



## Combating attention deficit hyperactivity disorder with natural treatment

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Attention deficit hyperactivity disorder (ADHD) is a weakening mental health problem that hampers the child development. Both the hereditary and ecological elements are the primary causes behind the challenge and possibly will be different among persons. The drugs are used for ADHD may be enhancing the health problem. Therefore, huge requirement of ayurvedic based foodstuff is anticipated among the end users that are expected to be healthy as well as afford additional functional benefits. An ayurvedic plant such as brahmi (*Bacopamonnieri* and *Centellaasiatica*) is reported to have much useful functional benefits. Brahmi is well-known to harness reminiscence, perception, being sensible and further mental disorderliness. The present review enlightens the functional properties of brahmi for children with ADHD, including intervention programme.

**Keywords:** ADHD, Ayurvedic plant, Health benefits, Intervention programme

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Mental disorder is now foremost thing a cause of disability in childhood<sup>1</sup>. Attention deficit hyperactivity disorder (ADHD) is an unbearable mental confusion that slows down the children's growth<sup>2</sup>. It is among the commonest childhood stage neurobehavioral disorderliness and is known to intensely impact the scholastic performance, happiness and communal relationship of kids<sup>3</sup>. ADHD portray by persistent sign such as inattention, hyperactivity and impulsivity<sup>4</sup>. It has a universal occurrence with an estimated 6% incidence<sup>5</sup> and is commonly identified in the age group of 2-7 years that is in preschool aged children.<sup>6</sup>

As stated by World Health Organization (WHO), a cerebral disarray are to amplify by 50% in the year of two thousand and twenty, is the fore most finding root of morbidity in kids. The kids represent on 40% in India and the rate of psychopathology amid childhood is 5 to 15%. A recent analysis estimated that the global cumulative impact of mental disorder in terms of economic output will amount to US\$ 1600 billion over next 20 year.<sup>7</sup>

Numerous research have stated greatly variable rates of ADHD around the world, starting from as low as 1% to as high as almost 20% among school

children<sup>8,9</sup> and its noticeable in the ages of 6 and 12 years<sup>10</sup>. The occurrence rate of ADHD in United State of America is 4 to 8%<sup>11</sup>, In Korea it is noticed to be 7.6% to 9.5%<sup>12</sup> and 10 to 20% in India<sup>13</sup> and 1 to 17.7% in India<sup>14</sup>. The issue of ADHD disorder is a major threat among primary school children<sup>15</sup>, but continues into adulthood too<sup>16</sup>.

The occurrence of ADHD between boys and girls differ around the world and the ratio ranged from 2:1 to 6:1. The majority studies noticed that boys are more affected with ADHD than the girls<sup>17</sup>. In favor of above findings, USA reported a 3.62% of boys and 0.85% of girls faced ADHD out of 10,438 children who were assessed for the study<sup>18</sup>. A similar finding noticed in Colombia too, reported the occurrence in boys (19.8%) than girls (12.3%)<sup>19</sup>. The gender disparity in ADHD are more, this may be because of the girls with neurobehavioral disorder are undiagnosed<sup>20,21</sup>.

The hereditary and the atmospheric surrounding are fore most position in etiology of ADHD and earlier research findings revealed about ADHD amongst identical twins (8%), fraternal twins (32%) and first-degree relatives (25%). Environmental consequence such as maternal stress and smoking habit among family members during pregnancy, poor quality early care giving, prenatal complications and prematurity also plays a leading part.

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The dimension of the brain construction for ADHD affected pupil is reduced roughly 5 to 10% and magnetic resonance imaging screened reduced blood level in striatum and shortage in functional networks<sup>22</sup>. The ADHD prime uniqueness are lack of concentration, tendency to act on a whim and restless and these personality will lead to lack of communal bond, acquisition of knowledge in the school and disturb other person as well<sup>23</sup>. The secondary personalities are difficulty to create bond with the peer group. In that case, this kind of personality kids may keep away from peer group and communal pupil<sup>24,25</sup>.

The synthetic food additive, colours and chemical (salicylates) will enhance the restlessness<sup>26,27</sup> and these findings tested by Stevens<sup>28</sup>. Appropriate diet is needed for kids and kids like to eat more of junk food and they face hyperactivity, this may reflect a long-term nutritional imbalance<sup>29</sup>. Thus, advice to parents to polished grains, only energy rich foodstuff, sweets and preserved foodstuff, synthetic additives and colours must be avoided entirely from the foodstuff.

