

A REVIEW ON EXPLORING THE THERAPEUTIC POTENTIAL OF *BENINCASA HISPIDA*

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ABSTRACT

Benincasa hispida (Cucurbitaceae), commonly known as ash gourd or winter melon, is a plant with significant medicinal and nutritional value. This review explores its botanical characteristics, traditional uses, and phytochemical composition. It is a rich source of bioactive compounds that include phenols, triterpenes, sterols, and glycosides, present in different parts such as fruit, leaves, roots, seeds, and peels. In Ayurveda, *Benincasa hispida* is known to treat several ailments such as diabetes and gastrointestinal disorders and neurological conditions like Alzheimer's disease. Its pharmacological properties include antioxidant, anti-inflammatory, gastroprotective, anxiolytic, antihypertensive, and nephroprotective activities. Moreover, shows potential in managing obesity and diabetes respectively. Furthermore, the plant's seeds offer prebiotic effects, contributing to gut health, while its peel extracts have skin whitening and anti-aging properties. This comprehensive review highlights the therapeutic potential of *Benincasa hispida*, emphasizing its significance in both traditional medicine and modern pharmacology.

KEYWORDS: *Benincasa hispida*, Cucurbitaceae, Phytochemical composition, Traditional uses, Antioxidant.

INTRODUCTION

Herbal medicine is considered one of the most important science bases for ancient and advanced medical systems. In developing countries, about 75–80% of the world population relies on natural product-based medicine for primary health care due to their better cultural acceptability and compatibility with the human body and minimal adverse reactions.^[1]

There is currently a resurgence of interest in using plants for both food and medicine. Certain bioactive therapies derived from plants can prevent specific diseases. It is commonly acknowledged that consuming more fruits and vegetables reduces the risk of aging-related degenerative diseases such as cancer, heart disease, cataracts, and immune system and brain malfunction.^[2]

Ayurveda is an ancient Indian science that focus on promoting healthy living and describes food and medicines. Medicinal herbs played a significant part in ancient medicine. Herbal remedies were a significant component of traditional medicine. Herbal remedies are less or nontoxic, less expensive, more effective, and distinctive. According to the World Health Organization (WHO), 80% of people worldwide utilize natural therapies. In ancient medicinal practices like Ayurveda,

Unani and Siddha a variety of plant species are utilized to cure a wide range of ailments.^[2]

The Cucurbitaceae family is a large plant family, with roughly 960 species and 125 genera. Since ancient times, the many parts of plants i.e. fruit, seeds, stems, and leaves of the Cucurbitaceae family have been widely used in various cuisines. Presence of a large number of metabolites it is employed in ayurveda and folk medicine for its many therapeutic properties. *Cucurbit* species grow over a wide range of environments, tropical and subtropical regions, arid deserts, and temperate regions. Most of these species are used in Indian traditional food and medicine systems. These are the source of vitamins and minerals and soluble fiber.^[3]

Benincasa hispida (Thunb.) Cogn., known as Kundur or winter melon, ash gourd, and white gourd, is a vegetable cultivated in dry areas of the lowland tropics. In ayurveda, *Benincasa hispida* is used to treat diverse ailments like diabetes mellitus, diuresis diseases, urinary infection, chronic inflammatory disorders, epilepsy, insanity, peptic ulcer and internal haemorrhages. Studies reveal that juice of *Benincasa hispida* is stable over time and of high nutritional value, low sugar, and low sulphide content.^[4]

The current generation relates to Ash gourd as the miracle fruit that helps detoxify the body and helps in weight loss, social media has been popularizing the use of fruit juice as part of dieting techniques.^[5] It conveys that functional and nutraceutical foods could replace medicines.

Botany and Traditional uses

Benincasa (*Cucurbitaceae*) is a monotypic genus with a single species. It is indigenous to both arid and temperate regions of the earth and requires long periods of warm, dry weather for its optimal growth.

Taxonomy

Benincasa hispida belongs to the **Kingdom:** Plantae, **Phylum:** Tracheophyta, **Oder:** Cucurbitales, **Family:** *Cucurbitaceae*, **Genus:** *Benincasa*, **Species:** *Benincasa hispida* (Thunb.) Cogn.

Synonyms: Kushmanda, Pushpaphala, Pitaphushpa, Karkaru, Aaru, kundur fruit, Chalkumra.

