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**A SYSTEMATIC REVIEW ON PHYTOCHEMISTRY AND
PHARMACOLOGICAL ACTIVITIES OF *BENINCASA HISPIDA* (THUNB.)
COGN.**

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ABSTRACT

Medicinal plants have been used for many centuries and numerous cultures still depends on plants for their primary health care needs. *Benincasa hispida* belonging to the family Cucurbitaceae also called as ash gourd, wax gourd, white guard, winter gourd, winter melon, gourd melon, white pumpkin. It is a widely grown trailing or climbing plant that is grown as a vegetable in India's plains and on hillsides as high as upto 1,200 meters Comprehensive research demonstrates that *Benincasa hispida* contains flavonoids, terpenoids, alkaloids, steroids, saponins, tannins, phenols and carbohydrates. Researchers evaluated different parts of *Benincasa hispida* for Anti-ulcer, anti-convulsant, anti-oxidant, antipyretic, antidiarrheal, cardioprotective, anti-inflammatory, anti-asthmatic, antimicrobial, diuretic, antiobesity, antihyperlipidemic, antiosteoporosis, antiaging, antistress and memory enhancing property. This work presents an updated overview of the literature to shed light on the state of research on *Benincasa hispida* which demonstrating its phytoconstituents, ethnomedicinal uses and outlining their most significant pharmacological activities.

Keywords: *Benincasa hispida*, Ash gourd, Winter melon, Cucurbitaceae, Phytochemistry, Pharmacological activity

INTRODUCTION

Herbal remedies are mentioned in the traditional Indian medical system for a number of ailments. Herbal remedies show promise effect when compared to contemporary synthetic medications [1]. *Benincasa hispida*, also called as ash gourd, wax gourd, white guard, winter gourd, winter melon, gourd melon, white pumpkin, tallow gourd [2]. *Benincasa hispida* is a widely grown trailing or climbing plant that is grown as a vegetable in plains of India and on hillsides as high as upto 1,200 meters [3]. This well-liked vegetable crop is particularly accessible to Asian people for both culinary and therapeutic uses. Most likely, it was grown in India and other warm nations, as well as in Japan and Java [4]. Its stem is found with stout, angular, hispid, tendrils 2-fid. Leaves are reniform, orbicular, cordate, about profoundly 5-lobed, and hispid underneath. They are 10 to 25 centimeters in diameter. The

plant's petioles are 7.5–10 cm long and gland-free, while the flowers are big, yellow, serrated, and monoecious. The female flowers have densely hairy, ovary, and five petals, whereas the male flowers have three stamens and five petals. The fruits are enormous, measuring 30-45 cm in length, broad, cylindrical, hairy and finally covered with a waxy bloom and also non-ribbed. The seeds have margins, are numerous, oblong, and compressed [2]. *Benincasa hispida* has anti-cancer, antihelmintic, gastroprotective, anti-inflammatory, antidiarrhoeal, antidiabetic, antimicrobial, antiobesity, anti-convulsant, antioxidant, antipyretic, antidepressant and analgesic activity [5]. The primary goal of this review is to learn about the traditional application, phytochemical and pharmacological characteristics of *Benincasa hispida* (Thunb.) Cogn.

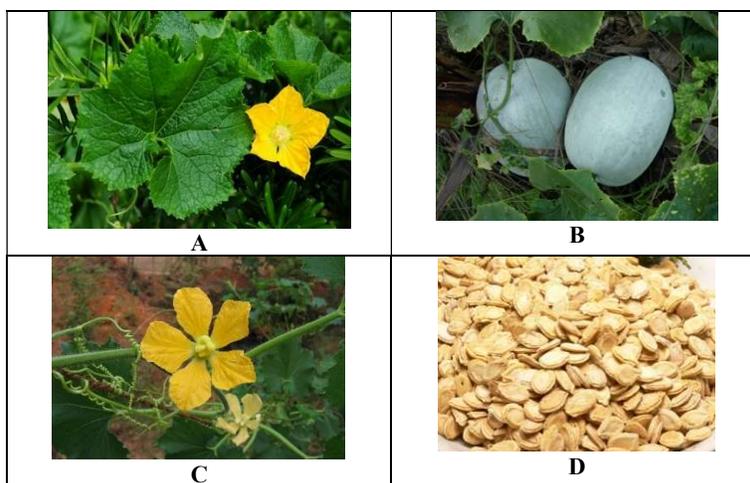


Figure 1: *Benincasa hispida* leaves with petioles (A), stem with fruit (B), flowers (C), seeds (D)

