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## Traditional value added products from Indian penny wort (*Centella asiatica*) and water hyssop (*Bacopa monnieri*) to alleviate ADHD

**Amaravathi T, PS Geetha, M Murugan, S Selvam and S Kanchana**

### Abstract

Attention deficit hyperactivity disorder (ADHD) is deteriorating mind related health problem slow down the children growth. The drugs are used for ADHD may be enhancing the health problem. Therefore, there is a huge require of ayurvedic based eatable foodstuff that are give some functional benefits. An ayurvedic plant such as brahmi (*Bacopa monnieri* and *Centella asiatica*) comes with many functional benefits. A Brahmi leaf is identified for improving mental related illness. The present research enlightens the importance of nutrition requirement in ADHD and value added products from brahmi and its goodness for ADHD affected children. The value added products such as nutri balls mix, pittu mix, health drink mix, cookies and soup mix has been prepared with using brahmi powder. Theses value added product improve the mental ability of affected ADHD children.

**Keywords:** Attention deficit hyperactivity disorder-Indian penny wort and water hyssop-traditional value added food products

### Introduction

The ayurvedic plants signify an affluent store up of organic composite, many of which have been used for medicinal use and could provide as guide for the progress of drugs. The presence of chemical constituents in the ayurvedic plants helps to cure various mental disorders. The ayurvedic plants have maximum potential for benefitting community, particularly those livilihood in nation with poverty and poor health. According to the World Health Organization (WHO) about eighty percent of the people living in rural areas are depend on ayurvedic and medicinal plants as prime source of health care system [1].

At the present time, consumers are ready to buy healthy natural foods. Undoubtedly ayurvedic based foods are the maximum store of all nutrients and it is accessible in our nation with reasonable price. But many people are selecting costly foods and medicines. We won't understand the valuable of ayurvedic plant foods around us.

Ayurveda" which is more than five thousand years older and it has a beneficial effect on nerve function (CNS) and increase the mental capability [2, 3, 4]. The bramhi (*C. asiatica*, *B.monnieri*) which contain large amount of secondary metabolites providing active compounds stimulating cell upgrading, enhance physical and mental health. Amongst the ayurvedic plant, brahmi leaf is one of the best example, which contains essential nutrients, antioxidants and phytochemical compounds the entire found in one leaf. Currently brahmi leaf has gained a lot importance, due to its manifold uses and benefits to ADHD (Attention Deficit Hyperactivity Disorder) and other health related issues. The brahmi can be eaten as a vegetable and the brahmi leaf powder can also be dried in cabinet dryer and keep for several months exclusive of refrigeration. The dried brahmi leaf make into powder form and it will be supplement with any dish, it helps to enhance the nutritional value of the foods.

The fundamental cause for life style disorders in the world is the change in food habit in both urban and rural communities, where traditional based food systems are going down and increasing towards a western type cereal based energy diets. Due to the accessibility of energy rich foods (Junk foods, sweet, chocolate and fried items) in the market, human beings are avoiding the functional foods. This show the way to numerous health issues and so as to overcome this is issue, there is a need for locally accessible foods that are nutritious, less cost and convenience to cook and also combating ADHD (Attention deficit hyperactivity disorder) and other health hazards.

Mental disorder is now foremost thing a cause of disability in childhood [5]. Attention deficit hyperactivity disorder (ADHD) is an unbearable mental confusion that slows down the children's growth [6]. It is among the commonest neurobehavioral disorder of childhood and can profoundly affect the academic performance, happiness and communal relationship of kids [7]. It is characterized by persistent symptoms of inattention, hyperactivity, and impulsivity [8]. It has a worldwide prevalence with an estimate of 6% [9] and is commonly identified in the age group of 2-7 years that is in preschool aged children [10].

### Brain Differences in ADHD

Change in the brain, particularly the anterior cingulum, the dorsolateral as well as ventrolateral prefrontal cortex, the orbito frontal cortex, the superior parietal regions, the caudate nucleus, the thalamus, the amygdala and the cerebellum [11]. Activity levels as well as capacity of volume are varied in brains with ADHD, but only MRI scans cannot consider as a tool for diagnosis for ADHD as there is still a lot to learn about the brain [12].

