

## Autism-Heavy Metal Toxicity and Herbal Remedies: A Review

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**Abstract:** *Autism is a developmental disorder that appears in the first 3 years of life, and affects the brain's normal development of social and communication skills. Many researches are supportive of the fact that toxic metals increase the symptoms of autism, PDD and ADHD. Current research ascertains the presence of increased levels of toxic metals such as lead, mercury, thallium, tin and tungsten in the blood and urine of autistic children as compared to other children. These toxic metals can impair brain development and function, and also interfere with the normal functioning of other body organs and systems. Quite a few herbs have been used to treat neurological disorders through the ages. Several herbs appear to have antioxidant, antiseptic, antiviral, antifungal, or antibiotic properties. They include- Brahmi, Gotu kola leaf, Calamus root, Aloe vera, Ashwagandha, Black cohosh, Chamomile, Damiana, Gingko, Sarsaparilla and many more. The purpose of this study was to review the available literature of heavy metal toxicity and herbal remedies for autistic spectrum and attention deficit hyperactivity disorder (ADHD).*

**Keywords:** Autism, PDD, ADHD, Neurological disorder, Heavy metal toxicity, Herbal Remedies.

### Introduction

Autism is a frightening word to parents. Autism is a developmental disorder that appears in the first 3 years of life, and affects the brain's normal development of social, and communication skills (Medline Plus Medical Encyclopedia). India is home to about 10 million people with autism and the disability has shown an increase over the last few years. According to statistics by the Centers for Disease Control and Prevention (CDC), one in every 88 children today are born with autism spectrum disorder (ASD) against a ratio of one in 110 few years back (Aakriti Uttam, 2012). Decades of research have shown that males are at far greater risk for neurodevelopmental disorders such as autism spectrum disorder (ASD) than females. Boys, on average, are five times more likely to have autism than girls (Carl Engelking, 2014).

Researchers have found significantly higher levels of toxic metals in children with autism, compared to typical children. Many researches are supportive of the fact that toxic metals increase the symptoms of autism, PDD and ADHD.

Toxic metals are a group of minerals that have no known function in the body. Toxic metals are generally harmful in nature and have become a major cause of illness and genetic

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defects. Current research ascertains and concludes the presence of increased levels of toxic metals such as lead, mercury, lead, thallium, tin and tungsten in the blood and urine of autistic children as compared to other children. These toxic metals can impair brain development and function, and also interfere with the normal functioning of other body organs and systems (James B. Adams et al., 2012).

This article is an attempt to investigate, with historic evidences and voluminous literature especially, the role of heavy metals in the development of neurological disorders like ASD and ADHD. Since herbal therapies are quite beneficial for the symptoms of autism and its associated difficulties we tried to review the use of herbal remedies in assisting the autistic children to eliminate the heavy metals. This article shows the possibility of a positive outcome via herbal therapies.

### **Methods**

This review is based upon extensive review of PubMed data base, journals as well as results from many researches on autism and ADHD.

### **Heavy Metal Toxicity in Autistic Children**

All children with autism, without exception, have excessive amounts of toxic metals in the brain (Lawrence Wilson, MD, 2013). (Natural News) New evidence suggests that heavy metal exposure may be a cause of autism. The researchers found that autistic children had significantly higher levels of numerous toxic metals in their blood than non-autistic children (David, 2013).

### ***Toxic metal types of autistic children***

Most of the children have a combination of these types, with predominance of one or other of the toxic metal types below:

A. *Cadmium/mercury types*. This is the most severe autistic type, usually with very abnormal behavior patterns, no speech, almost complete withdrawal from family and society, and the most difficult to correct. Fortunately, it is not the most common one, however.

B. *Manganesel/aluminum types*. This is the most common type of toxic metal autism. It causes severe mental illness, but not the level of mental retardation found with the cadmium type, so it is easier to correct in this regard.

*C. Copper type.* This is also a fairly common type, with copper as the predominant toxic metal. This type is the one with the most digestive problems, for whom getting off all gluten such as wheat, rye, oats and barley, as well as all casein or dairy products, produces quite dramatic improvements, although it is not nearly enough for full correction (Lawrence Wilson, 2013).

