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REVIEW ARTICLE

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FUNCTIONAL COMPONENTS AND NUTRACEUTICAL APPLICATIONS OF BRAHMI (*BACOPA MONNIERI*) IN FOOD SYSTEMS: A COMPREHENSIVE REVIEW

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ABSTRACT: As demand for natural, food-based health programs increases, the scientific interest in nutraceuticals and functional foods from medicinal plants has gained momentum. *Bacopa monnieri* (L.) Wettst. or Brahmi is an ancient Ayurvedic herb that is well known for its cognitive-boosting and neuro-protective properties. With its esteemed phytochemical content and wide-ranging health advantages, Brahmi has become a preferred choice for nutraceutical ingredient in food systems in recent years. This review critically synthesizes the current scientific evidence regarding phytochemical composition, nutraceutical properties and functional-food applications of *B. monnieri*. Its bioactive components such as bacosides, alkaloids, flavonoids, phenolic acids, saponins and their antioxidant, anti-inflammatory, neuroprotective, metabolic and immunomodulatory properties are especially highlighted. Technological issues related to functional foods are also discussed, such as formulation methods, stability during processing, sensory challenges, enhancement of bioavailability, and emerging technologies, like microencapsulation and nano-formulations containing Brahmi. The safety, toxicity, and regulatory aspects of the use of Brahmi in nutraceuticals in various countries are also included. The potential is great, but there are issues to address regarding standardisation, clinical validation and efficacy studies on food. In conclusion, *B. monnieri* is a valuable, sustainable and multifunctional nutraceutical ingredient that holds potential applications in the development of functional foods for cognitive health and overall well-being.

Keywords: *Bacopa monnieri*, Brahmi, Nutraceuticals, Functional foods, Bioactive compounds, Cognitive health, Food fortification

1. INTRODUCTION

1.1 Nutraceuticals and Functional Foods: A Global Perspective

Lifestyle and consumer behavior changes over the last few decades have placed nutrition and functional foods at the forefront of food-science research. The growing incidence of chronic disease, along with consumer demand for preventative methods to health care, are becoming a major factor in research in this area. Nutraceuticals are usually defined as food or food components that offer a health advantage in addition to their nutritional content, such as disease prevention and health promotion [1]. Related, functional foods are traditional or manufactured products with biologically active components, which have a beneficial physiological effect. Such foods are typically eaten regularly as part of the diet and are believed to either optimize bodily functions or decrease the likelihood of developing a disease. These ideas represent a paradigm shift away from treatment-based health care and are an indicator of a nutrition-based approach to wellness.

The increasing popularity of nutraceutics and functional foods has taken off across the globe. Increased health awareness, the industrialisation of food production and the health care requirements of an ageing population have been cited as reasons for this growth [2]. In this context, plant based functional foods have been the focal point of interest where the traditional knowledge of the food with modern food science is being combined. Many of these foods are based on traditional dietary systems and are rich in plant derived nutraceuticals, whose benefits are becoming more and more confirmed by current research [3].

The medicinal plants contain a variety of bioactive components such as polyphenols, flavonoids, alkaloids, saponins, and other compounds, which when combined, can exert synergistic antioxidant, anti-inflammatory, neuro-protective, and metabolic regulatory effects [4]. Brahmi (Bacopa monnieri), one of these plants, has long been used in traditional medicine and modern systems of medicine for its possible health benefits and it is now recognized as a versatile health promoting agent.

With increasing consumer awareness of healthy eating and the importance of nutrition, Brahmi has gained significant interest as a functional food and nutraceutical ingredient in recent years due to its rich phytochemical profile, its scientifically proven health benefits, and its high nutritional value [5,6]. Herbal bioactive compounds in the food products is a response to the growing interest in the consumption of functional foods,

which are foods with health benefits beyond their nutrient content, that can help prevent disease [7].

1.2 Brahmi (*Bacopa monnieri*): Botanical and Ethnomedicinal Overview

Bacopa monnieri (L.) Wettst. is a creeping perennial herbaceous member of Plantaginaceae. It grows in marshes, wetland and aquatic habitats and is common in the Indian subcontinent, Southeast Asia, Australia, Africa and the Americas. Flowers are pale purple to white, succulent stems are very thick and oval leaves are very small. The ability of growth in aquatic and semi-aquatic environments opens the prospect of sustainable cultivation and large-scale production to supply nutraceutical use.

