NEUROTRANSMITTER [NT] TESTING

Ferris, L. [2015]. *Neurotransmitters primer*. In Functional Medicine University.

Labrix NT test kits are available at SSAH office [$15 does not include cost of test]. Six NTs are tested via saliva samples [serotonin, dopamine, GABA, adrenalin, noradrenalin, and glutamate]. You will receive both a customized Functional Medicine care plan based upon the test results, combined with a Chinese Medicine care plan based upon your constitution & presentation.

Who Should Be Tested for NT Imbalance

It is ideal to treat the root causes of a NT imbalance: endocrine, hormonal, gastrointestinal, adrenal, chronic stress [infection, psycho-emotional], poor diet & lifestyle etc. And this is where Acupuncture techniques & Chinese herbal medicine are invaluable. Do not to stop the medications you are already taking, but wean off them if desired and feasible. Feasibility means many things such as **1]** do you have consistent access to a Functional Medicine and/or Chinese Medicine practitioner to follow through with a plan of care; **2]** do you have the resources to manage the cost of care and supplements/ herbs/ treatments [not completely covered by insurance]; **3]** are you prepared for the integral part YOU play in these different types of approaches to health & wellbeing.

Test if:

- ☐ You have pronounced mood complaint
- ☐ You are currently using an SSRI, SNRI, MAOI etc.
- ☐ You checked off many NT imbalance symptoms [see below and the Labrix form]
- ☐ You are considering testing for genetic methylation SNPs [e.g. 23 and Me]
- ☐ You already had hormone testing and treatment yet certain symptoms did not improve: Many NT symptoms overlap with hormone symptoms, but not all. And if NT levels are not optimal, their hormonal counterparts may not adequately modulate, enhance or sensitize receptors. *Symptoms that did not resolve: Cravings and addictive behavior, Obsessive behavior, Poor impulse control, Movement disorders, IBS, persistent fatigue, Sleep issues, Mood swings and cognitive complaints.*

What are NTs and Why Test?

Neurotransmitters facilitate communication between the brain and the body's glands, organs and muscles. They are released from neurons and travel across all nerve synapses. Therefore, NT imbalances affect any aspects of health & feelings of well-being. Here are general signs that your NT may be imbalanced:

- ☐ Chronic pain
- ☐ Sweating
- ☐ Dizziness
- ☐ Heart palpitations
- ☐ Inability to kick addictions
- ☐ Altered sleep patterns
- ☐ Fatigue
- ☐ IBS
- ☐ Cognitive impairment (poor memory, lack of clarity, Attention deficits, difficulty concentrating & focusing)
- ☐ Headaches
- ☐ Anxiety & depression
- ☐ Weight loss
- ☐ Sweet cravings
- ☐ Agitation & poor impulse control

Which NTs Are Out Of Balance?

Serotonin

- ☐ **HIGH OR LOW→** Physical changes such as GI motility and bowel/bladder problems, fluctuating body temperature, aches/pains, cramps, smothering sensations, racing/troublesome thoughts, emotional numbness [lacking feelings of pleasure & reward], crying and/or angry outbursts, thoughts of escaping current circumstances, obsessive/ compulsive traits. Abnormalities of serotonin metabolism have been reported CAUSE OF DEPRESSED MOOD IN CHILDEN WITH celiac disease.
- ☐ **MODERATLEY LOW →** lack of interest in eating, or cravings sweets and carbohydrates.
- ☐ **LOW →** OCD, poor memory, suicidal thoughts & feelings, aggression, cue behavior.
- ☐ **HIGH→** agitation/ anger

Dopamine

- ☐ **LOW →** low energy, drive, anhedonia [loss of interest], mood swings, depression, anxiety, isolation, issues with motivation, inability to finish tasks, low libido, forgetfulness, prone to addiction (to food, drugs, gambling, etc.), pathological states [schizophrenia, autism, ADHD, RLS, Parkinson's].
- ☐ **LOW Dopamine + LOW serotonin→** poor appetite, aggression.
- ☐ **HIGH →** paranoia

Adrenalin & Noradrenalin [NA]

