



"Therapeutic Potential Of Ash Gourd (*Benincasa Hispida*): Phytochemicals, Mechanisms And Functional Food Applications"

¹Shatakshi Gupta, ^{2*}Akansha, ³Divita Jain

¹Msc Student, Department of Nutrition and Dietetics, SSAHS, Sharda University,

²Assistant Professor Department of Nutrition and Dietetics, SSAHS, Sharda University,

³Research Scholar Department of Nutrition and Dietetics, SSAHS, Sharda University
Department of Nutrition and Dietetics, SSAHS, Sharda University, Greater Noida, India

Corresponding author: akansha@sharda.ac.in

Abstract

Benincasa hispida, commonly known as Ash gourd, has been extensively utilized in traditional Chinese medicine for its diverse therapeutic applications. The plant's richness of bioactive compounds, including as flavonoids, alkaloids, tannins, saponins, and phenols, enhances its medicinal potential. *B. hispida* is a potential option for the development of functional foods and pharmaceutical formulations due to the potent antiviral, anticancer, anti-inflammatory, and antioxidant qualities of these bioactive components. The formulation and stability of beverages derived from ash gourds have also been the subject of recent research, particularly when combined with jamun (*Syzygium cumini*), which is high in anthocyanins, flavonoids, and polyphenols. Over time, the bioactive compounds in these formulations have shown remarkable stability and pharmacological performance, indicating their potential as functional food additives with beneficial health effects. It was also demonstrated that the bioaccessibility of these fractions was enhanced by the addition of sugar, suggesting potential avenues for enhancing functional food compositions. Despite the promising pharmacological characteristics, additional clinical studies are required to validate the therapeutic applications of *B. hispida*, enhance dosage formulations, and establish consistent protocols for its administration in therapeutic settings. Closing the existing knowledge gap and encouraging more research into the therapeutic potential of ash gourd as a medicinal plant and functional food are the goals of this review.

Keywords: *Benincasa hispida*, antioxidant activity, functional foods, bioactive compounds

1. Introduction

Benincasa hispida, commonly known as ash gourd, is a versatile medicinal plant that has been utilized extensively in traditional medical systems such as Ayurveda, Unani, and ancient Chinese medicine (TCM). Ash gourd has been studied extensively for its varied phytochemical profile, which includes bioactive compounds such as phenols, flavonoids, alkaloids, tannins, and saponins. Ash gourd is valued for its therapeutic properties. These bioactive elements make *B. hispida* a good choice for the production of pharmaceuticals and functional foods since they help a range of pharmacological functions, including anti-inflammatory, antiviral, anticancer, and antioxidant properties (Islam et al. (2021).

In recent years, ash gourd has drawn a lot of attention due to its ability to prevent and treat chronic ailments, such as diabetes, cancer, cardiovascular disease, and neurological disorders. Numerous research have demonstrated the cardioprotective and antidiabetic effects of *B. hispida*. The plant's high content of flavonoids and phenolic compounds, which have potent free radical scavenging capabilities, is responsible for these benefits. The fact that its anti-inflammatory properties have also been connected to the decrease of pro-inflammatory cytokines lends more credence to its therapeutic potential in the management of chronic inflammatory diseases.

The neuroprotective potential of ash gourd has also been studied; in animal models of neurodegeneration, studies have demonstrated that it successfully lowers oxidative stress and brain damage. For instance, recent research has shown that ash gourd extract can lessen the cytotoxicity that oxidative stress causes in brain cells, suggesting that it could be utilized as a neuroprotective treatment for conditions like Parkinson's and Alzheimer's. (Rapaka et al. 2021)

Additionally, several studies have shown that *B. hispida* has anticancer properties, causing apoptosis and inhibiting the development of cancer cells. The presence of flavonoids and alkaloids in ash gourd has been associated with anticancer activities, possibly through mechanisms such as angiogenesis inhibition, apoptotic pathway regulation, and oxidative stress modulation. These findings underline the necessity of more research to elucidate the molecular mechanisms behind *B. hispida*'s anticancer activity and explore its potential as an adjuvant therapy for cancer treatment. (Kanase, M., Dharkar and Ladke, 2025).

Because of its potential application in nutraceutical formulations, ash gourd has gained increased recognition in the realm of functional food development. The potential for enhancing the pharmacological efficacy and bioaccessibility of significant bioactive compounds by combining ash gourd with other medicinal fruits, such as jamun (*Syzygium cumini*), has been investigated. Studies suggest that including sugar into ash gourd formulations may enhance the bioaccessibility of anthocyanins, flavonoids, and polyphenols, hence optimizing the therapeutic advantages of these functional foods. (Palamthodi, S., Kadam, D. D., & Lele, S. S. 2019).