Brahmi belongs to the class of Medhya Rasayana herbs in Ayurveda which are rejuvenating and increase the memory in humans. It has been used traditionally to treat mental fatigue, anxiety, epilepsy, and cognitive defects that are seen in the elderly. Other traditional medicines have also recognised Brahmi for its anti-inflammatory, digestive, cardiotonic and adaptogenic effects [8]. It is also used as food fresh and dried and hence has ethnonutritional as well as medicinal importance.

Brahmi has been assigned a role as a medicinal herb and, in recent years, it is also considered to be a nutraceutical ingredient with a variety of functions. The beneficial effects have been attributed to specific compounds, called phytochemicals, which have been identified by analysis and tested pharmacologically and are being added to various food and beverage products. This shift reflects the broader international adoption of Brahmi and other traditional medicines into the food supply, under the current guidelines of safety, efficacy, and quality.

1.3 Rationale and Scope of the Review

Despite the widespread research of *Bacopa monnieri*, very little research has been conducted on food applications, and a significant amount of research on therapeutic use in food supplements and pharmaceuticals. With growing interest in functional foods, Brahmi should be systematically evaluated from the point of view of food ingredient. Most of the literature available concentrates on either the phytochemistry or pharmacology or clinical aspects alone and fails to consider the possibility of a unified, food-based approach [9]. Brahmi-based functional foods are relatively scarce, as little attention is given towards its poor bioavailability, sensory acceptability, stability during processing and regulatory status. It is therefore appropriate to have a thorough review, which combines traditional knowledge with the knowledge gained from phytochemistry and functional nutrition and food technology. The bioactive constituents and functional potential of *B. monnieri* and their ability to meet the needs of the present-day food and nutritional systems are reviewed, highlighting its use in functional foods and future prospects for overcoming major hurdles in the use of *B. monnieri*.

2. Methodology of the Review

Literature searched and analyzed from Scopus, Web of Science, PubMed and ScienceDirect on recent studies of *Bacopa monnieri* and its use as nutraceuticals in food systems. The search terms were "*Bacopa monnieri*", "Brahmi", "nutraceutical", "functional food", "bioactive compounds", and "food fortification" were used in combination with the Boolean operators. Only peer-reviewed studies published in English in the last 20 years was considered. Literature retrieved was filtered for its relevance with regard to phytochemical composition, health promoting properties and food applications. Thematic data were then extracted from the data and synthesised by a narrative approach.

3. Phytochemical Profile of Brahmi

3.1 Major Bioactive Constituents

Bacopa monnieri has been proposed to have various health benefits due to the presence of several phytochemicals in the plant [10]. Of these, the bacosides (mainly bacoside A and B) are well-documented triterpenoid saponins with neuroprotective properties. These compounds have been extensively used to indicate the quality of extracts of Brahmi. Brahmi is also known to be rich in alkaloids like brahmine and herpestine which are said to have a positive effect on the central nervous system, and anti-stress activity (Fig. 1).

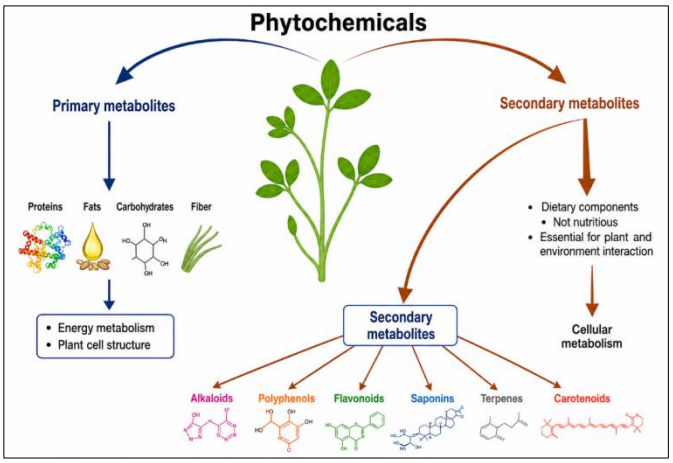

FIG. 1: GENERAL CLASSIFICATION OF PLANT-DERIVED PHYTOCHEMICALS RELEVANT TO THE BIOACTIVE PROFILE OF BRAHMI [11]

The plant also contains a number of other phytochemicals such as flavonoids and phenolic acids, including derivatives of luteolin and apigenin which are known for their strong antioxidant activity. These antioxidants can help reverse the oxidative effects that play a role in chronic disease [12]. The saponins and sterols present in Brahmi also further contribute to its nutritional and functional value, and are prime contributors to the use of Brahmi in functional foods.

