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Review article

Therapeutic and culinary uses of *Benincasa hispida* (Alupuhul)

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ABSTRACT

Benincasa hispida (Thunb.) Cogn. (Cucurbitaceae) is commonly called as winter melon or ash melon. It is a popular vegetable crop, especially among Asian communities both for nutritional and medicinal purposes. It has been used as a medicinal plant by Ayurvedic and Sri Lankan traditional physicians since antiquity. It is used singly or in various formulations in combination with different medicaments in Ayurveda and traditional medicine. The literature for the present review was gathered from Ayurvedic texts, traditional medical texts, books on plant science, modern medicinal texts, journals and online scientific tools. The fruits, pericarp, seeds, stems, roots and leaves of this plant are used in various preparations. It is used in internal treatment for urinary disorders including calculi, dysuria, pain in pelvis and genitals, disorders like gastritis, gastric ulcers, worm infestation, hiccough, hyperdipsea, anaemia, jaundice, diabetes mellitus, piles, fever, internal haemorrhages, hemoptysis, general debility, epilepsy, cough, hoarseness, all kinds of asthma, bronchitis, tuberculosis, ulceration of lungs, heart diseases, testosterone-induced prostatic hypertrophy and especially in the vitiated condition of Pitta Dosha. Externally, it showed anti-inflammatory, anti-asthmatic and antimicrobial effects. Rejuvenate, antioxidant, anti-ageing, nutritive, tonic, diuretic, aphrodisiac, nephron protective, styptic, vermin fugue, antidiabetic, hyperlipidemic, anxiolytic, muscle relaxant, antidepressant and antimicrobial in properties of *Benincasa hispida* are scientifically proven. It is concluded that *Benincasa hispida* is with multi-faceted medicinal values.

INTRODUCTION

Benincasa hispida (Thunb.) Cogn., vernacularly known as Alupuhul, is belonging to the family Cucurbitaceae. This plant is believed to have originated in Java and Indonesia. It is cultivated throughout India, Sri Lanka and other tropical countries. In Sri Lanka, it is mostly cultivated in the dry zone during the rainy season. It is a popular vegetable crop, especially among Asian communities both for nutritional and medicinal purposes (Jayaweera, 2006).

The plant is used medicinally in various complains such as gastrointestinal problems, respiratory diseases, heart diseases, diabetes mellitus and urinary diseases (Al-Snafi, 2013). Through various researches, it has been reported that the plant has no toxicity and hence, safe to use therapeutically. *B. hispida* contains several chemical compounds such as cucurbitine together with a fixed oil, starch, resin, proteins, myosin, calcium, vitamin B and C (Jayaweera, 2006).

The present study aims to thoroughly reviewed the therapeutic and culinary usages of *B. hispida* including scientifically proven bioactivities of the plant.

SOURCE OF INFORMATION

Medicinal and other uses of *B. hispida* were gathered from Ayurvedic texts, traditional medical texts, books of modern medicine, journals and various scientific databases.

MORPHOLOGY

Benincasa hispida is a large trailing or climbing plant (Fig. 1). Its stem is found with stout, angular, hispid, tendrils 2-fid. The leaves are 10-25 cm in diameter, reniform, orbicular, cordate, more or less deeply 5-lobed and hispid beneath. The

petioles of the plant are 7.5-10 cm long, without glands whereas the flowers are large, yellow, monoecious and serrate. The male flowers are with 5 petals and 3 stamens while female flowers with oblong ovary and densely hairy. The fruits are very large, 30-45 cm long, broadly, cylindrical, not ribbed, hairy, ultimately covered with a waxy bloom. The seeds are many, oblong, compressed and margined (Jayaweera, 2006).

