

# The Biochemistry of Neurotransmitters

Neurotransmitter	Structural Precursors	Enzyme Catalysts	Metabolites	Signs of deficiency	Signs of excess	Sources and supplements
Acetylcholine	Choline Acetyl CoA	Choline acetyltransferase Acetylcholinesterase	Acetate Choline	Myasthenia gravis, weakness, fatigue, spastic paralysis, insomnia, memory loss, Alzheimers	Anxiety, hallucinations, tachycardia, flaccid paralysis diarrhea, sweating	Choline rich foods, Thiamin, B12, phosphatidylcholine
<b>Biogenic Amines:</b>						
Serotonin - 5HT (5-hydroxytryptamine)	Tryptophan 5-HTP (5-hydroxytryptophan)	Tryptophan Hydroxylase 5-HTP Decarboxylase	5-HIAA (5-hydroxyindoleacetic acid)	Depression, sleep disturbance, dementia, overeating, OCD migraine headache, anxiety	Anxiety, loss of appetite, hypersomnia, headache, depression, asthma	High tryptophan foods, 5-HTP, Vitamin B6
Dopamine	Tyrosine L-DOPA	Tyrosine Hydroxylase L-DOPA decarboxylase	Norepinephrine	Parkinson's disease, tremors, apathy, depression	Schizophrenia, anxiety irritability, hallucinations	Tyrosine rich foods, Kava, cocaine
Norepinephrine	Tyrosine Dopamine	Dopamine B-hydroxylase	Epinephrine	Fatigue, severe depression, increased appetite, bradycardia	Anxiety, paranoia, tachycardia, decreased appetite	Tyrosine rich foods, amphetamines
Epinephrine	Tyrosine Norepinephrine	phenylethanolamine-N-methyltransferase	Vanillylmandelate (VMA)	Asthma, bradycardia, hypotension, allergic reactions	Hypertension, tachycardia, impaired gastric motility, anxiety	Tyrosine rich foods
Histamine	Histidine	Histidine decarboxylase		decreased gastric acid production,	Vaso dilation, allergic reactions, asthma, eczema, ulcers, reflux, hives, itching	Histamine inhibitors: 1. Coleus forskolii 2. Licorice 3. Flavinoids (quercetin) 4. Grape seed (Vitis vinifera) 5. Ginko biloba 6. Green tea (Camellia sinensis)
<b>Amino Acids:</b>						
GABA (gamma-aminobutyric acid)	Glutamate	Glutamic acid decarboxylase	Succinate	Seizure, anxiety, aggression tremors, delirium, hallucinations, headaches.	Lethargy, respiratory depression, lower inhibitions, relaxation	Glutamate rich foods, GABA
Glycine	undetermined	undetermined				
Glutamate	undetermined	undetermined	GABA	Relaxation, depression	Tremor, seizure, anxiety	Glutamate rich foods

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