

Brain Wave

1. The Logic behind Brain Wave

1.1 Physical Needs

Vitamins are classified as either **water-soluble**, meaning that they dissolve easily in water, or **fat-soluble** vitamins, which are absorbed through the intestinal tract with the help of lipids (fats). In general, water-soluble vitamins are readily excreted from the body. Each vitamin is typically used in multiple reactions and, therefore, most have multiple functions. In humans there are 13 vitamins: 4 fat-soluble (A, D, E and K) and 9 water-soluble (8 B vitamins and vitamin C).

Vitamins are essential for the normal growth and **development** of a multicellular organism. Using the genetic blueprint inherited from its parents, a fetus begins to develop, at the moment of conception, from the nutrients it absorbs. It requires certain vitamins and minerals to be present at certain times. These nutrients facilitate the chemical reactions that produce among other things, skin, bone, and muscle. If there is serious deficiency in one or more of these nutrients, a child may develop a deficiency disease. Even minor deficiencies may cause permanent damage.

Once growth and development are completed, vitamins remain essential nutrients for the healthy **maintenance** of the cells, tissues and organs that make up a multicellular organism; they also enable a multicellular life form to efficiently use chemical energy provided by food it eats and to help process the proteins, carbohydrates and fats required for respiration.

For the most part, vitamins are obtained with **food**, but a few are obtained by other means. For example, microorganisms in the intestine—commonly known as "gut flora"—produce vitamin K and biotin, while one form of vitamin D is synthesized in the skin with the help of natural ultraviolet in sunlight. Humans can produce some vitamins from precursors they consume. Examples include vitamin A, produced from beta carotene, and niacin, from the amino acid tryptophan.

Deficiencies of vitamins are classified as either primary or secondary.

A primary deficiency occurs when an organism does not get enough of the vitamin in its food.

A secondary deficiency may be due to an underlying disorder that prevents or limits the absorption or use of the vitamin, due to a "lifestyle factor", such as smoking, excessive alcohol consumption or the use of medications that interfere with the absorption or use of the vitamin.

People who eat a varied diet are unlikely to develop a severe primary vitamin deficiency. In contrast, restrictive diets have the potential to cause prolonged vitamin deficits, which may result in often painful and potentially deadly diseases.

Because human bodies do not **store** most vitamins, humans must consume them regularly to avoid deficiency. Human bodily stores for different vitamins vary widely; vitamins A, D, and B12 are stored in significant amounts in the human body, mainly in the liver and an adult human's diet may be deficient in vitamins A and B12 for many months before developing a deficiency condition. Vitamin B3 is not stored in the human body in significant amounts, so stores may only last a couple of weeks. Some evidence also suggests that there is a link between vitamin deficiency and mental disorders.

Just like vitamins, **minerals** help your body grow, develop, and stay healthy. The body uses minerals to perform many different functions - from building strong bones to transmitting nerve impulses. Some minerals are even used to make hormones or maintain a normal heartbeat.

There are two kinds of minerals: **macrominerals** and **trace** minerals. Macro means "large" in Greek (and your body needs larger amounts of macrominerals than trace minerals). The macromineral group is made up of calcium, phosphorus, magnesium, sodium, potassium, chloride and sulfur.

A trace of something means that there is only a little of it. So even though your body needs trace minerals, it needs just a tiny bit of each one. Scientists aren't even sure how much of these minerals you need each day. Trace minerals includes iron, manganese, copper, iodine, zinc, cobalt, fluoride and selenium.

Dr Linu Pauling (two-time Nobel Prize winner) says "You can trace every sickness, every disease and every ailment to a mineral deficiency".

Dr Charles Northen, MD researcher reports that, "In the absence of minerals, vitamins have no function. Lacking vitamins, the system can make use of the minerals, but lacking minerals, vitamins are useless."

1.2 Circumstantial Needs

Our needs are no longer met by what we eat.

Circumstantial influences impact on the extent to which our needs are met by what we eat. For example:

- Our soil is poor, so our food is not as rich in nutrients as it used to be;
- Food is genetically altered to produce more than one harvest a year, so nutrient content is affected;
- Fruit and vegetables are harvested when still green, which means that it is not ripened by the sun and the sun's energy is required for the formation of the essential sugars in fruit and vegetables;
- Children (and people in general) are a lot more stressed;
- We live in a high-paced society, so we don't often have time to eat healthy food;
- Our food contains preservatives and MSG etc which are harmful to our bodies;

As a result, we experience problems which our ancestors did not have to cope with. Children are more allergic, cancer is more prevalent, children suffer from attention deficit disorders and we are relying more and more on pharmaceutical drugs to solve our health problems.

We are complex organisms and therefore our needs are complex, but the answers to these needs are not complex. Where our food does not supply our needs, we must make use of alternative resources. The only thing working against us is our lack of knowledge. We do not know what we need and as a result we rely on others to tell us what we need. This information is often prejudiced because the person selling you the information, want you to use his product.

When we designed Brain Wave, we looked at what our bodies need for normal functioning and to stay healthy. For this reason we started of with all the vitamins our bodies require. The water soluble vitamins were added in high dosages (higher than required daily allowance), while the fat-soluble vitamins were added with reference to the required daily allowance. We then added the most needed minerals. We also added 3 glyconutrients. Glyconutrients are responsible for cell-to-cell communication and it therefore keeps our immune systems healthy. If, at this point, we stopped the development, Brain Wave would keep you healthy and you would have no deficiencies of any vitamins or minerals.

But then we looked at the environmental influences and for this reason, we added Brahmi.

Brahmi plays a roll in increasing **Intelligence** and **Alertness**;

Brahmi helps to alleviate **Anxiety, Attention Deficit/Hyperactivity Disorder** and **Depression**

Brahmi helps to improve **Learning** ability, **Memory, Long-Term Memory, Spatial Memory** and **Concentration**

Brahmi helps to repair damaged **Neurons**.

Brahmi helps the Brain to cope with excessive **Stress**.

Brain Wave is therefore an all-in-one product that addresses the everyday nutritional needs of children while providing their brains with the added nutrition it needs to cope with the requirements for success.