### Biochemistry of ADHD

The innovative study at Örebro University in Sweden conclude that kids with ADHD have less protein (50%), that is necessary for attention and learning. Brain to be capable to generate the substance need to send signals; it is based on different amino acids. In situation with ADHD, the transportation of amino acid such as tyrosine and tryptophan, this amino acid is to produce the signal substances to dopamine, noradrenaline, and serotonin. The study reveals that the transportation of tryptophan is lower in kids with ADHD and brain generates less serotonin. Another study the biochemical changes in bipolar disorder, as there are parallels between ADHD and bipolar disorder. In this condition, the transportation of tyrosine is decreased and reduced level of dopamine and noradrenaline [13].

The most fashionable area of the brain to focus in condition with ADHD is the pre frontal cortex and frontal lobes. This area of the brain connected with concentration, motivation, impulsiveness, emotional processing and executive functioning [14]. In a study by Castellanos a volume of three per cent small overall in ADHD brains, with the decrease in mostly white matter (the connectors of the neurons) [12].

### Nutrients and brain function

The brains compose a variety of chemical messengers, or neurotransmitters, to regulate wakefulness and sleep and others have revealed that protein triggers alertness-inducing neurotransmitters, whereas carbohydrates trigger drowsiness. Proteins influence the brain performance by provide adequate amount of amino acids from which neurotransmitters are made [15].

Two amino acids, tryptophan and tyrosine, are foremost building blocks of neurotransmitters. These amino acids influence the four top neurotransmitters — serotonin (tryptophan) as well as dopamine, epinephrine, and norepinephrine (tyrosine).

Most two essential fatty acid for brain function are linoleic (or omega 6) and alpha linolenic (or omega 3) and these fatty acids mostly found in fish oil. These are the major structural components of brain cell membranes and vital part of the enzymes that permit cell membranes to transport nutrients in and out of cells. The development of the mental focus and

cognitive ability when they add more these fats in regular diet [16].

Protein rich breakfast and lunch is helpful for people with ADHD. A child psychologist said that the 500 child he evaluates for ADHD per year, less than 5 percent of the child are eating protein as per the recommended dietary allowance [15].

The study published in pediatrics in 2010, state that pesticides, particularly organophosphates, available in fruits and vegetables may be linked to ADHD. The increased levels of these compounds identified in a child's urine, the more likely he or she is to be diagnosed with ADHD [17]. Another study, published in the *Journal of Attention Disorders* in 2010, revealed that a western diet — processed meats, fast foods, high-fat dairy products, and sugary foods increase the risk of having an ADHD diagnosis, compared with a healthier diet [18].

### Nutrition affects the ADHD brain in three ways

1. Cells in the brain require appropriate nutrition to carry out their functions.
2. The myelin sheath, which covers the axons of brain cells, as insulation covers electrical wires, require the appropriate levels of nutrients to fasten the transmission of the electrical signals between brain cells.
3. Neurotransmitters — dopamine, serotonin, and norepinephrine need appropriate diet for proper functioning.

### ADHD and medhyarasayana

Drugs are used in ADHD are psycho stimulants, tricyclic antidepressants and tranquilizers. These drugs may be enhancing the possibility of heart related problem, liver injury and other health issue [19]. Today the need came to find out effective treatment without hampering the development of health and psychology of children. Therefore, there is a actual need of our natural medicine and several traditional based food products. In that case, the need for exploration of new foodstuff from naturally available source, this may enhance the cognition ability and earlier studies noticed that the ayurvedic plant such as *Bacopa monnieri* and *Centella asiatica* has potency to increase the mental function.

*Bacopa* comprises of 146 species of aquatic herbs distributed throughout the warmer regions of the world. Apart from India, Nepal, Sri Lanka, China, Taiwan and Vietnam, it is also found in Florida and other southern states of USA [20]. In India, it grows in damp, marshy places and on the banks of slow flowing rivers and lakes, ascending up to an attitude of 1,320 m. It is a small creeping, spreading, succulent plant with numerous branches and small fleshy, oblong leaves. Flowers and fruits appear in summer and the whole plant is medicinally important [21, 22].