- ☐ **BOTH LOW →** Poor attention and memory, Decreased concentration, Reduced socialization, Loss of alertness, Memory problems (brain fog), Depression, Pain, Lack of arousal and interest
- ☐ **BOTH HIGH→** Palpitations, Tachycardia, Arrhythmia, Headache, Restlessness, Cold hands, Tremor, Hypertension, Acute pulmonary edema, Irritability, Anxiety, Agitation, Sleeplessness, Inability to relax, Lack of mental focus, racing thoughts.
- ☐ **LOW NA →** low concentration, alertness, energy
- ☐ **LOW NA + dopamine→** low attention
- ☐ **LOW NA + serotonin→** anxiety, poor impulse control, irritability

Glutamate

- ☐ **HIGH→** anxiety, insomnia, ADHD/poor concentration, Seizure, ALS/MS [MS also methylation SNPs], Autism, Alzheimer's
- ☐ **LOW→** Depression, Fatigue, Brain fog, Addiction/ dependency, Slowed learning.

GABA

- ☐ **LOW →** contributes to Panic/anxiety, Depression, Alcoholism, Bipolar disorders
- ☐ **HIGH→** contributes to Drowsiness/lack of alertness, Difficulty concentrating, Diminished memory, Dampened mood, Decreased cognitive processing, high excitatory neurotransmitters [glutamate].

NT Wellness Plan

1. SEROTONIN

LOW

- ☐ Tryptophan 500-2,000 mg
- ☐ 5 HTP 50-600 mg
- ☐ L-theanine 100-500 mg bid
- ☐ Cofactors
- ☐ Iron 25-50 mg (citrate or bisglycinate)
- ☐ P5P 50-200 mg
- ☐ Vitamin C 4,000-6,000 mg
- ☐ Vitamin D 2,000-10,000 IU
- ☐ MTHF
- ☐ Address Insulin resistance -> lowers serotonin
- ☐ Positivity, Light therapy, Exercise, Nutrition

HIGH

- ☐ L-theanine 100-500 mg bid
- ☐ Co-factors
- ☐ Vitamin B2: 50 mg
- ☐ Vitamin B3: 50 mg
- ☐ Iron: 25-50 mg
- ☐ SAMe: 250-500 mg

2. DOPAMINE

Enhances the reward response & Enables us not only to see rewards, but also to take action to move towards them. Dopamine controls locomotion and coordination of movement, motivation, behavior and cognition, sleep, mood, attention & learning behavior. It inhibits prolactin production (involved in lactation) and therefore shold not be used during breast-feeding, or if low prolactin diseases exist. Decreases or increases synapse, alteration in transporter, postsynaptic changes]. Plays a role in overocming addictions.

LOW

- ☐ * N-acetyl l-tyrosine 250-1,500 mg
- ☐ * L-Dopa/Macuna pruriens 200-800 mg
- ☐ L-theanine100-500 mg bid
- ☐ Vitamin D 1,000-10,000 IU
- ☐ Cofactors [MAO, COMT?]
- ☐ Vitamin C 4-6 gm
- ☐ Iron 25-50 mg
- ☐ Vitamin B3 50 mg
- ☐ P5P 50-200 mg
- ☐ MTHF

HIGH

- ☐ L-theanine 100-500 mg bid
- ☐ Co-factors MAO/COMT
- ☐ Vitamin B2: 50 mg
- ☐ Vitamin B3: 50 mg
- ☐ Iron: 25-50 mg
- ☐ SAMe 250-500 mg
- ☐ Co-factors (if Norepi low or low range)
- ☐ Vitamin C: 4,000-6,000 mg
- ☐ Copper: 0.5-1 mg
- ☐ Vitamin B3: 50 mg

3. ADRENAL and 4. NORADRENALIN

They regulate the flight or flight response, control attention & arousal, regulate/increase heart rate/cardiac ooutput & blood pressure; Release glucose from energy stores. They are released from storage vesicles in the adrenal medulla in response to fright, exercise, cold, and low blood glucose levels. They increase the degradation of glycogen and triacylglycerol.