2. Features

Brain Wave contains the Required Daily Allowance of all the Vitamins and Brain Minerals;

Brain Wave contains glyconutrients which modulate the immune system;
Brain Wave contains Brahmi which have specific benefits for the brain and brain development;
Brain Wave addresses general health;
Brain Wave addresses the health of the brain;

Brain Wave contains the following fortificants:

- **Vitamins:**

Vit A
Vit E
Vit C
Vit D3
Vit B1 (Thiamine)
Vit B2 (Riboflavine)
Vit B3 (Nicotinamide)
Vit B5 (Pantothenic acid)
Vit B6 (Pyridoxine)
Vit B12
Folic Acid (one of the B-group vitamins)
Biotin (Vit H – one of the B-group vitamins)

- **Minerals**

Magnesium (Magnesium Glycinate – oral absorption excellent)
Zink

- **Glyconutrients**

Arabinogalactan
Gum Ghatti
Gum Tragacanth
Brahmi

3. Benefits

- Vit A

- May be useful for the treatment of (Iron Deficiency) **Anemia** (due to Vitamin A's ability to enhance the absorption of Iron);
- Loss of **Appetite** may occur as a result of Vitamin A deficiency;
- May be required for the optimal function of the **Inner Ear**;
- The **Cochlea** (a component of the Inner Ear) contains high concentrations of Vitamin A and may be functionally dependent on Vitamin A;
- Helps to maintain the health of the **Cornea** of the Eyes;
- May be involved in the formation of new **Bone** during Growth;
- May enhance **Learning** ability (the Retinoic Acid form of Vitamin A activates Retinoic Acid Receptors in the Hippocampus and this activation of Retinoic Acid Receptors is essential for Learning to occur);
- May enhance **Memory** (the Retinoic Acid form of Vitamin A activates Retinoic Acid Receptors in the Hippocampus and this activation of Retinoic Acid Receptors is essential for Memory processes);
- Deficiency may lead to impaired **Spatial Memory**;
- May facilitate the growth and repair of **Neurons**;
- May facilitate the regeneration of **Axons**;

- All **Sensory Receptors** contain relatively high concentrations of Vitamin A and are functionally dependent upon Vitamin A;
- Infants who do not receive Vitamin A supplementation during their first year of life may have an increased risk of Sudden Infant Death Syndrome (**SIDS**);
- May help to prevent **Bronchitis**;
- May increase resistance to the **Common Cold** and may exert direct anti-viral effects;
- May help to prevent **Croup**;
- May help to prevent **Pneumonia**;
- May help to prevent **Respiratory Tract** Infections;

- Vit E

- May facilitate the elimination of cellular waste from **Cells**;
- May accelerate the healing of **Fractures**;
- May be useful for the treatment of Attention Deficit/Hyperactivity Disorder (**ADHD**);
- Poor **Coordination** may occur as a result of Vitamin E deficiency;
- May help to counteract the toxic effects of excessive **Stress**;
- May help to preserve **Memory** and poor Memory may occur as a result of Vitamin E deficiency;
- May improve the quality of **Sleep**;
- May help to prevent damage to the **Brain Stem**;
- May help to protect the Neurons of the **Hippocampus**;
- May help to protect the Fatty Acids in the **Nervous System** from oxidation;
- May protect **Neurons** from the degenerative effects of various toxins;
- May help to prevent and treat **Asthma**;
- May help to prevent (upper) **Respiratory Tract** Infections;
- May be useful as an adjunct therapy for the treatment of **Acne**;
- May accelerate the healing of **Wounds**;

- Vit C

- **Anxiety** may increase the body's requirements for Vitamin C;
- May alleviate **Depression** (1,000 - 3,000 mg per day for at least three weeks);
- **Irritability** may occur as a result of Vitamin C deficiency;
- Human studies have demonstrated that large dosages of Vitamin C over an extended period can increase the **IQ** scores of Mentally Retarded subjects by 15-20 points;
- Lowers the production of **Cortisol** during periods of Stress(2,500 mg per day);
- Sudden Infant Death Syndrome (**SIDS**) is speculated to occur as a result of Vitamin C deficiency;
- May improve some aspects of human **Intelligence**;
- May improve **Learning** ability;
- May improve **Memory**;
- May improve **Mood** (3,000 mg per day);
- Concentrates in the **Brain** (the Brain contains the second highest concentration of Vitamin C in the body) and supplemental Vitamin C can influence Brain Wave activity;
- May inhibit the ability of **Homocysteine** to cause Memory impairment and may counteract the negative cardiovascular effects of Homocysteine;
- May lower the production of **Cortisol** by the Adrenal Glands during periods of Stress and may counteract the suppression of the Immune System caused by Cortisol (2,500 mg per day);
- May lower elevated blood **Histamine** levels and people who exhibit elevated blood Histamine levels are often found to be deficient in Vitamin C;

- Vit D3

- Also known as the "sunshine vitamin," since it is made by the body after being in the **sun**;
 - Promotes the body's absorption of calcium, which is essential for the normal development and maintenance of healthy **teeth** and **bones**;
 - Helps maintain proper blood levels of **calcium** and **phosphorus**;
 - Research links vitamin D deficiency with an increased risk of death, especially from **cardiovascular disease**;
 - Study after study has shown that vitamin D plays a key role in human **immunity**.
 - Vitamin D deficiency has also been associated with several types of **cancer**;
 - Studies have shown that giving small children supplemental vitamin D helps prevent them from developing type 1 **diabetes** later on;
- Vit B1 (Thiamine)
 - **Aggressiveness** may occur as a result of Vitamin B1 deficiency and supplemental Vitamin B1 may reduce Aggressive behavior;
 - May increase **Alertness**;
 - Anxiety may occur as a result of Vitamin B1 deficiency and Vitamin B1 may alleviate some cases of **Anxiety**;
 - **Apathy** (state of indifference) may occur as a result of Vitamin B1 deficiency;
 - Vitamin B1 deficiency may be implicated in Attention Deficit/Hyperactivity Disorder (**ADHD**);
 - High concentrations of Vitamin B1 are found in the **Brain**;
 - Vitamin B1 may be essential for the optimal function of the **Cerebellum**;
 - Vitamin B1 deficiency may lead to a reduction in the thickness of the Frontal Lobe and the Parietal Lobe of the **Cerebral Cortex**;
 - **Poor Concentration** may occur as a result of Vitamin B1 deficiency;
 - **Confusion** may occur as a result of Vitamin B1 deficiency;
 - Vitamin B1 deficiency can result in damage (measured as a reduction in the thickness of) the **Corpus Callosum** of the Brain;
 - **Depression** may occur as a result of Vitamin B1 deficiency;
 - May facilitate the survival of Neurons in the **Hippocampus**;
 - **Insomnia** may occur as a result of Vitamin B1 deficiency;
 - Vitamin B1 deficiency may result in lowered **Intelligence levels** and supplemental Vitamin B1 may increase Intelligence in some cases;
 - **Irritability** may occur as a result of Vitamin B1 deficiency;
 - May improve **Learning ability** and Vitamin B1 deficiency may lead to severe impairment in Learning ability;
 - Severe impairment of **Memory** may occur as a result of Vitamin B1 deficiency;
 - The Sulbutiamine form of Vitamin B1 may improve **Long-Term Memory**;
 - May improve **Short-Term Memory**;
 - Supplemental Vitamin B1 (50 mg per day) may improve **Mood** and Mood changes may occur as a result of Vitamin B1 deficiency;
 - Present in **Synaptic Vesicles** (where it is involved in synaptic transmission of Neurotransmitters and Nerve Impulses);
 - Vit B2 (Riboflavine)
 - Vit B2 is a water-soluble B-vitamin;
 - May enhance **Cell Respiration** - it may enhance the ability of Cells to efficiently utilize Oxygen;
 - May be essential for the production of **Antibodies**;
 - Is involved in the production of **Energy** within the body. Vit B2 is an integral component of the **coenzymes** that participate in many energy-yielding metabolic pathways.
 - They promote the first steps in the **metabolism** (breakdown and production) of **glucose** and of **fatty acids**.