Benincasa hispida and it's profileBotanical name - *Benincasa hispida*Synonym – *Benincasa cerifera***Vernacular names [6]**

English : Ash pumpkin, tallow gourd, white gourd, wax gourd, white gourd melon

Sanskrit : Brihatphala, kumbhanda, kushmanda, pushpaphala

Hindi : Golkaddu, kondha, kudimah, kumra, petha, phuthia

Tamil : Kalyanappushinikkay, pusanikkai, pushini

Malayalam : Kumpalam, kumpalanna

Telugu : Budidegurumadi, burdagumudu, pendligummadikaya

Taxonomical classification [7]

Kingdom : Dicotyledonae

Class : Dicotyledonae

Subclass : Polypetalae

Series : Calyciflorae

Order : Passiflorales

Family : Cucurbitaceae

Genus : *Benincasa*Species : *hispida***Table 1: Ethno medicinal uses of *Benincasa hispida* [6, 8]**

Parts	Uses
Fruit	Fruits are utilized as antidote to scorpion sting, antiasthmatic, antitussive, antidiabetic, laxative, diuretic, aphrodisiac, and cures jaundice, strangury, urinary discharges, urinary calculi, biliousness, blood diseases, haemoptysis, haemorrhages, removes foul taste from the mouth, heart tonic (Ayurveda), and also used for treating epilepsy, insanity and other neurological diseases.
Fruit Juice	Vrindamadhava recommends the juice of the fruit for internal use in snake-bite, produces tranquilizing activity and mild CNS depressant activity.
Seed	Seed possess anthelmintic properties and useful in cases of taenia, dry cough, fever, urethral discharges, biliousness, thirst and utilized as brain tonic
Oil from Seed	Good for brain, liver and used to treat syphilis (Yunani)

Phytochemistry

Benincasa hispida is recognised to contain a variety of phytochemicals, the majority of which have been found to have potent medicinal effects. Each part of *Benincasa hispida* contain different phytoconstituents that have effective pharmacological activity. The major

constituents of *Benincasa hispida* fruit were volatile oil, flavonoids, glycosides, sacchrides, proteins, carotenes, vitamins, minerals, β -sitosterin and uronic acid [4]. The reported Phytoconstituents of different parts of ash gourd is described in following Table 2.

Table 2: Reported Phytoconstituents of *Benincasa hispida* [8-10]

S. No.	Parts	Reported Phytoconstituents
1	Fruit	Lupeol, α -sitosterol and their acetates, adenin, trigonelline, histidine, cucurbitin, pentacyclic triterpene, triacontenol and pyrazine compounds
2	Seed	24z-ethylidenecholest-7 enol (avenasterol), 24- β -ethyl cholesta-7,25-dienol, triterpene alcohols, euphol, tirucallol, cycloartenol, taraxerol, α -amyrin, butyrospermol, β - amyrin, isomultiflorenol, 24-methylene-24-

		dihydroparkeol, cycloartenol, lupeol, 24-methylene cycloartenol and multiflorenol
3	Root	Pentacyclic triterpene, bryonolic acid
4	Leaves	Phytol, oleic acid, Cis-vaccenic acid, eicosane, 1-Pentadecene, 1-Nonadecene, n-Hexadecanoic acid, octacosane, 1,2-diethyl cyclohexadecane