It is a group of plant medicines known as *medhyarasayana* - that improve mental health, intellect and memory (medhya) and promote longevity and rejuvenation (rasayana) [23]. The sanskrit name brahmi stems from Brahma - the creative aspect of God and since the brain is seen as the creative centre of humans [21]. Compounds reported in this plant include; phenylethanoid glycosides, flavonoids, amino acids such as alpha-alanine, aspartic acid, glutamic acid, and betulinic acid, stigmasterol, b-sitosterol and stigmastenol [21, 24, 25].

*Centella asiatica L.* (Gotu Kola) is a tropical medicinal plant from India, Sri Lanka, China, Indonesia, Malaysia, South Africa and Madagascar [26]. It is a nerve tonic and this

m micronutrient in the extract is responsible for retarding brain aging and assist in renewal of neural tissue. Hence it is effective in enhance memory and revitalize the brain as well as increasing attention span and concentration [27, 28, 29]. Its potential antioxidant, antimicrobial, cytotoxic, neuroprotective, and other bioactive constituents, namely the triterpenic acid (asiatic acid madecassoside acid), triterpenic saponin (madecassoside and asiaticoside), flavonoids, and other phenolic compounds [30, 31, 32]. The asiaticoside is the most plentiful triterpene glycoside, it enhancing the antioxidant level in wound healing process [33]. Brahmic acid, isobrahmic acid, brahminoside, and brahmoside present in *C. asiatica* have shown some psychotropic, sedative, and anticonvulsant properties. It is also useful in dementia, mental disorders, and anxiety [34].

Attention Deficit Hyperactivity Disorder (ADHD) is a neuro-developmental disorder, particularly dopamine and nor epinephrine neurotransmitter which manage a different of cognitive process. These neurotransmitter hormones control the behavior, motivation and motor function. [35, 36].

As per the need of human being *bacopa* helps to maintain dopamine production. Steroidal saponine, (bacosides), the primary active principles in brahmi leaves. There are reference that bacosides have cognitive and nootropic effect by activation of the serotonergic and cholinergic systems and

improvement of synaptic plasticity and increase the metabolism of the neurotransmitters, thus enhancing the function of the brain [37]. Asiatic acid (AA) is a triterpene compound found in *Centella asiatica* that can defend against reduction of neurogenesis in the hippocampus and memory deficits induced by valproic acid (VPA) [38].

Human beings are looking for variety foods in their diet. It is the right time to develop nutritious and organoleptically acceptable products with locally available food sources. Development of ready to use and ready to cook foods using brahmi leaves will be a most suitable way to bring dietary improvement of the community and enhance the mental ability among ADHD affected children. The brahmi leaves based foods should be in the form of convenience foods to meet the requirements of ADHD. Advertising a brahmi leaf powder incorporated foods will help not only for alleviating ADHD but also development of functional foods using brahmi leaves helps to treat many health issues. With this above reason, the present study was intense to exploit the beneficial uses of brahmi leaves powder with the developing and standardizing new innovative traditional value added products using brahmi leaves powder by applying new technologies. Figure.1 Illustrates the health benefits of the brahmi.

