synergic Action: A Review - ResearchGate, accessed on July 30, 2025, https://www.researchgate.net/publication/331268285_Polyherbal_Formulation_Concept_for_Synergic_Action_A_Review

[112] Vidangarishta : Benefits, Precautions and Dosage - 1mg, accessed on July 30, 2025, https://www.1mg.com/ayurveda/vidangarishta-285

[113] Vidangarishta Uses & Benefits - Sitaram Ayurveda, accessed on July 30, 2025, https://www.sitaramayurveda.com/product/vidangarishta-450-ml/

[114] Vidangarishta: Uses, Benefits, Method, Dosage, Side Effects And Precautions - Netmeds, accessed on July 30, 2025, https://www.netmeds.com/health-library/post/vidangarishta-uses-benefits-method-dosage-side-effects-and-precautions

[115] Krimikuthar Ras For Pharma Franchise | Bulk orders | Manufacturer and Export, accessed on July 30, 2025,

https://www.wilsondrugs.com/krimikuthar-ras/

[116] Baidyanath Krimikuthar Ras Tablet 80 - Uses, Side Effects, Dosage, Price | Truemeds, accessed on July 30, 2025, https://www.truemeds.in/otc/baidyanath-krimikuthar-ras-tablet-80-tm-tacr1-082027

[117] Krimikuthar Ras - Lama Pharmaceuticals, accessed on July 30, 2025, https://www.lamapharma.com/shop/krimikuthar-ras/

[118] Pharmacodynamics: Mechanisms of Anthelmintic Action in Animals - Pharmacology, accessed on July 30, 2025, https://www.merckvetmanual.com/pharmacology/anthelmintics/pharmacodynamics-mechanisms-of-anthelmintic-action-in-animals

[119] A BRIEF REVIEW ON THE MODE OF ACTION OF ANTINEMATODAL DRUGS - PMC, accessed on July 30, 2025, https://pmc.ncbi.nlm.nih.gov/articles/PMC5798647/

[120] Mastering Anthelmintics: A Pharmacological Guide - Number Analytics, accessed on July 30, 2025, https://www.numberanalytics.com/blog/ultimate-guide-anthelmintics-pharmacology

[121] Ivermectin - Wikipedia, accessed on July 30, 2025, https://en.wikipedia.org/wiki/Ivermectin

[122] Resistance to Anthelmintics in Animals - Pharmacology - Merck ..., accessed on July 30, 2025, https://www.merckvetmanual.com/pharmacology/anthelmintics/resistance-to-anthelmintics-in-animals

[123] www.merckvetmanual.com, accessed on July 30, 2025, https://www.merckvetmanual.com/pharmacology/anthelmintics/resistance-to-anthelmintics-in-animals#:~:text=Resistance%20mechanisms%20include%20decreased%20uptake,many%20parts%20of%20the%20world.

[124] Benzimidazoles | zars.2's Site - U.OSU, accessed on July 30, 2025, https://u.osu.edu/zars-2/benzimidazoles/

[125] Benznidazole: Uses, Dosage, Side Effects & Warnings - Drugs.com, accessed on July 30, 2025, https://www.drugs.com/benznidazole.html

[126] Safety of Anthelmintics in Animals - Pharmacology - Merck Veterinary Manual, accessed on July 30, 2025, https://www.merckvetmanual.com/pharmacology/anthelmintics/safety-of-anthelmintics-in-animals

[127] (PDF) A Review on Anthelmintic Plants (2008) | Ravindra G Mali, accessed on July 30, 2025, https://scispace.com/papers/a-review-on-anthelmintic-plants-12obriqvme

[128] (PDF) (R)-(+)-Palasonin, a Cantharidin-Related Plant Toxin, Also Occurs in Insect Hemolymph and Tissues - ResearchGate, accessed on July 30, 2025, https://www.researchgate.net/publication/11187997_R--Palasonin_a_Cantharidin-Related_Plant_Toxin_also_occurs_in_Insect_Hemolymph_and_Tissues

[129] In silico to In vivo development of a polyherbal against Haemonchus contortus - PMC, accessed on July 30, 2025, https://pmc.ncbi.nlm.nih.gov/articles/PMC8789534/

[130] Synthesis, in vitro antioxidant, anthelmintic and molecular docking studies of novel dichloro substituted benzoxazole-triazolo-thione derivatives - PubMed, accessed on July 30, 2025, https://pubmed.ncbi.nlm.nih.gov/21453994/