Pharmacological activity

Anticancer and antibacterial activity

In this study, silver nanoparticles (AgNPs) were synthesized from *Benincasa hispida* fruit proteins. MTT assay on the lung cancer cell line (A549) tested for anticancer activity and NPs were effective against bacterial pathogens such as *Escherichia coli*, *Staphylococcus aureus*, *Salmonella enteric* and *Staphylococcus epidermis*. Results showed that $IC_{50} = 57.11\mu M$ value. These nanoparticles was found to inhibit the lung cancer cell line (A549) [11]. Biostable inorganic silver nanoparticles synthesized from aqueous extract of fresh peel of *Benincasa hispida* exhibited strong antimicrobial activity with inhibitory concentration (MIC) values of 14.5, 8.6, 6.063 and 13.4 $\mu g/mL$ against *Staphylococcus aureus*, *Micrococcus luteus*, *Escherichia coli* and *Klebsiella pneumonia*, respectively and AgNPs showed effective *In vitro* cytotoxicity against human cervical cancer cell line with half maximal inhibitory concentration $IC_{50} = 0.066 \mu g/mL$ and normal human primary osteoblast cell line did not exhibit any cytotoxic effects [12].

Anti-convulsant activity

Methanolic extract of *Benincasa hispida* was tested using chemo-convulsive agents and maximal electro seizures (MES) model in mice at dose levels from 0.2-1g/kg, i.p. Results indicates that hind limb extension significantly inhibited ($p < 0.001$) by the extract at 0.2-0.6g/kg in MES and 0.4 and 0.6 g/kg of extract significantly ($p < 0.01$) increased the latency of convulsion and death induced by pentylenetetrazole and strychnine. This study concludes that *Benincasa hispida* fruit have anticonvulsant activity [13]. Ethanol extract of seed of *Benincasa hispida* (EEBH) was evaluated for anticonvulsant activity by Maximal Electroshock seizure (MES) and Pentylenetetrazol induced seizure models on Albino (Wistar strain) rats by using phenytoin as a standard in MES model and Diazepam in PTZ model and results showed that in MES model, EEBH dose dependently shortens the duration of tonic hind limb extension and in PTZ model; it increase latency and convulsions occurrence and it conclude that EEBH has a potential anticonvulsant effect [14].

Anti-ulcer activity

Rats were used to analyse *Benincasa hispida* fruit for its antiulcer property against model of ethanol-induced cold restraint-stress (CRS) induced gastric ulcer models, pylorus ligated (PL) gastric ulcers and gastric mucosal damage. Ethanol and petroleum ether extract significantly reduced ulcer index in all animal models ($P < 0.05$) and omeprazole used as treatment group [15]. Methanol extract of *Benincasa hispida* seed was evaluated for antiulcer activity using pyloric ligation, water immersion stress and NSAID (indomethacin) induced gastric ulcer model in rats by using ranitidine as standard. The MEBH produce 52.7, 67.4 and 61.2% ulcer inhibition in pyloric ligation, water immersion stress and NSAID induced ulcer model, respectively at 300 mg kg⁻¹ [16].

Diuretic activity

Benincasa hispida fruit rind extract in chloroform was analyzed for diuretic activity in sprague-dawley rats and hydrochlorothiazide used as a standard drug. The extract significantly increased the urine volume ($p < 0.001$), increased the excretion of sodium and chloride and decreased the excretion of potassium ($p < 0.001$). Fruit rind extract from *Benincasa hispida* exhibited significant diuretic activity with potassium sparing effect [17]. In Swiss Albino rats, the diuretic efficacy of an ethanol extract of stem

of *Benincasa hispida* was assessed and standard drug used was hydrochlorothiazide. Volume of urine, and sodium, potassium and chlorine contents were measured in urine. Significant diuresis produced at 100 and 200 mg/kg of extract and sodium elimination was increased but not potassium. This investigation showed that aqueous extract of *Benincasa hispida* stem has significant saluretic, natriuretic, diuretic and carbonic anhydrase activity [18].

Antioxidant activity

Ethanol, ethyl acetate and aqueous extract of *Benincasa hispida* fruit was subjected to total antioxidant and free radical scavenging activity by DPPH, Nitric oxide, Superoxide, Hydroxyl radicals scavenging activities. Results indicates that ethanolic extract of *Benincasa hispida* fruit has potential scavenging activity. IC₅₀ value for super oxide anion radical for ethanol extract was 128±1.91 µg/ml, ethyl acetate extract was 184±1.29 µg/ml and aqueous extract was 271±1.89 µg/ml [19]. Aqueous and ethanol extract of *Benincasa hispida* fruit was evaluated for antioxidant activity by Hydrogen peroxide and DPPH method. Activity of DPPH for aqueous extract was 59.7 % at 200 µg/ml and activity of hydrogen peroxide was 20.5 % at 1000 µg/ml. Activity of DPPH and hydrogen peroxide for ethanolic extract was found to be

77.4 % at 250 µg/ml and 21.3 % at 1000 µg/ml respectively [20].