- The metabolism of some vitamins and minerals also require Vit B2.
- Symptoms associated with Vit B2 **deficiency** include the inflammation of the mouth and tongue, cracks or sores on the outsides of the lips and at the corners of the mouth, dermatitis (inflammation of the skin), various eye disorders, sensitivity to the sun and confusion.
- May alleviate some cases of **Acne**;
- Deficiency of Vit B2, when it occurs is usually in combination with deficiency of other water-soluble vitamins, such as **thiamin**, **vitamin B6**, and **folate**, and therefore may be difficult to identify.

- Vit B3 (Nicotinamide)

- Is essential for the body's production of **Energy**. Works closely with vitamin B1, vitamin B2, vitamin B6, Pantothenic acid, and biotin to break the carbohydrates, fats, and proteins in food down into energy;
- May reduce **Aggressiveness**;
- May alleviate **Anxiety** (1,000 - 6,000 mg per day);
- May improve **Blood Circulation** to the Brain;
- May alleviate **Depression**;
- **Irritability** may occur as a result of Vitamin B3 deficiency;
- **Nervousness** may occur as a result of Vitamin B3 deficiency;
- May alleviate **Asthma** and many Asthma patients are found to be deficient in Vit B3;
- Aids in the production of stomach acid, needed for proper **digestion**;
- Is essential for the activity of many **enzymes** in the body. Enzymes are special substances that speed up chemical reactions in the body;
- Needs can be partially met by eating foods containing protein because the human body is able to convert **tryptophan**, an amino acid, into Vit B3;
- Is required by the body for **digestive processes**, activating enzymes which nourish the brain;
- Is a water-soluble vitamin that participates in more than 50 **metabolic functions**, all of which are important in the release of energy from carbohydrates;
- Because of its pivotal role in so many metabolic functions, Vit B3 is vital in supplying energy to, and maintaining the integrity of, all **body cells**;
- Assists in antioxidant and **detoxification** functions;
- Promotes healthy **skin**, the health of the **myelin sheath** (the protective covering of the spinal nerves), and good digestion, where it is also vital for the production of stomach acid;
- Can also help relieve **forgetfulness**;

- Vit B5 (Pantothenic acid)

- May be useful for the treatment of **Allergies** (500 mg per day);
- May increase the body's production of **Antibodies**;
- May help to prevent **Bacterial & Viral** Diseases;
- May increase the body's production of and **Macrophages** and may activate Macrophages;
- May activate NK **Lymphocytes**;
- Is a potent **Antioxidant**;
- May improve **Athletic Performance**;
- May be essential for the conversion of Fats, Carbohydrates and Proteins into **Energy**;
- **Fatigue** may occur as a symptom of Vitamin B5 deficiency;
- May increase **Stamina**;
- Loss of **Appetite** may occur as a result of Vitamin B5 deficiency;
- Impaired motor **Coordination** may occur as a result of Vitamin B5 deficiency;
- **Depression** may occur as a result of Vitamin B5 deficiency;
- **Irritability** may occur as a result of Vitamin B5 deficiency;
- May help the body to counteract **Stress**;
- May alleviate **Bruxism** (grinding of the Teeth);

- May alleviate **Hay Fever** (500 mg per day);
- Deficiency may increase the risk of Upper **Respiratory Tract** Infections;
- May alleviate **Sinusitis** (500 mg per day);
- Vit B6 (Pyridoxine)
 - May alleviate **Anxiety**;
 - May facilitate the production of Serotonin in Attention Deficit/Hyperactivity Disorder (**ADHD**) patients (Serotonin is often depleted in ADHD patients);
 - **Confusion** may occur as a result of Vitamin B6 deficiency;
 - May alleviate some types of **Depression**;
 - **Insomnia** may occur as a result of Vitamin B6 deficiency;
 - May alleviate **Irritability** and Irritability may occur as a result of Vitamin B6 Deficiency;
 - May alleviate **Nervousness**;
 - May protect the body against the toxic effects of excessive **Stress**.
 - May improve the ability to recall **Dreams** and may also increase their intensity and color (200 mg taken at bedtime) (effects are usually noticeable three nights after commencing this regime);
 - may improve **Memory**(at least 20 mg per day);
 - May improve the quality of **Sleep**;
 - Is essential for the utilization of Glucose in the Brain for the production of **Energy**;
 - Abnormal **Brain Wave** patterns (EEG readings) may occur as a result of Vitamin B6 Deficiency;
 - Recovery of function to damaged **Dopamine Receptors** may be impaired in the presence of Vitamin B6 deficiency;
 - May facilitate the development and health of the **Myelin Sheaths** that cover the Nerves which allows them to conduct Nerve Impulses;
 - May be required for proper electrical function of the **Nervous System**;
- Vit B12
 - Impaired **Abstract Reasoning** may occur as a result of Vitamin B12 deficiency;
 - **Aggressiveness** may occur as a result of Vitamin B12 deficiency;
 - May increase **Alertness**;
 - may alleviate **Anxiety** (administered concurrently with Folic Acid);
 - May improve **Concentration** ability;
 - **Confusion** may occur as a result of Vitamin B12 deficiency;
 - **Depression** may occur as a result of Vitamin B12 deficiency;
 - May improve some aspects of **Intelligence**;
 - May improve the rate of **Learning**;
 - **Memory** impairment may occur as a result of Vitamin B12 deficiency;
 - **Mood** changes may occur as a result of Vitamin B12 deficiency;
 - **Nervousness** is one of the initial symptoms of Vitamin B12 deficiency;
 - May facilitate the production of Ribonucleic Acid (RNA) within **Neurons** and Vitamin B12 helps to prevent the damage to Neurons caused by exposure to excessive levels of Glutamic Acid;
 - May facilitate the regeneration of damaged **Axons**;
 - May help to maintain the correct Fatty Acids environment in the **Myelin Sheaths** that surround Neurons;
 - **Poor Reflexes** may occur as a result of Vitamin B12 deficiency;
 - May improve the quality of **Sleep**;
- Folic Acid (one of the B-group vitamins)
 - Impaired **Abstract Reasoning** may occur as a result of Folic Acid deficiency;
 - Folic Acid (administered concurrently with Vitamin B12) may alleviate **Anxiety**

