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Brahmi (Bacopa monnieri) as functional food ingredient in food processing industry

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Abstract

Brahmi is one of the oldest traditional ayurvedic medicines in India. It was originated in India more than 3000 years ago. *Brahmi* is known for enhancing memory, cognition, mood and other mental disorder. Saponins are the major compounds in *Brahmi* which is responsible to enhance the nerve impulse transmission. It has many long researched and proven for many beneficial medicinal and functional properties. Functional ingredients are the foods that have health benefits beyond normal nutrition. *Brahmi* has its own unique strong herbal taste and a bitter aftertaste. Due to change in lifestyles and growing consciousness for health there is a great demand of food products that are healthy as well as provide some functional benefits. An Ayurvedic herb such as *Brahmi* comes with many functional benefits. The present review enlightens the various such properties and use of *Brahmi* in various food systems.

Keywords: *Brahmi*, cognition, saponins, food systems, herbal taste, nootropic drugs, medicinal properties, functional ingredient

Introduction

Ayurveda is the world oldest medication system and is originated in India more than 3000 years ago. It is the purest and traditional health care system. Nootropic herbs and drugs are used to enhance memory, cognition, mood, and other factors associated with mental functioning^[1]. Examples of herbs with nootropic activity include Ashwagandha (*Convolvulus arvensis* / *Withania somnifera*), Shankpushpi, Ginkgo (*Ginkgo biloba*) and gotu kola (*Centella asiatica*) and *Brahmi (Bacopa monnieri)* are some of the famous nootropic herbs. *Bacopa monnieri* (BM), also referred to as, *Herpestis monniera*, water hyssop, locally known as *Brahmi* or *Jalanimba* in India, has been used for centuries in the Ayurveda, a holistic system of medicine originating from India. It is classified as a Medhyarasayana, a drug used to improve memory and intellect (medhya)^[1]. It was used traditionally as a brain tonic to enhance memory development, learning, and concentration, and to provide relief to patients with anxiety or epileptic disorders^[2]. *Brahmi* name is derived from the word 'Brahma-creator of the universe in the Hindu pantheon [3]. Because the brain is the Centre for creative activity, any compound that improves the brain health is called *Brahmi*, which also means 'bringing knowledge of the supreme reality'. The herb has been mentioned in several ancient Ayurvedic treatises including the 'Charaka Samhita' since sixth century AD, in which it is recommended in formulations for the management of a range of mental conditions including anxiety, poor cognition and lack of concentration, as a diuretic and as an energizer for the nervous system and the heart. Plant of *Brahmi* has been extensively researched and it shows nootropic ability, improve learning and respiratory function. It is found in wetlands throughout the Indian subcontinent in damp and marshy or sandy areas near streams in tropical regions. The genus *Bacopa* contains over 100 species of aquatic herbs scattered throughout the warmer areas of the world. Apart from India, it is also found Nepal, Sri Lanka, China, Taiwan, Vietnam, Florida and other southern states of the USA. The entire plant is used medicinally.

Plant Description and Morphology

Bacopa monnieri, a member of the Scrophulariaceae family, is a small, creeping herb with numerous branches, small oblong leaves, and light purple flowers. In India and the tropics it grows naturally in wet soil, shallow water, and marshes. The herb can be found at elevations from sea level to altitudes of 4,400 feet, and is easily cultivated if adequate water is available. Flowers and fruit appear in summer and the entire plant is used medicinally^[4]

