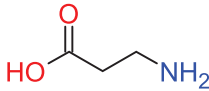
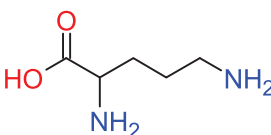
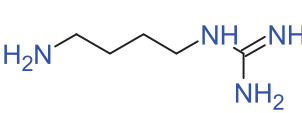
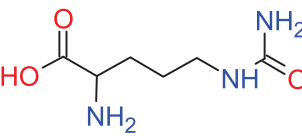
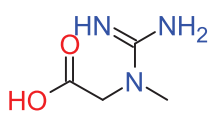
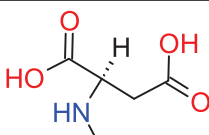
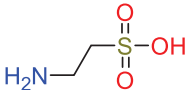
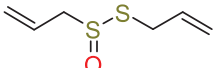
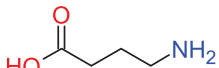
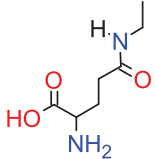
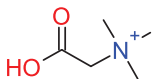
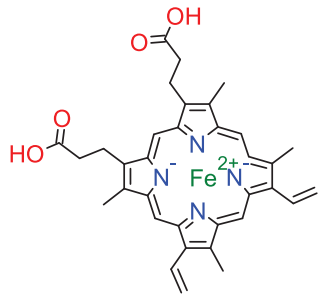
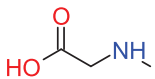


TABLE 2.4 Biological roles of non-protein aminoacid derivates and analogues. Abbreviations: GABA – γ -aminobutyrate; SAM – S-adenosylmethionine. Adapted from [166].

Amino Acid		
Derivate	Structure	Biological Role
Alanine		
β -alanine		<ul style="list-style-type: none"> • A component of vitamin B₅ and coenzyme A • A component of antioxidant dipeptides carnosine, carbinine, anserine, and balenine
Arginine		
Ornithine		<ul style="list-style-type: none"> • Amino acid degradation and ammonia detoxification (urea cycle intermediate) • Proline, glutamate, and polyamine biosynthesis • Mitochondrial integrity • Wound healing
Agmatine		<ul style="list-style-type: none"> • Modulator of various biological processes, like neurotransmission, ion transport, NO synthesis, and polyamine metabolism
Nitric oxide (NO)		<ul style="list-style-type: none"> • Regulation of hemodynamics and blood pressure through vasodilation (widening of blood vessels) • Innate immunity (as antibacterial agent produced by macrophages) • Neurotransmission (learning and memory through long-term potentiation)
Citrulline		<ul style="list-style-type: none"> • Anti-oxidation • Arginine synthesis • Osmoregulation • Amino acid degradation and ammonia detoxification (urea cycle intermediate) • Nitrogen reservoir
Creatine		<ul style="list-style-type: none"> • Skeletal muscle action (ATP replenishment after strenuous activity) • Anti-oxidation
Aspartate		
NMDA		<ul style="list-style-type: none"> • Neurotransmission (excitation, withdrawal)

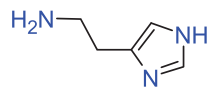
Amino Acid		
Derivate	Structure	Biological Role
Cysteine		
Taurine		<ul style="list-style-type: none"> • Digestion (conjugation of bile acids to form bile salts) • Anti-oxidation and regulation of cellular redox state • Osmoregulation • Modulation of calcium homeostasis
Glutathione	Glu-Cys-Gly	<ul style="list-style-type: none"> • Major endogenous antioxidant • Inflammatory response (participation in leukotriene synthesis) • Detoxification (conjugation to hydrophobic toxins in liver) • Metabolism (processes involving DNA, proteins, and hormones)
Alliin		<ul style="list-style-type: none"> • Antimicrobial activity • Anti-cancer activity
Glutamate		
GABA		<ul style="list-style-type: none"> • Neurotransmission (inhibiting neuronal excitability) • Regulation of muscle tone • Inhibition of T-cell response and inflammation
Glutathione	Glu-Cys-Gly	<ul style="list-style-type: none"> • See cysteine above
Glutamine		
Theanine		<ul style="list-style-type: none"> • Anti-oxidation • Neurotransmission (increasing brain levels of GABA, dopamine, serotonin, and glycine) • Neuroprotective effect
Glycine		
Trimethylglycine (betaine)		<ul style="list-style-type: none"> • Homocysteine methylation (methionine regeneration; homocysteine detoxification) • One-carbon unit metabolism (synthesis of bioactive molecules and SAM) • Osmoregulation
Heme		<ul style="list-style-type: none"> • Oxygen binding and transport • Electron binding and transport • CO production
Sarcosine		<ul style="list-style-type: none"> • Intermediate in glycine metabolism • Possible treatment of certain mental disorders
Glutathione	Glu-Cys-Gly	<ul style="list-style-type: none"> • See cysteine above

