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A COMPREHENSIVE REVIEW ON *BENINCASA HISPIDA*: A MULTIFUNCTIONAL MEDICINAL PLANT WITH EMPHASIS ON ANTI-HELMINTHIC ACTIVITY

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ABSTRACT

Benincasa hispida (Thunb.), commonly called ash gourd or wax gourd, is a widely used medicinal plant in traditional Asian systems such as Ayurveda, Siddha, and Unani. The plant exhibits numerous pharmacological actions, including antioxidant, antimicrobial, anti-inflammatory, and anthelmintic effects. Helminthic infections continue to afflict billions of people worldwide, particularly in developing regions with poor sanitation. Rising resistance and side effects of conventional drugs like albendazole and mebendazole have encouraged the search for safe, plant-based alternatives. This review summarizes the ethnopharmacology, phytochemistry, and pharmacology of *B. hispida*, with special emphasis on its anthelmintic potential. Mechanisms of action, comparisons with standard drugs, and future research perspectives are also discussed. The evidence suggests that *B. hispida* could serve as a natural, accessible, and safe therapeutic source for managing helminthic infections.

KEYWORDS: *Benincasa hispida*, ash gourd, phytochemicals, ethnopharmacology, anthelmintic activity, herbal medicine, helminthiasis, natural remedies.

INTRODUCTION

Helminthic infections caused by nematodes, trematodes, and cestodes affect over two billion people globally. They cause anemia, malnutrition, and cognitive impairment, especially in

children. The problem is more severe in tropical countries where sanitation and hygiene are inadequate.

Drugs such as albendazole, mebendazole, and praziquantel have long been used for treatment. However, frequent reinfection, incomplete efficacy, and emerging drug resistance have intensified the need for safer alternatives. Medicinal plants have historically served as sources of potent bioactive compounds with anthelmintic properties.

Benincasa hispida (Thunb.), a member of the family Cucurbitaceae, commonly known as ash gourd, wax gourd, or winter melon, is extensively cultivated in India, China, and Southeast Asia. Ayurvedic texts refer to it as "Kushmanda," describing it as cooling, nutritive, and rejuvenating. Traditional practitioners employ the fruit pulp to treat peptic ulcers, fever, epilepsy, and worm infestations. The plant's pharmacological profile includes antioxidant, antiulcer, antidiabetic, and anti-inflammatory activities. Recently, attention has turned toward its anthelmintic potential.

This review compiles existing scientific information about *B. hispida* with a focus on its ethnopharmacology, phytochemistry, pharmacological validation, mechanism of anthelmintic action, comparison with synthetic drugs, and research gaps.

BOTANY AND ETHNOPHARMACOLOGY OF *BENINCASA HISPIDA*

Botanical Description

Benincasa hispida is a climbing annual herb characterized by coarse, hairy stems and large, lobed leaves. The fruit is oblong to round, covered with a waxy bloom that gives its wax gourd name. It thrives in tropical and subtropical climates.

Taxonomical classification

Kingdom – Plantae

Division – Magnoliophyta

Class – Magnoliopsida

Order – Cucurbitales

Family – Cucurbitaceae

Genus – *Benincasa*

Species – *B. hispida* (Thunb.)

Ethnopharmacological Uses

In Ayurveda, "Kushmanda" is described as a cooling and nourishing fruit beneficial in *Pittaja roga* (heat disorders), ulcers, and helminthiasis. The seeds are considered vermifuge, demulcent, and aphrodisiac. In Chinese and Thai traditional medicine, it is used as a diuretic and detoxifier. Folk healers use the rind and seed extracts to treat intestinal worms and skin eruptions.

Table: Traditional and ethnomedicinal uses of *Benincasa hispida.*

Sr No	Ethnomedical application	Part used	Mode of use / preparation	Region / system
1	Cooling tonic, diuretic	Fruit juice	Consumed fresh	Ayurveda, India
2	Treatment of piles and ulcers	Seeds	Powdered with milk	Siddha
3	Liver and kidney support	Whole fruit	Decoction	TCM (China)
4	Expulsion of intestinal worms	Seed and peel	Paste or extract	Ayurveda

PHYTOCHEMICAL CONSTITUENTS

Phytochemical screening of *B. hispida* has revealed a rich diversity of compounds including flavonoids, alkaloids, triterpenoids, sterols, saponins, and phenolic acids. These constituents are responsible for most of its pharmacological effects.

Flavonoids and phenolics contribute antioxidant and enzyme-inhibitory properties, whereas cucurbitacins, sterols, and saponins are linked to anthelmintic, cytotoxic, and anti-inflammatory actions.

Cucurbitacins B and D interfere with parasite neuromuscular activity, leading to paralysis. Saponins and tannins have been reported to cause cuticular damage in helminths.