<b>Brahmi</b>	
<i>Bacopa monnieri</i>	<i>Centella Asiatica</i>
<p><b>Biological properties in brain</b></p> <ul style="list-style-type: none"> <li>• Antioxidant and mitochondrial protection</li> <li>• Increased gene expression and enzyme activities</li> <li>• Protection against cellular stress</li> <li>• Metal chelation</li> <li>• Inhibits A Che activity</li> <li>• Protection against neurotoxicity</li> <li>• Modulation of LTP pathway</li> <li>• Down regulation of NMDA and glutamate receptors</li> <li>• Regulation of neurotransmitter levels</li> <li>• Regulation of serotonin receptors</li> </ul> <p><b>Other benefits</b></p> <ul style="list-style-type: none"> <li>• Hepatoprotective</li> <li>• Anti-inflammatory</li> <li>• Anti-ulcerogenic</li> <li>• Anticancer</li> <li>• Vasodilation /bronchodilation</li> <li>• Anti-epileptic</li> <li>• Cardiovascular effects</li> <li>• Enhances T4 in hypothyroidism</li> </ul>	<p><b>Biological properties in brain</b></p> <ul style="list-style-type: none"> <li>• Antioxidant and mitochondrial protection</li> <li>• Improved activities of antioxidant enzyme</li> <li>• Anxiolytic</li> <li>• Protection against neurotoxicity</li> <li>• Improves neuronal morphology</li> <li>• Inhibits phospholipases</li> <li>• Stimulates neuronal proliferation</li> </ul> <p><b>Other benefits</b></p> <ul style="list-style-type: none"> <li>• Anticancer</li> <li>• Anti-genotoxic</li> <li>• Prevents gastric mucosal lesions</li> <li>• Anti-ulcerogenic</li> <li>• Epithelial cell proliferation</li> <li>• Angiogenesis</li> <li>• Immunological activity</li> </ul>

Fig 1: Health benefits of brahmi

**Methods and Methodology**

**Processing of brahmi leaf**

**Selection of green leaves**

Fresh, green vallarai and nir brahmi leaves were separated from the thin branches. The good quality of leaves were chosen by discarding the discolored, decayed and wilted leaves since the decayed and wilted leaves gives a bad flavor.

**Washing of leaves**

The selected leaves were washed thoroughly with plenty of water to remove all the adhere dust and dirt particles. After washing, the leaves were drained out from the water. The residual moisture was evaporated at a room temperature (32 °C, 2-3 hours), by scattering the leaves on the filter paper with regular turning over to avoid the fungal growth.

After removing the residual moisture from the leaves, to arrive superior quality of dried leaves, the leaves were blanched for 3 minutes. The brahmi leaf chosen for steam blanching were scatter uniformly on perforated idly pans consist of two to three liters of boiling water. The brahmi leaf was steam blanched for 2 to 3 minutes to inactivate the enzymes before drying.

The main benefits of blanching was it assist to kill the dangerous micro organisms both on the leaf surface and within the leaf, cell walls become softer and fasten the drying process, and also this method deactivate the plant enzymes mainly lipoxidases, that can ruin the flavour and the nutritional quality of the leaves. Blanching help out to store the dried leaf powder for numerous months.

The blanched leaves were loaded on the trays forming one single layer and were dried in the dehydrator by force air technique. The cabinet dryer was preheated to 60 °C and then the loaded trays with leaves were kept in an oven. The temperature was maintained at 60 °C for 6- 7 hours. The research study revealed that the drying of leaves at 60 °C temperature to get a first grade of dried leaves [39, 40].

### Sprouting of grains

Generally cleaned grains have standard moisture level is twelve per cent. Rinse the grain in the water, the moisture level of the grain was elevated to an average of 45 per cent. After steeping phase the water was drained and the grain has been died with muslin cloth around the aerobic environment

for 1 to 3 days. The sprouting days are based on grains and the total time required for sprouting was minimum 2 days and maximum 4 days. Sprouting process is complete when grain starting to show the rootlets. Following the completion of sprouted grains was dried in cabinet dryer for 10 to 12 hours until a grain moisture content reach 5 per cent. After drying process, the grain has been heated and cured to give colour and flovour character. After drying process, the rootlets and loose husk were removed.

Sprouting is a simple, cheapest process with no equipment, low processing methods and no additives. Sprouting helps to improve the nutrient composition (Vitamin B and C), increase the bioavailability of nutrients, decrease the anti nutritional factors (phytic acid, pentosan and tannin) and finally enhance the sensory characteristics of the food product.