[131] Phytochemical analysis of Embelia ribes seeds for antimicrobial activities - Journal of Medicinal Plants Studies, accessed on July 30, 2025, https://www.plantsjournal.com/archives/2018/vol6issue4/PartA/6-3-39-781.pdf

[132] Polypharmacology: promises and new drugs in 2022 - PMC, accessed on July 30, 2025, https://pmc.ncbi.nlm.nih.gov/articles/PMC10243259/

[133] Synergistic Effects of Chinese Herbal Medicine: A Comprehensive Review of Methodology and Current Research - Frontiers, accessed on July 30, 2025, https://www.frontiersin.org/journals/pharmacology/articles/10.3389/fphar.2016.00201/full

[134] TRADITIONAL MEDICINE: Using our Past to Advance Our Future | Distilled Periodical, accessed on July 30, 2025, https://yaledistilled.sites.yale.edu/browse-issues/2019-issue/traditional-medicine-using-our-past-advance-our-future

[135] Ayurvedic Pharmaceutical's - Challenges And Opportunities | PPTX, accessed on July 30, 2025, https://www.slideshare.net/RekharamChoudhary/ayurvedic-pharmaceuticals-challenges-and-opportunities

[136] Natural Products for Drug Discovery in the 21st Century: Innovations for Novel Drug Discovery - PMC - PubMed Central, accessed on July 30, 2025, https://pmc.ncbi.nlm.nih.gov/articles/PMC6032166/

[137] Embelin, a Potent Molecule for Alzheimer's Disease: A Proof of Concept From Blood-Brain Barrier

Permeability, Acetylcholinesterase Inhibition and Molecular Docking Studies - Frontiers, accessed on July 30, 2025, https://www.frontiersin.org/journals/neuroscience/articles/10.3389/fnins.2019.00495/full

[138] The Integration of Traditional and Modern Medicine: Future Prospects for Pharmacognosy, accessed on July 30, 2025, https://www.ijpsjournal.com/article/The+Integration+of+Traditional+and+Modern+Medicine+Future+Prospects+for+Pharmacognosy+

[139] Plant-Based Natural Products for the Discovery and Development of Novel Anthelmintics against Nematodes - ResearchGate, accessed on July 30, 2025, https://www.researchgate.net/publication/339827522_Plant-Based_Natural_Products_for_the_Discovery_and_Development_of_Novel_Anthelmintics_against_Nematodes

[140] Advances in the discovery and development of anthelmintics by harnessing natural product scaffolds, accessed on July 30, 2025, https://research-repository.griffith.edu.au/items/f285bcf0-6515-40f2-b6b9-638993abfdfd

[141] Challenges of Ayurvedic Practitioners - Drishti IAS, accessed on July 30, 2025, https://www.drishtiias.com/daily-updates/daily-news-editorials/challenges-of-ayurvedic-practitioners

[142] Integrating Ayurveda with Modern Medicine for Enhanced Patient Care: Analysis of Realities, accessed on July 30, 2025, https://www.researchgate.net/publication/379972851_Integrating_Ayurveda_with_Modern_Medicine_for_Enhanced_Patient_Care_Analysis_of_Realities

[143] Problems associated with clinical trials of Ayurvedic medicines - SciELO, accessed on July 30, 2025, https://www.scielo.br/j/rbfar/a/rjVhRWbrhCdRVnYhqBhFtwp/

[144] Standardisation and QC of Ayurvedic Drugs RARC Dimapur 04.03.2-23.pptx - SlideShare, accessed on July 30, 2025, https://www.slideshare.net/slideshow/standardisation-and-qc-of-ayurvedic-drugs-rarc-dimapur-0403223pptx/266593745

[145] Challenges in Ayurvedic drug dispensing - A Review, accessed on July 30, 2025, https://www.jaims.in/jaims/article/view/3715/6397

[146] Standardization and quality control parameters of Dashanga Kwatha ghana tablet: An Ayurvedic formulation - PMC, accessed on July 30, 2025, https://pmc.ncbi.nlm.nih.gov/articles/PMC3157108/

[147] (PDF) Challenges in Ayurvedic drug dispensing - A Review - ResearchGate, accessed on July 30, 2025, https://www.researchgate.net/publication/390159445_Challenges_in_Ayurvedic_drug_dispensing_-_A_Review