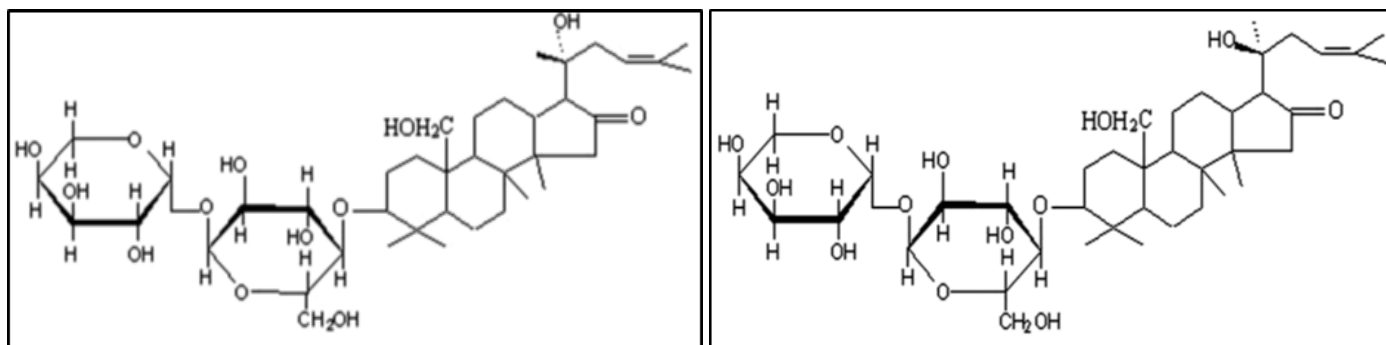


Fig 1: Picture of *Brahmi* (*Bacopa monnieri*) plant [5]

Kingdom – Plantae
 Division – Anthophyta
 Class – Dicotyledoneae
 Order – Scrophulariales
 Family – Scrophulariaceae
 Genus – *Bacopa*
 Species – *monniera*

Structure of Major Chemical Entity

Bacoside A and B are the *Bacopa monnieri* isolate with neuroprotective activity. Bacoside A is one of many structural analogues found in the Ayurvedic nootropic herb *Bacopa monnieri* [6].



Bacoside A (levorotatory);

(b) Bacoside B (dextrorotatory)

Fig 2: Chemical structures of some well-known Saponins from *Bacopa monnieri* [6]

Chemical Composition of *Brahmi*

Brahmi (*Bacopa monnieri*) contains 88.4% moisture along with carbohydrates, fat, protein and minerals. The major chemical composition of the herb is given in table below.

Table 1: Chemical Composition of *Brahmi* [5]

Component	Amount (/100gm)
Moisture	88.4 gm
Protein	2.1 gm
Fat	0.6 gm
Carbohydrates	5.9 gm
Crude Fiber	1.05 gm
Ash	1.9 gm
Calcium	202.0 mg
Phosphorus	16.0 gm
Ascorbic Acid	63.0
Nicotinic acid	0.3
Iron	7.8 mg
Energy	38 cal

Mode Of Action *Brahmi* (*Bacopa monnieri*)

Extracts of *Brahmi* (*Bacopa monnieri*) have been extensively investigated for their neuropharmacological effects. There are some compounds such as Saponins and their bacosides present in *Brahmi*, which are responsible to enhance the nerve impulse transmission [7]. The bacosides aid in repair of damaged neurons by enhancing kinase activity, neuronal synthesis, and restoration of synaptic activity, and ultimately nerve impulse transmission. In animals, *Bacopa* has a relaxant effect on pulmonary arteries, aorta, trachea, and ileal and bronchial tissue, possibly mediated by inhibition of calcium-ion influx into cell membranes [4]. There are numerous clinical trials and studies have been performed by various researchers to check the nootropic effects of *Bacopa monnieri*.

Functional/ Therapeutic Properties of *Brahmi* (*Bacopa monnieri*)

It is a well proven herb of many medicinal properties. All the parts of the plant can be used as medicine. In Ayurveda, *Brahmi* has been used to promote memory and intellect and also used for treatment of neurological disorders and also as a rejuvenator [5]. It has also an ability to improve cognitive function. *Brahmi* has many medicinal properties such as antispasmodic, anticholinesterase, neuroprotective, antioxidant, Alzheimer's disease, antidepressant, bronchodilatory, antiulcerogenic, anti-inflammatory, antibacterial, anticancer, cell stabilization, antileishmanial, etc.