### Processing of brahmi leaf powder incorporated value added products

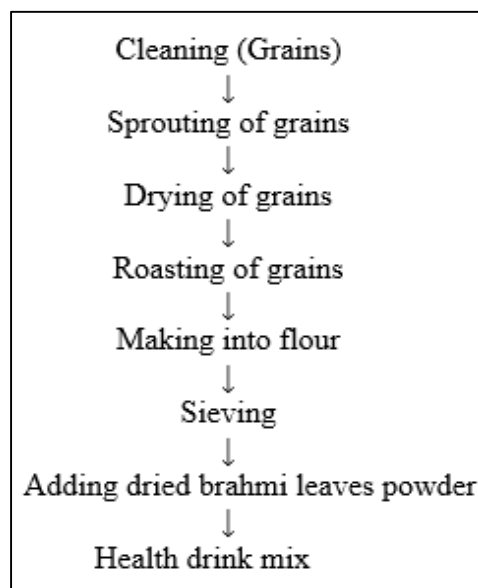
The dried brahmi leaf powder was incorporated at different levels (1, 2, 3, 4 and 5, 6, % with 1:1 of *Bacopa monnieri* and *Centella asiatica*).

### Health drink mix

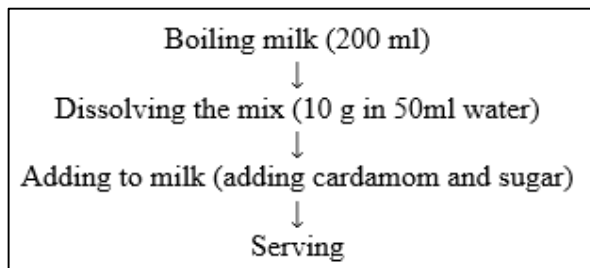
Health drink mix was prepared with hot milk or water or used as porridge. This drink mix was standardized with the incorporation of three, four and five per cent brahmi leaf powder. The ingredients and preparation of health drink were given in Table 1, Fig.2 and Plate 1.

**Table 1:** Ingredients used for health drink mix

Ingredients	C	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
Whole wheat flour (g)	50	50	50	50
Finger millet flour(g)	25	25	25	25
Green gram flour powder (g)	25	25	25	25
Vallarai and Nir brahmi powder (%)	-	3	4	5
Jaggery (g)	17	17	17	17
Milk (ml)	2000	2000	2000	2000
Water (ml)	500	500	500	500
Cardamom	2 pinch	2 pinch	2 pinch	2 pinch



Processing of health drink mix



Preparation of health drink

Fig 2: Processing and preparation of brahmi leaf based health drink mix Processing of health drink mix



Plate 1: Brahmi leaf powder based health drink mix

**Processing of brahmi leaf based puttu mix**

Brahmi leaf powder puttu mix was standardized by incorporating 4, 5 and 6 per cent (dried brahmi leaves powder

of 1:1 *Bacopa monnieri* and *Centella asiatica*). The detail of processing of puttu mix is given in Table.2 and Plate 2.

Table 2: Ingredients used for puttu mix

Ingredients	C	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
Whole wheat flour (g)	50	50	50	50
Finger millet flour(g)	40	40	40	40
Green gram flour powder (g)	10	10	10	10
Vallarai and nir brahmi powder (%)	-	4	5	6
Sugar (g)	30	30	30	30
Coconut (g)	30	30	30	30
Water	As required	As required	As required	As required
Salt	To taste	To taste	To taste	To taste
Cardamom	2 pinch	2 pinch	2 pinch	2 pinch



Plate 2: Brahmi based puttu mix

Raw rice was covered with water for one hour at room temperature. Deplete the water completely after soaking. The soaked raw rice was milled into flour at 60 mesh and sweltering the flour at 14 °C for three minutes. Puttu mix were prepared with sprouted wheat flour, sprouted ragi flour, sprouted green gram flour and raw rice flour by mixing systematically with inclusion of required amount of salt. The nir brahmi powders were added in puutu mix in the range of 4%, 5% and 6%. The puttu mix was tempered with water, adds ghee and mixed well and it was steamed for 15 to 20 minutes. The scrapped coconut, jaggery and cardamom powder were added in steamed puttu and mixed thoroughly.

**Preparation of nutri balls with incorporation of brahmi powder**

The nutri balls were tried with the 1, 2 and 3% incorporation of brahmi leaf powder. The details of processing of nutri balls were given in Table.3, Plate.3and Fig.3.

