

Therapeutic Potentials of *Cinnamomum zeylanicum* Blume (*Twak*), Bridging Ayurveda and Contemporary Science

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ABSTRACT

Cinnamomum zeylanicum Blume. (*Twak*), is widely used in Ayurveda for its therapeutic properties. A systematic screening of PubMed, Scopus, Web of Science, and Google Scholar (2014-2024) was conducted alongside an analysis of Ayurvedic texts, including *Nighantus* and the Ayurvedic Formulary of India (AFI) Volumes I-III. A total of 31 pharmacological studies and 118 Ayurvedic formulations containing *Twak* were reviewed. *Twak* exhibits antifungal, antibacterial, anti-helminthic, cardioprotective, gastrointestinal, anti-inflammatory, antispasmodic, spermatogenesis-enhancing, antitumor, antidiabetic, and antilipidemic effects. These properties are linked to bioactive compounds like cinnamaldehyde, eugenol, tannins, and polyphenols. Ayurvedic Pharmacological properties (*Rasapanchaka*) analysis classifies *Twak* as bitter (*Tikta*), pungent (*Katu*), and sweet (*Madhura*) in taste, with hot potency (*Ushna*), lightness (*Laghu*), and sharpness (*Tikshna*), balancing *Kapha* and *Vata doshas*. The review of AFI confirmed its presence in 118 formulations across various dosage forms. Concluding, Ayurvedic and pharmacological evidence support *Twak's Cinnamomum zeylanicum* Blume. role in treating infectious, metabolic, inflammatory, and cardiovascular disorders. Its bioactive compounds enhance therapeutic efficacy, justifying its continued use in Ayurvedic medicine and integrative healthcare.

Keywords: *Cinnamomum zeylanicum*, *Twak*, Ayurveda, Pharmacology, Herbal medicine, *Rasapanchaka*, Integrative medicine.

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INTRODUCTION

Ayurveda has long been an ancient medical science that focuses primarily on natural remedies. The texts of Ayurveda mention a great number of herbal medications. Based on their hundred years of observations, the ancient doctors employed these medications to cure a variety of illnesses. Among them is *Twak* (*Cinnamomum zeylanicum* Blume) is been explored with its properties.

Throughout years, people from all across the world have used cinnamon as a common spice. It is derived from the inner bark of trees belonging to the genus *Cinnamomum*, which is a tropical evergreen plant with two primary varieties: *Cinnamomum Cassia* (CC), sometimes called *Cinnamomum aromaticum* or *Chinese cinnamon*, and *Cinnamomum zeylanicum* (CZ). Apart from its culinary applications, cinnamon is used in traditional Ayurveda

medicine as a treatment for gynaecological, digestive, and respiratory problems and other different ailments.^[1]

Cinnamomum, a spice with over 250 aromatic species, is primarily found in Asia and Australia. The two most significant species are *Cinnamomum zeylanicum* Blume. (*Ceylon cinnamon*) and *Cinnamomum cassia* (*Cassia cinnamon*), while *C. cassia*, *C. burmannii*, and *C. loureirii* are together referred to as *Cassia cinnamon*. *C. zeylanicum* also known as the "true cinnamon," natively from Sri Lanka.^[2]

Ceylon cinnamon, a high-quality and unique flavour, dominated the market in 2023, accounting for 36.7% of revenue. Its health benefits, subtle flavour and high oil content have attracted a loyal following. The growing demand for natural, organic ingredients in food and beverages is expected to drive its growth. The cassia segment is predicted to experience the fastest CAGR (Compound Annual Growth Rate) due to its affordability, strong taste, and versatility in savoury dishes. The rise in global cuisines and home cooking trends, along with various varieties, drive market expansion.^[3]



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In Ayurvedic classics *Cinnamomum zeylanicum* Blume (*twak*) is included under categorization of *Eladi*^[4-6] and *Sirovirechana gana*⁶ and included in the trio group of *Trijataka* according *Brahatraxis*. In general the properties of Twak are its having *Katu Rasa* (Pungent taste), *Tikta Rasa* (Bitter taste), *Madhura Rasa* (Sweet taste), *Ushna Virya* (Hot potency), *Laghu Guna* (Light property), *Ruksha Guna* (Dry property), *Tikshna Guna* (Sharp property), *Katu Vipaka* (Pungent post-digestive effect), *Karma* (Pharmacological actions) are *tridoshahara* (Pacifies *Vata*, *Pitta doshas* and *kapha dosha*), *Sukrala* (Promotes spermatogenesis), *Balya* (Strengthening and tonic action), *Varnya* (Improves complexion and skin health) etc.^[7]

The primary objective of the study is to bridge classical Ayurvedic knowledge with contemporary scientific validation. This involves aiding Ayurveda practitioners in understanding the rationale behind traditional formulations, supporting researchers in substantiating ancient wisdom with scientific evidence, and promoting public awareness for the safe and informed use of herbal medicines.

METHODOLOGY

The study systematically reviewed databases including PubMed, Scopus, Web of Science, and Google Scholar, analyzing full-text articles published between 2014 and 2024. The search focused on keywords such as “*Cinnamomum* bark pharmacological properties,” “*in vitro*, *in vivo*, clinical studies on *Cinnamomum*,”

“True *Cinnamomum*,” and “Ceylon *Cinnamomum*,” with English as the language criterion. Additionally, the Ayurvedic perspective was explored by compiling the qualities and therapeutic indications of Twak (cinnamon) from seven classical Nighantus (*Bhavaprakasha*, *Raja*, *Dhanvantari*, *Madhava*, *Kaideva*, *Shodhala*, and *Priya Nighantu*). To further understand its clinical relevance, a comprehensive survey of the Ayurvedic Formulary of India (AFI), encompassing all three volumes, was conducted to identify formulations listing Twak as an active ingredient, providing insight into its role in Ayurvedic therapeutics (Figure 1).