[148] (PDF) Quality Control of Ayurveda Drugs - A Birds Eye View - ResearchGate, accessed on July 30, 2025, https://www.researchgate.net/publication/264942006_Quality_Control_of_Ayurveda_Drugs_-_A_Birds_Eye_View

[149] Integrating Ayurveda with Modern Medicine for Enhanced Patient Care: Analysis of Realities, accessed on July 30, 2025, https://www.physicianjnl.net/index.php/phy/article/view/174

[150] The Future of Global Health - Number Analytics, accessed on July 30, 2025, https://www.numberanalytics.com/blog/future-global-health-traditional-medicine

[151] New combination of medicines to treat parasitic worm infections - EMA - European Union, accessed on July 30, 2025, https://www.ema.europa.eu/en/news/new-combination-medicines-treat-parasitic-worm-infections

[152] Study Details | Evaluation of Effectiveness of ALBENDAZOLIVERMECTIN Coformulation vs ALBENDAZOLE for Treatment of Intestinal Worms | ClinicalTrials.gov, accessed on July 30, 2025, https://clinicaltrials.gov/study/NCT05124691

[153] Back to the future: Traditional medicine, innovative uses | University of Technology Sydney, accessed on July 30, 2025, https://www.uts.edu.au/case-studies/back-future-traditional-medicine-innovative-uses

[154] WHO's Big Push To Integrate Traditional Medicine Into Global Healthcare Framework, accessed on July 30, 2025, https://healthpolicy-watch.news/whos-big-push-to-integrate-traditional-medicine-into-global-healthcare-framework/

[155] (PDF) Traditional Medicine and Global Public Health - ResearchGate, accessed on July 30, 2025, https://www.researchgate.net/publication/367313437_Traditional_Medicine_and_Global_Public_Health

[156] Potential antimicrobial agents of Charakokta Mahakashaya – A review, accessed on July 30, 2025, https://www.phytojournal.com/special-issue/2018.v7.i3S.4853/potential-antimicrobial-agents-of-charakokta-

mahakashaya-ndash-a-review

[157] Anthelmintic potential of Calotropis procera, Azadirachta indica and Punica granatum against Gastrothylax indicus - PMC, accessed on July 30, 2025, https://pmc.ncbi.nlm.nih.gov/articles/PMC5118284/

[158] In vitro Evaluation of Antifungal Activity of the Seed Extract of Embelia Ribes - PMC, accessed on July 30, 2025, https://pmc.ncbi.nlm.nih.gov/articles/PMC3267316/

[159] Phytochemical analysis, antioxidant activities and optimized extraction of embelin from different genotypes of Embelia ribes Burm f.: a woody medicinal climber from Western Ghats of India - PMC, accessed on July 30, 2025, https://pmc.ncbi.nlm.nih.gov/articles/PMC7468010/

[160] (PDF) AN INVESTIGATION INTO THE USE OF NEEM LEAF EXTRACT (AZADIRACHTA INDICA) AS AN ANTHELMINTIC FOR THE CONTROL OF GASTRO-INTESTINAL PARASITES IN POST-WEANED SMALL RUMINANTS - ResearchGate, accessed on July 30, 2025, https://www.researchgate.net/publication/320944732_AN_INVESTIGATION_INTO_THE_USE_OF_NEEM_LEAF_EXTRACT_AZADIRACHTA_INDICA_AS_AN_ANTHELMINTIC_FOR_THE_CONTROL_OF_GASTRO-INTESTINAL_PARASITES_IN_POST-WEANED_SMALL_RUMINANTS

[161] In vitro studies for the antiparasitic activities of Azadirachta indica extract - SciELO, accessed on July 30, 2025, https://www.scielo.br/j/cta/a/YmNzQbD9WWCRqvg6TGcqCCw/?format=pdf&lang=en

[162] Anthelmintic activity of Butea monosperma - PubMed, accessed on July 30, 2025, https://pubmed.ncbi.nlm.nih.gov/11395269/

[163] Evaluation of anthelmintic potential of the Ethiopian medicinal plant Embelia schimperi Vatke in vivo and in vitro against some intestinal parasites, accessed on July 30, 2025, https://pmc.ncbi.nlm.nih.gov/articles/PMC4470045/