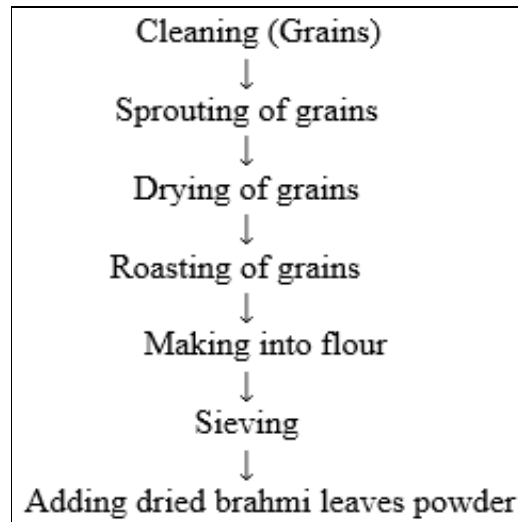
Table 3: Ingredients used for nutri ball mix

Ingredients	C	T <sub>1</sub>	T <sub>2</sub>
Wheat flour (g)	40	40	40
Finger millet flour (g)	20	20	20
Roasted bengal gram flour (g)	25	25	25
Green gram flour (g)	15	15	15
Nir brahmi and vallarai green leaf powder (%)	-	2	3



Plate 3: Brahmi based nutri balls

**Processing of nutri ball mix**



**Preparation of nutri balls**

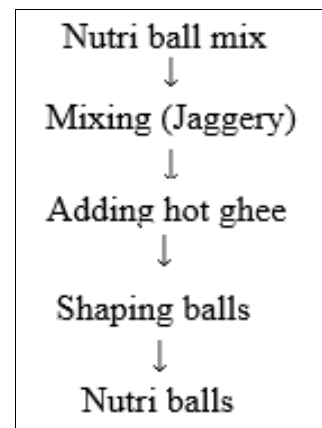


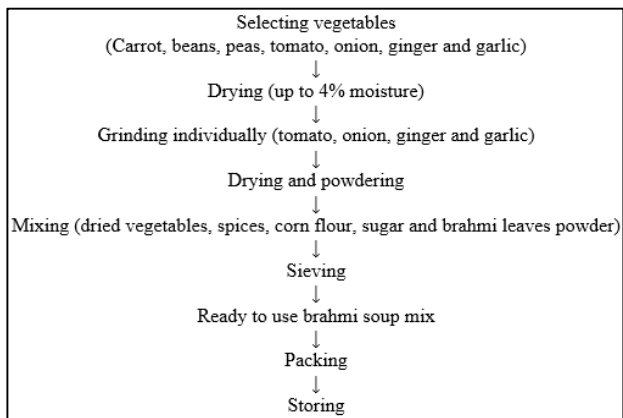
Fig 3: Preparation of nutri balls

**Brahmi based soup mix**

Brahmi leaf based soup powder was prepared by mixing with carrot powder, beans powder, tomato powder, onion powder, peas, ginger garlic powder with other ingredients (corn flour, salt, citric acid, pepper powder, sugar). The prepared soup powders were then packed for sensory evaluation. The ingredients used for soup mix listed in Table 4, Figure 4 and Plate 4.

Table 4: Brahmi leaf powder incorporated soup mix

Ingredients	C	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
Dried carrot (g)	15	15	15	15
Dried Beans (g)	11	10	10	10
Dried Peas (g)	11	10	10	10
Tomato powder (g)	11	10	10	10
Onion powder (g)	11	10	10	10
Ginger and garlic paste (g)	10	10	10	10
Pepper powder (g)	5	5	5	5
Corn flour (g)	8	8	8	8
Citric acid (g)	2	2	2	2
Salt (g)	3.5	3.5	3.5	3.5
Sugar (g)	1.5	1.5	1.5	1.5
Dried brahmi leaf powder (%)	-	4	5	6



**Fig 4:** Processing of ready to use brahmi leaf powder incorporated soup mix



**Plate 4:** Brahmi soup mix

**Preparation of soup**

Twenty five gram of soup mix was soaked in 450 ml of water. Boil the water upto 5 to 8 minute. After 8 minutes the required amount of corn flour soaked in little water and poured in boiling water containing soup mix.