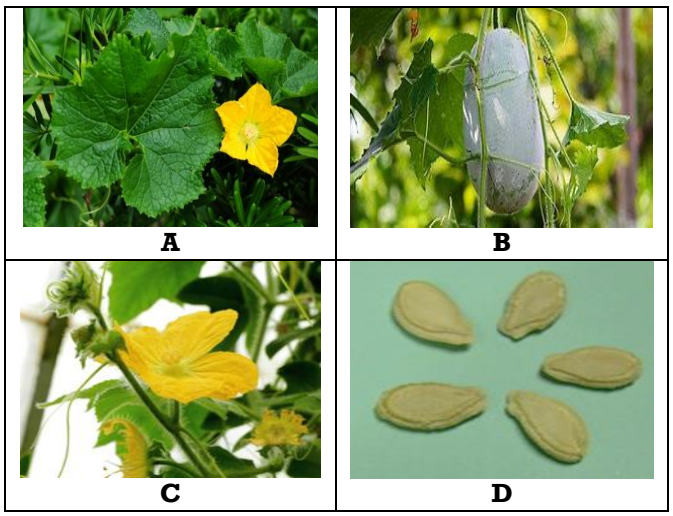

Fig. 1. *Benincasa hispida* leaves with petioles (**A**), stem with fruit (**B**), flowers (**C**) and seeds (**D**)

TAXONOMY

Kingdom	:	Plantae
Class	:	Dicotyledonae
Sub-class	:	Polypetalae
Series	:	Calyciflorae
Order	:	Passiflorales
Family	:	Cucurbitaceae
Genus	:	*Benincasa*
Species	:	*hispida*

SYNONYMS AND VERNACULAR NAMES

Synonyms	:	*Benincasa cerifera*
Sinhala name	:	Alupuhul
Tamil name	:	Pooshinikai, Kalayan
Hindi name	:	Golkaddu, Pethaa
Malayalam	:	Kumbalam
English name	:	White gourd melon, White pumpkin
Sanskrit name	:	Kushmanda, Pusphala, Sthiraphala, Ashmarighna Shamaka, Peetapushpa, Mahaphala, Valliphala (Dash, 1979)

CHEMICAL CONSTITUENTS

The phytochemical investigation depicted several compounds which possess one or more therapeutic applications (Nadkarni, 1976). Among those screened are flavonoids, triterpenes which are responsible for marked free radical scavenging potential. The phytochemical studies on the fruit of *B. hispida* indicated two triterpenes, alunsenol and multiflorenol, which have cell stabilizing effects. In addition, this plant is reported to contain flavonoids, triterpenes and vitamin C which are responsible for the antioxidant activity (Al-Snafi, 2013). The fruits contain 96% moisture, fixed oil, starch, cucurbitine, resin, proteins, mucins, mineral salts, starch and calcium, myosin, vitellin, sugar, vitamin -B, -C, β-sitosterol, lupeol, n-triacontanol, mannitol, amino acid, aspartic acid, glutamic acid, asparagine, glutamine, prolin, hydroxyproline, isoleucine, cysteine, L-leucine, glucose and rhamnose. The pulp of the fruits is a rich source of the vitamin-B and -C. The seeds contain fixed oil whereas the roots have berberine and quinolone type alkaloids (Nadkarni, 1976).

DISTRIBUTION

It is cultivated throughout India, Sri-Lanka and other tropical countries, probably native of Java. The Chinese have been cultivating it for over 2000 years. In Sri-Lanka, it is cultivated in the dry zone during the rainy season and elsewhere throughout the year (Prakash, 2005). Worldwide geographical distribution of *B. hispida* is given in Fig. 2.