Triterpenoid saponins: The main bioactive compounds of *Bacopa monnieri* are a group of triterpenoid saponins known as dammarane-type saponins, or bacosides. These include the

mixture of bacoside A3, bacopaside II, bacopasaponin C, and a jujubogenin isomer, and bacoside B, which are both believed to be significant compounds which contribute to the cognition enhancing properties of Brahmi [13] (Table 1). Bacosides have been found to increase synaptic transmission, to facilitate the repair of neurons, improve conduction of nerve impulses and to prevent oxidative damage to the neurons [6,14].

TABLE 1: PHYTOCHEMICAL CONSTITUENTS OF *BACOPA MONNIERI* AND THEIR FUNCTIONAL RELEVANCE

Phytochemical class	*Major compounds*	*Functional relevance*	*Nutraceutical importance*
Triterpenoid saponins	Bacoside A, Bacoside B	Neuroprotection, synaptic plasticity	Cognitive enhancement, memory support
Alkaloids	Brahmine, Herpestine	Modulation of the nervous system	Stress and anxiety management
Flavonoids	Luteolin, Apigenin	Antioxidant, anti-inflammatory	Reduction of oxidative stress
Phenolic acids	Caffeic acid derivatives	Free-radical scavenging	Cellular protection
Sterols	β-Sitosterol	Anti-inflammatory activity	Cardiometabolic support

Alkaloids and glycosides: Brahmi possesses pharmacological and functional properties and the principles present in its extracts include alkaloids like brahmine, herpestine and nicotine-like compounds, and glycosides like monnierin. These compounds are believed to affect the neurotransmitter function, and to help control the body's reaction to stress [5].

Phenolic compounds and flavonoids: Brahmi contains high levels of the antioxidants – phenolic acids and flavonoids. Brahmi contains these types of compounds that neutralise ROS and reduce lipid peroxidation and helps to protect biomolecules from oxidative stress, which makes Brahmi a good candidate for use in functional-food systems [14,15].

3.2 Chemical Structure and Functional Relevance

Chemical structure is responsible for the biological activity, stability and interactions of bioactive components of Brahmi with food matrixes. Bacosides are amphiphilicity molecules which have membrane-stabilising effects, promoting neuronal signalling and synaptic plasticity [16]. These compounds, however, are susceptible to degradation in the high temperatures, extremes of pH, and oxidative conditions normally found during food processing. This means it is very important to conduct structure–activity relationship studies to inform the design of food products that contain Brahmi, in which the functional integrity of the bioactive compounds is maintained (Fig. 2).