Observations and results

The pharmacological properties of Twak (*Cinnamomum zeylanicum* Blume) were systematically reviewed from articles published over the past 10 years across the specified databases. The compiled findings highlight its diverse therapeutic actions, summarized as follows (Table 1):

Anti-Fungal activity

Rangel *et al.*, found cinnamon Essential Oil (EO) antifungal (*Candida biofilm*) and cytoprotective, with eugenol as the main active compound.^[8] Hoang N. H Tran *et al.*, found cinnamon bark EO more effective against specific *Candida* species (*Candida auris* and *Candida albicans*) than the cinnamon leaf EO, with antifungal action, membrane damage, and lower MIC/MFC values.^[9]

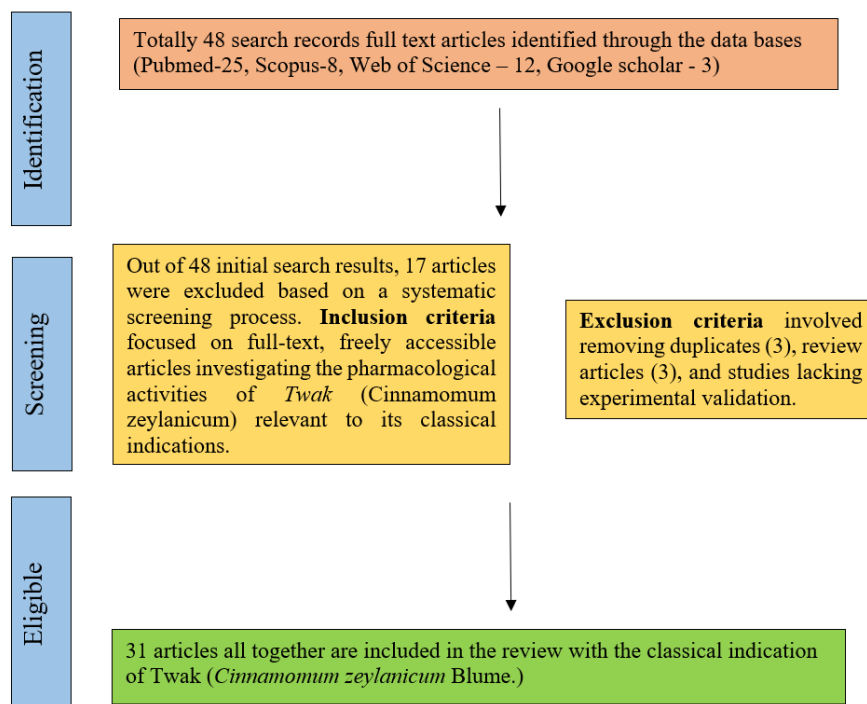


Figure 1: Methodology of extraction of articles for the medicinal properties of Twak (*Cinnamomum zeylanicum* Blume).

Table 1: Results of Phytochemicals and Pharmacological Action as Per the Articles Selected.

Sl. No.	Authors	Phytochemicals expressed in studies	Pharmacological action inferred
1	Rangel <i>et al.</i> , ^[8]	Eugenol	Antifungal
2	Hoang N. H. Tran <i>et al.</i> , ^[9]	Trans-Cinamaldehyde & Eugenol	Antibacterial
3	N Gupta <i>et al.</i> , ^[10]	E-Cinnamaldehyde, α -copaene and δ -cadinene	
4	Vairappan <i>et al.</i> , ^[11]	Monoterpenes, eucalyptol, terpinen-4-ol, eugenol, and α -cadinol	
5	Al-Garadi MA <i>et al.</i> , ^[12]	E-Cinnamaldehyde	
6	Al-fekaiki <i>et al.</i> , ^[13]	cinnamonaldehyde, cyclohexane carboxylic acid, and 6-octadecenoic acid	
7	Mohammad Azamansari <i>et al.</i> , ^[14]	Eugenol + ZnO particles	
8	GAYAN K. WIJESINGHE <i>et al.</i> , ^[15]	Eugenol (77%) Benzyl benzoate (5%), Trans- caryophyllene (3%), Eugenol acetate (3%) and Linalool (2%)	
9	Andrew R. Williams <i>et al.</i> , ^[16]	Tannins like proanthocyanidins and, most significantly, trans-cinnamaldehyde.	
10	Jayasinghe <i>et al.</i> , ^[17]	Aqueous extract of C. Bark having polyphenols, alkaloids & tannins.	Cardioprotective activity
11	Imen Kallel <i>et al.</i> , ^[18]	Monoterpenes such as alpha-pinene & sesquiterpens	
12	Yu <i>et al.</i> , ^[19]	cinnamic acid, catechin, and procyanidin B1/2 are water soluble also the cinnamaldehyde and cinnamic acid, trans-cinnamaldehyde with p-cymene, cinnamyl alcohol, or cinnamic acid	GI disorders
13	Stefania <i>et al.</i> , ^[20]	Tannins, cinnamic acid	Anti-inflammatory action
14	N.-Y. Kim <i>et al.</i> , ^[21]	cinnamic acid and coumarin	
15	Amit D. Kandhare, <i>et al.</i> , ^[22]	Type-A procyanidin polyphenols	
16	Molouk Jaafarpour <i>et al.</i> , ^[23]	Cinnamaldehyde and Eugenol	Antispasmodic action
17	A. Arbati <i>et al.</i> , ^[24]	Cinnamaldehyde	
18	Alev Onder <i>et al.</i> , ^[25]	Cinnamaldehyde	
19	A. Hazarika <i>et al.</i> , ^[26]	Cinnamaldehyde and trans-cinnamaldehyde	
20	Najeeb <i>et al.</i> , ^[27]	Cinnamaldehyde	
21	Madhusmita Sahu <i>et al.</i> , ^[28]	Aqueous bark having major phenolic metabolite like proanthocyanidins such as dimeric, trimeric, and higher oligomeric proanthocyanidins	
22	A.Chakraborty <i>et al.</i> , ^[29]	High eugenol content (80%) with comparsion to Cinnamomum Tamal leaf (60%)	