Antidiabetic activity

Rats with diabetes induced by alloxan were used to test the antidiabetic effect of ethanolic extract of *Benincasa hispida* seed. Ethanolic extract of *Benincasa hispida* seed was found to have a greater effect on blood glucose regulation [21]. Methanolic extract of *Benincasa hispida* fruit lowers blood glucose level ($p < 0.01$) in Streptozotocin induced diabetic rats and furthermore revealed decrease ($0 < 0.05$) in serum triglyceride, VLDL levels and increase in HDL levels [22]. The aqueous extract of *Benincasa hispida* fruit at dose of 250 mg/kg showed significant effect in decreasing blood glucose level (BGL) and also protecting the liver and kidney from serious damage [23].

Antiobesity activity and Antihyperlipidemic activity

Ethanolic extract of *Benincasa hispida* (EEBH) and its active fraction (AFBH) on high fat diet fed rats were evaluated for antiobesity effect and results showed that AFBH has better results in decreasing level of lipids such as cholesterol, triglycerides, phospholipids, LDL, insulin, leptin and enzyme levels [24]. Fresh juice of *Benincasa hispida* at dose of 0.9 ml/200g oral administration in Wistar Albino rats

significantly reduces the serum lipid parameters such as cholesterol, LDL, VLDL, triglycerides and increase in HDL and results indicated that *Benincasa hispida* possess anti hyperlipidemic activity with no toxicity and increased efficacy in the treatment of obesity and hyperlipidemia [25]. The antihyperlipidemic and antiobesity effects of an absolute ethanolic extract of *Benincasa hispida* were evaluated in olive oil induced Wistar Albino rats and the findings proved that *Benincasa hispida* extract revealed reduction in weight gain pattern of body and liver, serum lipids, atherogenic index and blood glucose [26].

Anti-osteoporosis effect

This study aimed to evaluate the anti-osteoporosis effect of aqueous extract of *Benincasa hispida* (BHE, HR1901-W) and 2-furoic acid in ovariectomy (OVX)-induced osteoporosis in female ICR mice and results suggest that BHE supplementation prevents bone resorption and promotes bone formation in OVX mice and bone metabolic diseases [27]. *Benincasa hispida* (HR1901-W) aqueous extract was assessed in this study for its effects on osteoblast and osteoclast differentiation and Based on the results, HR1901-W stimulated high dose-dependent proliferation and extracellular matrix mineralization in MC3T3-E1, preventing

osteoporosis by maintaining the right ratio of bone-forming osteoblasts to non-resorbing osteoclasts [28].

Anti-Inflammatory activity

In-vitro anti-inflammatory activity were analyzed by using proteinase inhibitory activity, albumin denaturation assay, membrane stabilization and anti-lipoxygenase activity and ethanolic extract of seeds of *Benincasa hispida* demonstrated potential anti-inflammatory activity at a concentration of 59 µg/ml compared to petroleum ether extract. This study showed that the potential for developing anti-inflammatory drugs may be enhanced by *B. hispida*'s anti-inflammatory properties [29]. Methanolic extract of *Benincasa hispida* seed possess anti-inflammatory activity using carrageenan-induced paw edema in rats and reduced the paw volume (59.7 %) [30]. A methanolic extract of *Benincasa hispida* fruit administered at a dose of 350 mg/kg significantly decreased ($P < 0.05$) the paw edema in rats [31].

Anti asthmatic activity

From the methanolic extract of *Benincasa hispida* fruit, two triterpenes, named alonusenol and multiflorenol, had a stabilizing impact on mast cells and were discovered to have a possible inhibitory effect on the histamine release by an antigen

antibody reaction [32]. Even at a very low dosage of 50 mg/kg orally, methanol extract of *Benincasa hispida* (MEBH) demonstrated remarkable protection against histamine-induced bronchospasm in guinea pigs. However, MEBH was not considerably prevent acetylcholine-induced bronchospasm, even at a higher dose level of 400 mg/kg. Based on the information, antihistaminic activity (H1 receptor antagonism) may be the mediating factor for the protective action against bronchospasm caused by histamine aerosol [33].