Amino Acid

Derivate	Structure	Biological Role
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Histidine

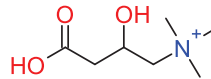
Histamine



- Mediation of allergic reaction
- Vasodilation
- Brain acetylcholine secretion
- Regulation of gut function

Lysine

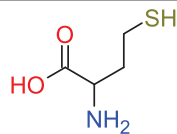
Carnitine



- Energy production by lipid oxidation

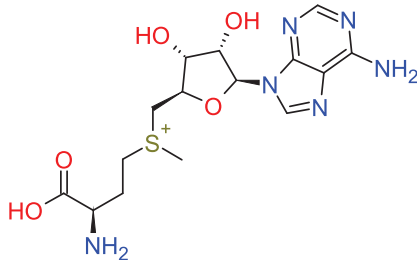
Methionine

Homocysteine



- Cysteine biosynthesis
- Methionine regeneration
- Risk factor for cardiovascular diseases

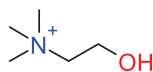
SAM



- One-carbon unit metabolism (synthesis of different bioactive molecules)

Serine

Choline



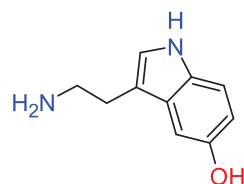
- Neurotransmission and muscle control (acetylcholine)
- Membrane structure (phosphatidylcholine, sphingomyelin)
- Trimethylglycine (betaine), methionine, sarcosine and SAM synthesis

D-serine

- Brain neurotransmission (activation of NMDA receptors)

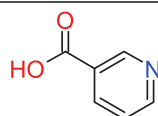
Tryptophan

Serotonin



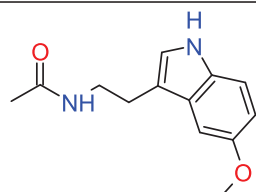
- Neurotransmission (mood, appetite, sleep, memory, learning)
- Hemostasis and blood clotting (as vasoconstrictor)
- Inhibiting production of inflammatory cytokines and superoxide radical

Niacin



- Redox metabolism (as component of NADH and NADPH)

Melatonin



- Hormonal mediation of day-night cycles
- Anti-oxidation
- Possible effect on immune system and inflammatory response

Amino Acid

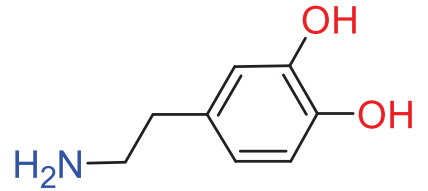
Derivate

Structure

Biological Role

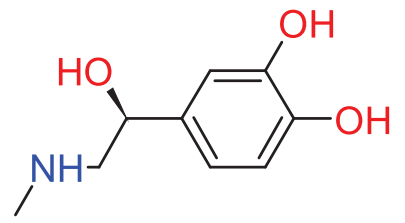
Tyrosine

Dopamine



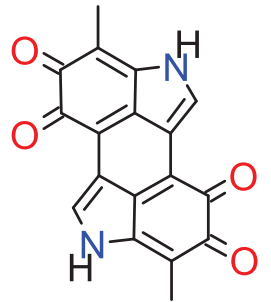
- Neurotransmission (reward-motivation, motor control, vasodilation, regulation of prolactin secretion)

Epinephrine and norepinephrine



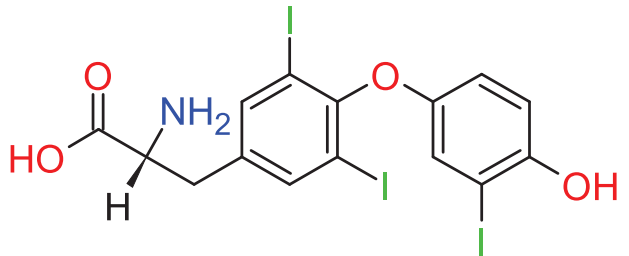
- Neurotransmission (exercise, 'fight-or-flight', emotional response, memory)
- Muscle activity
- Sugar metabolism

Melanin



- Pigmentation
- Anti-oxidation

T3 and T4



- Regulation of metabolic rate (thyroid hormones)