Dosage

Therapeutic doses of *Bacopa* are not associated with any known side effects, and *Bacopa* has been used safely in Ayurvedic medicine for several hundred years [8]. Traditional daily doses of *Bacopa* are 5- 10 g of non-standardized powder, 8-16 mL of infusion, and 30 mL daily of syrup (*Brahmi*). Dosages of a 1:2 fluid extract are 5-12 mL per day for adults and 2.5-6 mL per day for children ages 6- 12 [9]. For *Bacopa* extracts standardized to 20-percent bacosides A and B the dosage is 200-400 mg daily in divided doses for adults, and for children, 100-200 mg daily in divided doses to achieve the medicinal/therapeutic properties of *Brahmi*.

Clinical Studies

There are numerous clinical trials and studies have been performed by various researchers to check the nootropic effects of *Bacopa monnieri*. Summary of results are enlisted in the table given below.

Table 2: Summary of clinical studies performed on *Brahmi* (*Bacopa monnieri*).

S. No.	Substances/treatments	Subjects/patients	Results/comments	References
1.	BM crude extract; chronically for 4 weeks	Patients with anxiety neurosis	Enhancing of memory	[10]
2.	BM extract; chronically for 12 weeks	Children	Enhancing memory and learning	[11]
3.	BM standardized extract (300 mg); acute treatment for 2 h	Healthy adult subjects	No significant changes were found	[10]
4.	BM standardized extract	Mentally retarded children	Effective in enhancing learning and in controlling abnormal behaviour	[12]
5.	BM standardized extract (300 mg); chronically for 12 weeks	Healthy adult subjects	Improving early information processing, verbal learning and memory consolidation	[7]
6.	BM standardized extract (300 mg); one trial after chronic treatment for three months and another trial and for 6 weeks after the completion of the trial	Healthy adult subjects	Significant effect on a test for retention of new information. Tasks assessing attention, verbal and visual short term memory and the retrieval of pre-experimental knowledge were unaffected	[13]

Brahmi As A Functional Food Ingredient In Commercial Food Products

Functional foods are promoting public health but require strong scientific evidence [14]. It is applicable for use of *Brahmi* or any other Ayurvedic herb too. Confusion also exists about claims applied to foods and those applied to dietary supplements. Claims must be communicated effectively to the consumers so that there is less confusion about the product [15]. Care must be taken so that consumer can differentiate the claims of health and structure-function

scientific claims. In recent times, the use of herbal products has increased tremendously in the western world as well as in developed countries due to its tremendous health benefits. *Bacopa monnieri*, a well-known nootropic, an outstandingly important medicinal plant and widely used therapeutically in various food systems. There are numerous of food products available in market of India which contains *Brahmi* as functional food ingredients. The description of various products along with ingredients, product origin and different claims has been enlisted in the table 3.

Table 3: Description of various products available worldwide with *Brahmi* as ingredient [16]