Sl. No.	Authors	Phytochemicals expressed in studies	Pharmacological action inferred
23	Khaki A <i>et al.</i> , ^[30]	Antioxidant compounds	Spermatogenesis activity
24	S.M. Arisha <i>et al.</i> , ^[31]	Anthocyanins, polyphenols, flavonoid, diterpenes, cinnamaldehyde and phenolic compounds	
25	Muthusamy, <i>et al.</i> , ^[32]	Cinnamaldehyde	
26	Giulia Cappelli <i>et al.</i> , ^[33]	terpenoidic components (mono- and sesquiterpenes)	Anti-tumour effect.
27	Anindita Mandal <i>et al.</i> , ^[34]	62.09-89.31% of trans-Cinnamaldehyde	Anti-diabetic activity
28	Citarrella <i>et al.</i> , ^[35]	cinnamaldehyde, cinnamate, cinnamic acid and eugenol	
29	Ranasinghe <i>et al.</i> , ^[36]	cinnamaldehyde, cinnamate, cinnamic acid and eugenol	
30	Abeysekera <i>et al.</i> , ^[37]	Cinnamyl acetate Eugenol Kaempferol Cinnamaldehyde Trans cinnamic acid Phlorizidin Epicatechin Hydroxybenzoic acid Catechin Gallic acid	Anti-lipidemic action
31	Joohee Oh <i>et al.</i> , ^[38]	Cinnamaldehyde, Eugenol, Trans-Cinnamyl acetate, Caryophyllene	

Anti-bacterial activity

N. Gupta *et al.*, Emphasized the synergistic effects of EO formulations (cardamom:cinnamon) against foodborne pathogens (*Bacillus subtilis*, *Staphylococcus aureus*, *E coli*, *Pseudomonas aeruginosa*), linked to molecular binding to bacterial proteins.^[10] Vairappan *et al.*, showcased broad-spectrum antibacterial activity (*Staphylococcus aureus*, *Listeria monocytogenes*, *Salmonella typhimurium* and *Salmonella enteritidis*), especially against *Listeria monocytogenes*, using the broth dilution method. Disc volatilization (Gupta) targeted volatile EO effects, while broth dilution (Vairappan) provided quantitative insights into antibacterial potency.^[11] Al-Fekaiki *et al.*, identified cinnamaldehyde as a key active compound in cinnamon bark,^[12] while Al-Garadi *et al.*, MA focused on ethanol-extracted cinnamon bark, showing strong antibacterial effects against Gram-positive and Gram-negative bacteria (*Staphylococcus aureus*, *Listeria monocytogenes*, *Escherichia coli*, and *Salmonella Typhimurium*).^[13] Mohammad Azamansari *et al.*, showcased the nanoscale antibacterial efficacy of green-synthesized ZnO-NPs against (*S. aureus* and *E. coli*).^[14] GAYAN K. WIJESINGHE *et al.*, demonstrated the strong antibacterial and antibiofilm effects against *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Klebsiella pneumonia* of cinnamon leaf EO.^[15]

Anti-helminthic activity

Andrew R. Williams *et al.*, Cinnamon bark exhibits anthelmintic properties *in vitro*, primarily due to proanthocyanidins and trans-cinnamaldehyde tannins. Stabilizing and preserving these compounds is crucial for their anthelmintic against intestinal helminths (against the *swine nematode Ascaris suum*) *in vivo* is to be attained.^[16]

Cardioprotective action

Jayasinghe *et al.*, demonstrated the cardioprotective effects of bark extract, reducing oxidative damage in wistar rats model against doxorubicin-induced cardiotoxicity.^[17] Whereas Imen Kallel *et al.*, Used chemical assays (DPPH, H₂O₂, phosphomolybdenum) analysis compared with BHT & ascorbic acid to test antioxidant potential under controlled lab conditions revealed the antioxidant efficacy of essential oil *in vitro*.^[18]

GI Disorders

Yu *et al.*, found that cinnamon extract relieved irritable bowel syndrome with diarrhoea of visceral hyperalgesia in TNBS rats and decreased defecation frequency in MS rats, similar to Ramosetron's effectiveness. It also reduced excess 5-HT, a pathogenic factor for IBS, in the colon and bloodstream.^[19]

Table 2: Medicinal Qualities of the Twak according to different Nighantus.