Vernacular names: Sanskrit -Kushmanda, Hindi -Kumhra, Pani kumhra, Petha, Kannada -Boodkumbala kayi, Malayalam -Elavan, Kumbalam, Neyakumbalam, Tamil -Kalyana pooshni, Pushanikai, Telugu -Budidagummadi, Marathi -Kohla.^[5]

Common names: Common names include wax gourd, winter melon, ash gourd, and winter gourd. Chinese watermelon, gourd melon, white gourd, and tallow gourd.

Benincasa hispida is a large trailing or climbing plant. Its stem has robust, angular, hispid tendrils that are 2-fid. The petioles are 7.5–10 cm long and lack glands, while the flowers are large, yellow, monoecious, and serrate. The leaves are reniform, orbicular, cordate, more or less deeply 5-lobed, and hispid beneath. The male flowers have 5 petals and 3 stamens while the female flowers with oblong ovaries and are densely hairy. The fruit is large, measuring 30–45 cm in length, broad, cylindrical, hairy, and finally covered with a waxy bloom. The seeds are many, oblong, compressed, and margined. Fruits are 30–45 cm long, densely hairy when young, and thick waxy deposits when ripe. Cuticular waxes over the fruit surface could prevent plants from unlimited water loss to maintain fruit quality and from pathogen infection, waxes they are synthesized and change during fruit development. Cuticular waxes are synthesized from the pedicel, whose thickness is increased with the development of the fruit.^[6]

Phytochemistry

Benincasa hispida fruit contains 93–96% moisture and is rich source of nutrients such as vitamin C, vitamin B₂, Na, and Ca. Phenolic compounds like astilbin, catechin, and naringenin, other bioactive compound constituents include triterpenes (alnusenol, multiflorenol, isomultiflorenol), sterols (lupeol, lupeol acetate, β -

sitosterol), glycosides, saccharides, carotenes, β -sitosterin, tannins, uronic acid.^[7] cucurbitacins,^[8] citrulline and malic acid is the predominant acid component that affects the taste of wax gourd.^[9]

Leaf: Alkaloids, Flavonoids, Steroids, and amino acids, pectic polysaccharides, hemicellulose polysaccharides, terpenes and terpenoids, flavonoid C-glycosides, sterols, proteins, phenols, alkaloids, glycosides, tannins, saponins, hydroxybenzoic acids, flavanols, hydro cinnamic acids, and triterpenes.^[10]

Root: Proteins, glycosides, alkaloids, tannins.^[11]

Seeds: Crude fat and crude protein, minute amounts of a triterpenoid known as isomultiflorenol, proteins (trigonelline, coffearin, and osmotin), steroids (beta-sitosterol and stigmast-5-ene-3-beta-ol), alkaloids (5-methylcytosine), and triterpenoids (cucurbitacin B, polyphenols, tannins, and fixed oil), and seed oil is a rich source of linoleic acid, palmitic acid, stearic acid.^[12]

Peels: According to chemical analysis the main sugars were galactose, glucose, xylose and sorbose. Phenols, alkaloids, saponins, steroids, carbohydrates, and flavonoids were present. Ascorbic acid, quercetin and rutin are the main bioactive compounds in chloroform, alcoholic, and aqueous peel extracts.^[13]

Food use

The mature fruit is the mainly used part of the plant, although stems and leaves are also cooked and eaten. The fruits, pericarp, seeds, stems, roots, and leaves of this plant are used in various types of preparations in pickles, and curries. The fruits are consumed in various ways, those are cooked as fresh vegetables, candied, dried, pickled, and also used in salad, chutney, chips, fried seeds in ghee, and in Ayurvedic medicine preparation. Edible pulp is used in various food products such as tea and juice.^[13] The sweet delicacy that is known to the world as “Agra petha”, is also prepared from ash gourd. It is been used as a medicinal plant by Ayurvedic and Sri Lankan traditional physicians since antiquity.^[14]

Medicinal use

Benincasa hispida is a winter melon used in India for medicinal purposes. Its widespread medicinal properties have been recognized in the Ayurvedic system of medicine, spiritual traditions of India, and Yoga.^[15] *Benincasa hispida* (Thunb.) Cogn. is mentioned in Ayurveda as ‘Kushmanda’, having anabolic, anthelmintic, brain tonic, carminative, diuretic, memory enhancer, refrigerant, restorative, rejuvenator and vitalizer properties.^[8] Kundur fruits commonly assimilated as a tonic, aphrodisiac, laxative, cardiogenic, kidney stones, diuretic disorders, lunacy, schizophrenia, bile bladder diseases, digestion disorder, and oestrous cycle disorders.^[16] Further, also used as *Mutraghata* (Urethritis), *Prameha* (Diabetes mellitus),