- **Apathy** may occur as a result of Folic Acid deficiency;
- Folic Acid may be useful for the treatment of **Autism**;
- Poor **Concentration** ability may occur as a result of Folic Acid deficiency;
- **Confusion** may occur as a result of Folic Acid deficiency;
- **Depression** may occur as a result of Folic Acid deficiency and supplemental Folic Acid may be an effective treatment for Depression;
- **Irritability** may occur as a result of Folic Acid deficiency;
- Poor **Memory** may occur as a result of Folic Acid deficiency (primarily due to Folic Acid deficiency increasing the risk of elevated Homocysteine levels);
- Some of Folic Acid's beneficial effects on the Nervous System occur from its ability to stimulate the conversion of Phenylalanine into Tyrosine and **Norepinephrine**;
- Folic Acid may facilitate the growth of **Axons**;
- Folic Acid may facilitate the production of **Energy** within the Brain;
- Folic Acid may enhance the function of the **Cerebral Cortex** - Folic Acid deficiency may lead to atrophy of the Cerebral Cortex;
- Folic Acid may facilitate the growth of Neurons in the **Hippocampus**;
- Folic Acid may improve the Sense of **Taste**;

- Biotin (Vit H – one of the B-group vitamins)

- May be essential for the production of **Antibodies**;
- Is required for the production of **Lymphocytes**;
- Deficiency may cause shrinkage of the **Thymus** gland;
- Loss of **Appetite** may occur as a result of Biotin deficiency;
- **Confusion** may occur as a result of Biotin deficiency;
- **Depression** may occur as a result of Biotin deficiency;
- **Nervousness** may occur as a result of Biotin deficiency;
- Poor **Reflexes** may occur as a result of Biotin deficiency;
- Is essential for **Cell** growth;
- Is closely involved (via its role as a cofactor for various Enzymes) in the Endogenous production of **Energy** and the process of gluconeogenesis;
- **Fatigue** may occur as a result of Biotin deficiency;
- May **enhance** the function of Vitamin A;
- May enhance the ability of Beneficial Bacteria that reside in the Intestines to manufacture endogenous Vitamin B2;
- May enhance the function of Vitamin B3;
- May enhance the function of Vitamin B6;
- May enhance the function of Vitamin B12;
- May improve the **absorption** of Vitamin C;

- Magnesium

- May improve **Athletic Performance**;
- May facilitate the conversion of endogenous **Glucose** (blood sugar) into **Energy**;
- May increase the capacity for prolonged **Exercise**;
- May prevent Exercise-induced increases in **Cortisol levels**;
- May alleviate **Fatigue**;
- May increase **Stamina** (Magnesium deficiency may result in lowered Stamina);
- Is involved in the health of **Bones** (64% of the body's Magnesium is concentrated in the Bones);
- May help to prevent **Fractures**;
- Supplemental Magnesium (560 mg per day) may increase **Muscle Strength**;
- **Muscle Weakness** may occur as a result of Magnesium deficiency.

- Magnesium may harden **Teeth** and may prevent **Tooth Decay**;
- **Aggressiveness** may occur as a result of Magnesium deficiency;
- May improve **Memory**;
- **Anxiety** may occur as a symptom of Magnesium deficiency;
- **Apathy** (state of indifference) may occur as a symptom of Magnesium deficiency;
- **Loss of Appetite** may occur as a result of Magnesium deficiency;
- Attention Deficit/Hyperactivity Disorder (**ADHD**) may occur as a result of Magnesium deficiency and Magnesium supplementation (200 mg per day) may alleviate the hyperactivity associated with ADD;
- **Reduced Attention Span** may occur as a result of Magnesium deficiency;
- Poor **Concentration** ability may occur as a result of Magnesium deficiency;
- **Irritability** may occur as a result of Magnesium deficiency;
- **Poor Memory** may occur as a result of Magnesium deficiency;
- **Nervousness** may occur as a symptom of Magnesium deficiency (and supplemental Magnesium often alleviates Nervousness);
- **Nightmares** may occur as a result of Magnesium deficiency;
- (400 mg per day) may alleviate **Stress**;
- Is required for the transmission of **Nerve Impulses**;
- Is a component of the structure of **Neurons**;

- Zinc

- **Apathy** (state of indifference) may occur as a result of Zinc deficiency;
- **Poor Appetite** may occur as a result of Zinc deficiency and supplemental Zinc can stimulate the Appetite;
- Many Attention Deficit/Hyperactivity Disorder (**ADHD**) patients have been found to have low (up to 50% lower) serum Zinc levels;
- **Depression** may occur as a result of Zinc deficiency. Supplemental Zinc may improve Mood in Depression patients;
- **Irritability** may occur as a result of Zinc deficiency;
- May be involved in **Abstract Reasoning**;
- May increase **Attention Span**;
- Is involved in the processes that take place during **Learning** (due to its role as an essential component of Ion Channels);
- May be involved in **Memory** processing;
- Concentrates in the **Cerebral Cortex** of the Brain;
- May enhance the function of the **Corpus Callosum** of the Brain (due to its essential role in the structure of Ion Channels that transmit Nerve Impulses across the Corpus Callosum);
- Deficiency may cause malfunctions within the **Hippocampus**;
- Optimal Zinc levels may be essential for the conduction of **Nerve Impulses** (due to Zinc's role in the structure of Ion Channels). (Zinc is an essential component of ion channels that are involved in the transmission of nerve impulses. Lack of zinc can impair learning ability by hindering the flow of ions through ion channels);