Although the pharmacological action of *B. hispida* is encouraging, there are still several gaps in the current data. Notably, the lack of established extraction methods and dosage recommendations makes it more challenging to translate preclinical findings into clinical settings. Furthermore, the potential of ash gourd as a cure for human populations has not been thoroughly investigated in clinical studies. Therefore, future research should focus on conducting meticulously designed clinical trials to demonstrate *B. hispida*'s efficacy and safety, particularly in relation to chronic conditions including diabetes, cardiovascular disease, and neurodegenerative diseases.

This study gathers research data from 2019 to 2025 to provide a comprehensive picture of the therapeutic potential of ash gourd as a functional food and medicinal plant. By integrating recent data, this review seeks to bridge the existing knowledge gap and encourage further research into the pharmaceutical use of *Benincasa hispida*.

Ash gourds' diverse phytochemical composition has been extensively studied for its ability to treat long-term ailments like diabetes, cancer, heart disease, and neurological disorders. It is beneficial for diabetics due to its high fiber content, which aids in glucose regulation and weight control. Additionally, its flavonoids and phenolic components are strong antioxidants that reduce oxidative stress and inflammation in cardiovascular disorders. (Zin et al, 2024).

The neuroprotective properties of ash gourd have been associated with its anti-inflammatory and antioxidant components, which protect brain cells from oxidative damage and apoptosis. Additionally, the alkaloids and saponins in ash gourd have shown anticancer potential by causing apoptosis and preventing angiogenesis.

Despite its promising pharmacological qualities, additional clinical studies are needed to validate Ash gourd's therapeutic advantages and establish the ideal dosage regimes for certain medical conditions. This study provides a comprehensive overview of the nutritional composition and therapeutic potential of *Benincasa hispida* by presenting research findings from 2015 to 2025. This will help to close existing knowledge gaps and stimulate further research into the plant's functional food applications and medicinal benefits. (Lewis & Shenoy, 2025).

2. Ash Gourd's Nutritional Benefits

In ancient medical systems such as Ayurveda, Unani, and ancient Chinese Medicine, the nutrient-dense vegetable *Benincasa hispida*, commonly known as ash gourd, has a variety of therapeutic applications. Ash gourd's nutritional composition includes a wide range of macronutrients, micronutrients, vitamins, and minerals, which significantly increases its potential for therapeutic usage. The fruit's high dietary fiber content and low-calorie content make it an excellent tool for weight management and metabolic health maintenance. It also contains a variety of bioactive compounds, including flavonoids, alkaloids, saponins, tannins, and phenolic acids, which have potent anti-inflammatory, anti-cancer, and antioxidant properties. (Islam et al. 2021)

2.1 Ash Gourd's Complete Nutritional Composition:

About 96% of the weight of an ash gourd is made up of water. Its high-water content makes it a hydrating, low-calorie food that is ideal for weight loss and detoxification programs. Its low caloric value of 13 kcal per 100g makes it suitable for dietary therapy aimed at metabolic diseases and obesity.

- **Energy (13 kcal/100g):** has a low-calorie content, which makes it a perfect food for low-calorie diets and weight management.
- **Protein (0.4 g/100 g):** Despite its small amount, this protein helps in enzyme synthesis and basic tissue repair.
- **Fatty Acids (0.2 g/100 g):** Traces of essential fatty acids, which are important for preserving the integrity of cell membranes, are present in fat (0.2 g/100 g).
- **Dietary Fiber (3.0 g/100 g):** The main component of carbohydrates (3.0 g/100 g) is dietary fiber, which also helps to control blood sugar levels and promote satiety.

According to dietary fiber (2.9 g/100g) is essential for preserving gut health, avoiding constipation, and helping to control blood sugar levels.

Table 1: Comprehensive Nutritional Composition of Ash Gourd

Nutrient	Quantity per 100g	Function/Health Benefit	Reference
Energy	13–17.45 kcal	Supports metabolic functions	Islam et al., 2021; Anuvaad Solutions, 2021
Protein	0.30–0.79 g	Essential for tissue repair and enzyme function	Islam et al., 2021; Anuvaad Solutions, 2021
Fat	0.02–0.20 g	Provides essential fatty acids and cell structure	Islam et al., 2021; Anuvaad Solutions, 2021
Carbohydrates	1.10–4.00 g	Primary source of energy	Islam et al., 2021; Anuvaad Solutions, 2021
Dietary Fiber	0.50–3.37 g	Enhances digestive health and prevents constipation	Islam et al., 2021; Anuvaad Solutions, 2021
Water	93.80–96.80 g	Maintains hydration and supports metabolic processes	Islam et al., 2021

2.2 The Profile of Micronutrients and Their Therapeutic Significance:

Ash gourd contains a number of essential micronutrients that support a variety of physiological functions. These include calcium, iron, magnesium, potassium, and phosphorus, all of which are necessary for heart health, metabolism, and strong bones.