Exposures to environmental toxicants such as mercury, lead, arsenic, polychlorinated biphenyls (PCBs) and toluene are known causes of neurodevelopmental disorders (Grandjean, 2006).

Cohen et al., (1976) found elevated blood lead levels in ASD children. Lonsdale et al., (2002) noted increased urinary concentrations of cadmium, nickel, and lead among children with pervasive mental disorder. AL-Ayadhi (2005) assessed that Riyadh children had significantly higher levels of toxic heavy metals mercury, lead, arsenic, antimony and cadmium in the hair of children with autistic spectrum disorder as compared to normal children. Blaylock and Strunecka (2009) reported that aluminium causes oxidative stress within brain tissue, exacerbating the clinical presentation of autism by worsening of excite-toxicity and by microglia priming. Bernard et al., (2001) noted that mercury is a potential cause or aggravator of neurological disease patterns such as ASD. They observed that autistic children who were postnatal poisoned with mercury developed articulation problems, from slow, slurred word production to an inability to generate meaningful speech.

Communication and learning problems are common among ASD patients. Toxic metals affect trace element absorption, and the interaction between essential elements and toxic metals affect threshold values and toxicity effects (Abdulla, 1990). The toxic metals cadmium, lead, mercury, and aluminium may interact metabolically with nutritionally essential metals. Iron deficiency increases absorption of cadmium, lead, and aluminium. Lead interacts with calcium in the nervous system to impair cognitive development. Cadmium and aluminum interact with calcium in the skeletal system to produce osteodystrophies. Lead replaces zinc and cadmium has the potential to replace zinc. Calcium deficiency along with low dietary magnesium may contribute to aluminium-induced degenerative nervous disease (Goyer, 1997).

In a recently published study, researchers report that children with autism had higher levels of several toxic metals in their blood and urine compared to typical children. The study involved 55 children with autism aged 5-16 years compared to 44 controls of similar age and

gender. The autism group had significantly higher levels of lead in their red blood cells (+41 percent) and significantly higher urinary levels of lead (+74 percent), thallium (+77 percent), tin (+115 percent), and tungsten (+44 percent).

Lead, thallium, tin, and tungsten are toxic metals that can impair brain development and function, and also interfere with the normal functioning of other body organs and systems. A statistical analysis was conducted to determine if the levels of toxic metals were associated with autism severity, using three different scales of autism severity. It was found that 38-47 percent of the variation of autism severity was associated with the level of several toxic metals, with cadmium and mercury being the most strongly associated (Joe Kullman, 2013).

In another study involving 44 children, aged 3 to 9 years, with Autistic Spectrum Disorder (ASD) according to Diagnostic and Statistical Manual of Mental Disorders 4<sup>th</sup> Edition, (DSM- IV), the severity of autistic symptom was measured by the Childhood Autism Rating Scale (CARS) and hair analysis was performed to evaluate the long term metal exposure and mineral level. By comparing autistic vs. non-autistic children, elevated hair toxic metal concentration of aluminium, arsenic, cadmium, mercury, antimony, nickel, lead, and vanadium were observed in autistic children. Hair levels of essential minerals and Trace elements of autistic children such as calcium, iron, iodine, magnesium, manganese, molybdenum, zinc, and selenium were deficient. There was a significant positive correlation between lead & verbal communication ( $p=0.020$ ) and general impression ( $p=0.008$ ). In addition, there was a significant negative correlation between zinc & fear and nervousness ( $p= 0.022$ ) (Blaurock-Busch et al., 2012).

Overall, children with autism have higher average levels of several toxic metals, and levels of several toxic metals are strongly associated with variations in the severity of autism for all three of the autism severity scales investigated.

#### ***Autistic children seem to have difficulty eliminating toxic metals***

Ninety-nine percent of autistic children in a recent study have dysfunctional metallothionein metabolism. Metallothionein is a protein that binds to toxic minerals such as mercury, copper and others and allows the body to eliminate them. If this binding protein does not function well, one is less able to transport and eliminate many toxic metals (Lawrence Wilson, 2013).