- Arabinogalactan

- Larch Arabinogalactan is an excellent source of **dietary fiber** that is able to increase short-chain fatty acid production via its vigorous fermentation by intestinal microflora;
- Larch Arabinogalactan given to human subjects increased levels of **beneficial intestinal anaerobes**, particularly *Bifidobacterium longum*, via their fermentation specificity for Arabinogalactan compared to other complex carbohydrates;
- Recurrent otitis media (middle ear infection) is common in pediatric populations and it appears that improving **immune system** function might lead to a decrease in both frequency and severity of this condition;

- Research has demonstrated larch and other Arabinogalactans to be capable of enhancing the **immune response** to bacterial infection via stimulation of phagocytosis, competitive binding of bacterial fimbriae, or bacterial opsonization;
- Larch arabinogalactan's mild taste and excellent solubility in water and juice make it a relatively **easy** therapeutic tool to employ in pediatric populations;

- Gum Ghatti

- It has **Anti-allergenic** benefits;
- It promotes cell-to-cell **communication**;
- It enhances **immune** responses;
- It enhances **wound** healing;
- It increases **calcium** absorption;
- It triggers long-term **memory** formation;
- It accelerates the process of cellular communication and healing;
- It prevents bacterial, viral, parasitic and fungal **infections**;
- It helps in the production of **cytokines** (the chemicals which the body produces to fight invaders);

- Gum Tragacanth

- Treatment for **digestive** complaints and coughing;
- Useful as **laxative**;
- Treatment for **diarrhea**;
- Has soothing effect on irritated mouth and throat tissue;
- Enhances **wound** healing;
- Enhances cellular **communication**;
- Increases **calcium** absorption;
- Triggers long-term **memory** formation;
- Influences **brain** development;
- Is an immune **modulator**;
- **Anti-allergenic** benefits;
- Enhances **immune** responses;

- Brahmi

- May increase **Alertness**
- May alleviate **Anxiety**.
- May alleviate **Attention Deficit/Hyperactivity Disorder**.
- Improves **Concentration** ability.
- May alleviate **Depression**.
- May enhance the function of the **Hippocampus**
- May increase **Intelligence**.
- May improve **Learning** ability.
- May improve **Memory**:
- May improve **Long-Term Memory**.
- May improve **Spatial Memory** (This ability is important for generating and conceptualizing solutions to multi-step problems that arise in areas such as architecture, engineering, science, mathematics, art, games, and everyday life.
- May help to repair damaged **Neurons**.
- May enhance the ability of the Brain to cope with excessive **Stress**.

Studies and Research

The following information has been sourced and re-produced from independent studies and researches and publications, in an effort to provide information for medical professionals.

Brahmi and ADD (Research)

Laypersons' Publications

Mishra, M. Memory Plus works, claim clinical studies. The Times of India. March 29, 1998.

Block, W. Revitalize your intellect: introducing Bacopa vitality, a new memory function enhancer. Life Enhancement. March 2000: 4-10.

A double-blind, randomized trial conducted at BRD Medical College at Gorakhpur involved 36 attention deficit disorder children aged 8-10-years. 19 children were given 50 mg of Brahmi twice per day and the remaining 17 received a placebo. After 12 weeks of treatment, the children were tested on a battery of tests. The data revealed a significant improvement in the areas of sentence repetition, logical memory, and pair-associative learning (matching things that go together; e.g., "test" and "grade") in 100% of the children who received Brahmi. The evaluation did not occur until four weeks after withdrawal from Brahmi therapy, indicating that it had a long-lasting effect. The head of the study stated that (the study) "beyond doubt established the efficacy and tolerability of [Brahmi] as there were no side effects."

Brahmi and Depression (Research)

Peer-Reviewed Professional Journals

Sairam, K., et al. Antidepressant activity of standardized extract of *Bacopa monniera* in experimental models of depression in rats. *Phytomedicine*. 9(3):207-211, 2002. Department of Pharmacology, Institute of Medical Sciences, Banaras Hindu University, Varanasi, India.

Bacopa monniera Wettst. (syn. *Herpestis monniera* L.; *Scrophulariaceae*) is a commonly used Ayurvedic drug for mental disorders. The standardized extract was reported earlier to have significant antioxidant effects, anxiolytic activity and improve memory retention in Alzheimer's disease. In this study, the standardized methanolic extract of *Bacopa monniera* (bacoside A - 38.0+/-0.9) was investigated for potential antidepressant activity in rodent models of depression. The effect was compared with the standard antidepressant drug imipramine (15 mg/kg, ip). The extract when given in the dose of 20 and 40 mg/kg, orally once daily for 5 days was found to have significant antidepressant activity in forced swim and learned helplessness models of depression and was comparable to that of imipramine.

Summary

Animal study (rats) demonstrated the ability of brahmi to exert antidepressant effects after five days of use. Brahmi

Brahmi and Stress (Research)

Peer-Reviewed Professional Journals

Chowdhuri, D K., et al. Antistress effects of bacosides of *Bacopa monnieri*: modulation of Hsp70 expression, superoxide dismutase and cytochrome P450 activity in rat brain. *Phytotherapy Research*. 16(7):639-645, 2002.

Industrial Toxicology Research Center, Marg, Lucknow, UP, India.