S. No	Product/Country	Country of Origin	Ingredients	Product Claims
1.	B-Natural <i>Brahmi</i> Ready to Serve Fruit Beverage	India	Water (69.4%), <i>Brahmi leaf</i> extract (16%), de-ionised apple concentrate (14.5%), citric acid (1%)	<i>Brahmi</i> is proven to improve the mental acuity and support the physiological process involved in relaxation. Its active constituents help calm the mind and reduce stress
2.	Baidyanath Junior Chyawanprash	India	Chyawanprash Avaleha Baelchhal Ganiyari Cleodendym Parul Chhal Mugdaparni Prishniparni Gokhru Mashparni Pipal Shalparni Gangeticum Chhoti Kateri Bari Kateri dalchini tejpatha nagkesar chhoti elaichi madhu, <i>Brahmi</i> .	It provides energy, immunity and strength. The complete brain and body nourishment product is specially formulated for growing children and contains 50 vital herbs and minerals to help all-round growth of the child
3.	Jain Memovit Flavoured <i>Brahmi</i> Granules	India	Mandukaparni, ashwagandha, <i>Brahmi</i> , shankpushpi, yashtimadhu, guduchi, khandsarkara q.s, approved flavours	These granules have been designed to help improve the immune system and increase concentration levels in children
4.	Verjina Wondy Custard Powder	India	Edible starch, edible common salt, permitted food colours, artificial flavours, <i>Brahmi</i> extract.	It is described as a memory and concentration booster. This vegetarian product retails in a 160g pack, which contains two separate flavour packs of 80g each
5.	Shree Guruji Brahma Tej	India	Badam, keshar paste, kheera beej paste, <i>Brahmi</i> concentrate, shankh puspil concentrate, shahad, mulethi concentrate, durva concentrate, vacha concentrate, ashwagandha concentrate, posta dana pasta, manduk parni permitted class II preservatives (E218, E216), flavours, colours (E110, E102)	It is for Brain improves concentration, enhances memory, nourishes brain and strengthens nerves. This vegetarian product is a combination of 28 ayurvedic herbs that are effective on brain and is said to be very delicious and nutritive
6.	Assorted Nutrition Bar Pack	India	Ritebite smart: rice crispies, corn syrup, cane sugar, caramel, rolled oats, cocoa powder, (INS 322, INS 471), herbs (ashwagandha, <i>Brahmi</i> , shankpushpi)	
7.	Pitambari's Geni Health and Memory Enhancer Granules	India	Shatavari, ashwagandha, bhui kohala, <i>Brahmi</i> , shankpushpi, yashtimadhu, gokshur, vidang, vekhand, sugar, added preservative, permitted colours, permitted flavours	It is an ayurvedic medicine that enhances memory and grasping power. It relieves stress and fatigue, builds stamina and strength, provides essential nourishment and improves health and immunity
8.	Paradise Gold Premium <i>Brahmi</i> Almond Syrup	India	<i>Brahmi</i> booti, rose water, giribadam, istakhadus-booti, cardamom, shankpushpi, sugar, skimmed milk, water, citric acid, permitted synthetic food colours (19140, 42090), artificial flavour, natural flavour, nature identical flavour, permitted class II	It can be used to sweeten puddings, cereals, <i>lassi</i> , ice cream and toppings. The vegetarian product retails in a 700 mL recyclable bottle
9.	Panchwati Health Prash	India	<i>Brahmi</i> , shankpushpi, arjuna, pipali, amla, ashwagandha, honey	It is recommended for students and is also claimed to be ideal for adults. The product is available in a 1kg jar
10.	Ojasvita	India	Ashwagandha (<i>withania somnifera</i>), shatavari (<i>asparagus racemosus</i>), <i>Brahmi</i> (<i>Bacopa monnieri</i>),	The product contains seven herbs, including ashwagandha, shatavari, <i>Brahmi</i> , jatamansi,