Sl. No.	Medicinal Qualities	B. P Karpuradi varga ^[39]	R. N Pippalyadi Varga ^[40]	D. N Shatapushpadi Varga ^[41]	M. N Karpur adi Varga ^[42]	K. N Aushadi Varga ^[43]	Sho.N Shatapushpadi Varga ^[44]	P.N Haritak yadi Varga ^[45]
1	Swadi rasa (Sweet taste)	✓					✓	✓
2	Tikta rasa (Bitter taste)	✓				✓		✓
3	Sugandha (Pleasant smell)	✓						
4	Vata -pittahara (Decreases Vata & Pitta Dosha)	✓						
5	Sheeta (Cold potency)		✓				✓	
6	Katu rasa (Pungent taste)		✓			✓		✓
7	Laghu (Light)		✓	✓	✓	✓		
8	Kaphahara (Decreases Kapha)		✓	✓		✓		
7	Tikshna (Sharp)			✓		✓		
8	Ushna (Hot potency)			✓	✓	✓		✓
9	Vishada (Clearness)				✓			
10	Pittalam (Increases pitta)				✓	✓		✓
11	Madhura vipaka (Sweet after digestion)					✓		
12	Kapha -vataghnam (Decreases kapha & vata)			✓		✓		✓
13	Deepana (Increases the appetite)							✓
14	Pachana (Carminative, absorption, stimulate metabolism)							✓
15	Ruchya (Improves tastiness)							✓

Sl. No.	Medicinal Qualities	B. P Karpuradi Varga ^[39]	R. N Pippalyadi Varga ^[40]	D. N Shatapushpadi Varga ^[41]	M. N Karpuradi Varga ^[42]	K. N Aushadi Varga ^[43]	Sho.N Shatapushpadi Varga ^[44]	P.N Haritak yadi Varga ^[45]
16	Sukralam (Increases semen or semen production)	✓	✓					
17	Varnyam (Increases complexion)	✓						
18	Kantashudikaram (Cleanses throat)		✓					
20	Bastishodhana (Cleanses the bladder)		✓					
21	Mukha shuddikara (cleanses the oral cavity)						✓	

Anti-inflammatory action

Stefania *et al.*, Digestion of an extract showed significant antioxidant and anti-inflammatory effects on Caco2 cells and an intestinal barrier model, suggesting potential benefits for gut health.^[20] N.-Y. Kim *et al.*, The extract reduced inflammatory markers like IL-1 β , IL-8, CCL5, COX-2, and ROS levels and inhibited nuclear translocation of AP-1 and NF- κ B, key transcription factors driving inflammation, and suppressed oxidative stress, suggesting potential use in chronic inflammation conditions.^[21] Amit D. Kandhare, *et al.*, Tested TAPP-CZ against compound 48/80-induced mast cell degranulation in isolated rat peritoneal mast cells. Significantly reduced mast cell degranulation and stabilizing those potentially combating allergic diseases like asthma and rhinitis.^[22]

Anti-spasmodic action

Molouk Jaafarpour *et al.*, Cinnamon is a safe for the treatment of primary dysmenorrheal discomfort in young girls trial. A.^[23] Arbati *et al.*, demonstrates spasmolytic (muscle-relaxing) and anti-diarrheal potential in cattle by inhibiting calcium channels and reducing smooth muscle contractions especially those involving spasms or hypermobility.^[24] Alev Onder *et al.*, investigated the effects of Cinnamon Essential Oil (CEO) and Cinnamaldehyde (CA) on Human Corpus Cavernosum (HCC) and rat Corpus Cavernosum (rat CC) wherein the CEO and CA induced 96.9% relaxation in HCC and rat CC.A.^[25] Hazarika *et al.*, assessed the skeletal muscle relaxant effects of Aqueous Extract of Bark of *Cinnamomum verum* (AEBCV) in albino mice. AEBCV significantly reduced motor coordination and locomotor activity. The highest relaxation was observed at 100 mg/kg dosage.^[26] Najeeb *et al.*, examined the role of cinnamaldehyde

in effective in relaxing guinea pig tracheal muscles, particularly against carbachol-induced bronchospasms.^[27] Madhusmita Sahu *et al.*, Evaluated the skeletal muscle relaxant Activity of *Cinnamomum zeylanicum* Bark extract (ABCZB) in albino mice, compared with methocarbamol (a standard muscle relaxant).^[28] A. Chakraborty *et al.*, Investigated the spasmolytic potential of essential oils from *Cinnamomum tamala* and *Cinnamomum verum* on isolated rat ileum found out that *C. tamala* (with 60% eugenol) had less spasmolytic potential compared to *C. verum* (with 80% eugenol).^[29]

Spermatogenesis activity

Khaki A *et al.*, examined the impact of cinnamon on spermatogenesis in Wistar male rats, showed significant improvements in sperm quality, increased testosterone and antioxidant enzyme levels and decreased plasma MDA levels despite no significant changes in testis weights. S.M.^[30] Arisha *et al.*, investigated the protective effects of cinnamon on the testes of rats fed a High-Fat Diet (HFD), cinnamon group fed alongside HFD showed significant protection from testicular damage, improving the condition after 8 weeks.^[31] Muthusamy, *et al.*, Evaluated the impact of heat-induced oxidative stress and Cinnamaldehyde (CA) on testicular structure and function in Wistar rats where the Cinnamaldehyde treatment helped reverse heat-induced damage to testicular function and sperm quality.^[32]

Anti-tumor activity

Giulia Cappelli *et al.*, found that *C. zeylanicum* Essential Oil (CINN-EO) inhibits cell proliferation in M14 human metastatic melanoma cells, increasing ROS production and enhancing Fe (II) content, suggesting ferroptotic cancer cell death.