The antistress effect of bacosides of Brahmi (*Bacopa monnieri*, BBM), dissolved in distilled water, was studied in adult male Sprague Dawley rats by administering oral doses of 20 and 40 mg/kg for 7 consecutive days. In half of the animals treated with 20 or 40 mg/kg of BBM, stress was given 2 h after the last dose. Stress was also administered to the

animals treated with distilled water alone. BBM, at both doses, did not induce a significant change in the expression of Hsp70 in any brain region studied while stress alone produced a significant increase in the Hsp70 expression in all the brain regions. A significant decrease in the activity of superoxide dismutase (SOD) was evident in the hippocampus with the lower dose of BBM and in animals given stress alone, while an increase in the activity of SOD was observed in the brain regions with the higher dose of BBM. An increase in the activity of cytochrome P450 (P450) dependent 7-pentoxoresorufin-o-dealkylase (PROD) and 7-ethoxyresorufin-o-deethylase (EROD) was observed in all the brain regions after exposure to stress alone and with both doses of BBM although the magnitude of induction of P450 expression was less with a higher dose of BBM. Interestingly, stress when given to the animals pretreated with BBM for 7 days resulted in a decrease in Hsp70 expression in all the brain regions with a significant decrease occurring only in the hippocampus. Likewise the activity of SOD was found to be further reduced in all the brain regions in the animals treated with the lower dose of BBM followed by stress. However, when stress was given to the animals pretreated with the higher dose of BBM, a significant increase in the enzyme activity was observed in the cerebral cortex and in the rest of the brain while the activity of SOD was reduced to a much greater extent in the cerebellum and in the hippocampus. Likewise, the activity of P450 enzymes was found to be restored to almost control levels in the animals given stress and pretreated with the higher dose of BBM, while a lesser degree of induction, compared with animals treated with BBM or stress alone, was observed in the animals pretreated with the lower dose of BBM and given stress. The data indicate that BBM has potential to modulate the activities of Hsp70, P450 and SOD thereby possibly [allowing the brain to be prepared to act under adverse conditions such as stress](#).

Laypersons' Publications

Jensen, A. W. Bacopa may help your brain cope with stress. Life Enhancement. March 2003:19-22.

Brahmi and Concentration (Research)

Information Sheets

Ayurvedic and Chinese Herbs: Summary of uses. Mediherb Australia Product Information Sheet, 1997.

Laypersons' Publications

Block, W. Revitalize your intellect: introducing Bacopa vitality, a new memory function enhancer. Life Enhancement. March 2000:4-10.

Johnston, A. Brahmi: the newest brain nutrient. Nature & Health. 22(3):88-89, 2001. A student's concentration ability is normally at its optimum for the first hour, then reduces to 50% in the second hour and further reduces to 25% in the third hour. Studies have demonstrated that the concentration ability of students taking brahmi remain at optimal levels for three hours or longer.

Brahmi and Concentration (Research)

Information Sheets

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Block, W. Revitalize your intellect: introducing Bacopa vitality, a new memory function enhancer. Life Enhancement. March 2000:4-10.

Johnston, A. Brahmi: the newest brain nutrient. Nature & Health. 22(3):88-89, 2001. A student's concentration ability is normally at its optimum for the first hour, then reduces to 50% in the second hour and further reduces to 25% in the third hour. Studies have demonstrated that the concentration ability of students taking brahmi remain at optimal levels for three hours or longer.

Brahmi and Glutathione Peroxidase (Research)

Peer-Reviewed Professional Journals

Bhattacharya, S. K., et al. Antioxidant activity of Bacopa monniera in rat frontal cortex, striatum and hippocampus. Phytother Res. 14(3):174-179, 2000.

Seven, 14 or 21 days of oral treatment with a standardized extract (containing 82% bacoside A) of Bacopa monniera (brahmi) administered at a rate of 5 mg or 10 mg per kg

of body weight was tested on rat brain frontal cortical, striatal and hippocampal superoxide dismutase (SOD), catalase and glutathione peroxidase activities, following administration for. Brahmi's effects were compared with those of deprenyl (2 mg/kg). Bacopa monniera caused a dose-related increase in SOD, catalase and glutathione peroxidase activities, in all the brain regions investigated, after 14 and 21 days. Deprenyl induced an increase in SOD, catalase and glutathione peroxidase activities in the frontal cortex and striatum, but not in the hippocampus, after treatment for 14 or 21 days. Bacopa monniera, like deprenyl, exhibits a significant antioxidant effect after subchronic administration which, unlike deprenyl, extends to the hippocampus. The increase in antioxidant effects induced by Bacopa monniera may help to explain the cognition **facilitating activity of Bacopa monniera.**

Brahmi and Aluminium (Research)

Author	Study Type	Intervention	Results
Jyoti, 2006	Animal: rats	Rats received aluminium chloride together with Brahmi extract.	Co-administration of Brahmi extract during aluminium treatment prevented the aluminium-induced decrease in SOD activity and the increased oxidative damage to lipids and proteins. It also inhibited aluminium-induced lipofuscin accumulation in the hippocampus.

Peer-Reviewed Professional Journals

Jyoti, A., et al. Neuroprotective role of Bacopa monniera extract against aluminium-induced oxidative stress in the hippocampus of rat brain. Neurotoxicology. 2006. Neurobiology Laboratory, School of Life Sciences, Jawaharlal Nehru University, New Delhi, India.

Bacopa monniera is a nerve tonic used extensively in traditional Indian medicinal system "Ayurveda". Reports regarding its various antioxidative, adaptogenic and memory enhancing roles have already appeared in the last few decades. In the present study, **aluminium chloride** (AlCl₃) was **used to generate neurotoxicity**. The authors investigated the neuroprotective effect of Bacopa extract against aluminium-induced changes in peroxidative products, such as thio-barbituric acid-reactive substance (TBARS) and protein carbonyl contents and superoxide dismutase (SOD) activity. Effect on lipofuscin (age pigments) accumulation and ultrastructural changes were also studied. Bacopa effects were compared with those of l-deprenyl. **Co-administration of Bacopa extract during aluminium treatment significantly prevented the aluminium-induced decrease in SOD activity as well as the increased oxidative damage to lipids and proteins**. Protective effect was also observed at microscopic level. Fluorescence and electron microscopic studies revealed **considerable inhibition of intraneuronal lipofuscin accumulation and necrotic alteration in the CA1 region of the hippocampus**. Observations showed that Bacopa's neuroprotective effects were comparable to those of l-deprenyl at both biochemical and microscopic levels.

Brahmi and Epilepsy (Research)

Peer-Reviewed Professional Journals

Stough, C., et al. The chronic effects of an extract of Bacopa monniera (Brahmi) on cognitive function in healthy human subjects. Psychopharmacology. 2001.

Brahmi has been used for centuries as an anti-epileptic agent in Indian medicine.

Monograph: Bacopa monniera. Alternative Medicine Review. 9(1):79-85, 2004. Laypersons' Publications

Bitomsky, M. Herbs falling into favor down under. Life Extension. 6(3):40-46, 2000.

An uncontrolled clinical study has demonstrated the ability of brahmi to improve the condition of epilepsy patients after two to five months of daily use.