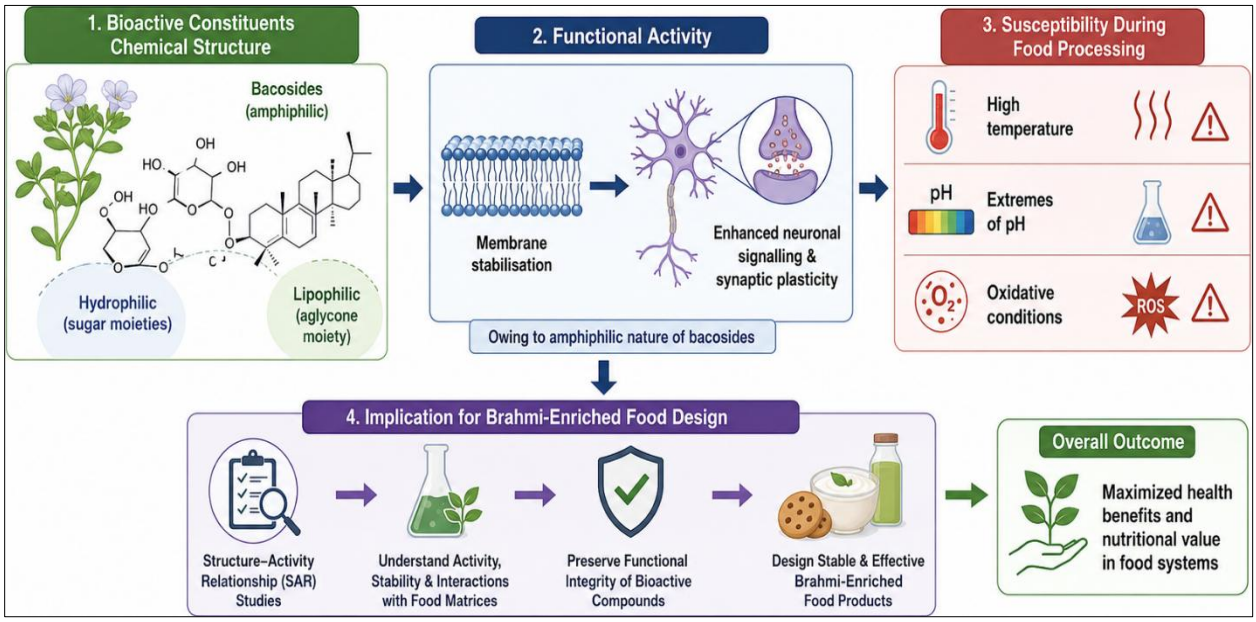

FIG. 2: SCHEMATIC ILLUSTRATION OF THE CHEMICAL STRUCTURE, FUNCTIONAL ACTIVITY, PROCESSING SUSCEPTIBILITY, AND FOOD APPLICATION OF BACOSIDES IN BRAHMI (*BACOPA MONNIERI*).

3.3 Factors Influencing Phytochemical Composition

The phytochemical profile of *Bacopa monnieri* can vary based on the geographical location, cultivation methods, harvesting stage and post-harvest processing methods [17]. The extraction procedures (aqueous, hydroalcoholic and supercritical) also play a key role in the yield and composition of the recovered bioactive compounds. It is very important to carefully monitor these factors to ensure the production of uniform quality nutraceutical food products using Brahmi.

4. Nutraceutical and Health-Promoting Properties

There is ample empirical evidence of the cognitive-enhancing effects of Brahmi. It enhances synaptic communication, stimulates neurogenesis and provides protection against oxidative stress and acts as a Neuroprotective agent thanks to its bacosides. In addition to its antioxidant properties, these attributes render Brahmi as an appropriate ingredient in functional foods for cognitive health promotion [1]. It also has the ability to regulate inflammatory processes and enzymatic

pathways, which further enhances its potential application in foods targeting the management of oxidative-stress related diseases. The antidiabetic and hypolipidaemic properties of *Bacopa monnieri* are also supported by evidence, suggesting the use of *B. monnieri* in functional foods for cardiovascular risk reduction (Fig. 3). The bioactive components of Brahmi strengthen its use as a poly-functional nutraceutical ingredient in food.