Table 3: AFI volumes I, II, III formulations as Twak being the ingredient.^[46-48]

I)	Asava & Arishta (Herbal Fermented Formulations)	II)	Avaleha & Paka (Herbal Electuary/Polyherbal Paste Formulation)
	AFI Vol I		AFI Vol I
1	Ashwagandhayarishta	1	Kutajavaleha
2	Kumaryasava	2	Kasamandaka Rasayana
3	Kadhirarishta	3	Chitraka Haritaki
4	Jirakadyarishta	4	Cyavanaprasha
5	Dashamoolarishta	5	Jirakadi Modaka
6	Devadaryarishta	6	Danti Haritaki
7	Draksharishta	7	Dashamoola Haritaki
8	Pippalyadyasava	8	Narikela Khanda
9	Mrgamadasava	9	Puga Khanda
10	Mrtasanjivani sura	10	Bilvadi Leha
11	Mridvikarishta	11	Madhushunti Rasayana
12	Rodhrasava	12	Brahama Rasayana
13	Vasakarishtha	13	Bharangi Guda
14	Rohitakarishtha	14	Laghu Cincadika Lehya
15	Vidangarishta	15	Suranavaleha
16	Saraswatiarishta	16	Haridra Khanda
	AFI Vol II	17	Hrdyavirechana Leha
1	Drakasava		AFI Vol II
2	Punarnavadyarishta	1	Adraka Khanda Avaleha
3	Babbularishta	2	Eranda Paka
	AFI Vol III	3	Puga Khanda
1	Palasapushpasava		AFI Vol III
2	Yogarajasava	1	Abhayadi Modaka
3	Vidangasava	2	Amalaki Jivana
III)	Guggulu (Herbo-Mineral Resin Formulation)	3	Kameshwara Modaka
	AFI Vol I	4	Chandravaleha
1	Kanchanar Guggulu	5	Jeerakadi Rasayana
2	Yogaraj Guggulu	6	Brhad Vasavleha
V)	Churna (fine powders)	7	Brhad Haridra Khanda
	AFI Vol I	8	Methi Modaka
1	Yavanadi Churna	9	Yogasaramruta
2	Chandanadi Churna	10	Loha Rasayana
3	Chaturjata Churna	11	Vasakushmanda Khanda
4	Jatiphaladya Churna	12	Vasaharitakyavaleha
5	Talisadi Churna	13	Shatavari Modaka
6	Drakshadi Churna	IV)	Ghrita (Medicated Clarified Butter Preparations)
7	Lavana Bhaskara Churna		AFI Vol I
8	Sitopaladi Churna	1	Amrtaprasha Ghrita
9	Sudharshana Churna	2	Eladi Ghrita
	AFI Vol II	VI)	Taila (Medicated Oil Preparations)

I)	Asava & Arishta (Herbal Fermented Formulations)	II)	Avaleha & Paka (Herbal Electuary/Polyherbal Paste Formulation)
1	Ashwagnadha Churna		AFI Vol I
2	Astangalavana Churna	1	Anu Taila
3	Gandhaka Rasayana	2	Irimedadi Taila
4	Dashana Samskara Churna	3	Chandanadi Taila
5	Dadimashtaka Churna	4	Chandana Bala Lakshadi Taila
6	Sama Sharkara Churna	5	Dhanvantara Taila
	AFI Vol III	6	Prameha Mihira Taila
1	Ashwagandadi Churna	7	Bala Taila
2	Dantadhavana Churna	8	Baladhatryadi Taila
3	Badaradya Churna	9	Manjishyadi Taila
4	Mahakandava Churna	10	Madhuyashtyadi Taila
5	Mahatalisadi Churna	11	Vacachandanadi Taila
6	Methikadi Churna		AFI Vol II
7	Vyoshadhika Churna	1	Guduchyadi Taila
8	Shuntyadi Churna	2	Vyaghri Taila
VII)	Vati & Gutika (Tablets)		AFI Vol III
	AFI Vol I	1	Rudra Taila
1	Eladi gutika	VIII)	Rasa yoga (Herbo-mineral Formulations)
2	Kasturyadi Gutika		AFI Vol I
3	Khadiradi Gutika	1	Navaratna Rajamrganka Rasa
4	Chandraprabha Vati	2	Brhat Nrpavallabha Rasa
5	Pranada Gutika	3	Srinrapativallabha Rasa
6	Manasamitra Vataka	4	Sutashekhara Rasa
7	Shiva Gutika		AFI Vol II
8	Shulavajrini Vatika	1	Garbhapala Rasa
9	Surana Vataka	2	Nrapathi Vallabha Rasa
IX)	Mandura Kalpas (Medicated Iron-Based Formulation)	3	Piyushavalli Rasa
	AFI Vol III	4	Vrhachgarabhranam Rasa
1	Tryushanadi Mandhura	5	Shringabhra Rasa
		6	Sutashekara Rasa
		7	Lauha Rasa
			AFI Vol III
		1	Shwasakaleshwara Rasa
		2	Sarivadi Vati
		3	Tapyadi Louha

Co-administration with antineoplastic drugs enhances the antitumour effect.^[33]

Anti-diabetic activity

Anindita Mandal *et al.*, supports *C. zeylanicum* as a natural and effective treatment for type 2 diabetes, particularly in Northern India. It enhance insulin signalling through PTP1B inhibition.^[34]

Citarrella *et al.*, supports the nutraceutical potential of cinnamon-based supplements in improving glucose metabolism, lipid profiles, and weight management in Metabolic Syndrome patients.^[35] Ranasinghe *et al.*, This trial aims to provide clinical evidence on cinnamon's hypoglycemic effects in diabetic patients, potentially establishing it as a natural alternative or adjunct to conventional diabetes medications.^[36]

Anti-lipidemic action

Abeysekera *et al.*, evaluated the anti-lipidemic effects of Ceylon cinnamon leaf extracts, finding that both ethanolic and dichloromethane:methanol extracts inhibited key enzymes involved in cholesterol metabolism, suggesting potential cholesterol-lowering benefits.^[37] Joohee Oh *et al.*, studied *Cinnamomum zeylanicum* extract's anti-obesity effects, showing that in cell and animal models, cinnamon supplementation enhanced fat breakdown (via AMPK, p-ACC, CPT-1) and reduced fat storage (by inhibiting SREBP-1c, FAS), indicating its potential for weight management.^[38]

Review on Classical pharmacological action of Twak

The classical *Nighantus*, akin to *Kosha* (compendiums), which details the synonyms, properties, therapeutic actions, and applications of *Dravya* (medicinal substances). A *Nighantu* is essentially a comprehensive collection of terms encompassing the names of plants, animals, minerals, and substances administered as food or medicine. In this review, seven prominent well known *Nighantu* texts were examined to identify references to the herb *Twak*, including its categorisation (*Varga*) and pharmacological attributes, as summarized in Table 2.

