

# **Nutrition and the Brain**

## **Basic Neurobiology**

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Unfortunately the main understanding of nutrition and the brain focuses on the fact that the brain requires glucose to function properly. Though that is an accurate statement, the fundamentals of nutrition and the brain doesn't begin with glucose at all. It begins with the main communication, and body building blocks, the amino acids.

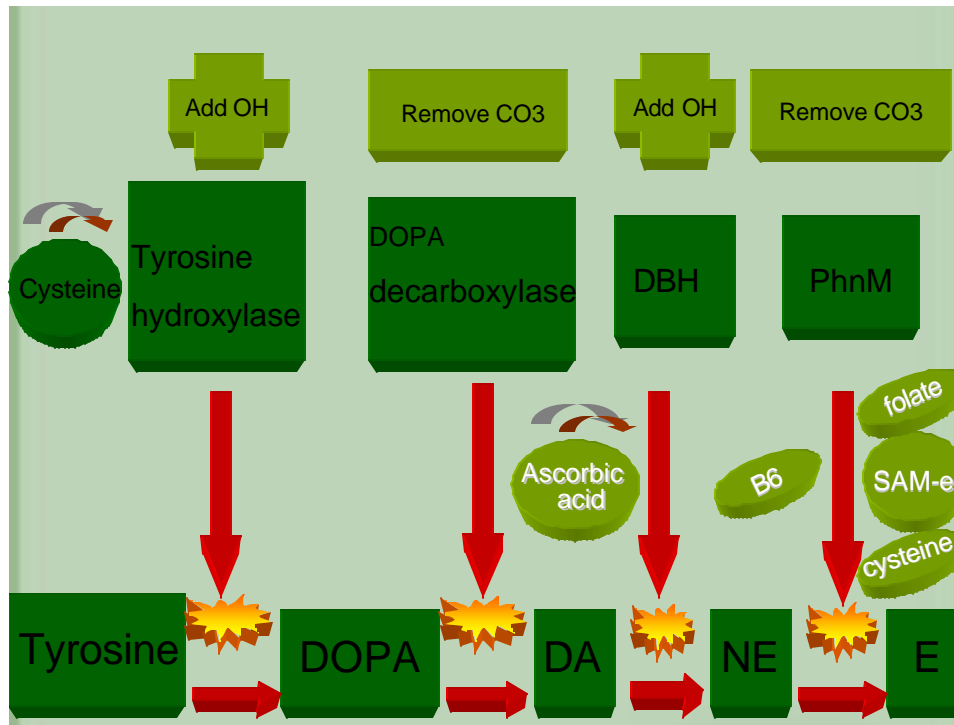
The way amino acids interact in the brain is an absolutely fascinating science. Once a basic understanding of nutritional neurobiology is grasped, it might change the view one has of amino acids and ask the question "what is an essential amino acid?"

Eight amino acids are generally regarded as essential for humans: tryptophan, lysine, methionine, phenylalanine, threonine, valine, leucine, and isoleucine. Two others, histidine and arginine are essential only in children. This is what I was taught in school. Then I started practicing, and noticed this may not be the case. Let me explain.

Neurotransmitters are chemical messengers that are used to relay, amplify and modulate electrical signals between a neuron and another cell. Though there are many, the common ones include acetyl choline, dopamine, norepinephrine, epinephrine, GABA, and serotonin.

Dopamine, norepinephrine and epinephrine are constructed from the nutrient soup inside our cells via the following pathway.

1. Tyrosine hydroxylase (adds a OH group) converts and amino acid L-Tyrosine into L-DOPA. This is called the rate limiting substance in catecholamine synthesis because if it is not present, the reaction will not continue. So there must be a mechanism to request from our genome appropriate levels of L-Tyrosine synthesis when needed. Cysteine makes up the sulfur group at the heart of heme-thiolate, the key enzyme that catalysis tyrosine hydroxylase.
2. DOPA, formed by hydroxylation of L-tyrosine, is then converted into dopamine by DOPA decarboxylase (take away a carboxyl group).
3. Dopamine is then converted into norepinephrine by DBH, dopamine--beta--hydroxylase (add a hydroxyl group to the beta carbon). Ascorbic acid is involved.
4. Norepinephrine is then converted into epinephrine by phenylethanolamine--N--methyltransferase (PhnM - add a methyl group to the amine group on the alpha carbon). L-cysteine, folate, B6 and SAME are involved in that enzyme reaction.



This graphic above illustrates what the basic formation of catecholamine synthesis within the human brain.