			lyotismathi, vanilla powder, E202, contains permitted natural colours, added flavours	shankapushpi, bringaraj and kali musali
11.	Natura Tammy Raw Mango Flavoured Jelly	India	Aloe vera (10mg) (aloe barbadensis), <i>Brahmi</i> (5mg), nimbu satva (32mg), shankpushpi (3mg), stabilizer, preservative (sodium benzoate), colour (pea, green supra FCF), added flavour, fructooligosaccharide (dietary fibre)	The ayurvedic product is suitable for vegetarians and retails in a 4g pack
12.	Sandali <i>Brahmi</i> Badam Sharbat	India	Sugar, water, arq (kewra, kashni, anjbar, rose, khus), almonds, shankpushpi extract, sandalwood oil, <i>Brahmi</i> booti, citric acid (E330), permitted synthetic food colour, added flavour, permitted class II preservative (E224)	It is said to bring the rich aroma of the Mughal area for the summer season. One part of the vegetarian product can be mixed with three parts of iced water or milk to prepare. It needs no addition of sugar, and retails in a 750ml bottle
13.	Himani Sona Chandi Chocoprash	India	Agnimantha, haritaki, bala, mashaparni, mudgaparni, vidarikanda (0.05g each); arjuna, jyotishmati, shankpushpi, <i>Brahmi</i> ; 0.01 each of bilva, gambhari, jeevanti, brihati, gokshura, kantakari (0.11g each); 20g skimmed milk powder, 5g cocoa butter, water, preservatives	It is marketed as a sensational breakthrough formula featuring the super powers of precious of gold, silver and saffron incorporated with 51 rare herbs, minerals and rich chocolate
14.	Patanjali <i>Brahmi</i> sharbat	India	<i>Brahmi</i> Extract Baccopa monnieri, Sugar, Jala Nimbu Sat, Preservative, Sugandhit, Dravya Colour,	
15.	Amrapali Mums Breakfast cereals	India	Corn, sugar, salt, <i>Brahmi</i> , malt extract, baking powder, sodium bicarbonate, niacin	Amrapali Mum's Corn Flakes have been repackaged and are now retailed in a 500g carton featuring a new design. This 100% vegetarian cereal features Memory Enhancer and natural herbs for Memory Plus. Corn flakes are rich in vitamin A, vitamin B, vitamin C, iron
16.	Amrita Drugs <i>Brahmi</i> Powder	India	<i>Brahmi</i> , sankhapushpi, ashwagandha, shatavari, jatamansi, gokshur, sugar	Amrita Drugs <i>Brahmi</i> Powder is described as a memory booster. The ayurvedic product is said to improve memory and concentration levels, relieve the problems associated with excessive stress among professions, intellectuals, students and elderly people, and is also an excellent tonic
17.	Ayursona Fine Foods memory milk biscuits	India	Nachani, soyobean, wheatflour, sugar, edible fats, milk powder, ashwagandha, shatavari, shankpushpi, <i>Brahmi</i> , bhrungaraj, vekhand, jeshthimadh, sunth, vavding, anantmul, manjishtha, harda, nutmeg, cardamom	A 160g pack of biscuits, said to improve health and memory. The product is highly nutritious and fibrous
18.	Basic Ayurveda Muslifed Energic Drink	India	Safed musali (asparagus adscendens), shatawar (asparagus racemosus), <i>Brahmi</i> , samel musli (bombax malabaricum), gond katira (astragalus gummifer), ashwagandha (withania somnifera), swarn varka (pure gold foil), kesar/ saffron (crocus sativus)	Basic Ayurveda Muslifed Energic Drink is described as a powered energy booster and is a routine health support for men, women, children, teens and seniors
19.	Dabur Chyawan junior Malted Food Drink	India	Malt extract, sugar, liquid glucose, amla dry, skimmed milk powder, yashtimadhu, <i>Brahmi</i> , shankha pushpi, nature identical vanilla flavour, permitted raising agents (INS 500)	
20.	Dabur Chyawanprash	India	Dashmool, bala, mudgaparni, mashaparni, karkatshring, tamalaki, draksha, jivanti, pushkara, haritaki, guduchi, karchura, musta, punarnava, utpala, vasa, yashti, kakrasika, varahi, ashwagandha,	The product ensures immunity, mental and physical fitness in growing children it keeps youth fit by protecting from day to day ailments like common cold and cough, provides active elders with antioxidants and strengthens their immune system
21.	Double Horse Health Putthu mix	India	Samba wheat, brown rice, njavara rice, maize, ragi, barley, sago, green gram, bengal gram, badam, cashew nut, <i>Brahmi</i> , tulasi, carrot, cocoa, cardamom, rice bran, soya beans	It is a combination of cereals and herbs, which meet the daily nutritive requirement of the family. This tasty and healthy breakfast mix which is 100% natural and free from preservatives, is designed to prepare in a Puttu maker (kutt)
22.	Haritage Almond Syrup	India	<i>Brahmi</i> booti (<i>Bacopa monnieri</i>), rose water, giribadam (almond clusters), istakhadus-booti, cardamom, shankpushpi (convolvulus pluricalis), sugar, skimmed milk, water, citric acid, colour (19140, 42090)	It is a beverage concentrate that can be used to make an almond flavoured drink or to sweeten puddings, cereals, lassi, ice creams and toppings

Food Product Segments Study

In recent times, the use of herbal products has increased tremendously in the western world as well as in developed countries. *Brahmi* (*Bacopa monnieri*), one of the outstandingly important medicinal plants, widely used therapeutically in the orient and becoming increasingly

popular ingredient in food products. There are numerous of food products available in market which contains *Brahmi* as functional food ingredients. Summary of product segments available in the market with *Brahmi* as an ingredient is presented in below chart.