Indications

Kasavinasham^[39] (reduces cough), *Shiroruka*^[40] (good for headache), *Hridroga*^[41] (indicated in cardiac disorders), *Basti roga*^[40] (indicated in bladder disorders), *Vataarsha*^[40,42] (indicated in vata doshaja haemaroids), *Pinasa*^[40,41] (in cough cold symptoms), *Krimi roga*^[40] (indicated in worm infestations), *Aruchi*^[41] (in condition of tastelessness), *Kandu*^[41] (in case of itching), *Vanhimandhya*^[42] (low digestive fire).

Review of Classical Formulations containing Twak as ingredient across all dosage forms in AFI Volumes I, II, and III

The Ayurvedic Formulary of India (AFI), published by the Government of India, serves to regulate the formulation, preparation, and use of Ayurvedic medicines. It provides comprehensive descriptions of classical formulations, detailing their ingredients, proportions, preparation methods, and dosages, while offering legal recognition that promotes Ayurvedic research and quality control. To assess the prevalence of *Twak* as an ingredient, a thorough survey of AFI volumes I, II, and III was conducted, with the findings summarized in Table 3.

DISCUSSION

The study aims to explore the medicinal properties of *Twak* (*Cinnamomum zeylanicum*) by establishing a bridge between the principles of classical Ayurveda and contemporary pharmacology. A comprehensive review of recent research highlights the pharmacological actions of *Twak*, correlating its Ayurvedic

Rasapanchaka with relevant formulations indicated for similar therapeutic effects. AFI vol I, II, III are screened for the list of specific formulations where *Twak* was one of the ingredients in all the dosage forms. This will confirm that the indication of the classical formulations selected are using *Twak* for the synergistic action required. A total of 31 studies have reported the pharmacological properties of *Cinnamomum zeylanicum* (*Twak*), demonstrating its diverse therapeutic potential. These include antifungal (2 studies), antibacterial (6 studies), anti-helminthic (1 study), cardioprotective (2 studies), gastrointestinal disorder management (1 study), anti-inflammatory (3 studies), antispasmodic (7 studies), spermatogenesis-enhancing (3 studies), antitumor (1 study), antidiabetic (3 studies), and antilipidemic (2 studies) activities. According to traditional *Nighantu* texts, *Twak* is characterized by *Madhura* (sweet), *Tikta* (bitter), and *Katu* (pungent) tastes, along with *Laghu* (light), *Tikshna* (sharp), and *Ushna* (hot potency) attributes. It is primarily recognized for its *Kapha-Vatahara* (Kapha and Vata-reducing) effects, as supported by the consensus of multiple authors. An analysis of Ayurvedic Formulary of India (AFI) formulations containing *Twak* across all volumes identified 118 formulations, categorized as *Asava* and *Arishta* (22), *Avaleha* and *Paka* (33), *Guggulu* and *Ghrita* preparations (2), *Churna* preparations (23), *Taila* preparations (14), *Vati* and *Gutika* (9), *Rasayoga* (14), and *Mandura Kalpana* (1). Considering its solubility, synergistic interactions, and the pharmacodynamic effects of its volatile compounds, the inclusion of *Twak* (*Cinnamomum zeylanicum* Blume) in formulations is scientifically justified.

Anti-fungal property

According to the reviewed articles, the antifungal activity of *Twak* (*Cinnamomum zeylanicum*) is attributed to eugenol and trans-cinnamaldehyde, which disrupt fungal cell integrity, leading to cell death. Ayurvedic texts describe *Twak* with *Tikta* (bitter) and *Katu* (pungent) rasa, having *vishodhana* (cleansing) and *shoshana* (drying) properties, which balance *Kapha* and *Pitta* doshas—key factors in the pathogenesis of *Kushta* (skin disorders). Relevant antifungal formulations include *Khadhirarishta*, *Methika Churna*, *Gandhaka Rasayana*, *Vyoshadi Churna*, and *Khadiradi Vati*, which are traditionally indicated for managing skin disorders and microbial infections. Their synergistic actions, including blood purification, detoxification, and dosha balance, support the antifungal efficacy of *Twak* as per classical Ayurvedic principles.

Antibacterial property

The major constituents of *Twak* (*Cinnamomum zeylanicum*), including eugenol and cinnamaldehyde, along with α -copaene, δ -cadinene, monoterpenes, eucalyptol, terpinen-4-ol, α -cadinol, cyclohexane carboxylic acid, and 6-octadecenoic acid, exhibit antibacterial activity by disrupting bacterial cell membranes, increasing permeability, and causing cell death. According to Ayurveda, the *Tikta* (bitter) and *Katu* (pungent) rasa of

Twak contribute to this effect by cleansing impurities and inhibiting bacterial growth, while balancing *Kapha* and *Pitta* doshas. Formulations such as *Dashamoolarishta*, *Drakasava*, *Kanchanar Guggulu*, *Dadimashtaka Churna*, *Sitopaladi Churna*, *Sudarshana Churna*, *Khadiradi Gutika*, *Chyavanprasha*, *Brahma Rasayana*, and *Haridra Khanda* contain synergistic antimicrobial ingredients, supporting this traditional and contemporary understanding.