Studies have shown that levels of the major intracellular antioxidant “Glutathione” is typically about 50% lower in children with autism. Glutathione, which is produced by every cell in the body, is responsible for a number of functions including removing or neutralizing dangerous substances that we are exposed to on a daily basis, including toxic metals. Toxins, pollution, disease, stress, and poor diet can all contribute to loss of glutathione (Kern et al., 2013).

### ***Autism and Herbal Remedies***

Toxin overload affects most individuals these days. Toxins in general and heavy metals particularly influence individuals with autism in particular. The build-up of toxins in the brain results in nerve damage. The build-up of toxins in the intestines causes destruction of the intestinal wall. Toxins adversely affect every cell in the body. The toxins must be removed from the cells and the body to fully restore health and reverse symptoms of autism in a process called natural detoxification ([specialeducationresource.weebly.com/therapy.html](http://specialeducationresource.weebly.com/therapy.html)).

The use of herbal medicines in aiding treatment of autism is essential. Its actions of restoration of endocrine activity, repair of mucosa and dysbiosis, antibacterial and antifungal properties, elimination of toxins and digestive functions, can be practiced in one prescription without harmful side effects (Diana Oliver, 2013).

Recent research shows promise for the use of herbal remedies to treat autism. A recent study conducted in Japan examined the effects of yokukansan on the behavior of children with pervasive developmental disorder (PDD), which is one of the autism spectrum disorders. In this study, 20 children and teenagers aged 6 to 17 with diagnoses of PDD were administered 2.5 to 7.5 grams of yokukansan daily over a 12 week period. The investigators evaluated the subjects’ behavior using the Clinical Global Impressions-Improvement of Illness Scale, the Children’s Global Assessment Score, and the Aberrant Behavior Checklist. The results of this study showed that the subjects’ symptoms of irritation and agitation improved significantly after 8 weeks, while symptoms of hyperactivity improved after 12 weeks (Janet Meydam, 2013).

Herbs are complex and often have multiple bioactive compounds. These compounds may work on multiple systems – immune, oxidative stress, mitochondria, etc. In general, herbs are better tolerated by sensitive children. Utilizing herbs may allow you to reduce the dosage of or avoid drugs.

Herbal products that have antioxidant properties may be useful for Autism. For example

### **Brahmi (*Bacopa monnieri*)**

A traditional, therapeutic herb native to India, brahmi (also known as *Bacopa monnieri*) is commonly used in Ayurvedic medicine as a memory enhancer, aphrodisiac, and general tonic. Its impact on cognitive performance has prompted a number of investigations into its positive benefits (Gubbannavar et al., 2013).

*B. monnieri*(L.) ameliorates behavioral alterations and oxidative markers in sodium valproate induced autism in rats. Early prenatal or post natal exposure to environmental insults such as valproic acid (VPA), thalidomide and ethanol could induce behavioral alterations similar to autistic symptoms. Treatment with *B. monniera* significantly improved behavioral alterations, decreased oxidative stress markers and restored histoarchitecture of cerebellum (Suruchi Chandra, 2013). Pretreatment with *B. monnieri* extract offsets 3- nitropropionic acid induced mitochondrial oxidative stress and dysfunction in the striatum of prepubertal mouse brain (Shinomol, 2011).

### **Gotu kola leaf (*Centella asiatica*)**

Gotu kola is a mainstay of herbal medicine in Ayurveda, and sneaked into European treatment many years ago. It was used in France in the 1880s. A standout herb for the nervous system, gotu kola has a host of benefits for neurological recovery and cognition (Vaidya, Ashok D.B, 1997). Gotu kola is a medicinal herb that has tremendous healing properties that are known to benefit a wide variety of ailments. Gotu kola is rich in vitamins A, C, & B-complex as well as minerals such as silicon, selenium, calcium, magnesium, and iron. Gotu kola is one of the premier herbs for neurological disorders including dementia, Bell's palsy, epilepsy, Parkinson's disease, bipolar disorder, tremors, Guillain-Barre syndrome, Tourette syndrome, and narcolepsy (Medicalmedium.net). In Ayurveda, CA is one of the main herbs for revitalizing the nerves and brain cells (Hagemann RC et al., 1996).