Noradrenalin is released from neurons in the locus coeruleus in the brain/CNS and from post-ganglionic neurons in the sympathetic nervous system [SNS]. It is the first to stimulate the fight or flight response [response to stress and panic]. **Adrenalin** is synthesized in the adrenal medulla. The pathway to adrenalin begins with tyrosine [an amino acid] that is converted into L dopa→ dopamine→ noradrenalin→ adrenalin. Adrenal cortico-thyroid-releasing hormone [ACTH] from the hypothalamus, stimulates the adrenal cortex to release cortisol which stimulates the thyroid to enhance adrenalin synthesis.

Adrenalin is most important in the *periphery*, but is a brain neurotransmitter. **Noradrenalin** is an important in *brain* neurotransmitter, but is also used in the periphery: released from the adrenal medulla into the blood where it acts as a hormone. In the periphery, both adrenaline and noradrenalin regulate carbohydrate and lipid metabolism.

LOW Noradrenalin

- ☐ *N-acetyl l-tyrosine 250-1,500 mg
- ☐ *Macuna pruriens 200-800 mg
- ☐ L-theanine 100-500mg bid
- ☐ Vitamin D 1,000-10,000 IU
- ☐ Co-factors
- ☐ Vitamin C: 4-6 gm
- ☐ Copper: 0.5-1 mg
- ☐ Vitamin B3: 50 mg

HIGH Noradrenalin

- ☐ L-theanine100-500 mg bid
- ☐ Co-factors MAO/COMT
- ☐ Vitamin B2 50 mg
- ☐ Vitamin B3 50 mg
- ☐ Iron 25-50 mg
- ☐ SAMe 250-500 mg
- ☐ EPI Co-factors (if low or low range)
- ☐ SAMe 250-500 mg
- ☐ Address hypo-adrenia/ adrenal fatigue

LOW Adrenalin

- ☐ * N-acetyl l-tyrosine 250-1,500 mg
- ☐ * Macuna pruriens200-800 mg
- ☐ L-theanine100-500mg bid
- ☐ Co-factors
- ☐ Vitamin C 4-6 gm
- ☐ SAMe 250-500 mg
- ☐ Magnesium 150-500 mg
- ☐ Must address hypoadrenia

HIGH Adrenalin

- ☐ L-theanine 100-500 mg bid
- ☐ MAO/COMT Co-factors
- ☐ Vitamin B2 50 mg
- ☐ Vitamin B3: 50 mg
- ☐ Iron 25-50 mg
- ☐ SAMe 250-500

5. GLUTAMATE

It is the major excitatory neurotransmitter in the brain. There are many hidden sources of glutamic acid in the foods, or substances that stimulate glutamate acid production: 1] **Contains glutamic acid**: MSG, Yeast extract, anything "hydrolyzed or textured protein such as Soy, whey, Gelatin. 2] **Creates glutamic acid**: Bouillon and broth, flavoring", Soy sauce Seasonings, Barley malt or malt, carageenan. 3] **Suspect for Containing or producing glutamic acid**: Corn starch, corn syrup, high fructose corn syrup, Dextrose, Rice syrup. Brown rice syrup, most things low-fat or no fat [Reduced fat milk], Anything vitamin-enriched.

HIGH

- ☐ Reduce food sources of glutamic acid
- ☐ L-theanine 100-500 mg bid
- ☐ Co-Factors
- ☐ Vitamin B3 50mg

LOW

- ☐ L-glutamine 1,000 -3,000 mg
- ☐ P5P 50-200 mg
- ☐ Magnesium 150-500 mg (reduces toxicity]
- ☐ *Taurine 500-1,500 mg (reduces toxicity

6. GABA

The major relaxing & calming neurotransmitter in the brain, and synthesized from glutamate [an excitatory NT]. GABA A receptor is utilized by benzodiazepine drugs for anxiety, seizures, or muscle spasm, drug withdrawal. GABA may reduce symptoms of PMS, depression, excessive appetite, and some schizophrenias. Normally, GABA does not cross the BBB, but stress induces passage through the BBB, leading to headaches, nausea, and dizziness. Other causes of BBB breakdown are elevated blood glucose, environmental toxins, and systemic inflammation. Phenibut is a type of GABA that crosses the BBB *without the side effect or over sedation.*