Block, W. Revitalize your intellect: introducing Bacopa vitality, a new memory function

enhancer. Life Enhancement. March 2000: 4-10.

Brahmi is believed to help to stabilize the brain wave activity of epilepsy patients.

Magnesium and ADHD (Research)

Author	Study Type	Intervention	Results
Starobrat-Hermelin, 1997	Human	ADHD children with low red blood cell, hair or serum magnesium levels received 200 mg of magnesium per day for six months; and were compared with magnesium-deficient ADHD children who did not receive magnesium (controls).	Children receiving magnesium supplementation experienced a decrease in their hyperactive behavior.
Kozielec, 1997	Human	Serum, red blood cell and hair magnesium levels were measured in ADHD patients aged 9 – 12.	95% of ADHD children were found to have magnesium deficiency.
Nogovitsina, 2005	Human: case study.	Plasma and red blood cell levels of magnesium were measured in ADHD patients aged 6 – 11.	Magnesium levels were found to be modestly decreased in ADHD children.

Peer-Reviewed Professional Journals

Kozielec, T., et al. Assessment of magnesium levels in children with attention deficit hyperactivity disorder (ADHD). *Magnesium Research*. 10(2):143-148, 1997.

A positive influence of magnesium in the prevention and treatment of hyperactivity in children is more and more frequently raised in the literature. The aim of this work was to estimate magnesium contents in children with attention deficit hyperactivity disorder, (ADHD). The investigations comprised 116 children (94 boys and 20 girls), aged 9-12 years, with recognized ADHD. In 68 out of 116 patients examined ADHD occurred with other coexisting disorders specific to the developmental age and in the remaining 48 patients it occurred together with disruptive behaviour. Magnesium levels have been determined in blood serum, red blood cells and in hair with the aid of atomic absorption spectroscopy. **Magnesium deficiency was found in 95 per cent of those examined**, most frequently in hair (77.6 per cent), in red blood cells (58.6 per cent) and in blood serum (33.6 per cent) of children with ADHD. The conclusion from the investigations is that **magnesium deficiency in children with ADHD occurs more frequently than in healthy children**. Analysis of the material indicated the correlation between levels of magnesium and the quotient of development to freedom from distractibility.

Nogovitsina, O. R., et al. [Diagnostic value of examination of the magnesium homeostasis in children with attention deficit syndrome with hyperactivity.] *Klin Lab Diagn*. 5:17-19, 2005.

The authors followed, within the present case study, 51 children, aged 6 to 11, with attention deficit hyperactive syndrome (ADHS); special biochemical tests were made. The **magnesium level was found to be moderately decreased in plasma and erythrocytes and the Mg²⁺ -ATPase activity was reduced in ADHS children**. No essential changes of calcium or sodium homeostasis were detected in cells. The MAGNE-B6 drug, when used in the complex therapy of ADHS, normalizes the magnesium homeostasis, it **enhances the large and small motility, attention, psychic stability and EEG parameters, and it reduces anxiety**. The method of determination of magnesium in erythrocytes and in blood plasma can be used to detect the deficit of the microelement in patients and to monitor the efficiency of therapy.

Starobrat-Hermelin, B., et al. The effects of magnesium physiological supplementation on hyperactivity in children with attention deficit hyperactivity disorder (ADHD). Positive response to magnesium oral loading test. *Magnes Res*. 10:149-156, 1997.

50 children with ADD children who had low magnesium (as determined by red blood cell, hair, and serum levels of magnesium) were given 200 mg of magnesium per day for six months. A further 25 magnesium deficient ADD children served as a control. Those patients receiving magnesium supplementation experienced a significant decrease in hyperactive behavior.

Laypersons' Publicatons

Borek, C. How A better understanding of ADHD leads to new approaches in treating the disorder. Life Extension. 6(4), 2000.

A Polish study on a group of 116 ADHD children demonstrated low blood and hair levels of magnesium in many ADHD children.

Lombardi, R. M. ADHD: A modern malady. Nutrition Science News. July 2000.

Sahley, B. J. Natural control of ADD and ADHD. Vitamin Research News. 14(10), 2000. Almost all ADHD patients are found to be deficient in magnesium. Magnesium deficiency may be an underlying cause of ADHD.

South, J., M.A. Magnesium - the underappreciated mineral of life (part II). Vitamin Research News. October, 1997.

Many of the classic symptoms of magnesium deficiency are identical to the classic symptoms of attention deficit disorder. The author suspects that the majority of ADHD patients are deficient in magnesium and that magnesium deficiency may be a major contributory cause of ADD.

Zinc and Attention Span (Research)

Author	Study Type	Intervention	Results
Penland, 2005	Human	Adolescent children received orange juice containing 0, 10 or 20 mg of zinc (from zinc gluconate) five days per week for 10 – 12 weeks.	Zinc supplementation at the 20 mg per day level resulted in increased attention ability.

Conferences

Penland, J. G., et al. Experimental Biology 2005 Conference. San Diego, USA. April 2005. USDA's Grand Forks Human Nutrition Research Center. North Dakota, USA.

Supplementation with zinc helps improve the mental performance of adolescent boys and girls. In this study, 98 seventh-grade boys and 111 girls were given fruit juice that contained 0, 10 or **20 mg zinc from zinc gluconate five days per week for 10 to 12 weeks**

. Students, parents and teachers were not aware of which children received the supplement. The students were administered tests measuring attention, memory, problem solving and eye-hand coordination to assess mental and motor skills at the beginning and end of the study. Questionnaires concerning the participants' physical, mental and social abilities, and school performance were completed by parents, teachers and students to determine any changes in psychosocial function. Blood samples taken before and after the study were analyzed for zinc levels. The authors found that supplementation with **20 milligrams zinc led to greater memory and attention abilities** than those demonstrated by children who did not receive zinc. **Visual memory reaction time was lowered by 12 percent in those who received zinc** compared to 6 percent in those who received no supplements. Word recognition and **attention similarly improved in the group who received 20 milligrams**. Prior zinc status appeared to have no effect on the benefits of supplementation. Students who received 10 milligrams zinc, which is the Recommended Dietary Allowance for this age group, did not experience significant improvement. The study is the first to demonstrate zinc's effect on mental performance in adolescents, who are particularly at risk of deficiency due to rapid growth and poor dietary habits. If further studies show that the mental abilities of adolescents improve with increasing zinc intake, the findings could be used when revising dietary guidelines

Zinc and Learning (Research)

Laypersons' Publications

Zinc in nerve cell function. Energy Times. 9(3):12, 1999.