- **Calcium (26 mg/100g):** Vital for nerve transmission, muscular contraction, and bone health. When eaten in greater amounts, ash gourd's relatively low calcium content can nevertheless help with daily calcium consumption.
- **Iron (0.3 mg/100g):** Essential for the movement of oxygen and the synthesis of cellular energy. Iron in ash gourd, albeit in tiny amounts, can aid in the production of hemoglobin.
- **Magnesium (10 mg/100g):** Controls blood pressure and nerve activity. Additionally, the body uses magnesium as a cofactor for more than 300 enzymatic processes.
- **Phosphorus (13 mg/100g):** Promotes cellular activity, especially ATP synthesis, and bone mineralization. As a vital electrolyte, potassium (150 mg/100 g) preserves fluid balance and lowers blood pressure by vasodilating the blood vessels
- **Copper (0.03 mg/100g):** As a component of the enzyme superoxide dismutase (SOD), copper promotes the absorption of iron and possesses antioxidant qualities.

Table 2: Micro-nutrient profile and their Therapeutic Implications

Micronutrient	Quantity per 100g	Function/Health Benefit	Reference
Calcium	26 mg	Bone density, muscle function	Islam et al., 2021; USDA, 2020
Iron	0.3 mg	Oxygen transport, energy metabolism	Islam et al., 2021; NIH, 2020
Magnesium	10 mg	Nerve function, blood pressure regulation	Islam et al., 2021; Anuvaad Solutions, 2021
Phosphorus	13 mg	Bone and cellular health	USDA, 2020; Islam et al., 2021
Potassium	150 mg	Electrolyte balance, cardiovascular health	NIH, 2020; Islam et al., 2021
Zinc	0.2 mg	Immune function, antioxidant defense	Anuvaad Solutions, 2021; Islam et al., 2021

2.3 Vitamin and Mineral Content:

Ash gourd's rich vitamin and mineral content enhances its potential as a medicine. Its vitamin profile includes fat-soluble vitamins like vitamin A and vitamin E, water-soluble vitamins like vitamin C, and B-complex vitamins.

- **Vitamin C (15 mg/100g):** A strong antioxidant that strengthens the immune system and fights oxidative stress
- **Vitamin B6 (0.04 mg/100g):** Essential for the production of neurotransmitters and cognitive development. It also helps with protein and carbohydrate metabolism.
- **Vitamin A (0.01 mg/100g):** Supports immune system function, skin integrity, and eye health. When ingested in greater amounts, it helps with daily vitamin A intake despite its low level. Pregnancy-

related neural tube abnormalities can be avoided and DNA synthesis and cell division depend on folate (16 mcg/100g).

- **Niacin (B3) (0.2 mg/100g):** Essential for lowering cholesterol and producing energy. Energy metabolism and red blood cell formation are supported by riboflavin (B2) (0.03 mg/100g).
- **Thiamin (B1) (0.02 mg/100g):** Supports nerve and glucose metabolism.
- **Vitamin E (0.05 mg/100g):** Promotes skin and cardiovascular health by shielding cell membranes from oxidative stress.

Table 3: Vitamin and Mineral Content

Vitamin/Mineral	Quantity per 100g	Function/Health Benefit	Reference
Vitamin C	15 mg	Immune support, antioxidant protection	Smith et al., 2019; J Nutr Sci
Vitamin B6	0.04 mg	Brain health, neurotransmitter synthesis	Lee & Kim, 2018; Neurochem Int
Vitamin A	0.01 mg	Vision health, skin health	Johnson et al., 2020; Clin Exp Dermatol
Folate	16 mcg	DNA synthesis, cell division	Martinez & Lopez, 2022; Mol Biol Reports
Niacin (B3)	0.2 mg	Energy metabolism, cholesterol regulation	Chen et al., 2017; Metab Clin Exp
Riboflavin (B2)	0.03 mg	Red blood cell production, energy metabolism	Singh & Patel, 2021; Hematol Rev
Thiamin (B1)	0.02 mg	Carbohydrate metabolism, nerve function	Gomez et al., 2016; J Neurol Sci
Vitamin E	0.05 mg	Antioxidant protection, skin health	Wang & Zhao, 2019; Free Radic Biol Med

3. Bio-active substances

Bioactive chemicals are naturally occurring chemical components of plants that have biological effects on living organisms. Unlike essential nutrients, they are not required for basic survival, but they are vital for preserving health and preventing disease. These substances encompass a broad range of substances, including phenolic compounds, which are widely recognized for their potent antioxidant properties.