Ashmari (kidney stone), *Manasa Vikara* (psychological problems). It possess various pharmacological properties including antioxidant, ACE inhibitory, anti-ulcer, anti-inflammatory, anti-obesity, and anti-diarrheal activity.^[3] The antacid action of ash gourd helps maintain body pH and counteracts acidity. Cucurbitin B found in ash gourd has cytotoxic and anti-inflammatory activity. The triterpenes alnusenol and multiflorenol from ash gourd are active histamine release inhibitors.^[16] *Benincasa* Exocarpium (BE) is a fruit peel of *B. cerifera* used traditionally in Chinese medicine for the treatment and prevention of metabolic diseases such as hyperglycemia and obesity.^[17]

Pharmacological properties

Antioxidant properties

Benincasa hispida, have been observed with rutin and quercitrin content (flavonoids). The hydroxyl radical (OH), hydrogen peroxide (H₂O₂), and superoxide anion (O₂) can all be scavenged by quercetin. These ROS (reactive oxygen radicals) obstruct the metabolism of biomolecules resulting in epigenetic changes.^[18] Ethanolic *Benincasa hispida* fruit extracts have free radical scavenging activity. Aqueous ethanolic *B. hispida* seed extracts have the maximum amount of DPPH radical scavengers, dietary antioxidants such as phenolic compounds and tocopherols are present in the seed oils and serve as a possible component in the functional food and nutraceutical industry.^[19] The ethanolic peel extract obtained showed radical scavenging of DPPH and ABTS radicals, reduced free radicals in the FRAP assay, and inhibited peroxide radicals with significant antioxidant activities.^[13]

Alzheimer's disease

Kusmanda is described in *Ayurveda* as a *Medhya* (nootropic) drug. Kusmanda is used as the *Kusmanda Ghrita*, it is indicated in the treatment of mental disease.^[20] *Benincasa hispida* ethanolic fruit extract produced significant improvement in the latency time and mean time spent in target quadrant of treated animals when compared to disease control animals in Morris water maze test and attenuated the behavioural abnormalities and cognitive impairment in the Y maze test. Treatment groups (*Benincasa hispida*) produced significant improvement in the reduction of Amyloid β levels and significantly improved the damage of hippocampal cells and in the management of aluminum chloride (AlCl₃) induced rat model of Alzheimer's disease.^[21]

Antiepileptic activity

The alcoholic extract of *Benincasa hispida* protected animals the against maximal electroshock-induced convulsion, pentylenetetrazol-induced convulsion, and strychnine-induced convulsions and reduced the mean recovery time from convulsion.^[22] *Benincasa hispida* ethanolic extract (200 and 400mg/kg) has a potential antistress effect and increased entries into the open arm and the time spent in the open arm on the elevated plus

maze test indicates that extract reduced the stress level and it significantly reduced the spontaneous motor activity and decreased the anxiety.^[23]

Gastroprotective

Benincasa hispida is recommended in *Ayurveda* to manage peptic ulcers. *Cucurbita pepo* fruit and *Benincasa hispida* fruit showed gastroprotective activity on various ulcer-induced model including aspirin + Pylorus ligation induced, acetic acid induces chronic ulcer, and HCl-ethanol induced ulcer. Ethanolic extracts of *Benincasa hispida* fruits have potent antioxidant activity and gastroprotective activity.^[24] Fruit juice of ash gourd is also used to relieve common symptoms of dyspepsia, such as burning, pain, nausea, bloating, belching, and irregular bowel movements.^[25]

Anti-inflammatory

The methanolic extract of the fruit have anti-inflammatory, anti-antihistaminic activity.^[27] Also, ethanolic extracts of the seeds have exhibited notable anti-inflammatory activity.^[28]

Antihypertensive

Benincasa hispida extract alters the metabolic pathways of amino acid in Dahl salt-sensitive rats and its antioxidant potential reduced the hypertension patterns of Salt-sensitive rats hence results provide theoretical basis for the development and research using *Benincasa hispida* as an effective natural antioxidant for hypertension.^[29]