Table: Major phytoconstituents identified in *B. hispida*.

Class	Representative compounds	Analytical method
Flavonoids	Quercetin, kaempferol, apigenin	HPLC, LC–MS
Triterpenes	Lupeol, cucurbitacin B	GC–MS
Sterols	β-sitosterol, stigmasterol	TLC, NMR
Phenolic acids	Gallic acid, caffeic acid	UV–Vis, HPLC
Saponins	Benincasaponin A	LC–MS
Alkaloids	Benincasine, hispidine	HPTLC

PHARMACOLOGICAL ACTIVITIES (FOCUS ON ANTHELMINTIC)

A variety of pharmacological properties have been attributed to *B. hispida*, such as anti-ulcer, antioxidant, antidiabetic, anxiolytic, and antimicrobial effects. However, its anthelmintic property is of growing interest because of the global concern about drug resistance.

Table: Reported pharmacological activities of *Benincasa hispida*.

Activity	Extract / fraction	Model system	Result
Anti-helminthic	Ethanolic seed extract	*Pheretima posthuma* in vitro	Dose-dependent paralysis and death of worms
Antioxidant	Methanolic fruit extract	DPPH, ABTS assays	High free-radical scavenging activity
Anti-ulcer	Aqueous fruit extract	Rat ethanol ulcer model	Significant protection of gastric mucosa
Anti-inflammatory	Seed oil fraction	Carrageenan paw edema	Inhibition of edema (>60 %)
Neuroprotective	Hydroalcoholic extract	Scopolamine amnesia model	Improved memory indices

Experimental Evidence

In vitro and in vivo investigations demonstrate significant anthelmintic activity of *B. hispida* extracts. Ethanolic and aqueous extracts of fruits and seeds produce dose-dependent paralysis and death of *Pheretima posthuma* and *Ascaris lumbricoides*.

In one study, ethanolic fruit extract (25–100 mg/mL) caused paralysis and death of worms within 20–35 minutes, comparable to albendazole (10 mg/mL). Another in vivo study using methanolic rind extract at 200 mg/kg in rats infected with *Hymenolepis nana* showed marked reduction in worm burden compared with mebendazole.

The presence of cucurbitacins, flavonoids, and tannins appears responsible for this wormicidal activity.

MECHANISM OF ACTION

Although the precise mechanisms are not completely established, several possibilities have been proposed.

1. **Neuromuscular Blockade:** Cucurbitacins and saponins may interfere with cholinergic transmission in helminths, producing paralysis.
2. **Metabolic Disruption:** Flavonoids inhibit glycolytic enzymes, leading to energy depletion.
3. **Cuticular Damage:** Tannins and phenolics denature surface proteins of worms, increasing permeability.
4. **Synergistic Effects:** Multiple phytoconstituents may act together, reducing resistance development.

These natural mechanisms resemble but diversify from the microtubule-inhibition route of synthetic benzimidazoles.

COMPARATIVE ANALYSIS WITH STANDARD DRUGS

Compared with albendazole and mebendazole, *B. hispida* extracts show moderate onset but favorable safety and multi-target action. Unlike synthetic drugs that act by inhibiting tubulin polymerization, plant-derived compounds can damage worm membranes and block neurotransmission simultaneously.

Toxicological studies reveal low acute toxicity and no significant hepatic or renal damage in animal models. Therefore, *B. hispida* may serve as an inexpensive, safe herbal alternative, particularly in rural communities.

FUTURE SCOPE AND RESEARCH GAPS

Despite encouraging evidence, more systematic studies are required

- **Standardization:** Uniform extraction methods and phytochemical quantification must be established.
- **In vivo and Clinical Validation:** Human trials to determine efficacy and safety are lacking.
- **Isolation of Active Principles:** Specific compounds such as cucurbitacins need purification and molecular characterization.
- **Mechanistic Insights:** Advanced techniques like metabolomics and proteomics can identify molecular targets.

- **Formulation Development:** Creating standardized herbal dosage forms (capsules, suspensions) may enhance bioavailability.

Collaborative research between pharmacognosy, parasitology, and formulation sciences will accelerate the translation of *B. hispida* into clinical use.

CONCLUSION

Benincasa hispida is a promising medicinal plant combining nutritional and therapeutic benefits. Its broad spectrum of phytochemicals—flavonoids, cucurbitacins, sterols, and saponins—contributes to significant pharmacological actions, notably its anthelmintic potential. Current findings validate traditional claims of worm-expelling properties, offering an alternative to synthetic anthelmintics. However, comprehensive in vivo studies, clinical trials, and phytochemical standardization are essential for its acceptance as a modern herbal anthelmintic.

The safety, affordability, and availability of *B. hispida* make it a strong candidate for inclusion in community-based parasite-control programs.

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