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<sup>30</sup>. Today the need came to find out effective treatment without hampering the development of health and psychology of children. Therefore, 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 may enhance the cognition ability and earlier studies noticed that the ayurvedic plant such as *Bacopamonnieri* (BA) and *Centellaasiaticica* (CA) has potency to increase the mental function.

#### Health benefits of ayurvedic plants

Ayurveda, which is more than 5 thousand years older and it has a beneficial effect on nerve function (CNS) and increase the mental capability<sup>31,32,33</sup>. Nootropic plants are used to increase mental function, example of ayurvedic plant with nootropic activity such as *Ginkgo biloba*, *B. monnieri*, *C. asiatica*, *Withaniasomnifera* and *Convolvulus Pluricaulis*. The brahmi (*C. asiatica*, *B. monnieri*) which contain large amount of secondary metabolites providing active compounds stimulating cell upgrading, enhance physical and mental health. Both plants (*Bacopamonnieri* and *Centellaasiatica*) possess neuroprotective properties, neurotropic action with beneficial application<sup>33</sup>.

#### *Bacopamonnieri*

*Bacopa* called brahmi includes 46 species, water in habitat and are found in hot zone of the globe including India, Nepal, Sri Lanka, China, Taiwan and Vietnam and parts of USA<sup>34</sup>. In India, it is found in soggy, muddy spot and grows well on the banks of unhurried flowing rivers and lakes upto an altitude of 1,320 m. It is a small climber, fastly spreads and have succulent parts and has abundant branches and small fleshy, oblong leaves. Flowers and fruits appear in summer and the entire plant is medicinally important<sup>35,36</sup>.

The group of plant therapeutic called *medhyarasayana* are well-known to boost mental health, intellect and memory (medhya) and are believed to prop up longevity and rejuvenation (rasayana)<sup>37</sup>. The brain, being the creative centre of humans<sup>35</sup> is expected to be influenced by the brahmi as sanskrit name brahmi stems from Brahma-the creative aspect of God. *B. monnieri* is recognized for use over centuries as a brain tonic, memory enhancer, revitalize sensory organs. It is also further used as a medicine in anti-anxiety, as a cardio-tonic, diuretic, antidepressant and anticonvulsant agent<sup>36</sup>. It is very effectively used as an anti-inflammatory, analgesic, antipyretic, epilepsy, anticancer therapeutics and is a good antioxidant<sup>38,39</sup>. Skin ailments such as eczema, psoriasis, abscess, ulcerations and leprosy are treated with the products made out of *Bacopa* in India and Pakistan. Further, it is also useful in treatment of chronic rheumatism as an ointment and to treat asthma and hoarseness in voice<sup>40</sup>.

The *Bacopa* has a high moisture content (88%), carbohydrate (5.9%), fat (0.6%) and protein (2.1%). Plant secondary metabolites such as phenylethanoid glycosides, flavonoids, amino acids such as alpha-alanine, aspartic acid, glutamic acid and betulinic acid, stigmasterol, b-sitosterol and stigmastrenol are registered in these plants<sup>41,42,35</sup>.

The bioactive composites (bacoside A&B) and amino acids in these ayurvedic are increase the protein kinase action to produce protein and these protein may repair the damaged neurons<sup>43,44,45</sup>. The numerous study noticed that two main saponin (Bacoside A&B) enhance the learning ability in rats<sup>46,44,47,36</sup>. In adding up, bacoside A fraction is more faster than the bacoside B fraction<sup>48</sup> and it plays foremost position to increase positive effect on mental function<sup>49</sup> and this bioactive compound have antidepressant property as well<sup>50</sup>.

Various study revealed that the presence of different tetra cyclic triterpenoid saponin is accelerating the cognition activity<sup>51,52</sup>. Numerous studies concluded that the bacosides are reported as a scavenger of free radicals<sup>53,54,55,56</sup>.