A study in rats showed an impressive improvement in memory. The treated rats were able to retain learned behavior 3 to 60 times better than the control rats (Nalini K, et al., 1992). Scientific research into Gotu kola extracts and its effects on the brain really only began in earnest in the past decade. Gotu kola water extracts were administered to rats, where it improved their

cognitive function in terms of learning and memory in a standard shuttle box avoidance and step through test. Brain levels of malondialdehyde (MDA), an indicator of overall oxidative stress, were reduced, and brain levels of the endogenous antioxidant glutathione were increased (Veerendra Kumar MH, 2002).

### **Calamus root (*Acorus calamus*)**

Calamus is a major herb for the mind in Asian medicine. It is said to stimulate the power of self-expression and to enhance intelligence. Ancient yogis and seers used this herb. The root promotes circulation to the brain, heightens memory, enhances awareness, and increases communication and self-expression. It is a bitter herb that acts as an anti-gas digestive aid and mucolytic, so it sees use in autism. Calamus also has warming respiratory functions. This herb is often combined with gotu kola, which is cooling and mild. The complementary energetics makes the combination suitable for a wide variety of people. In attention deficit conditions, it combines well with gotu kola, valerian, shankpushpi and licorice. Over the long term, calamus will warm the body and pacify the mind (Karta Purkh Singh Khalsa, 2011).

*Acorus calamus* is a major herb used by yogis for the mind and meditation. Ancient yogis used this herb to stimulate the power of self-expression and to enhance intelligence. Calamus is said to promote circulation to the brain, sharpen memory, enhance awareness and consciousness, and increase communication in speech (John, 2015).

### **Aloe vera (*Aloe barbadensis*)**

Aloe vera (also known as *Aloe barbadensis*) is the most commonly used member of the 299-strong aloe genus. The leaves contain a gel which was documented by the ancient Greeks for use on wounds, and in the Middle Ages for action as a purgative when taken internally. Aloe vera leaf extract may assist in the loosening and elimination of toxins from the gut mucosa, thereby improving absorption and reducing mucosal inflammation. This can assist in the relief of conditions such as heartburn and hyperacidity. Its' dose-related laxative action relieves constipation, with higher doses exerting a purgative effect. Regular oral use of aloe promotes a regular cleansing of the colon, with dramatic health benefits. Aloe promotes rapid repair of damaged membranes in the GI tract and stimulates regeneration of enterocytes. The acemannan

component of aloe inhibits some types of viral replication, including HIV, influenza and measles. It also enhances the function of macrophages (Michael T Murray ND, 1995).

Aloe vera nourishes the body with many vitamins including A, C, E, folic acid, choline, B1, B2, B3 (niacin), B6. It is also one of the few plants that contain vitamin B12. Because aloe enhances blood quality allowing for more effective transport of oxygen and nutrients to the body's cells, it increases the efficacy of vitamin C, vitamin E and other antioxidants. Aloe vera is a gelatinous plant food, just like seaweed and chia seeds. The main benefit to consuming gelatinous plant foods is that these gels move through the intestinal tract absorbing toxins along the way and eliminating them through the colon. Consuming these gelatinous foods is a great way to detoxify the body. Aloe also decreases the amount of unfriendly bacteria in the gut, keeping the healthy intestinal flora in balance. Aloe vera contains substances that prevent the growth of disease-causing microorganisms (such as the yeast *Candida*) and provides antimicrobial activity to prevent and treat bacterial, fungal and viral infections. Aloe also seems to be excellent at regulating the immune system.