**Brahmi powder incorporated cookies**

The dehydrated brahmi leaf powder (1:1 of *Bacopa monnieri* and *Centella asiatica*) was incorporated into the refined wheat flour in 2 and 3 per cent respectively. The ingredient levels for brahmi leaf powder incorporated cookies are presented in Table 5 and Plate 5

**Table 5:** Ingredients used for cookies

Ingredients	C	T <sub>1</sub>	T <sub>2</sub>
Wheat flour (g)	50	40	40
Finger millet flour (g)	50	20	20
Powdered sugar (g)	50	25	25
Vanaspathi (g)	50	15	15
Baking powder	0.5	0.5	0.5
Vannila essence	Few drops	Few drops	Few drops
Milk powder (g)	5	5	5
Water	10-15 ml	10-15 ml	10-15 ml
Nir brahmi and vallarai green leaves powder (%)	-	2	3



**Plate 5:** Brahmi powder incorporated cookies

The required quantities of ingredients such as refined wheat flour, ragi flour, baking powder, skim milk powder were mixed in the brahmi leaf powder. The treatment and control flour sieved twice for thorough mixing. Fat and sugar were creamed together and refined wheat flour and other ingredients was added and kneaded. The dough was spread uniformly and cut into desired shape and size. The cut pieces were placed on the greased aluminum tray. The cookies were baked at 180 °C for 17 min in an electrical oven. The baked cookies were cooled and packed for further analysis.

**Result and Discussion**

**Table 6:** Nutrient content of brahmi (*Bacopa monnieri* and *Centella asiatica*)

Particulars	<i>Bacopa Monnieri</i>	<i>Centella Asiatica</i>
Moisture content (%)	85.16	83.13
Vitamin C (mg)	63	114
Total anti-oxidant activity (%)	85.58	83.74
β-carotene (mg)	24.62	28.95
Protein (g)	2.1	4.76
Iron (mg)	7.8	19.56
Carbohydrate (g)	5.9	4.24
Ash (g)	1.9	6.41
Calcium (mg)	202	425

Nutrient content of the brahmi leaves is described in Table. 6. Herbs *Bacopa monnieri* (Neer brahmi) and *Centella asiatica* (Vallarai) are proved very powerful to direct inattention, hyperactivity and impulsivity and other (CNS) central nervous system related diseases. Therefore, there is a demand for new food products that could aim to recover the mental capabilities. In this study, the dehydrated brahmi leaf powder was incorporated at different levels (1, 2, 3, 4,5 and 6% with 1:1 of *Bacopa monnieri* and *Centella asiatica*) in health drink mix, puttu mix, soup mix, cookies and nutri balls with the intend to enhance the functional properties of selected food products. The standardized products were sensory evaluated by 15 trained judges.

The health drink was given for sensory evaluation to 15 trained judges by using 9 hedonic scales (Table 7). The sensory attributes revealed that the T<sub>2</sub> (5% incorporation of brahmi leaf powder) secured maximum score in overall acceptability. The similar study conducted by Manjula state that the Indian penny wort leaf has a numerous health benefits and increase the mental ability, Indian penny wort incorporated health mix has potency to fighting the deficiency and new innovation in food material. Functional health mix was greatly acceptable by the public [41].

**Table 7:** Sensory evaluations of health drink mix

Particulars	C (%)	T <sub>1</sub> (%)	T <sub>2</sub> (%)	T <sub>3</sub> (%)
Appearance	82	79	77	70
Flavour	79	78	77	74
Consistency	82	79	78	75
Taste	82	80	80	73
Overall acceptability	80	80	81	73

Herbal rice drinks from churna powder (tree of *Teminalia Arjuna* or *Ficus Religiosa*- locally known as Asaralimara), old red rice, cow milk, jaggery or sugar. The herbal rice drink is advised to drink an empty stomach and it's used to cure the lung related problems [42].