- **Flavonoids:** Have the ability to reduce inflammation and prevent cancer.
- **Triterpenoids and steroids:** Display a range of pharmacological actions.
- **Alkaloids:** Frequently exhibit strong physiological effects.
- **Saponins:** renowned for their ability to reduce cholesterol.

Certain polysaccharides function as prebiotics to promote gut health.

The traditional and modern medicinal applications of *Benincasa hispida* (ash gourd), which include anti-inflammatory, anti-diabetic, antioxidant, and neuroprotective qualities, are supported by these bioactive constituents.

3.1 Ash Gourd's Bioactive Compounds

The ash gourd (*Benincasa hispida*) is rich in a variety of bioactive compounds, including phytosterols, polyphenols, flavonoids, and polysaccharides, which all contribute to its various health benefits. Recent research from 2015 to 2025 has shown compelling evidence for its antibacterial, antioxidant, prebiotic, and anti-diabetic properties. These findings demonstrate the ash gourd's potential as a functional food and as a beneficial component in nutraceutical formulations. The preceding table lists the primary bioactive compounds discovered in ash gourd over the past 10 years, along with references and associated health benefits.

Table 4: Bioactive Compounds in Ash Gourd

Compound	Description	Function/Health Benefit	Reference
Inulin	Prebiotic polysaccharide	Gut health, prebiotic activity	Kumar et al., 2018; J Funct Foods
Resistant starch	Polysaccharide	Glycemic control, gut health	Smith & Johnson, 2020; Nutr Metab
Essential oils	Volatile compounds	Antimicrobial, antioxidant	Lee et al., 2017; Phytomedicine
Terpenoids	Secondary metabolites	Anti-inflammatory, antimicrobial	Martinez & Chen, 2022; Bioorg Med Chem
Ribosome-inactivating proteins	Proteins	Antiviral, anticancer	Patel & Singh, 2019; Mol Cancer Ther

3.2 Synthesis of Evidence

Recent research has demonstrated the medicinal potential of the bioactive chemicals found in ash gourds:

- **Anti-diabetic effects:** In prediabetic rat models, lyophilized ash gourd juice with stigmasterol derivatives dramatically lowered fasting blood sugar levels and enhanced insulin sensitivity.
- **Antioxidant qualities:** The blended beverages made from ash gourd and jamun had high concentrations of flavonoids and polyphenols, which enhanced their antioxidant potential.
- **Prebiotic activity:** Inulin and resistant starch found in ash gourd seeds were found to support the growth of *Lactobacillus* and other beneficial gut bacteria.
- **Antimicrobial activity:** Terpenoids and essential oils extracted from ash gourd peels showed strong antimicrobial activity against a variety of pathogens.

4. Therapeutic Potential and Health Benefits

4.1 Effects of Antimicrobials

Ash gourd extracts have demonstrated significant antibacterial activity against a range of bacterial and fungal species due to their phytochemical composition. A comprehensive study assessing its antibacterial properties found that its phenolic components effectively inhibit bacterial strains, including *S. aureus* and *E. coli*. (Kumar et al., 2017; J Ethnopharmacol). Further research is required to examine its potential as a natural antibacterial agent in pharmaceutical applications. Ash gourd extracts have demonstrated

significant antibacterial activity against a range of bacterial and fungal species due to their phytochemical composition. (Singh & Patel, 2021; *Phytotherapy Res*). Its phenolic compounds have been shown in studies to be effective in inhibiting the growth of germs. (Lopez & Garcia, 2019; *Microb Pathog*).

4.2 Effects of Antidiabetes

Numerous studies have demonstrated the antidiabetic effects of ash gourd. In an alloxan-induced diabetic rat model, ethanolic extracts from ash gourds significantly reduced blood glucose levels and improved lipid profiles. (Rao et al., 2018; *J Ethnopharmacol*). Additional research has supported its hypoglycemic and hypolipidemic effects, suggesting potential as a natural therapeutic agent for diabetes management (Singh & Kumar, 2020; *Phytomedicine*).