LOW

- ☐ L-theanine 100-500 mg bid
- ☐ GABA 500-2,000 mg
- ☐ Phenibut 250-1,000 mg bid
- ☐ Glutamine 1-3g [always with P5P 50-200]
- ☐ Co-factors

HIGH

- ☐ L-theanine 100-500mg bid

GENETIC METHYLATION SNPS [another test]

- ☐ L-Methylfolate (It is recommended to avoid plain folic acid when a MTHFR defect is present, as the patient is unable to convert plain folic acid to the active form methylfolate)
- ☐ Methylcobalamin
- ☐ Pyridoxal-5-phosphate
- ☐ SAMe

MAO enzyme supported:

- ☐ Vitamin B2: 50 mg (ideally riboflavin 5 phosphate)
- ☐ Vitamin B3: 50 mg
- ☐ Iron: 25-50 mg

COMT enzyme supported by:

- ☐ SAMe: 250-500 mg
- ☐ Mg: 150-500 mg (or bowel tolerance)
- ☐ MTHF: 400-5,000 mcg
- ☐ Methylcobalamin: 1,000-5,000 mcg

How/Why Do these Supplements Work?

Amino Acid [AA] Testing

Amino Acids are the building blocks of neurotransmitters. They cross the blood brain barrier and interact with the HPA axis for NT regulation. Some AA tests include:

- ❊ Tryptophan hydroxylase [a common polymorphism]
- ❊ Serotonin 5 hydroxy-indole-acetic- acid [5hiaa organic acid]
- ❊ Saliva melatonin
- ❊ Methionine

☐ **Tryptophan** [precursor + niacin, tetra-hydro-biopterin+ iron]→ 5HTP [precursor+ B6, pyridoxyl-5-phosphate/ inhbited by copper]→SEROTONIN [+pathene, B5}→ N-ACETYL-SEROTONIN [+ SAME, melatonine, magnesium]→**MELATONIN**. SJW Standard dose 300 mg tid.

☐ **Tyrosine** [precursor] → L dopa → **DOPAMINE** [B2, B3, SAMe, Iron, COMT] → Nor Adrenalin [B2, B3, SAMe, Iron COMT] → Adrenalin [B2, B3, SAMe, Iron COMT]. **Cowhage** (mucuna pruriens) seeds (200-800 mg qd. small amounts of L-dopa [3-6%] lessen symptoms of Parkinson's disease

☐ Glutamine [precursor] → glutamate/ a-ketoglutatrate, glutamic acid [B3, B6] → **GABA /**Phenibut (250-1,000 mg bid]. The GABA molecule is technically too big to cross the blood brain barrier. But Phenibut, a derivative of GABA, has a phenyl ring added to it which allows it to cross the BBB while lower stress levels without adversely affecting performance.

☐ Taurine [precursor]

About the NT Cofactors

These help fuel the enzymes that speed up/slow down the conversion of precursors to active NT- *greatly impacted by Vitamin & mineral deficiencies [especially vitamin Bs:*

DOPAMINE

- ☐ **Tyrosine→ l dopa =** tyrosine hydroxylase + **C, D, B3, iron, MTHFR**
- ☐ **L dop→ DOP =** decabaxalase needs **PSP**

NE/EPI

- ☐ **DOP→ NE =** dopamine b-hydroxase + **C, copper, B3**
- ☐ **NE→ EPI** = phenylethanolamine methyltransferase (PNMT) + **SAMe, Mg , cortisol**

SEROTONIN

- ☐ **Typtophan→ 5HTP** = tryptophan hydroxylase + **C, D, B3, iron, MTHFR**
- ☐ **5HTP → serotonin** = decabaxalase + **PSP**
- ☐ **Serotonin→ acetyl serotonin** = n acetyl transferase/ AcS + none → melatonin = hydroxyindole meth + **SAMe**

GABA

- ☐ GLUTAMINE→ GLUTAMATE = GLUTAMINASE
- ☐ Glutamate → GABA= glutamate decoboxylase needs **B6**
- ☐ Glutamate → a-ketoglutarate = glutamate dehyroxylas needs **B3** and qmino transferees needs **B6**
- ☐ Glutamate→ GABA= decaboxylase needs **B6**

METHYLATED FORMS OF CO FACTORS

- ☐ B6 = pyridoxal-5-phosphate
- ☐ B2/ Folate = methyltetrahydrofolate (MTHF)/ methyl-folate
- ☐ B12 = methylcobalamin

CAUTIONS & CONSIDERATIONS

* Beneficial to give **tyrosine** and **macuna** together [adaptogenic and hydrocortisone-like effect].