This means it can stimulate the immune response for those with weakened immune systems, either from existing conditions or post-illness fatigue. But aloe can also calm the immune response, which would help people with seasonal allergies or food sensitivities, where less immune reaction is beneficial. However, while this plant is incredibly medicinal, there are some cautions against long-term use. Just because a little is beneficial, doesn't mean that a lot is better. This is an incredibly powerful plant and should be used with a level of respect for its potency (Josie Dovidio, 2013).

### **Ashwagandha (*Withania somnifera*)**

Ashwagandha has adaptogenic properties that might be helpful in Autism (veenadeo@herbsbenefits.com). Ashwagandha leaf derived *Withania somnifera* protects normal human cells against the toxicity of methoxyacetic acid, a major industrial metabolite. *Withania somnifera* protects cells from MAA - induced toxicity by suppressing the ROS levels, DNA and mitochondrial damage, and induction of cell defence signalling pathways (Priyandoko et al., 2011).

Ashwagandha is commonly known as "Indian Winter cherry" or "Indian Ginseng". It is one of the most important herb of Ayurveda (the traditional system of medicine in India) used for



millennia as a Rasayana for its wide ranging health benefits. Rasayana is described as an herbal or metallic preparation that promotes a youthful state of physical and mental health and expands happiness. These types of remedies are given to small children as tonics (Changhadi Govardhan Sharma, 1938).

The available scientific data support the conclusion that Ashwagandha is a real potent regenerative tonic (Rasayana of Ayurveda), due to its multiple pharmacological actions like anti-stress, neuroprotective, antitumor, anti-arthritis, analgesic and anti-inflammatory etc. Ashwagandha is used as a household remedy by Indians, who consider it as the best tonic for old people and children, and as aphrodisiac by young people. It is one of the best nervine tonics of Ayurveda, the most ancient system of Medical Sciences. The enumerated neurological conditions, brain strokes causing paralysis and neuronal deficit also improve in the long term treatment with Ashwagandha (Narendra Singh et al, 2011).

#### **Black cohosh (*Cimicifuga racemosa*)**

Black cohosh root has a history of noted anti-seizure activity. Although now known more for other applications, this herb was used extensively in the past as a relaxant (Karta Purkh Singh Khalsa, 2011).

The root of black cohosh is used for medicinal purposes. Black cohosh root contains several chemicals that might have effects in the body. Some of these chemicals work on the immune system and might affect the body's defences against diseases. Some might help the body to reduce inflammation. Other chemicals in black cohosh root might work in nerves and in the brain. These chemicals might work similar to another chemical in the brain called serotonin. Scientists call this type of chemical a neurotransmitter because it helps the brain send messages to other parts of the body ([www.webmd.com/.../ingredientmono-857-black%20cohosh.aspx?blac](http://www.webmd.com/.../ingredientmono-857-black%20cohosh.aspx?blac)).

#### **Chamomile (*Matricaria chamomilla* L)**

This sedative herb contains volatile oils with antiseizure and anti-inflammatory effects. Chamomile, scientifically known as *Matricaria recutita* and also called German chamomile, is normally employed by natural healers to treat digestive disorders, colds, muscle spasms, skin rashes, inflamed gums and infections. But it is the herb's ability to reduce anxiety,

elevate mood and combat insomnia that is presently of particular interest to medical researchers. ([http://www.naturalhealth365.com/food\\_news/chamomile.html](http://www.naturalhealth365.com/food_news/chamomile.html))

Chamomile is effective as a mild sedative and for promoting restful sleep when infused into tea, or otherwise taken internally. It is ideal for anyone who suffers from insomnia, because it is very unlikely to cause drowsiness the following morning, so long as it is taken at a reasonable time in the evening (Thomas Corriher, 2010).

### **Damiana (*Turnera diffusa*)**

Damiana has a bitter taste due to its volatile oils and alkaloids. Bitter herbs stimulate the bitter-sensitive taste buds in the mouth, leading to the release of the hormone gastrin in the stomach. Gastrin helps to stimulate the flow of bile, which can reduce the chance of gall bladder disease and acts as a cleansing agent for the liver. It is thought to be particularly helpful to improve digestion particularly when there is an emotional component such as anxiety involved. Damiana appears to provide laxative and diuretic actions that are the source of its cleansing effects. Damiana has been found to be useful in the treatment of nervous dyspepsia and atonic constipation. It also has a "tonic" action for overall improved body function and is said to boost energy levels, supports the immune system and rejuvenates the entire central nervous system, helping to relieve depression, lethargy, nervous exhaustion, anxiety and general debility during convalescence.