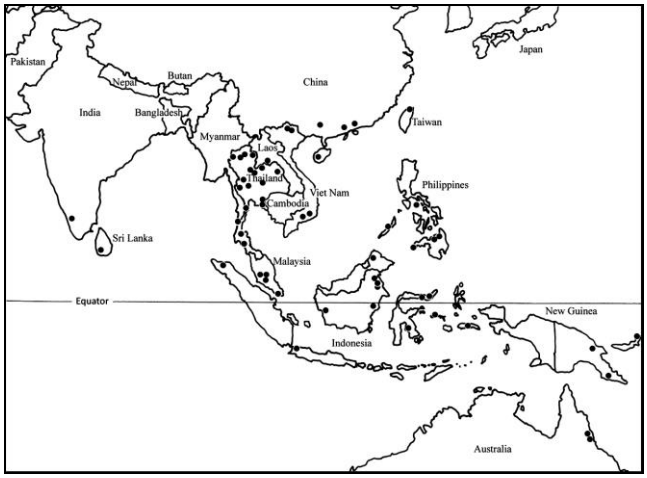

Fig. 2. Geographical distribution of *B. hispida*

PARTS USED IN MEDICINE

All the parts of this plant such as peel, outer layer, seeds, stem, roots, flowers and leaves are used in traditional medicine.

AYURVEDIC PROPERTIES

The properties of the fruit of *B. hispida* change according to stages of ripening. The tender fruits alleviate Pitta Dosha, medium ripened fruit alleviates Kapha Dosha, and ripened fruits alleviate all three Dosha. According to Ayurveda (Prakash, 2005), its properties are given below.

- Rasa (taste): Madhura (sweet)
- Guna (qualities): Laghu (lightness), Snigdha (moisture)
- Veerya (potency): Sheeta (cold)
- Vipaka (post-digestive effect): Madura (sweet)
- Prabhava (special potency): Nervine tonic
- Dosha Karma (actions): Vata-Pitta Shamaka.

INDICATIONS AS MENTIONED IN AYURVEDA

In Ayurvedic texts, *B. hispida* is indicated for the treatment of Mutrakrichra (dysuria), Rakta Arshas (bleeding piles), Krimi (tapeworm infestation), Amlapitta (hyperacidity), Kshaya (tuberculosis), Raktashteevana (haemoptysis), Kasa (cough), Swasa (asthma), Unmada (hysteria), Apasmara (epilepsy), Ashmri (urinary calculi), Hradroga (heart diseases), Madumeha (diabetics) and Atistaulya (obesity) (Nadkarni, 1976).

INDICATIONS IN DIFFERENT TRADITIONS

In Indian system of medicine fruit is used as nutritive, tonic, diuretic, aphrodisiac, styptic, vermin fugue and various diseases and disorders like asthma, bronchitis, insanity, epilepsy, dry cough, fever, urethrae, syphilis, hyperdipsia and vitiated of Pitta conditions. In Indo-China, the leaves and seeds are given as a purgative (Prakash, 2005; Jayaweera, 2006).

CONTRAINDICATION

Rasa Aushadha (mineral drugs) should not be administered orally along with *B. hispida* (Alupuhul). However, the fruit juice of Kushmanda (*B. hispida)* is used for purification of Rasa Aushadha (Anonymous, 2001).

PHARMACOLOGICAL STUDIES

Clinical studies

An anti-ageing cream prepared from *B. hispida* fruit extract was found effective in retarding the symptoms of ageing (Sabale et al., 2011). Huang et al. (2004) had undertaken a study to investigate the abilities of anti-oxidation and inhibition of angiotensin-converting enzyme (ACE) activity of *B. hispida* core, seed and peel prepared by different extraction methods. The seed had the lowest Cu^{2+} induced low-density lipoprotein (LDL) oxidation percentage and inhibition level of ACE activity among all parts. The higher antioxidant capacity of seeds resulted from the higher total phenolic and superoxide dismutase activity.

Animal studies

A tincture obtained from the fruits of *B. hispida* was found effective in the management of hypochlorhydria in male albino rats. The study suggested that the tincture also has antioxidant activity in addition to the anti-hypochlorhydric effect (Mandal and Ghosh, 2012). The petroleum extract and *B. hispida* seed oil were found to inhibit testosterone-induced hyperplasia of the prostate in albino rats (Prakash and Harini, 2017).

Rachchh and Jain (2008) evaluated the antiulcer activity of *B. hispida* fruit in rats against ethanol-induced gastric mucosal damage, pylorus ligated gastric ulcers, and cold restraint-stress induced gastric ulcer models. The petroleum ether and methanol extracts of the plant possessed most significant antiulcer as well as antioxidant property.