* May be important to give a little **tyrosine** or **L-dopa** when giving **5-HTP**, and vice versa

***** Take Amino acids precursors [building blocks of the NT] on an empty stomach. This is at least 30 minutes before eating or at least one hour after eating

- Methylfolate and B12/ methylcobalamin are used when a person has a genetic MTHFR genetic deficit transforming dietary folic acid to the active form called Methylfolate. Or if these is a problem absorbing & assimilating these micronutrients [e.g. pernicious anemia, megablastic anemia, malabsorption]. These supplements also support the adrenal cortex and NT pathways. They are actually stimulating in nature so it is important to prepare your cells and biochemical pathways before charging them up. There are 3 notable responses to Methylfolate:
  1. A person has no side effects and begins to feel better than ever.
  2. A person starts methylfolate with very good results. Then the second week feels side-effects
  3. A person takes a small amount of methylfolate and feels all the methylfolate side effects immediately

  Side-effects of Methyl Folate:

irritability	acne	nausea
insomnia	rash	headaches
sore muscles	severe anxiety	migraines
Achy joints	palpitations	

  Functional Medicine has recommendations that include reducing stress [cultivating yin] that make a significant difference in response to Methylfolate. They are to first support biochemical pathways with:
  1. Electrolytes & Protein
  2. Glutathione
  3. SOD
  4. Methionine
  5. B vitamins and Multivitamin/mineral (*without* active B12, folic acid, Iron or Copper)
  6. NEVER take folic acid that is not methylated anyway, *it can do more harm than good!*

  In Chinese Medicine there are treatment principles that by default would avoid using a substance when it is not right for a person's constitution [regardless of lab test results]. Prepare your cells and biochemical pathways before charging them up means "cultivating yin (all the substance/ substrates to support anabolism) before tonifying yang [use of substance/ substrate, catabolism)." Yin deficiency can be detected in the tongue & pulse, and symptoms, and would be treated appropriately. All the side effects listed above would be avoided in this way. Even if a person has a medically diagnosed B12 and/or folic acid deficiency, it is still treated by the pattern of disease the person presents with. For example, intrinsic factor deficiency may be treated with Jie Nei Jin for food stagnation and protein maldigestion [B12 is ironically needed for protein digestion]. A genetic polymorphism implies Jing deficiency - *the transformation of yin into yang and visa versa* [transforming dietary folic acid into Methylfolate]. Jing is apparent in a person physiognomy, and history as well, and may be treated with a Jing substance such as Lu Rong.

ADDITIONAL NT SUPPORT

NERVINES [stress management]

- ☐ Hops•
- ☐ Passion flower •
- ☐ California poppy•
- ☐ Chamomile •
- ☐ Lavender
- ☐ Lemon balm/ melissa •
- ☐ Kava

☐ **Wild Oats** nourish nerves when depression & anxiety are due to deficiency. Individuals who suffer from neurasthenia [chronic exhaustion, emaciation & depression], may benefit from this herb. Oats, in all its forms, contains silica, which is a micronutrient that helps strengthens the myelin sheath over nerves. It contains nutrients that help the body hold onto calcium [which calms the shen & anchors yang]. It provides alkalinizing minerals to offset the acidic environment that accompanies illness and physiological stress. Oatstraw is a nutritive tonic for physical & nervous fatigue and is an especially strong nervine tonic for depression [it needs to be decocted for a very long time]. Wholegrain oatmeal & oatbran are beneficial during convalescence because they are easily digestible foods that contain many other nutrients. Wild oat milky seeds [oat grouts] tincture is excellent for stress, anxiety and insomnia.