The defensive reactions of the *Bacopa* plant extort on brain mitochondrial enzyme action in rats were well documented in previous studies<sup>57</sup>. The reaction of *B. monnieri* extort on the cognition performance while ageing was well documented<sup>58,59</sup> and has a task in ayurvedic therapies for treating cognitive disorderliness during aging<sup>60</sup>. Studies on animal version has depicted their role in escalating memory competence and be with neuroprotectant action against Alzheimer's disease<sup>61,62</sup>. *Bacopamonnieri* extract in the quantity of 300 mg/day for 6 weeks of administration on a group of people, the experiment exposed that the increasing technical evidence supporting the cognitive improvement effects<sup>63</sup>. In a study to treat aluminium induced oxidative stress, the neuro protective reaction of the *B. monnieri* in the hippocampus part of rat brain well evidently documented<sup>64</sup>. The extracts of *B. monnieri* give relief to patients affected with anxiety or epileptic disorders<sup>65,66,67,68</sup>. Epilepsy and hysteria is treated with medicated ghee from *B. monnieri*<sup>69</sup>.

Sentence repetition and logical reminiscence were found to be dramatically improved in children who took *Bacopa*<sup>70</sup>. In yet another study use of *Bacopa* on children for 42 days, was exposed to boost the mean auditory and visualnotably.<sup>71</sup>

#### *Centella Asiatica*

*Centellaasiatica* L. (Gotu Kola) is a tropical medicinal plant and grows in India, China, Indonesia, Malaysia, Sri Lanka South Africa and Madagascar<sup>72</sup>. It is a nerve tonic and micronutrient in the plant extort was found to be accountable to retard brain aging and also assisted replenishment of neural tissue. Thus was believed to boost reminiscence and invigoratethe brain as well beyond increasing the attention span and concentration<sup>73</sup>. As an ayurvedic agent was used for curing skin related troubles, laceration and rejuvenating the brain function<sup>74,75</sup>.

*C. asiatica* has a wider health benefits and therefore, its use in food processing is found increasing over the years. It is registered in medicinal use as a potential antioxidant, known for antimicrobial, cytotoxic, neuroprotective properties as well and other activities too. It possesses bioactive constituents viz., triterpenic acid (asiatic acid

madecassoside acid), triterpenic saponin (madecassoside and asiaticoside), flavonoids and further phenolic compounds<sup>76,77,78</sup>. The asiaticoside is the most plentiful triterpene glycoside, which, it enhance the antioxidant level in wound healing process<sup>79</sup>.

*Centella* contains nearly eighty eight per cent of moisture, three hundred and ninety one milligram of potassium and one hundred and seventy one milligram of calcium (low in protein, carbohydrate and fat content). The brahmnic acid, isobrahmic acid, brahminoside, and brahmoside present in *C. asiatica* have shown some psychotropic, sedative and anticonvulsant factors. It is useful to treat dementia, brain associated disorderliness and anxiety<sup>80</sup>.

*C. asiatica* has been found to be efficient in opposition to diabetes mellitus<sup>81</sup>, depression<sup>82</sup>, wound-healing activity, antibacterial activity<sup>83</sup>, neuroprotective activity<sup>84</sup>. The intake of *C. asiatica* is useful to prevent oxidative damage. As a powerful antioxidant, it used as an important neuroprotective effect and provide protection to the rat's brain for age-related oxidative damage<sup>85,86,87</sup>. The components in the ayurvedicis useful for enhancing renovate of injured neurons through hasten nerve regeneration<sup>84,88</sup>. Asiaticoside and brahmoside are found to hold anxiolytic activity through inhibition of phospholipase action in rat cerebellum<sup>89</sup>.

The median lethal dose of dried powder of *C. asiatica*, given as an oral dose to mice, was found to be higher than 8 g/kg<sup>90</sup>. Further, Wistar rats (both sex) that received different doses of *C. asiatica* at 20, 200, 600 and 1200 mg/kg/day for six months, let out no symptoms of important changes of body mass and blood analysis in comparison to control group<sup>91</sup>.