TOXICOLOGICAL STUDIES

Qadrie (2009) found that the ethanolic extract of *B. hispida* seeds possesses potent anti-nociceptive and antipyretic effects and thus pharmacologically justifying its folkloric use in the management of fever and pain conditions. The study found that the extract is safe for rats and can be used for higher models. The aqueous and ethanolic extract of *B.hispida* was found to safe and no mortality was observed at a dose of 5 g/kg of body weight rats (Sabale et al., 2011). Its chloroform extract was tested for acute toxicity in albino rats at the doses of 250, 500, 750 and 1000 mg/kg. The extract was found safe as no adverse effects were observed. The parameters which were observed were hyperactivity, sedation, loss of righting reflex, respiratory rate and convulsions.

PHARMACEUTICAL PREPARATIONS

Many pharmaceutical preparations are described in authentic texts. It is used singly or in combination with various medicaments. These preparations are administered internally (Anonymous, 2001; Prakash and Harini, 2017) and externally (Anonymous, 1980) for different human ailments. Various preparations of *B. hispida* are given in Table 1.

Table 1. Selected pharmaceutical preparations of *B. hispida*

S.No.	Preparation	Use
	For internal use	
1.	Dried fruit powder (5 g) with warm water (15 ml)	relieves bronchial asthma and cough
2.	Fruit juice (240 ml) or decoction of tender stem (60 g)	treats food poisoning
3.	A mixture of 30 ml of *B. hispida* fruit juice, 1.25 g of Yawakshara (salt of tartar) and 1.25 g of Hingu (*Ferula narthex*)	improves dysuria and relieves pain in pelvis and genitals