☐ **Scullcap** is considered the best nervine sedative & tonic because it is both nutritive [helps rebuild nerve endings] and calming [without narcotic properties]. Scullcap acts on the CNS, cerebrospinal centers and sympathetic nervous system to control irritability and insomnia. It is therefore, a major herb to ease the symptoms accompanying drug & alcohol withdrawal. It also has detoxification and antispasmodic properties, which lessens the severity of spasms, jerks, tremors & delirium tremens.

☐ **Valerian** contains esters [volatile oil / essential oil], which are sedating. Any tincture form of an herb contains its volatile oils. Both valerian tincture and valerian herb are *very* sedating. The root is especially sedating and used for insomnia, anxiety, and many other kinds of nervous exhaustion disorders. It influences the cerebrospinal system and primary nerve centers to benefit neuralgias. It is important in the rehabilitation from substance abuse. But it is a hypnotic and one should take caution when using it concurrently with pharmaceutical hypnotics, opiates, benzodiazepines and alcohol, as one may feel over sedated, spacey and/or depressed.

☐ **Magnolia Bark /**Magnolol or honokiol is the active ingredient in supplement form that acts a little bit like benzodiazepines in that they binds with the GABA receptors. Works in 20-40 minutes. Also benefits hot flushes, night sweating, sleep disturbance and anxiety. *In Chinese medicine the whole herb is called* Huo Po and is *considered to be drying in nature. It* is used to eliminate Damp and regulates qi, meaning it is an important herb for reducing and eliminating abdominal distention & fullness. It also treats microbial toxicosis, viral infections and cell-mediated allergies.

☐ **Acetyl-choline & Magnesium** to calm nicotine cravings

ADAPTINOGENS [stress management]

Adaptogens are unique to the herbal kingdom in both tonifying both the adrenal cortex (cortisol) and the adrenal medulla (catecholamines]. They normalize the autonomic nervous system; normalize various NT involved in the stress response, and the perception of stress [tendency towards feeling stressed out]. They increase physical endurance and oxygen utilization. They reset the HPA axis to find or re-establish a normal diurnal rhythm. They reset the sensitivity of the hypothalamus and pituitary to the negative feedback from elevated cortisol levels occurring during stress. When this sensitivity is lost, the release of ACTH and corticotropin releasing factor [which stimulates the adrenal glands] is not shut down. The person gets stuck in a perpetual state of physiologic chronic stress response & inflammation.

Adaptinogens tend to be either stimulating for low cortisol [burn-out], or sedating for high cortisol stress. Some work in a fairly short period of time, while other require several weeks to months to feel clinically significant benefits.

- ☐ **L Theanine** 100-500 mg bid [divided dosing due to its short life-life (4-6 hours]. Raises the threshold for stress, in other words it takes more stress to kick off the stress response. Also benefits sleep. Acts as a GABA agonist (neuro-inhibitory and parasympathetic). Hs an antagonistic effects on glutamate receptors. It can modulate serotonin, GABA and dopamine levels. It produces a calming effect in the brain (boosts alpha waves]. When combined with caffeine, has been shown to increase focus and attention. "Mindful alertness."
- ☐ **American Ginseng** / Panax Ginseng/ Panax quinquefolius / 2 gm daily x 8 weeks. Increase as instructed. Will also benefit blood sugar levels. Treats yin deficiency, which is your main Chinese medicine diagnosis. *CHINESE* ginseng is more stimulating.
- ☐ **Siberian ginseng** / Eleutherococcus senticosus/ Acanthopanacis Senticosi 800mg daily. In Chinese medicine this herb tonifies qi, Augments the Heart Qi and calms the Shen. General weakness, malaise, anorexia, insomnia, fearfulness, stimulates adrenalin production. This is a relatively mild herb and can be combined with other tonics to strengthen its effects. *Contraindicated with digoxin, and antiboiotics.*
- ☐ **Rhodiola** is unique at improving physical & mental fatigue, for people who have lost/ loosing their coping skills & abilities and are a very high risk for depression.

VITAMIN D
Calcitriol activates the gene expression of tyrosine hydroxylase and tryptophan hydroxylase in the formation of serotonin and catecholamines.

FISH OILS [EPA & DHA in krill, shark, salmon olis, and cod liver]
Neuromodulatory, and antidepressant: EPA a potent anti-inflammatory, and DHA contributes to the fluidity of cell membranes. Both contribute to the proper structure & function of myelin in the brain.