Because Damiana is believed to stimulate the circulation of blood and oxygen throughout the body, it is considered a tonic that will boost metabolism, which can be helpful for weight loss, rejuvenating and clearing the kidneys, expelling liquids from the lungs, relieving symptoms of cold and flu, and generally produces an overall feeling of well being. When used as an antiseptic, Damiana is said to combat urinary tract infections, such as cystitis, vaginal discharge and others. Damiana has also been thought to be useful in treating bedwetting problems. (<http://store.newwayherbs.com/damiana-leaf-turnera-aphrodisiaca-p146.aspx>)

Damiana (*Turnera diffusa*) and Scullcup (*Scutellaria lateriflora*) are important herbs used for obsessive compulsive disorder. Obsessive compulsive disorder is a condition where people tend to appear paranoid or psychotic either due to their repetitive behaviors or other isolated compulsions and obsessions. Damiana help alleviate nervous tension and the symptoms associated with neuromotor and neurological problems (Newsmax, 2010).

**Ginkgo (*Ginkgo biloba*)**

Ginkgo contains powerful antioxidants that can protect the brain against oxidative free radicals and prevent neurodegeneration. This herb also improves blood flow to the brain and, in this way, it supports brain health. *Ginkgo biloba* is an herb that is known for its ability to boost cognitive function in the brain. Ginkgo increases the amine neurotransmitter substances in the brain, which helps counteract some of the chemical deficiencies often seen in children with ADHD. One specific effect of ginkgo in the brain that can help ADHD patients is the ability of the herb to block the reuptake of epinephrine and norepinephrine from the synaptic junctions between nerves. In this way, it acts like the stimulant ADHD drugs because it allows these neurotransmitters to act longer and help improve attention and concentration. Ginkgo can calm the mind and promote a peaceful spirit. It is known to improve memory and mental focus (Brad Chase, 2013).

Ginkgo is an herb that offers promise for treating a large collection of brain, nerve, and circulatory conditions. Ginkgo acts by increasing blood flow to the brain and central nervous system as well as promoting peripheral circulation, and it exerts a protective effect on cells in general and nerve cells in particular. Ginkgo's unusual biochemical properties lend it to treating memory loss and cognition disorders (Michael T. Murray, 1995).

**Sarsaparilla (*Hemidesmus Indicus*)**

Native Americans have been using sarsaparilla for hundreds of years in teas and tinctures as a way to effectively detox the blood. It also effectively treats liver, kidney and skin conditions (Christina Sarich, 2013).

Sarsaparilla, like licorice, seems to affect hormone production as well as settling the stomach and calming the nerves ([http://www.oreilly.com/medical/autism/news/supps\\_herbs.html](http://www.oreilly.com/medical/autism/news/supps_herbs.html)). Sarsaparilla promotes removal of toxins in the bowel; anti-inflammatory (Karla M. Parker, herbalist). It is said to attack and neutralize toxins, including environmental poisons, in the blood and also promotes urination and sweating. Sarsaparilla helps to cool the body and break intermittent fevers. Sarsaparilla, as an antibacterial, has been used internally and externally to counteract infections of all kinds. When taken internally, it is said to attack microbial substances in the blood and also counteract urinary tract infections. (<http://store.newwayherbs.com/sarsaparilla-root-smilax-medica-p273.aspx>).

## Conclusion

Many options exist about herbal remedies for the treatment of children with autism but it is still in an experimental stage when it comes to treating autism. Herbal medicine holds great promise for supporting health and life of autistic children as they show no adverse side effects. To conclude, herbal therapies in autism present a rational and balanced way to promote a positive amendment in children with autism relating to digestive, cognitive, emotional and brain balance concerns.

## Authors' Note

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