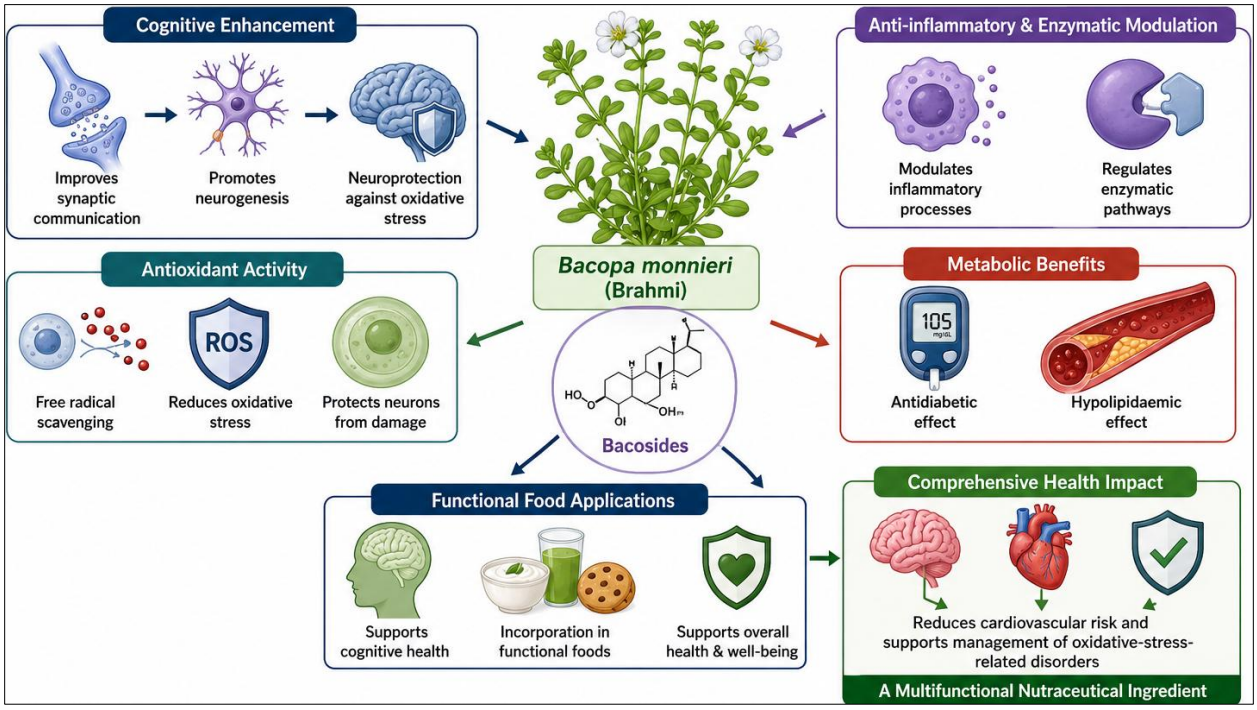

FIG. 3: BIOACTIVE MECHANISMS OF BACOSIDES FROM *BACOPA MONNIERI* AND THEIR ROLE IN PROMOTING COGNITIVE HEALTH AND OVERALL WELL-BEING.

4.1 Cognitive Enhancement and Neuroprotection

It has been shown through clinical and pre-clinical studies that Brahmi improves memory retention, memory acquisition, learning capacity, attention and information processing. These effects are achieved by modulation of cholinergic pathways, improvement of cerebral blood flow and the enhancement of the antioxidant defence [18, 19].

4.2 Antioxidant Activity

Brahmi also has significant antioxidant property and enhances the activity of endogenous antioxidant enzymes like superoxide dismutase (SOD), catalase and glutathione peroxidase. This property is useful in functional foods for the prevention of diseases such as neurodegenerative diseases, metabolic syndromes, etc. that are connected to the oxidative stress [15].

4.3 Anti-Inflammatory and Metabolic Effects

Bacosides have been found to inhibit pro-inflammatory mediators like tumour necrosis factor alpha (TNF- α) and interleukin-6 (IL- 6) thereby confirming the use of Brahmi in inflammatory disorders. Moreover, it has been recently shown to have a beneficial effect on glucose metabolism and lipid profiles, further supporting its inclusion in metabolic health food products [14].

5. Brahmi as a Functional Food Ingredient

Brahmi is available in a variety of forms to integrate into food systems, including dried powder, standardised extract and encapsulated form, which can be used to make ready-to-eat foods like beverages, baked products, dairy foods and nutrition bars. Loss of bioactive compounds during processing and storage is one of the main challenges in food industry. Other processing steps even can cause bitterness, which can diminish consumer acceptance. Micro- and nano-encapsulation can be used to improve the sensory properties of the product, as well as to obtain a controlled release of the bioactive compounds [20]. The bioavailability and absorption of bioactive constituents of Brahmi also rely on the food matrix and digestive processes afterwards. Importantly, micro-encapsulation and lipid-based matrices have been shown to improve the absorption and consequently the bioavailability and functional activity of Brahmi, which is a direct implication for the development of functional foods. Brahmi has been explored in different food products, such as herbal teas and beverages, dairy products like functional milk, ghee, and ice cream, bakery and cereal based products, and many traditional formulations like Chyawanprash (Fig. 4). These products are enhanced in their nutraceutical potential, phenolic content and antioxidant activity when Brahmi powder or extract is added [21].