Kidney disorders

Benincasa hispida has a long history of folk medicine to treat symptoms such as heat syndrome, dysuria, low back pain, and urticaria. *Benincasa hispida* extract shows diuretic activity which increases urine volume, sodium volume, and chloride volume and also shows a significant decrease in potassium excretion in rats with average daily dose of 100 mg/kg bw. Histological observations revealed that treatment using a hydro-alcoholic whole fruit extract of *Benincasa hispida* (ash gourd) reversed the degenerative alterations in kidney cells caused by paracetamol. It also helps in nephroprotective activity against mercury in poisoned rat models. And potentially reversing the conditions of kidney damage induced by gentamicin.^[30]

For obesity

Ash gourd (*Benincasa hispida*) contains plenty of moisture, protein, carbohydrates and fiber, calcium, phosphorous, iron, riboflavin, thiamine, niacin, and vitamin C. Being low in calories, it is ideal for diabetic patients and those seeking weight control. The ethanolic extract of *Benincasa hispida* and active fraction, reduced body weight gain, BMI (body mass index), lipid accumulation in adipose tissue, and decreased serum lipid profiles when compared with HFD control. It is potentially cardioprotective and useful for the management of obesity, hyperlipidemia, and

atherosclerosis.^[31] *Benincasa hispida* exocarp is a functional material for the treatment of type 2 diabetes and its complications.^[17]

Others uses

As per the analysis *Benincasa hispida* seeds, revealed 4.9% moisture, 24.8% protein, 40.27% crude fat, 2.41% crude fiber, 11.86% ash and 15.66% carbohydrate. The low molecular weight carbohydrates, resistant starch, and inulin present in the seeds accounted for 34%, 29.5%, and 26.01 mg/dL respectively. Upon conducting a comparative analysis on the growth of *Lactobacillus* and *E. coli* on carbohydrate supplemented media, and *Lactobacillus* exhibited a higher growth rate than *E. coli*. This positive effect was confirmed the prebiotic activity score (PAS) of 1.63 ± 0.005 . These prebiotics were derived from ash gourd seeds and were incorporated into chocolates. (1% and 5% concentrations).^[32]

The biostable inorganic silver nanoparticles (AgNPs) produced using aqueous fresh peel extract of *Benincasa hispida*, the bioactive components of peel extract acted as reducing and stabilizing agents. The antibacterial potential of biostable spherical AgNPs were further screened against *Staphylococcus aureus*, *Micrococcus luteus*, *Escherichia coli*, and *Klebsiella pneumonia*. Human cervical cancer cell line (HeLa) and normal human primary osteoblast cell line were used to assess cytotoxicity. The AgNPs characterized by UV-Visible spectroscopy, dynamic light scattering (DLS), FTIR, and electron microscopy confirmed the potential of *Benincasa hispida*-synthesized AgNPs for different therapeutic applications give lesser side effects and *Benincasa hispida* extract and its effectiveness is a promising source in producing AgNPs that could be employed for several therapeutic applications.^[33] Soap formulation of methanol extract of *Benincasa hispida* peel produced, gives effective antifungal activity.^[34]

Benincasa hispida also shows functional efficacy in cosmetic materials, seed extracts are used for skin whitening activities.^[35] peel extract for anti-aging activities obtained from 95% as standard control epigallocatechin gallate. Furthermore, this extract has an inhibiting effect on the enzyme hyaluronidase. Based on the molecular docking results, the interaction of peel extracts with collagenase and hyaluronidase suggests its potential to be used as an anti-aging agent.^[13]

CONCLUSION

Benincasa hispida make a valuable resource in both traditional medicine and modern pharmacology. This plant, belonging to the *Cucurbitaceae* family, offers a plethora of bioactive compounds, distributed across its various parts. Throughout history, ash gourd has been utilized extensively in Ayurvedic medicine, where it is revered for its diverse therapeutic applications. The nutritional profile of *Benincasa hispida*, enriched with vitamins, minerals, and dietary fiber, further enhances its significance as a functional food and is associated with

several health benefits, including weight management, cardiovascular health, and improved digestion.

Moreover, recent research highlights its potential in novel applications expanding its utility beyond conventional medical applications. Its rich phytochemical composition and diverse pharmacological properties, are promising for further exploration in drug development, nutraceuticals, and cosmeceuticals. Its integration into modern healthcare systems could offer effective, safe, and natural alternatives for addressing a wide spectrum of health concerns.

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