4.	Dry peel powder (5 g) with 5 ml of honey	controls diabetes
5.	Fresh fruit juice (120 ml)	a refreshing drink for insanity, epilepsy and other nervous diseases
6.	Decoction of leaves (120 ml) with 2.5 g of rock salt	relieves cholera
7.	Decoction of the tender stem (60 g) with of ghee (2.5 ml) and honey (2.5 ml)	relieves toxin and burning sensation of the body
8.	Dry seeds powder (5 g) with 10 ml of warm water	useful as an anthelmintic and a diuretic
9.	Fruit juice (30 ml)	relieves gastritis, peptic ulcers and constipation
10.	Mixture of fruit pulp (30 g) and 5 g of sugar	treats anemia and debility
11.	One teaspoon of fried uncoated seeds with 1 teaspoon of ghee or seeds powder (5 g) with warm water (15 ml) (a purgative drug should be taken after consumption)	treats tapeworm infection
12.	Raw fruits (200 g) after removing peel and seeds ground with equal quantity of water and a pinch of salt (food should not be taken for 4 hours after consuming the juice)	useful in obesity and ulcers
13.	Decoction of uncoated fruits (30 g)	useful in internal bleeding
14.	Dried slices of fresh fruits (250 g) put into the clay pot and heat it for a short-time, the black slices thus obtained are powdered and mixed with a pinch of dry ginger powder	relieves gastritis
For external use		
1.	Oil prepared with two tablespoon of powder of seeds and 240 ml of coconut oil by boiling until it is turned to red.	useful in dandruff, baldness and headache
2.	Paste of 30 gms of peel of fruits or leaves ground with 100 ml of water	relieves from burns
3.	Paste of seeds (50 g) with water	relieves from wounds and burns
4.	Paste of 100 g of fruit of *Emblica officinalis*, stem of *Santalum album*, rhizome of *Asparagus racemosus*, stem and filament of *Nelumbium aures*, the filament of *Mesua ferrea*, whole plant of *Centella asiatica* and seeds of *Phaseolus aures* by boiling with 750 ml of cow's milk. The paste thus obtained is mixed with 100 ml of breast milk, treacle of *Saccharum officinatum*, Sesame oil, juice of fruit of *B. hispida* and *Aloe indica*.	useful in insanity when applied on the scalp
5.	Fifty grams of rhizome of *Nymphaea lotus*, rhizome of *Aspaeagus racemosus*, fruit pulp of *B. hispida*, leaves of *Alternanthera sessilis* and wet fruits of *Emblica officinalis* boiled with 1000 ml of water and ground with 500 ml of cow's milk to prepare a paste.	useful in epilepsy when applied on scalp
Compound preparations		
1.	Fruit juice (30 ml) of *B. hispida* boil with 10 ml of ghee and 5 g of a paste of *Glycyrrhiza glabra.*	improves intelligence, speech, voice, and alleviates epilepsy
2.	Honey (25 ml), treacle of *Saccharum officinatum*, coconut water, juice of *Citrus limon* and *Centelle asiatica*, fruit juice of *B. hispida* and cow's milk are mixed with 5 g of sugar to prepare 120 ml of the mixture.	useful in insanity when given twice a day before meals
3.	Fifteen grams of fruit pulp of *B. hispida,* rhizome of *Musa pardisiaca*, roots of *Withania somnifera* and *Glycyrrhiza glabra* are mixed with 1920 ml of water and boiled down to 240 ml; 120 ml of the decoction is mixed with 2.5 g of sugar, 1.25 ml of honey and ghee.	useful in insanity when given twice a day before meals
4.	Every 12 Madatas of flowers of *Alangium salvifolium*, *Cinnamonmum camphora*, *Santalum album*, *Punica granatum*, *Jasminum grandiflorum*, *Madhuca nerifolia*, *Bauhinia racemosa*, *B. hispida*, *Musa paradisiaca*, *Meusa fere*, *Michelia champaka*, *Nelumbium speciosum*, *Abrus precatorius*, *Nymphaea lotus, Elaeocarpus serratus*, seeds of *Trigonella foenum* and *Strychnos potatorum*, *Glycyrrhiza glabra*, bark of *Santalum album*, *Tinospora cordifolia* are mixed with 1920 ml of water and boiled down to 240 ml.	useful in severe burning sensation due to Pittakopha when given 120 ml twice a day before meal

5.	Puhul Basna (every 240 ml of juice of *Centella asiatica*, *B. hispida*, rhizome of *Musa paradisiaca*, whole plant of *Eclipta alba*, treacle of *Saccharum officinarum*, human milk and cow's milk are mixed. This mixture is ground with 60 g of *Santalum album*, 20 g of seeds of *Strychnos potatorum* and 20 g of *Glycyrrhiza glabra* and put into the empty fruit of *B. hispida* (after removing the pulp and seeds) and top of the hole is covered with a piece of fruit peel; 120 ml of this mixture is mixed with 5 g of sugar.	useful in hysteria and epilepsy when given three times a day for a week
6.	Thirty ml of fresh fruit juice of *B. hispida* is boiled with 240 ml of cow's milk, after that, 10 g of sugar and 5 g of fruit powder of *Emblica offcinalis* is added and mixed them well.	relieves hyperacidity

There are various popular formulations of *B. hispida* mentioned in the Ayurvedic texts which are useful against various ailments (Jayawardana, 2006). Selected such preparations are given in Table 2.

Table 2. Combined Ayurvedic preparations

No.	Preparative drugs	Indications
1.	Kushmanda Rsayana	Krusha (emaciated), Rajayakshma, Kasa
2.	Kushmandavaleha	Amlapitta, Raktapitta
3.	Kushmanda Coorna	Kasa, Shwasa
4.	Kushmanda Ghrta	Unmada, Apasmara
5.	Kushmanda Khanda	Swasa, Kasa, Raktapitta, Amlapitta
6.	Kushmanda Gudakalyana	Krusha, Daha
7.	Vasa Kushmanda Khanda	Swasa, Kasa, Raktapitta
8.	Puhul Basna	Krusha, Raktapitta, Unmada