Anthelmintic property

The antihelminthic action of *Twak* (*Cinnamomum zeylanicum*) is attributed to tannins like proanthocyanidins and trans-cinnamaldehyde. According to Andrew R. Williams *et al.*, cinnamaldehyde disrupts nematode cellular integrity, impairing motility and causing death, while proanthocyanidins interfere with parasite energy metabolism and structural stability. Ayurveda explains this through *Katu* (pungent), *Tikshna* (sharp), *Ushna* (hot), and *Vishada* (clear) properties, which collectively create an inhospitable internal environment for parasites by reducing moisture, breaking protective layers, and balancing *Kapha* dosha—thereby regulating immune metabolism. Proven antihelminthic formulations include *Vidangarishta*, *Vidangasava*, *Sudharshana Churna*, and *Gandhaka Rasayana*.

Cardioprotective activity

The cardioprotective action of *Twak* (*Cinnamomum zeylanicum*) is attributed to polyphenols, alkaloids, tannins, monoterpenes (such as α -pinene), and sesquiterpenes. Its antioxidant potential mitigates oxidative stress and inflammation, key factors in cardiovascular health. Ayurveda indicates *Twak* for *Hridroga* (heart diseases) due to its *Ushna* (hot), *Tikshna* (sharp), *Laghu* (light), and *Kaphavatahara* (*Kapha*-*Vata* reducing) properties, which neutralize free radicals, reduce tissue damage, and promote metabolic balance. Proven formulations for this effect include *Cyavanaprasha*, *Ashwagandhadi Churna*, *Ashwagandhayarishta*, and *Chandraprabha Vati*. Together, these formulations complement *Twak's* therapeutic potential in managing oxidative stress and promoting cardiovascular wellness.

GI disorders

The chemical constituents of *Twak* (*Cinnamomum zeylanicum*), including cinnamic acid, catechin, procyanidin B1/2, and cinnamaldehyde, have shown efficacy in managing irritable bowel syndrome with diarrhea (IBS-D). Studies indicate that cinnamaldehyde reduces defecation frequency and visceral hypersensitivity by lowering serotonin (5-HT) levels through the suppression of Tryptophan Hydroxylase 1 (Tph1), the key enzyme involved in serotonin synthesis. According to Ayurveda, *Twak's* *Katu Rasa* (pungent taste), *Ushna Veerya* (hot potency), and *Laghu Guna* (lightness) contribute to *Deepana* (stimulating digestion), *Pachana* (carminative), and *Ruchya* (appetizing) actions. These properties enhance digestive fire (*Agni*), reduce

bloating, and improve gut motility, and support gut microbe balance, thereby aiding overall gastrointestinal function. Classical formulations exhibiting these actions include: for *Deepana* —*Dashamoolarishta*, *Draksharishta*, *Pippalyasava*, *Vidangarishta*, *Punarnavadyarishta*, *Yogarajasava*, *Lavana Bhaskara Churna*, *Sudharshana Churna*, and *Vyoshadi Vati*; for *Pachana* — *Jirakadyarishta*, *Kumaryasava*, *Talisadi Churna*, *Sitopaladi Churna*, *Gandhaka Rasayana*, *Vyoshadi Churna*, *Shuntyadi Churna*, and *Trayushanadi Mandura*; and for *Ruchya-Drakshadi Churna*, *Dadimashtaka Churna*, *Dashana Samskara Churna*, *Chandraprabha Vati*, and *Methika Churna*. Collectively, these formulations address various GI disorders related to digestion, metabolism, and excretion of toxins and waste, with *Twak* playing a pivotal role in enhancing therapeutic efficacy.

Anti-inflammatory action

The anti-inflammatory action of *Twak* (*Cinnamomum zeylanicum*) is attributed to phytochemicals like tannins, cinnamic acid, coumarin, procyanidin polyphenols, cinnamaldehyde, and eugenol. These compounds inhibit pro-inflammatory cytokines (TNF- α , IL-6, IL-1 β), COX-2, histamine release, nitric oxide production, and stabilize mast cells, reducing oxidative damage and inflammation. Ayurveda correlates this with *Pachana* (metabolism stimulation) and *Tikta Rasa* (drying, anti-*Pitta* action) which are present in *Twak* that alleviate inflammatory conditions. Classical formulations like *Mahayogaraj Guggulu*, *Chandraprabha Vati*, *Chyavanaprasha*, and *Haridra Khanda* enhance these therapeutic effects.

Anti-spasmodic action

The antispasmodic action of *Twak* (*Cinnamomum zeylanicum*) is attributed to cinnamaldehyde, eugenol, and proanthocyanidins. Cinnamaldehyde blocks calcium-gated channels, reduces acetylcholine release, and inhibits inflammatory markers, while eugenol desensitizes TRPV1 receptors, inhibits sodium channels, and reduces spasmodic contractions. Proanthocyanidins, with their anti-inflammatory properties, further contribute to this effect. Ayurveda explains this through *Tikta Rasa* (detoxifying and *Pitta*-reducing), *Deepana* and *Pachana* (digestive stimulation), and *Ushna* (*Vata*-pacifying), making the herb *Twak Shoolahara* (pain-relieving). Classical formulations as per the above list for pain management include *Dashamoolarishta*, *Yogarajasava*, *Kanchanar Guggulu*, *Kutajavaleha*, *Chitraka Haritaki*, *Dashamoola Haritaki*, and *Jeerakadi Rasayana*.