Zinc is an essential component of ion channels that are involved in the transmission of nerve impulses. Lack of zinc can impair learning ability by hindering the flow of ions through ion channels.

The importance of trace minerals. Life Enhancement. July 2000. Zinc deficiency can be an underlying cause of learning disabilities.

Zinc and Memory (Research)

Author	Study Type	Intervention	Results
Nowak, 2003	Human: preliminary placebo-controlled, double-blind study.	Major depression patients received 25 mg of elemental zinc (or placebo) per day, together with standard antidepressant therapy for twelve weeks.	Zinc supplementation reduced depression scores after six weeks compared with placebo. Zinc + antidepressant therapy was more effective than antidepressant therapy alone.
Levenson, 2006	Review	None.	Low serum zinc levels have been linked to major depression. Zinc treatment exerts an antidepressant effect (possibly via zinc affecting serotonin uptake in the brain).

Peer-Reviewed Professional Journals

Keller, K. A., et al. Age-dependent influence of dietary zinc restriction on short-term memory in male rats. *Physiol Behav.* 72(3):339-348, 2001.

Department of Physiology and Pharmacology, College of Veterinary Medicine, The University of Georgia, Athens, GA, USA.

Zinc is an essential micro-nutrient involved in numerous physiological functions. The high content of zinc in the hippocampus, coupled with the integral involvement of the hippocampus in memory, strongly implicates zinc in memory processing. The hypothesis of the current study was that dietary zinc restriction influenced short-term memory in postweaned rats, and this influence was age-dependent. Male rats (43 days to 18 months old) were divided into five experimental groups based on age, and fed zinc adequate (zinc at 20 mg/kg as zinc chloride) or zinc-deficient (zinc less than 1-2 mg/kg) diets for a minimum of 3 weeks. Short-term memory was assessed using the distal-cue version of the Morris water maze (MWM). All rats fed the zinc-restricted diet exhibited cyclic anorexia, decreased weight gain, and significantly lower liver and femur zinc concentrations compared to age-matched controls. Further, whole brain, hippocampal, and cerebral wet weights were significantly reduced in the zinc-restricted treatment groups of all the age groups. Only zinc-restricted rats that were less than 62 days of age at the start of zinc restriction demonstrated significantly prolonged escape latencies in the water maze, indicating [deficits in short-term memory](#). Regression analyses confirmed that the short-term memory deficits were correlated with significantly lower hippocampal and cerebral zinc concentrations compared to age-matched control and pair-fed rats. These results emphasize the significance of a critical age of [influence for dietary zinc in memory processing](#), and the importance of considering age when studying zinc nutrition and CNS function.

Conferences

Penland, J. G., et al. Experimental Biology 2005 Conference. San Diego, USA. April 2005. USDA's Grand Forks Human Nutrition Research Center. North Dakota, USA.

Supplementation with zinc helps improve the mental performance of adolescent boys and girls. In this study, 98 seventh-grade boys and 111 girls were given fruit juice that contained 0, 10 or [20 mg zinc from zinc gluconate five days per week for 10 to 12 weeks](#). Students, parents and teachers were not aware of which children received the supplement. The students were administered tests measuring attention, memory, problem solving and eye-hand coordination to assess mental and motor skills at the beginning and end of the study. Questionnaires concerning the participants' physical, mental and social abilities, and school performance were completed by parents, teachers and students to determine any changes in psychosocial function. Blood samples taken before and after the study were analyzed for zinc levels. The authors found that supplementation with [20 milligrams zinc led to greater memory](#) and attention abilities than those demonstrated by children who did not receive zinc. Visual memory reaction time was lowered by 12 percent in those who received zinc compared to 6 percent in those who received no supplements. Word recognition and attention similarly improved in the group who received 20 milligrams. Prior zinc status appeared to have no effect on the benefits of supplementation. Students who received 10 milligrams zinc, which is the Recommended Dietary Allowance for this age group, did not experience significant improvement. The study is the first to demonstrate zinc's effect on mental performance in adolescents, who are particularly at risk of deficiency due to rapid growth and poor dietary habits. If further studies show that the mental abilities of adolescents improve with increasing zinc intake, the findings could be used when revising dietary guidelines

Zinc and Major Depression (Research)

Peer-Reviewed Professional Journals

Levenson, C. W. Zinc: the new antidepressant? *Nutrition Reviews*. 64(1):39-42, 2006. Program in Neuroscience, Department of Nutrition, Food and Exercise Sciences, Florida State University, Tallahassee, FL, USA.

Low serum zinc levels have been linked to major depression. Furthermore, zinc treatment has been shown to have an antidepressant effect. With the hope of understanding the role of zinc in mood disorders, recent work has begun to explore possible mechanisms of zinc action on serotonin uptake in the brain.

Nowak, G., et al. Effect of zinc supplementation on antidepressant therapy in unipolar depression: a preliminary placebo-controlled study. *Pol J Pharmacol*. 55(6):1143-1147, 2003. Department of Neurobiology, Institute of Pharmacology, Polish Academy of Sciences, Poland.

A growing body of evidence implicates a derangement of zinc homeostasis in mood disorders. In general, unipolar depression (major depression) is connected with low blood zinc levels that are increased by effective antidepressant therapy. A placebocontrolled, double blind pilot study of zinc supplementation in antidepressant therapy was conducted in patients who fulfilled DSM IV criteria for major (unipolar) depression. Patients received [zinc supplementation](#) (6 patients; [25 mg of Zn\(2+\) once daily](#)) or placebo (8 patients) and were treated with standard antidepressant therapy (tricyclic antidepressants, selective serotonin reuptake inhibitors). Hamilton Depression Rating Scale (HDRS) and Beck Depression Inventory (BDI) were used to assess efficacy of antidepressant therapy, and patients' status was evaluated before the treatment and 2, 6 and 12 weeks after its commencement. Antidepressant treatment significantly reduced HDRS scores by the 2nd week of treatment in both groups, and lowered BDI scores at the 6th week in zinc-treated group. [Zinc supplementation significantly reduced scores in both measures after 6- and 12-week supplementation when compared with placebo treatment](#). This preliminary study is the first demonstration of the [benefit of zinc supplementation in antidepressant therapy](#). The mechanism(s) may be related to modulation of glutamatergic or immune systems by zinc ion.