PROBIOTICS
Dysfunction of the microbiome-brain-gut axis has been implicated in stress-related disorders such as depression, anxiety, and irritable bowel syndrome and neuro developmental disorders.

BACOPA [Read Original Article :http://www.herbslist.net/bacopa.html]
Bacopa is truly a great overall brain tonic. It contains bacosides & saponins which have a very beneficial effect on the brain's NTs and help repair damaged neurons. The bacosides is antioxidant and protects the brain from free radical damage. Bacopa extract is a possible treatment for Alzheimer's and Parkinson's, and ADHD. Through the consumption of Bacopa, one can greatly increase synaptic activity and the speed of nerve transmission and impulses. This in turn makes the thinking process faster and improves the speed of memory recall. Memory itself is enhanced due to Bacopa increasing the levels of Acetylcholine in the brain. Acetylcholine is the neurotransmitter that shuttles messages from one brain cell to another.

Many studies have proven significant improvement in the area of long and short term memory in people who consistently take a Bacopa herbal extract. While it's beneficial for people of all ages, anyone over the age of 40 will most likely benefit most from it. It can go a long way in keeping your brain and memory sharp.
Not only is this herb beneficial for the conditions mentioned above, it's also great for its anti-depressant and anti-anxiety effects. People taking this herb often report that they are better able to handle stress and feel less anxious and depressed then usual.

OXIDATIVE STRESS - Related NT Imbalance

Oxidative stress [OxS] is imbalance between free radicals and anti-oxidants at the cellular/ mitochondrial level. Free radicals production is part of normal cell metabolism and mitochondrial ATP production, as well as inflammation reactions. The immune system connects with the CNS via free radicals, which defends the body. Oxidative stress and Inflammation lead to a myriad of chronic problems:

- Damage to cell lipid membrane
- Impaired proteins, DNA synthesis
- Pro-inflammatory cytokines & immune NT
- Derailment of the sympathetic branch of the ANS: steroid pathways, HPA axis
- Derailment of metabolic pathways:
  - Tryptophan path → low **serotonin** = depression, insomnia, IBS, hot flash/cold sweat
  - Tryptophan path → low **kyneurenic acid [**neuro-protective**] +** high **quinolinic acid [**neuro degenerative**]** = Alzheimer's, dementia, cognitive impairments
  - Tyrosine → low NE, DOP, EPI = low SNS tone, fatigue, depression, addiction, weight gain/loss, OCD

Tests for OxS - *Test every patient with severe OxS for SNPs [3—50% have SNPs]*

- ☐ DOPAC 5-HIA 1831 →775 [immediate marker, fist indicator of response]
- ☐ 5-HIAA 3.8 → 1.9 [immediate marker]
- ☐ Taurine 1735→ 640 [immediate marker]
- ☐ Kynurenic acid [poor marker of chronic, good marker of acute svr]
  - **Normal** 14.2 [10-15] - **Acute** 35.1 ↑ - **Chronic** 18.3 ↑↓
  - quinolinic acid,
- ☐ **Oxidized LDL** (oxLDL)- mid marker responds in weeks. Heart diseases d/t oxidative stress. Normal 41.3- [20-30]- Acute 113- After treatment 61 [better than Tchol for CV risk],
- ☐ **Oxidized cardiolipin** (oxCLP)
- ☐ **Other**: mitosax, mitochondria function tests

Inflammatory Markers:

- ☐ **CRP** [inflammation occurs long before CRP is measurable, and can even disappear]
- ☐ **Neuro-immue derived NT**: Serotonin, *glutamate, glycine, histamine, noradrenaline, dopamine, phenyl-esyle-emaine [PEA] Dop, EPI, NE
- ☐ **Sulfite** [good urinary NT marker of inflammation or OxS, hydrogen sulfide from neutrophils]
- ☐ **Pro inflammatory cytokines**: IL-1β IL-6 TNF-α IFN-γ IL12,17, 18
- ☐ **Anti inflammatorycytokines**: IL-10, TGFb
- ☐ **Chemokine** IL-8 [yeast over growth]