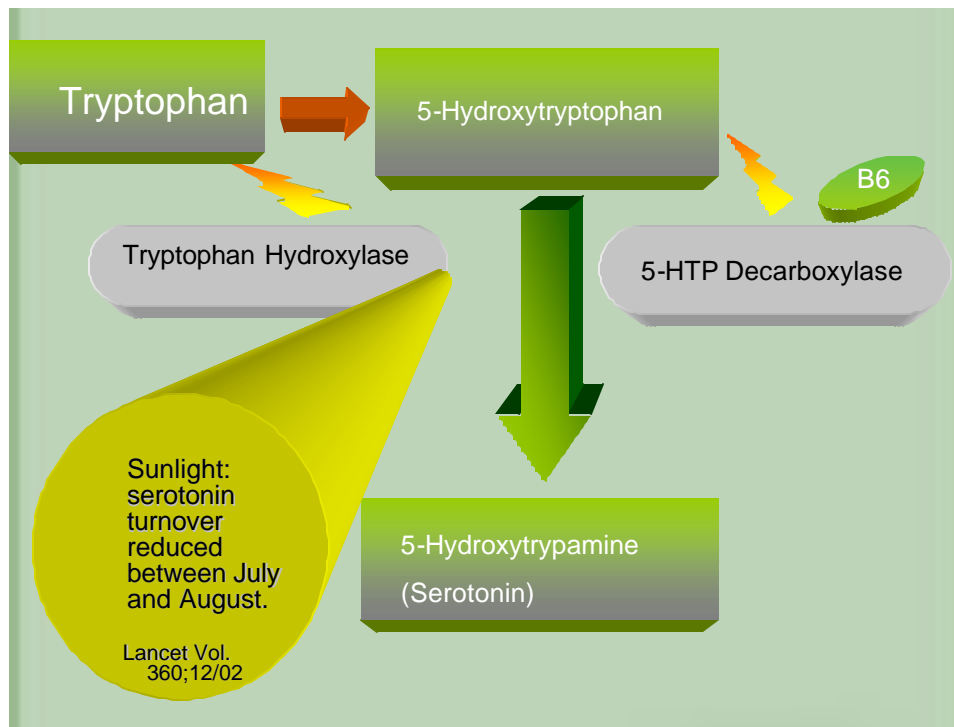
In clinical practice, I'm finding many patients are presenting with sulfur amino acid type deficiency symptoms such as delayed gastric emptying time, sensitivity to their environment such as in the condition environmental intolerance, better known as multiple chemical sensitivity, increased anxiety, sleeplessness, poor appetite.

When I hear those symptoms, I immediately request a neurotransmitter urine test to identify a base line measurement. If I notice low dopamine, or elevated norepinephrine with poor conversion to epinephrine, I think L-cysteine and L-tyrosine may be "conditionally essential" amino acids in this particular patient, and they might benefit from their supplementation.

Epinephrine helps stimulate the opening of the pyloric sphincter, allowing food contents to leave the stomach and enter the duodenum. Excess norepinephrine increases sensations of anxiety and sleeplessness. Low dopamine is usually associated with depression, poor focus, poor memory, low energy.

Though I'm being very basic here, and there are virtually hundreds of reactions induced by each neurotransmitter, it does indeed make you notice the effects of nutrition on the brain.

Let's take a look at serotonin production in the human brain. On a very basic level, the essential amino acid L-tryptophan meets with the enzyme tryptophan hydroxylase to form 5-hydroxytryptophan. The enzyme 5-HTP decarboxylase, initiated via B6, catalyzes 5-hydroxytryptophan into serotonin.



The graphic above depicts the said conversion of the essential amino acid L-tryptophan into serotonin. Note the added study from the Lancet regarding sunlight. To summarize, researchers found that vitamin D stimulated from sunlight exposure increases serotonin synthesis. Many patients with seasonal affective disorder have been receiving vitamin D therapy after measurement of 25 hydroxy Vitamin D levels were assessed.

There actually is a hierarchy of neurotransmitters and like everything else in the body, they strive to work together. The following graphic depicts that visually.

## The Neurotransmitter Hierarchy of the Catecholamine and Serotonin Systems

- Serotonin:
  - The Master Neurotransmitter controlling catecholamines
- Dopamine:
  - The Serotonin Modulator assuring the function of Serotonin
- Both Serotonin and Dopamine have to be present in adequate concentrations for the catecholamine system to function.

Serotonin plays a major role in not only the health of the brain and our sense of wellbeing, but also the health of the digestive tract and its efficiency of digestion.

The technology to measure neurotransmitters exists! At Fratellone Medical Associates, we measure urinary neurotransmitter levels and recommend targeted amino acid therapy based on those measurements.

Corrective neurotransmitter imbalances can help anxiety, depression, obesity, thyroid dysfunction, blood sugar imbalances, irritable bowel syndrome and other gastrointestinal disorders, headaches, sleeplessness, and numerous other conditions. Neurotransmitters dictate how the body will function. They affect every single cell, hormone and enzyme in the human body.