

Tyrosine - L-Tyrosine

Common Indications:

- Thyroid support
- Neurotransmitter support including dopamine pools
- Weight loss
- Stress support
- Phenylketonuria (PKU)

General Comments:

Tyrosine is a non-essential amino acid. It can be consumed from food or synthesized in the body from the essential amino acid phenylalanine. Tyrosine is the direct precursor to important neurotransmitters, such as dopamine, norepinephrine, and epinephrine. Some of the functions regulated by these tyrosine-dependent neurotransmitters include mood, stress response, mental function, satiety and sex drive. Tyrosine is also an important component of hormones that are produced by the thyroid. These hormones are in turn vital for managing metabolism. Tyrosine is required to form melanin, the dark pigment that provides protection from the harmful effects of ultraviolet light.

Benefits & Mechanism of Action:

Neurotransmitter & Hormone Production / Cognition

Tyrosine forms dihydroxyphenylalanine (DOPA), which is then converted into dopamine. It is then formed into noradrenaline and adrenaline. Laboratory animal studies have reported that tyrosine prevents depletion of brain catecholamines observed during acute environmental stress.¹ Tyrosine is also involved in the production of melanin, enkaphalins, and some types of oestrogen.^{2,3} One study found that treatment with L-tyrosine following one night of deprived sleep significantly reduced the usual performance decline on a psychomotor task compared to placebo.⁴

Thyroid Hormones

As tyrosine is the precursor for the synthesis of thyroid hormones, it is involved in the regulation of basal metabolic rate, oxygen use, cellular metabolism, growth and development (Tortora & Grabowski 1996). Tyrosine undergoes iodination to form monoiodotyrosine (T₁), a second iodination produces diiodotyrosine (T₂), and these combine to form triiodothyronine (T₃) and tetraiodothyronine (T₄).³

Antioxidant

L-Tyrosine, a monophenolic amino acid, demonstrates antioxidant activity in various assays, including 1,1-diphenyl-2-picryl-hydrazyl (DPPH) free radical scavenging, 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) (ABTS) radical scavenging, super-oxide anion radical scavenging, hydrogen peroxide scavenging, hydrogen peroxide scavenging, total ferric ion reducing power and metal chelating on ferrous ion activities, as well as inhibition of lipid peroxidation of linoleic acid emulsion. ⁵

Phenylketonuria (PKU)

In PKU, a severe deficiency of phenylalanine hydroxylase prevents the conversion of phenylalanine to tyrosine, resulting in a build-up of phenylalanine, which may cause severe mental retardation and a tyrosine deficiency. Thus, tyrosine is given as a supplement for the patient's deficiency. Free tyrosine supplementation has not always been shown to consistently improve neuropsychological function in PKU; this is possibly due to the fact that tyrosine levels naturally fluctuate through the day and increase in serum concentrations are not always maintained. ^{6,7}

Depression

Tyrosine is a popular supplement in mild depression due to its role as a precursor to both dopamine and noradrenaline. Also, it is a thought that tyrosine depletion may have a role in the pathogenesis of depression. Studies suggest that tyrosine's enhancement of epinephrine production may reduce effects of stress like short-term memory loss and depression. ⁸ Whether tyrosine supplementation has a major effect on mood and depression is still unclear as interventional clinical studies have produced inconsistent results. ⁹

Drug Withdrawal

Tyrosine has been used to aid in the withdrawal of cocaine, caffeine, and nicotine. Anecdotal reports and animal studies suggest it is successful; however large controlled studies are not available to determine clinical significance. Chronic cocaine use is believed to cause catecholamine depletion. As of date, results from trials using tyrosine as a stand-alone treatment during cocaine withdrawal have produced lacking results. ^{10,11}

Stress Adaptation

Tyrosine appears to enhance the release of catecholamines when neurons are firing at an increased rate due to stress, but not at their basal rates (Young 2007). Supplementation was found to reduce the effects of stress and fatigue on cognitive performance in a study conducted with a group of 21 cadets during a military combat training course. ¹²

Weight Loss

Tyrosine supplements have been used in weight loss. It could be used to potentially suppress appetite and stimulate brown adipose tissue due to its enhancement of noradrenaline synthesis. Also, since it is a precursor for thyroid hormones, it may also increase the basal metabolic rate.

Dose:

- 500 - 1,500 mg daily in divided doses
- Drug can be given three times daily

Signs/Symptoms of Deficiency:

- Depression
- Hypotension
- Cold Intolerance
- Restless Legs Syndrome
- Hypothyroidism
- Medications which may lead to depletion of tyrosine include:
 - Oral contraceptives

Cautions & Side Effects:

- Headache, Mild GI upset, Nausea, Fatigue, Heartburn, Arthralgia, Insomnia, and Nervousness
- Caution should be use if taking the following medications with tyrosine:
 - Antidepressants
 - CNS Stimulants
 - Levodopa
 - Morphine Sulfate
 - Thyroid medications

Food Sources:

- Soy products
- Chicken
- Fish
- Almonds
- Avocados
- Bananas
- Dairy Products
- Meat
- Eggs
- Nuts
- Beans
- Oats
- Wheat
- Pumpkin Seeds
- Sesame Seeds
- Yogurt

References:

Neurotransmitter & Hormone Production / Cognition

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Drug Withdrawal

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Stress Adaptation

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