CULINARY USES

Different parts of *B. hispida* are used in various culinary uses. It is used as a vegetable, herbal gruel, salad, milk, chutney, chips, Mellum, fried seeds or plant in ghee, battered plant, pickles, sweet meets, Dosi, Jam or confections. For the curry, 250 g of unripe fruit of *B. hispida* is cut into small pieces (without outer layer) and cooked with 100 ml of coconut milk, a small amount of onion, green chilli, curry leaves and spices. Salt could be added to the taste (Jayaweera, 2006). The leaves (100 g) are cut into large pieces. This can be cooked with 30 ml of thick fresh coconut milk or tempered with coconut oil. Spices and salt added to the taste.

The herbal gruel can be made with fruit pulp of *B. hispida*. The pulp (50 g) is finely chopped and boiled with 25 g of red-rice, well-cooked with 500 ml of water followed by the addition of 120 ml of thick freshly prepared coconut milk, to obtain a thick gruel. A pinch of salt can be added to improve taste when drinking. The salad can be prepared by using 100 g of fruits, 1 g of curry leaves, 5 g of skimmed milk powder (made into curd), pepper and salt. This salad is freshly prepared every day and can be served to hyperlipidemic diabetic patients in the morning for 3 months to find out the therapeutic effect of supplementation of ash gourd and curry leaves. This plant is also consumed with milk in which 30 ml of fresh fruit juice is boiled with 120 ml of cow's milk and can be used as a refreshing drink.

Chutney can be made with fruit and stem of *B. hispida*. The chopped fruits (without peel and seeds) (250 g), stems of *B. hispida*, 40 g of scraped coconut, half teaspoon of sugar, half teaspoon of mustard seeds and one chopped green chilli are ground together and kept aside. Another half teaspoon of mustard seeds is popped in coconut oil. Few pieces of curry leaves and half a teaspoon of turmeric powder are added and heated while mixing until curry leaves are roasted. This is added to the previously prepared ground mixture and mixed well. The salt can be added to the taste.

Besides, the stems of *B. hispida* are cut into slices, mixed with salt and pepper and deep-fried. This could be eaten like chips or papad. The roasted seeds are eaten like a peanut whereas the leaves of the plant are fried with ghee and consumed. Its stems (150 g) are cut into one-inch pieces and mixed with powdered salt and pepper. A thick batter is prepared with gram powder, coconut milk, turmeric powder, salt and pepper powder. The prepared stems of *B. hispida* are coated with batter and deep-fried. The pulp of the ripened fruits is candied into a delicacy.

USE IN SRI LANKAN TRADITIONAL EXORCISE RITUALS

In Bali Thovil like Shanthi karmas offering to the devils, it is believed to cure ill effects arising from evil spirits (Jayawardana, 2006). It is also used as an ornamental plant in home gardens and fens.

CONCLUSION AND PERSPECTIVES

It is clear that *B. hispida* is a plant which has many potential medicinal values. This plant is administered to patients suffering from various ailments in the form of fresh juice, powder, paste and oil. It is also used in culinary purposes and exorcises rituals. Various medicinal preparations of *B. hispida* are administered internally in the

treatment of internal haemorrhage, haemoptysis, epilepsy, diabetes, piles, dyspepsia, marasmus, cough, asthma., ulceration of lungs, hoarseness, hiccup, heart diseases, anaemia, jaundice, tuberculosis, worm infestation in the form of juice, powder or paste. Externally, it is used in the treatment of dandruff and baldness, burns and headache in the form of Alepa (paste). Anti-ageing, anti-oxidant, anti-inflammatory, anti-asthmatic, diuretic, nephron protective, anti-diabetic, hypolipidemic, anxiolytic, muscle relaxant, anti-depressant and anti-microbial effects are proven through in pharmacological studies and its safety has been scientifically proven through toxicity studies. *B. hispida* is a plant with multifaceted values including medicinal and nutritional values which are used especially for purifies of blood and rejuvenation activity.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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