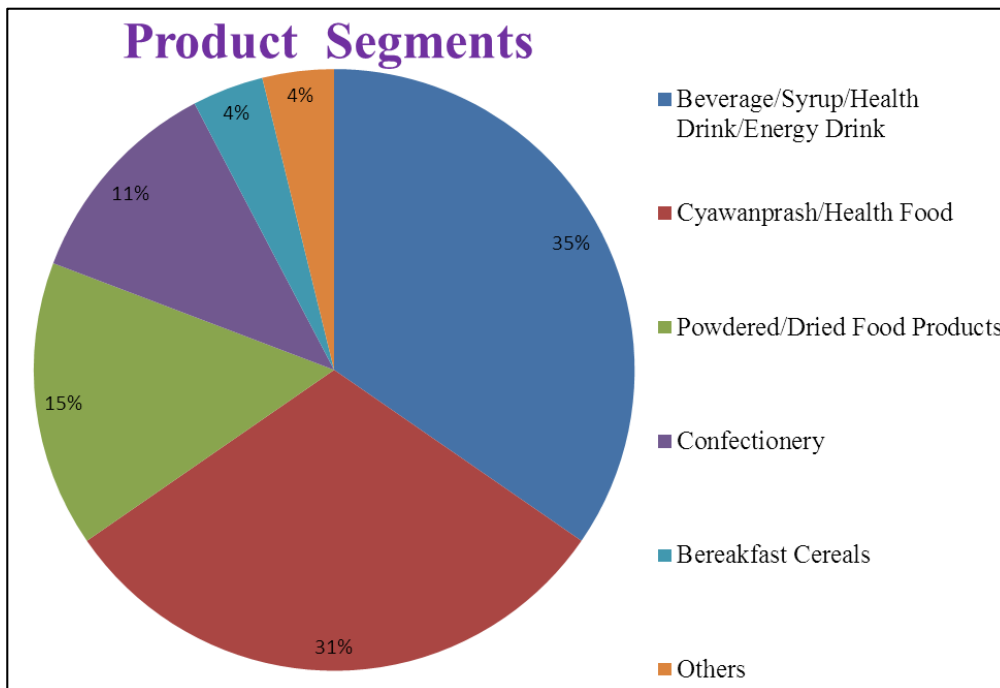


Fig 3: Sector wise Segregation of Products containing *Brahmi* as functional Food ingredient [16]

Conclusion

Brahmi is clinically proven for its functional and therapeutic benefits. It has been added as a functional ingredient in vast majority of commercial food products. The major problem comes with the herbs during their incorporation in to food products. Most of the times, the food product chemistry is so different from the herbs composition, it becomes very difficult to incorporate the dry herb extract in to food product matrix. The other major challenge with the herbal medicines like *Brahmi* is that they taste very bitter and gives a pungent herbal aroma. Bitter taste of *Brahmi* is the main reason for the rejection in various food products. But it is also keep in mind that various food drinks such as coffee, beer, wine, etc., is popular due to its bitterness.

Way Forward

Herbal plant is gaining interest now a day because of its various health benefits. It is becoming popular and growing very fast in the western world as well as in developed countries. So, the food company has to establish this herbal product under and a strong marketing required to change the behaviour of consumers about this herb. Flavour plays an important role in consumer satisfaction and influences further consumption of foods. The herbal note & bitterness makes flavour of the product unappealing to the consumers. A commercial process is needed that removes bitter components without adding anything which is not permitted, while still maintaining the expected flavour and nutritional value of the product. With the use of herbs like *Brahmi* as a functional food ingredient will bring revolution in the functional food market as it has immense potential to provide greater health benefits to the consumers.

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