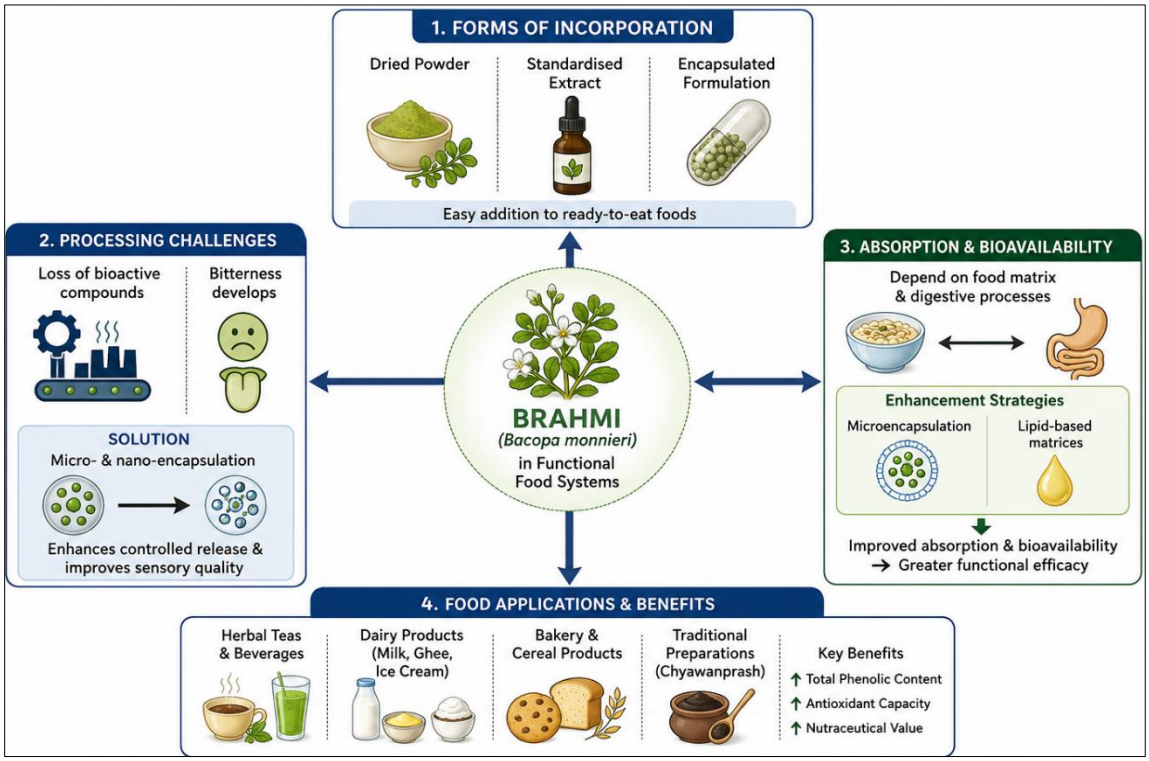

FIG. 4: DEVELOPMENT OF *BACOPA MONNIERI*-FORTIFIED FUNCTIONAL FOODS: FROM FORMULATION AND PROCESSING TO ENHANCED BIOAVAILABILITY AND HEALTH BENEFITS.

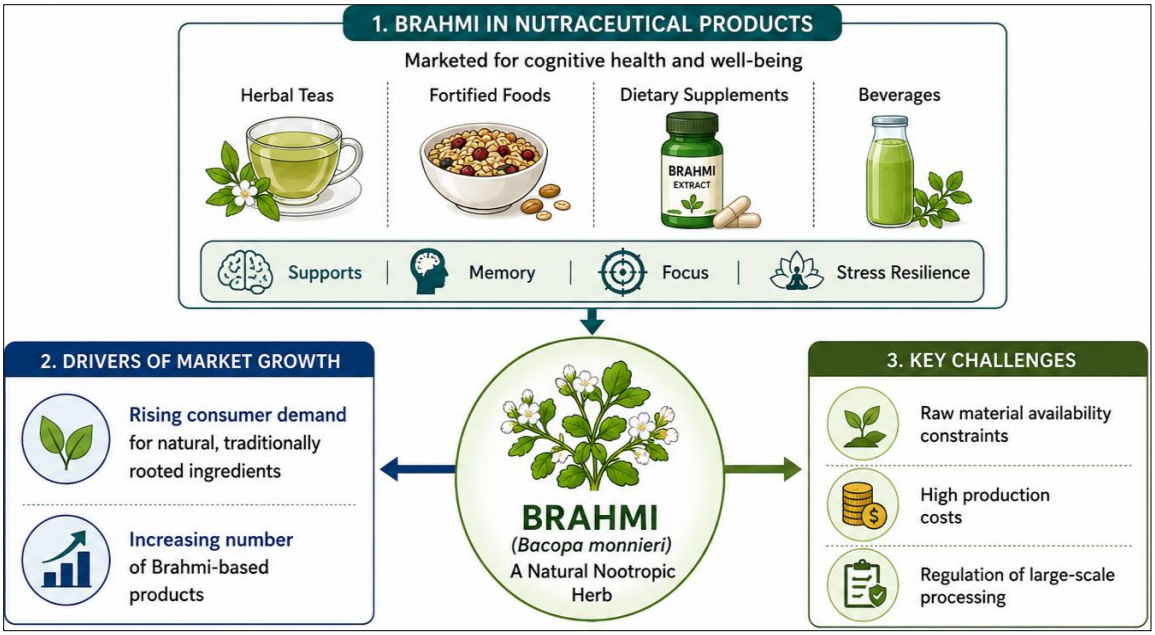

FIG. 5: MARKET LANDSCAPE OF *BACOPA MONNIERI*: PRODUCT APPLICATIONS, GROWTH DRIVERS, AND COMMERCIALIZATION BARRIERS IN THE NUTRACEUTICAL SECTOR.