The prepared brahmi leaf powder incorporated puttu was given to 15 trained judges for organoleptic evaluation by using 9 point hedonic scale (Table 8). The organoleptic evaluation revealed that the control has secured 81% followed by T<sub>1</sub> has secured 80% (four per cent brahmi leaf powder incorporated puttu mix). The T<sub>1</sub> puttu mix has been taken to assess the shelf life. The research revealed that the *Tribulus terrestris* (TT) is a medicinal herb by Ayurvedic seers. The developed puttu mix was up to the standards with inclusion of 10 g of *Tribulus terrestris* fruit powder [43].

**Table 8:** Sensory evaluation of puttu mix

Particulars	C (%)	T <sub>1</sub> (%)	T <sub>2</sub> (%)	T <sub>3</sub> (%)
Appearance	81	79	75	75
Flavour	81	80	78	76
Consistency	81	81	76	75
Taste	80	79	78	70
Overall acceptability	81	80	75	70

The nutri balls were prepared and it was organoleptically evaluated with 15 trained judges by using 9 point hedonic scale (Table 9). From the scores of sensory characters the nutri balls prepared with two per cent incorporation of brahmi powder in nutri ball was highly accepted. The study

**Table 11:** Sensory evaluation brahmi incorporated cookies

Particulars	C (%)	T <sub>1</sub> (%)	T <sub>2</sub> (%)
Appearance	83	79	70
Flavour	83	78	70.7
Texture	83	79	74.6
Taste	81.5	80.7	67.7
Overall acceptability	83.8	80	67.7

The cookies was evaluated by a panel of 15 trained judges using a nine point hedonic rating scale (Table 11). Results of the sensory evaluation revealed that the brahmi leaf powder incorporated cookies were fine in the formulations upto a level of 2 per cent. The related study states that the organoleptic investigation shows that the overall acceptability of the biscuit was scored 71.1 per cent [47].

**Conclusion**

In this study, the results illustrate that consuming of brahmi leaves incorporated food products (nutri balls mix, puttu mix, health drink mix, cookies and soup mix) is good for health. Fresh Leaves with minimal processing can be feed to children and provide as a good tonic and improve the memory function. However it may be hard for children to consume, as they are bitter. In this condition, the present study clearly picture the development procedure of ayurvedic based food product which can be broadly accepted by the people of all

concluded that the herbal based nutraceutical food items were accepted by all the age groups mainly due its functional properties of the food items [44].

**Table 9:** Sensory evaluation for nutri ball mix

Particulars	C (%)	T <sub>1</sub> (%)	T <sub>2</sub> (%)
Appearance	82	79	73
Flavour	83	80	74
Consistency	80	77	72
Taste	84	78	73
Overall acceptability	85	80	75

The soup was organoleptically evaluated with 15 trained judges by using a 9 point hedonic scale (Table 10). The sensory score sheet showed that a control secured 85% followed by T<sub>1</sub> has secured 83%. Finally T<sub>1</sub> is selected for further analysis. The similar product developed by Chandramouli 2012 concluded that the soup powder was prepared from three green leaves namely *Moringa oleifera*, *Solanum trilobatum*, *Centella asiatica* and this soup mix was up to the standards [45].

**Table 10:** Sensory evaluation of soup mix

Particulars	C (%)	T <sub>1</sub> (%)	T <sub>2</sub> (%)	T <sub>3</sub> (%)
Appearance	85	81	75	72
Flavour	82	82	74	73
Consistency	82	80	75	73
Taste	80	80	68	66
Overall acceptability	85	83	70	67

The study state that the herbal soup mix from the tomato, beetroot, onion, garlic, carrot, cabbage, potato, corn, spices powder, herbal powder, brown sugar and table salt. Sensory attributes reveal that the color and flavor of the soup mix was like extremely and like very much and flavor of the soup mix is due to the garlic and herbal powder. The soup mix secured overall acceptability score was 9.5 [46].

age groups mainly due its health benefits. This could be a substitute for supplementing medical treatment in an easy way to defeat ADHD and other health related problems.

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