Spermatogenesis activity

The phytochemicals in *Twak* (*Cinnamomum zeylanicum*), including anthocyanins, polyphenols, flavonoids, diterpenes, cinnamaldehyde, and phenolic compounds, reduce oxidative stress in the testes by scavenging free radicals, protecting Sertoli and Leydig cells, ensuring proper sperm maturation, and enhancing testosterone synthesis. Ayurveda attributes *Twak*

with *Shukralam* (spermatogenic) properties, supported by its *Swadi Rasa* (sweet taste) and *Ushna Guna* (hot potency), which stimulate reproductive function. Classical formulations from the list promoting this action include *Ashwagandhayarishta*, *Draksharishta*, *Chyavanaprasha*, *Brahma Rasayana*, *Bhrad Haridra Khanda*, *Loha Rasayana*, and *Shatavari Modaka*.

Antitumor effect

The terpenoid components of Twak (*Cinnamomum zeylanicum*), including mono- and sesquiterpenes, exhibit anti-melanoma activity through oxidative stress induction, apoptosis, cell cycle arrest, anti-metastatic effects, and anti-inflammatory action, as noted by Giulia Cappelli *et al.*, In Ayurveda, Twak's *Tikta Rasa* (bitter taste), *Katu Rasa* (pungent taste), *Ushna Guna* (hot potency), *Tikshna Guna* (sharpness), and *Vishada Guna* (clarity) act synergistically to eliminate metabolic toxins (*Ama*), reduce Kapha accumulation, improve circulation, and break down tumour masses, thereby preventing proliferation and recurrence. Classical formulations from the list supporting these actions include *Ashwagandhayarishta*, *Kanchanar Guggulu*, *Shringabhra Rasa*, *Sarivadi Vati*, *Lauha Rasa*, and *Tapyadi Lauha*.

Anti-diabetic activity

The phytochemicals of *Cinnamomum zeylanicum*, including cinnamaldehyde, cinnamate, cinnamic acid, and eugenol, exhibit anti-diabetic activity, as studies have shown their ability to enhance insulin signaling through PTP1B inhibition and support glucose metabolism, with clinical trials confirming hypoglycemic effects in type 2 diabetes. In Ayurveda, Twak's *Tikta Rasa* (bitter), *Katu Rasa* (pungent), *Ushna Veerya* (hot potency), and actions like *Deepana* (appetizer) and *Pachana* (carminative) aid in cleansing microchannels (*Srotoshodhana*), improving glucose metabolism, enhancing digestion, and preventing *Ama* (metabolic toxins). Classical formulations from the list supporting these effects include *Kumaryasava*, *Punarnavadyarishta*, *Kanchanar Guggulu*, *Chandraprabha Vati*, *Yavanadi Churna*, *Lavana Bhaskara Churna*, *Gandhaka Rasayana*, *Ashwagandhadi Churna*, *Cyavanaprasha*, *Haridra Khanda*, *Loha Rasayana*, and *Tapyadi Lauha*, along with external applications like *Guduchyadi Taila* and *Prameha Mihira Taila*.

Anti-lipidemic action

The phytochemicals of *Cinnamomum zeylanicum* including cinnamyl acetate, eugenol, kaempferol, cinnamaldehyde, trans-cinnamic acid, phlorizidin, epicatechin, hydroxybenzoic acid, catechin, gallic acid, and caryophyllene exhibit anti-lipidemic activity by inhibiting key enzymes in cholesterol metabolism, promoting fat breakdown, and reducing fat storage, as supported by referenced studies. In Ayurveda, Twak's *Tikta Rasa* (bitter), *Katu Rasa* (pungent), *Ushna Veerya* (hot potency), *Tikshna Guna* (sharpness), and its *Deepana* (appetizer) and *Pachana* (carminative) actions help reduce *Kapha* and *Meda*

(fat), enhance digestion, and clear *Ama* (metabolic toxins). Formulations from the list supporting this anti-lipidemic effect include *Kumaryasava*, *Kadhirarishta*, *Pippalyadyasava*, *Punarnavadyarishta*, *Vidangarishta*, *Kanchanar Guggulu*, *Yogaraj Guggulu*, *Lavana Bhaskara Churna*, *Sudharshana Churna*, *Methikadi Churna*, *Rohitakarishtha*, *Ashwagandha Churna*, *Haridra Khanda*, *Loha Rasayana*, and external applications like *Manjishtadi Taila*, *Guduchyadi Taila*, *Vyaghri Taila*, and *Prameha Mihira Taila*.

CONCLUSION

The present review establishes a scientific correlation between the classical Ayurvedic principles and contemporary pharmacological research on *Cinnamomum zeylanicum* (Twak). The herb demonstrates a broad spectrum of pharmacological activities, including antifungal, antibacterial, anti-helminthic, cardioprotective, anti-inflammatory, antispasmodic, spermatogenesis-enhancing, antitumor, antidiabetic, and antilipidemic properties, which align with its Ayurvedic *Rasapanchaka* attributes-*Tikta* (bitter), *Katu* (pungent), *Madhura* (sweet) rasa; *Ushna* (hot potency); *Laghu* (lightness); *Tikshna* (sharpness); and *Kapha-Vatahara* (Kapha and Vata-reducing) effects. A systematic review of the Ayurvedic Formulary of India (AFI) revealed Twak as a key ingredient in 118 formulations spanning multiple dosage forms, reinforcing its therapeutic relevance. Its solubility, synergistic interactions, and the bioactivity of its volatile compounds further substantiate its pharmacological efficacy. The alignment between Ayurvedic formulations and modern pharmacological findings underscores the importance of Twak in addressing a wide range of health conditions, particularly through its antimicrobial, digestive, metabolic, and cardioprotective mechanisms. Thus, the scientific validation of Twak's pharmacological potential supports its continued use in traditional formulations while also providing a foundation for future research and therapeutic applications in integrative medicine.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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