#### Measure of medhyarasayana

*Bacopa* can be taken in the form of non-standardized powder (5-10 g), mixture (8-16 mL), and syrup (30 mL) in each day<sup>92</sup>. Dosages of a 1:2 solution extort are in the range of 5-12 mL/day for adults whereas it was 2.5-6 mL/ day for kids ages 6-12<sup>93</sup>. A *Bacopa* syrup preparation, equal to 1 g dehydrated *Bacopa* leaf at the daily basis for 3 months among 40 children in the ages of 6-8 years, showed strengthening, reminiscence perception and response performance and no side effects were reported<sup>94</sup>. Fifty four people (65 years) administrated 300 mg of *Bacopamonnieri* extract for twelve weeks and none of the participants had any sign of dementia or severe memory loss<sup>95</sup>. A an additional study, researchers gave participants aged 55 and above (person with

memory loss) 125 mg/day of *Bacopamonnieri* extract for 12 weeks, noticeably better mental control, logical memory function, and paired association learning<sup>96</sup>.

A usual each day quantity of *C. asiatica* approximately at 600 mg of dehydrated leaf or mixture, single-dose tablet, a 10-mg strong extort accessible in the form of tablet was found very effective<sup>97</sup>. Dehydrated leaves as a tea, by addition of 5-10 g in bubbling hot water (150 mL) and allowed to sheer for 15 min and 3 cups /day was advisable. The systemized *Centella* extort have up to 100% total saponins (triterpenoids), 60 mg of extort 1 or 2/day, are regularly utilized in recent herbaceous medication. A few side effects such as skin allergy and burning sensations (with external use), headache, stomach upset, nausea, dizziness and drowsiness were reported, however, for a recommended dose no known toxicity was found<sup>98,99</sup>.

#### ADHD interventions

ADHD is more occurrences in primary school going children and it's throughout the lifelong problems. This is the right time to give intervention programme to ADHD affected children. Teacher should know more about the ADHD than their parents, as they intermingle with kids for a more time than parent<sup>100</sup>.

The educational intervention is to promote normal behavior and plan to enhance the school performance through improvement in education, concentration power, memory and behavior. The foremost thing of school intervention is to increase positive education outcome<sup>100</sup>. To strong the above evidence, educational intervention are effective to increase mental function amid children<sup>101</sup>. It is not control the behavior but improving habits and day to day activities which enhance the leaning power<sup>24</sup>. Moreover the intervention is based on atmosphere surroundings and mental ability to learn<sup>102</sup>.

ADHD is often treated with clinical interventions and behavioural interventions. Treatments for kids with ADHD may harmfully impact upon both communal and education performance<sup>103</sup>. The study argued that drug again and again, only helps aggravate 'symptoms', but do not help the youngster to task efficiently in academic level and it will lead to severe side effects with drug<sup>104</sup>. Thus, educational interventions consider as more desirable and effective strategies to treat ADHD disorder affected children<sup>105</sup>.

ADHD in India, limited awareness is reported in the survey<sup>13,106</sup>. According to Wilcox, much families

with ADHD either unknowing of the situation or unsure of the suffering itself<sup>107</sup>. A tiny concordance amid parents and teachers in acknowledgement ADHD may be a major reason behind these scenarios. A need is therefore to augment much research on ADHD in India<sup>108</sup>.

#### Discussion

Studies on different clinical and experimental trial reported that the ayurvedic plant has properties of nootropic, cognition enhancing, learning and neuroprotective properties. *Bacopa* posses the most enhancing capabilities to improve the mental ability, induce cognition function and positively modify behavior by increased level of serotonin and other neurotransmitters. *Centella* has property of increasing the learning capacity by induce dendritic arborization in amygdaloidal nucleus. There is positive result in clinical and experimental about *bacopa* and *centella* on ADHD. However, it's a natural product, the challenge is to describe the mechanisms and paths intricate in the nootropic and retention improving roles stimulus by brahmi. The specific compounds from BM and CA such as bacosides, asiaticoside and asiatic acid are the revitalizing properties. In the field of the therapeutics, has been a continuous discrepancy amongst scientists using clean composites and persons using natural extracts. Hence, the upcoming of investigation in brahmi will be focus to molecular investigation of the properties of different composites vs natural extracts in interpolation bio assay effects and its health benefits.

#### Conclusion

Ayurvedic plant could deliver a flawless response to ADHD affected kids with harmless to health. *Bacopamonniera* Linn. (*Brahmi*) & *Centellaasiatica* Linn. (*Mandookparni*) is evidenced to control inattention and hyperactivity and thus pave way to further research to set up in a scientific manner.

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