4.3 Effects on Cancer

The anti-cancer properties of ash gourd's antioxidant and apoptotic regulatory systems have showed promise. Triterpenoids and flavonoids, two of its bioactive components, have been shown to have deadly effects on cancer cell lines, particularly hepatocellular and breast cancer cells (Patel et al., 2019; *Cancer Lett*). More in vivo and clinical research is needed to validate these findings and assess the underlying molecular pathways, despite the encouraging anticancer potential shown by in vitro studies. The primary methods that ash gourd has anticancer properties are through its antioxidant activity and regulation of apoptotic pathways (Chen & Zhang, 2021; *Front Oncol*). Further research is required to elucidate its specific mechanisms against various cancer cell types (Kumar & Singh, 2023; *J Cell Biochem*).

4.4 Lipid-Lowering Effects and Anti-Obesity

Because of its impact on adipogenesis and lipid metabolism, ash gourd has been researched for its potential to lower cholesterol. In a study using diet-induced obese mice, lyophilized ash gourd juice significantly raised HDL cholesterol levels while lowering serum triglycerides and LDL cholesterol levels (Athira et al., 2025). Additionally, the fruit's high dietary fiber content may aid with satiety and weight management (Sharma & Patel, 2019; *J Nutr Biochem*). It has been demonstrated that ash gourd can help reduce obesity and metabolic syndrome. Studies have shown that lyophilized ash gourd juice effectively reduces adiposity and prediabetic signs in rats that have been fed an obese diet (Kumar et al., 2021; *Obesity Res Clin Pract*).

4.5 Effects of Anxiolytics and Antidepressants

Ash gourd's strong anxiolytic and antidepressant effects are most likely brought about by modifications to neurotransmitter pathways, including those involving serotonin and dopamine. A study found that in animal models, essential oil extracts had anxiolytic properties comparable to those of popular anxiolytic drugs (Patel et al., 2019; *Phytother Res*). Additionally, a different study showed that extracts high in alkaloids had antidepressant effects in rats, suggesting potential use in the treatment of anxiety and mood disorders (Singh & Kumar, 2022; *J Ethnopharmacol*). The molecular pathways and dose-dependent effects in human and animal models require further investigation (Chen et al., 2024; *Neurosci Lett*). Ash gourd's strong anxiolytic and antidepressant effects are most likely brought about by modifications to neurotransmitter pathways, including those involving serotonin and dopamine. By lessening the damage that oxidative stress does to neurons, its antioxidant properties may also help in neuroprotection. The molecular pathways and dose-dependent effects in human and animal models require further investigation. Ash gourd extracts exhibit promising anxiolytic and depressive effects, which could be mediated through modifications to antioxidant defense mechanisms and neurotransmitter pathways.

Table :5 Comprehensive Table of Therapeutic Effects

No.	Health Benefit	Key Findings	Reference
1	Antidiabetic	Reduced blood glucose levels in diabetic rats using ethanolic extract.	Rao et al., 2018; J Ethnopharmacol
2	Antiobesity	Lyophilized juice alleviates prediabetic symptoms and reduces adiposity.	Kumar et al., 2021; Obesity Res Clin Pract
3	Anticancer	Cytotoxic effects against cancer cell lines, particularly hepatocellular carcinoma.	Patel et al., 2019; Cancer Lett
4	Antidepressant	Anxiolytic and antidepressant effects mediated via neurotransmitter modulation.	Singh & Kumar, 2022; J Ethnopharmacol
5	Antimicrobial	Inhibition of bacterial and fungal strains via phenolic compounds.	Kumar et al., 2017; J Ethnopharmacol
6	Lipid-Lowering	Reduction in triglycerides and LDL, increase in HDL.	Athira et al., 2025; Nutr Metab

5. Conclusion

The plant known as ash gourd (*Benincasa hispida*) is beneficial both medicinally and nutritionally, and it has a number of therapeutic applications. Its rich phytochemical composition, which contains flavonoids, alkaloids, and antioxidants, has been associated with beneficial effects in neuroprotection, inflammation reduction, and the therapy of metabolic illnesses. Despite promising preclinical findings, additional clinical studies are needed to confirm these therapeutic claims and elucidate mechanisms of action. As ash gourd research advances, it may eventually be incorporated into evidence-based therapeutic regimens.

Acknowledgement

The authors are thankful to School of Allied Health Sciences, Sharda University, Greater Noida, Uttar Pradesh, India for her intense curiosity, leadership, and provision of research facilities Lab Technician, Sharda University, Greater Noida, Uttar Pradesh, India for his guidance in the lab throughout the analysis procedure.

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