Antidepressant activity

One of the most common mental illnesses impacting hundreds of millions of people worldwide is depression. Methanolic extract of *Benincasa hispida* fruit showed potent antidepressant-like activity in Swiss Albino mice probably by inhibiting MAO-A, and through interaction with dopaminergic, $\alpha 1$ -adrenergic, serotonergic, and GABAergic systems [34].

Antistress and Antianxiety activity

According to this study, zebrafish models treated with an aqueous extract of *Benincasa hispida* fruit showed reduced levels of stress and anxiety using neuropharmacological assessment, which involved figuring out behavioral parameters in tests like the open tank test (OTT), T-maze

and light-dark preference test (LDPT) of the fruit. According to the results, which suggest a considerable reduction in tension and anxiety [35]. An uncomfortable state of apprehension or fearful concern is called anxiety. Ethanolic extract of *Benincasa hispida* fruit was tested against various behavioural models like Open field, Hole board and mirror chamber and findings indicated that alcoholic extract of *Benincasa hispida* effectively avoid anxiety induced in behavioural model [36].

Antinociceptive and anti-pyretic activity

Ethanol extract of seeds of *Benincasa hispida* (Thunb.) Cogn. evaluated for antinociceptive and antipyretic property and Brewer's yeast (15%) was used to produce pyrexia in Wistar Albino rats. The extract considerably ($P < 0.05$) improved the antinociceptive efficaciousness in a dose-dependent manner in rats at doses of 250 and 500 mg/kg b.w. Similarly, the extract significantly ($P < 0.05$) reduced yeast-induced pyrexia in rats at dosages of 250 and 500 mg/kg b.w. These results demonstrate that *Benincasa hispida* ethanolic extract has potent antinociceptive and antipyretic effects [37].

Antiaging activity

Ethanolic extract of peel of *Benincasa hispida* and water extract (B95, B50 and BW) evaluated for antiaging activity. B95

demonstrated inhibitory effects on hyaluronidase and collagenase, with values of $41.68 \pm 0.92\%$ and $29.17 \pm 0.66\%$, respectively, indicating anti-aging properties. Results shows that peel extracts from *Benincasa hispida* show promise as future sources of anti-aging products for the food and cosmetics sectors [38].

Anti-diarrheal activity

Benincasa hispida fruit methanolic extract shown strong inhibitory action against PGE₂-induced enter pooling and castor oil-induced diarrhea in Wistar Albino rats. In experimental animal models, the frequency and severity of diarrheal episodes have decreased significantly and the findings indicate that BHFE is a useful antidiarrheal medication [39].

Memory enhancing activity

In this study nootropic potential of aqueous and methanol extract of *Benincasa hispida* was assessed on various behavioural models. On the ninth and tenth day, albino mice treated with aqueous and methanol extract (200 and 400 mg kg⁻¹) demonstrated a dose-dependent decrease in transfer latency using the Morris Water Maze (MWM), Elevated Plus Maze (EPM), and Object Recognition Task (ORT) models. Results shows that methanolic extract of *Benincasa*

hispida has potential memory restorative agent in the treatment of dementia [40].

CONCLUSION

On the basis of these investigations, we may conclude that *Benincasa hispida* shows anticancer activity, antibacterial activity, anticonvulsant activity, antiulcer activity, diuretic activity, antioxidant activity, antidiabetic activity, antiobesity activity, antihyperlipidemic activity, antiosteoporosis activity, anti-inflammatory activity, anxiolytic activity and antidiarrheal activity in animal model. *Benincasa hispida* has been historically used for various kinds of ethno medicinal purposes. Worldwide, there is a growing need for herbal medicinal plants due to the increased negative effects of allopathic pharmaceuticals. Herbal remedies, on the other hand, have multiple actions that can cure various diseases. Extensive investigation is required to determine the useful therapeutic qualities of *Benincasa hispida*, as well as the mode of action and pharmacological activity of various phytoconstituents.

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