5.1 Sensory and Technological Challenges

Although beneficial for the health, Brahmi is bitter and herbaceous in taste that may affect tastes and taste. Hence, methods including microencapsulation, flavour masking and optimization of dosage have to be adopted to achieve consumer acceptance while maintaining bioactivity [7].

6. Safety, Toxicology, and Regulatory Status

Due to the variability in the concentration of bacoside in the raw material as well as in the finished extracts, standardisation of both raw material and finished extract is very important to ensure functional efficacy [5]. Brahmi has been classified primarily as a dietary supplement or a herbal ingredient in

regulatory terms, and the health claims have to be aligned with the food-safety and food-labelling regulations governing these authorities like FSSAI, EFSA and FDA (Fig. 5).

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7. Commercial Applications and Market Potential

In recent times, Brahmi has been used in various nutraceutical products for cognitive health. It is used in herbal teas, fortified foods, dietary supplements and drinks, touted for their ability to improve memory, concentration, and stress resistance [1]. The rising popularity of Brahmi has led to a growing number of products featuring this ingredient. The demand for natural and traditionally used ingredients has fueled the growth of Brahmi-based products. However, raw material, production cost, and regulation issues with large scale processing still exist. These limitations are expected to be overcome by improved cultivation of Brahmi, development of standardised extracts and new food processing technologies, with a view to further expanding the Brahmi market.

8. Limitations, Research Gaps, and Future Perspectives

The nutraceutical effects of *Bacopa monnieri* are supported by a significant amount of evidence, however there are some gaps. Especially, its application in formulations of food has received relatively little attention and the literature is still relatively sparse. Furthermore, there is variability in the concentration of bioactive compounds in the extracts which makes it difficult to compare results from different studies. Research on standardised products, as well as on bioavailability, on safety of long-term consumption and on food technologies (microencapsulation, nanotechnology) in developing complex food products should be enhanced.

In the future, increased bioavailability of bacosides in foods, development of encapsulated and nano delivery systems, long-term human clinical trials of Brahmi enriched foods, optimisation of sensory quality and consumer acceptance research should be undertaken. These developments would validate the use of Brahmi as a scientifically backed functional-food ingredient.

CONCLUSION

Brahmi (*Bacopa monnieri*) is an abundant and sustainable source of functional phytochemicals (such as bacosides, alkaloids and phenolic compounds), with neuroprotective, antioxidant, anti-inflammatory and metabolic attributes. It is included in food systems that are similar to what is being demanded in the world as functional foods. With its multifunctional bioactive properties and the increasing body of scientific evidence, Brahmi is an attractive component in food products that are formulated for cognitive, metabolic and overall health. Brahmi has indeed great potential as a nutraceutical ingredient in modern food applications, provided it is formulated and standardized properly, and meets the regulatory standards.

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CONFLICT OF INTEREST: Nil

REFERENCES:

1. Gouthami NS, Jain SK, Jain NK, Wadhwan N, Agrawal C, Panwar NL. Exploring the nutraceutical effects of *Bacopa monnieri* in agriculture: Potential applications and benefits. Environ Ecol. 2023;41(4C):2947-2954.
2. Bishnoi S, Mudgil D. Current concepts and prospects of herbal nutraceuticals. In: Handbook of Nutraceuticals and Natural Products: Biological, Medicinal, and Nutritional Properties and Applications. Vol. 1. Hoboken (NJ): Wiley; 2022. p. 189-204.
3. Kapoor N, Jamwal VL, Shukla MR, Gandhi SG. The rise of nutraceuticals: Overview and future. In: Biotechnology Business: Concept to Delivery. Cham: Springer; 2020. p. 67-92.
4. Saloni, Rai DC, Panda P, Kumar S. A comprehensive review on *Bacopa monnieri* (L.) Pennell (Brahmi): Utilization as a functional food ingredient and health-promoting attributes. Ann Phytomed. 2022;11(1):142-150.
5. Aguiar S, Borowski T. Neuropharmacological review of the nootropic herb *Bacopa monnieri*. Rejuvenation Res. 2013;16(4):313-326. doi:10.1089/rej.2013.1431.
6. Singh HK, Dhawan BN. Neuropsychopharmacological effects of the Ayurvedic nootropic *Bacopa monnieri* Linn. (Brahmi). Indian J Pharmacol. 1997;29(5 Suppl):S359-S365.
7. Granato D, Barba FJ, Bursać Kovačević D, Lorenzo JM, Cruz AG. Putative health benefits of phenolic compounds in functional foods. Trends Food Sci Technol. 2020;99:461-473. doi:10.1016/j.tifs.2020.03.017.
8. Sharma P, Srivastava A, Shrivastava N. Breeding of *Bacopa monnieri* (Brahmi): Traditional to advanced approaches and future outlook. In: Biodiversity and Genetic Improvement of Medicinal and Aromatic Plants I. Cham: Springer; 2025. p. 1-22.
9. Sachdeva V, Roy A, Bharadvaja N. Current prospects of nutraceuticals: A review. Curr Pharm Biotechnol. 2020;21(10):884-896.
10. Riar CS, Panesar PS. Bioactive compounds and nutraceuticals: Classification, potential sources, and application status. In: Bioactive Compounds and Nutraceuticals from Dairy, Marine, and Nonconventional Sources. Oakville: Apple Academic Press; 2024. p. 3-60.
11. Rodríguez-Negrete EV, Morales-González Á, Madrigal-Santillán EO, Sánchez-Reyes K, Álvarez-González I, Madrigal-Bujaidar E. Phytochemicals and their usefulness in the maintenance of health. Plants (Basel). 2024;13(4):523. doi:10.3390/plants13040523.
12. Alzobaidi N, Quasimi H, Emad NA, Alhalmi A, Naqvi M. Bioactive compounds and traditional herbal medicine: Promising approaches for the treatment of dementia.