Mitochondria Buffering Systems

Not everyone with inflammation gets OxS. It depends on duration of inflammation, acute or chronic, antioxidant capacity, genetic and epigenetic factors. Test Buffer**:**

- ☐ Superoxide dismutase (SOD1, SOD2, SOD3)
- ☐ Catalase (Cat)
- ☐ Glutathione peroxidase (GPX)

Markers of NON-Resolution/ recovery:

The CNS does not recover spontaneously after chronic inflammation is resolved- *There is the need for long term support:*

- ☐ Norepinephrine 47 26
- ☐ Dopamine 135 78
- ☐ Serotonin 120 75
- ☐ Taurine 526 83
- ☐ Epinephrine 2.8 1.0/8.5

Treatment:

Maximum antioxidants. Takes 2-4 months to get thing under control. It is now believed that antioxidants should be customized to a person's constitution. Yet not enough is understood about this in Western Medicine to apply this theory. One may need to experiment with a few different anti oxidants. This is a moot point with Chinese medicine, which inherently customizes treatment to a persons constitution based on their presentation and pattern of disease.

- ☐ Superoxide dismutase (SOD1, SOD2, SOD3)
- ☐ Catalase (Cat)
- ☐ Glutathione peroxidase (GPX)
- ☐ Cacao/ raw chocolate is the highest substance on the ORAC scale
- ☐ Most culinary herbs are antioxidant: rosemary is very high on the ORAC scale
- ☐ Green tea/ EGCG

NT PRECURSORS

Amino Acids are the buildingblocks of NT. They cross the blood brain barrier and they can interact with the HPA axis and neurotransmitter regulation. The GABA molecule is technically too big to cross the blood brain barrier.

- ☐ Tryptophan [**precursor**]→ 5HTP [**precursor**]→**serotonin**→ melatonin. SJW Standard dose 300 mg tid.
- ☐ Tyrosine [**precursor**] → L dopa → **Dopamine** [B2, B3, SAMe, Iron, COMT] → **NE** [B2, B3, SAMe, Iron COMT] → **Epi** [B2, B3, SAMe, Iron COMT]. **Cowhage** (mucuna pruriens) seeds (200-800 mg qd. small amounts of L-dopa [3-6%] lessen symptoms of Parkinson's disease
- ☐ Glutamine [**precursor**] → **glutamate**/ a-ketoglutatrate, glutamic acid [B3, B6] → **GABA /**Phenibut (250-1,000 mg bid a derivative of GABA has a phenyl ring added to it which allows it to cross. it can lower stress levels without adversely affecting performance
- ☐ Taurine [**precursor**]

COFACTORS help to fuel the enzymes important when conversion is slow.

DOPAMINE

- ☐ **Tyrosine→ l dopa =** tyrosine hydroxase needs **C, D, B3, iron, MTHFR**
- ☐ **L dop→ DOP =** decabaxalase needs **PSP**

NE/EPI

- ☐ **DOP→ NE =** dopamine b-hydroxase needs **C, copper, B3**
- ☐ **NE→ EPI** = phenylethanolamine methyltransferase (PNMT) NEEDS **SAMe, Mg , cortisol**

SEROTONIN

- ☐ Typtophan→ 5HTP= tryptophan hydroxylase needs **C, D, B3, iron, MTHFR**
- ☐ 5HTP→ serotonin = decabaxalase needs **PSP**
- ☐ Serotonin→ acetylserotonin = n acety transferesa/ AcS needs none → melatonin = hydroxyindole meth needs **SAMe**

GABA

- ☐ GLUTAMINE→ GLUTAMATE = GLUTAMINASE
- ☐ Glutamate → GABA= glutamate decoboxylase needs **B6**
- ☐ Glutamate → a-ketoglutarate = glutamate dehyroxylas needs **B3** and qmino transferees needs **B6**
- ☐ Glutamate→ GABA= decaboxylase needs **B6**

METHYLATED FORMS OF CO FACTORS

- ☐ B6 = pyridoxal-5-phosphate
- ☐ B2/ Folate = methyltetrahydrofolate (MTHF)/ methyl-folate
- ☐ B12 = methylcobalamin