Degener Neurol Neuromuscul Dis. 2021;11:1-14. doi:10.2147/DNND.S299589.
13. Deepak M, Sangli GK, Arun PC, Amit A. Quantitative determination of the major saponin mixture bacoside A in *Bacopa monnieri* by HPLC. Phytochem Anal. 2005;16(1):24-29. doi:10.1002/pca.810.
14. Russo A, Borrelli F. *Bacopa monniera*, a reputed nootropic plant: An overview. Phytomedicine. 2005;12(4):305-317. doi:10.1016/j.phymed.2003.12.008.
15. Pandareesh MD, Anand T. Neuromodulatory and neuroprotective effects of *Bacopa monnieri* extract against oxidative stress. Neurochem Res. 2013;38:2296-2306. doi:10.1007/s11064-013-1144-9.
16. Agrawal M, Singhal M, Gupta R, Bhargava S, Bisht D, Arya RKK. Nutraceutical herbs in cardiovascular diseases. In: Herbals as Nutraceuticals. Oakville: Apple Academic Press; 2024. p. 109-146.
17. Bansal P, Maithani M, Gupta V, Kaur G, Bansal R. Future prospective of nutraceutical and functional food with herbs and spices. In: Herbs, Spices and Their Roles in Nutraceuticals and Functional Foods. London: Academic Press; 2023. p. 361-381.
18. Stough C, Lloyd J, Clarke J, Downey LA, Hutchison CW, Rodgers T. The chronic effects of an extract of *Bacopa monniera* (Brahmi) on cognitive function in healthy human subjects. Psychopharmacology (Berl). 2001;156(4):481-484. doi:10.1007/s002130100815.
19. Kongkeaw C, Dilokthornsakul P, Thanarangsarit P, Limpeanchob N, Scholfield CN. Meta-analysis of randomized controlled trials on cognitive effects of *Bacopa monnieri* extract. J Ethnopharmacol. 2014;151(1):528-535. doi:10.1016/j.jep.2013.11.008.
20. Sarkar R, Nayak SL, Suthar MK, Das M. Nutraceutical formulations from medicinal plants: A potential therapeutic agent. In: Ethnopharmacology and OMICS Advances in Medicinal Plants. Vol. 1. Uncovering Diversity and Ethnopharmacological Aspects. Cham: Springer; 2024. p. 391-417.
21. Sharma R, Rani P, Kumar V. Brahmi (*Bacopa monnieri*) as a functional food ingredient. J Pharmacogn Phytochem. 2018;7(3):1854-1858.
22. Pandey V, Maurya S, Pandey A, Parveen S. Herbal supplements and nutraceuticals. In: Herbal Pharmacy: From Traditional Remedies to Modern Applications. Cham: Springer; 2025. p. 81.
23. Karati D, Mukherjee S, Roy S. The antioxidant potential of bacoside and its derivatives in Alzheimer's disease: The molecular mechanistic paths and therapeutic prospects. Toxicol Rep. 2025;14:101945. doi:10.1016/j.toxrep.2025.101945.

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