

**Protein Amino Acids:
Sources, Characteristics, and Uses in Farming, Food, Fiber, and Cosmetics**

Amino Acid	Methods*	Characteristics	Uses
L-Alanine	Chem, GMO, SF	A white odorless crystalline powder having a sweetish taste. Freely soluble in water, sparingly soluble in alcohol. Optically inactive. The pH ranges between 5.5 and 7.0. Melting point 198° C.	Nutrient, dietary supplement.
L-Arginine	Ext, Ferm, GMO	White crystals or white crystalline powder. Freely soluble in water, insoluble in ether, sparingly soluble in alcohol. Strongly alkaline: absorbs CO ₂ from the air.	Nutrient, dietary supplement.
L-Asparagine	Ext	White crystals or white odorless crystalline powder having a slightly sweetish taste. Soluble in water, practically insoluble in alcohol and ether. MP 234-235° C.	Nutrient, dietary supplement, culture medium, cosmetic.
L-Aspartic acid	Enzy, Ferm, GMO	Colorless or white odorless crystals or white crystalline powder having a slightly acid taste. Soluble in water, practically insoluble in alcohol and ether. MP 270-271° C.	Nutrient, dietary supplement, flavoring.
L-Cysteine	Ext, Chem, Enzy, Ferm	Monohydrochloride salt: White odorless crystalline powder having a characteristic acid taste. Slightly sweetish taste. Soluble in water and alcohol. MP 175° C.	Anti-oxidant, dough conditioner, flavor / aroma enhancer, nutrient, dietary supplement.
L-Cystine	Ext, Chem	Colorless, practically odorless white crystals. Soluble in dilute mineral acids and in alkaline solutions. Slightly soluble in water and alcohol. Decomposes at 260°C.	Nutrient, dietary supplement. Emollient.
L-Glutamic acid	Ferm, GMO	A white, practically odorless, free-flowing crystalline powder. Slightly soluble in water, forming acid solutions. The pH of a saturated solution is about 3.2. MP 160°C.	Flavoring agent, nutrient, dietary supplement, salt substitute, chelating agent, antioxidant, softener, plant growth regulator.
L-Glutamine	Ferm	White odorless crystals or crystalline powder havine a slightly sweet taste. Soluble in water, practically insoluble in alcohol and in ether. Solutions are acid to litmus tests. Decomposes at 185°C.	Nutrient, dietary supplement, medicine, culture media.
Glycine	Chem	A white, odorless, crystalline powder having a sweetish taste. Solutions are acid to litmus tests. Decomposes at 233°C.	Nutrient, dietary supplement, texturizer, preservative, antioxidant.
L-Histidine	Ferm, GMO, SF	White odorless crystals or crystalline powder having a slightly bitter taste. Soluble in water, slightly soluble in alcohol, and insoluble in ether. MP / decomposition at 277-288°.	Nutrient, dietary supplement, chelating agent, used in cosmetic creams.
L-Isoleucine	Ferm, GMO, SF	Crystalline leaflets or a white crystalline powder with a bitter taste. It is soluble in water, hot alcohol, diluted mineral acids, alkaline solutions. Sublimes between 168 and 170°, decomposes at 184°. The pH is between 5.5 and 7.0.	Nutrient, dietary supplement.
L-Leucine	Ext, Ferm, Enzy	Small white lustrous plates, or a white crystalline powder. Sweet taste. Soluble in water, acetic acid, hydrochloric acid. Sparingly soluble in alcohol. Sublimes at 150°. Decomposes at 293-295°.	Nutrient, dietary supplement.
L-Lysine	Ferm, GMO, Ext	(monohydrochloride salt) A white or nearly white, practically odorless, free-flowing crystalline powder. Freely soluble in water, insoluble in alcohol and ether. MP 260°.	Nutrient, dietary supplement, chelating agent.
L-Methionine	Chem, Enzy (from synthetic precursors), SF	Colorless or white lustrous plates, or a white crystalline powder. Has a slight, characteristic odor. Soluble in water, alkali solutions, mineral acids. Slightly soluble in alcohol, insoluble in ether. MP 280-282°C.	Nutrient, dietary supplement, flavoring, texturizer.
L-Phenylalanine	Chem, Ferm, GMO, Enzy, SF	Colorless or white lustrous platelike crystals, or a white crystalline powder. Slight, characteristic odor and bitter taste. Soluble in water, alcohol, mineral acids, alkali hydroxides. MP 283°C. pH 5.4-6.	Nutrient, dietary supplement, emollient.
L-Proline	Ferm, GMO, SF	White crystals or white crystalline powder, odorless and has a slightly sweet taste. Very soluble in water and in alcohol, insoluble in ether.	Nutrient, dietary supplement.

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L-Serine	Chem, Ferm, GMO, Enzy, SF	A white crystalline powder without odor having a sweet taste and insipid aftertaste. Soluble in water, insoluble in alcohol and ether. MP 228° C.	Nutrient, dietary supplement.
L-Threonine	Chem, Ferm, GMO, SF	A white odorless crystalline powder having a slightly sweet taste. Soluble in water, practically insoluble in alcohol, chloroform, and ether. MP 256° C.	Nutrient, dietary supplement.
L-Tryptophan	Chem, Ferm, GMO, Enzy, SF	White to yellowish white crystals or crystalline powder having a bitter taste. Soluble in water, soluble in hot alcohol, hydrochloric acid and alkali hydroxide. MP 289° C.	Nutrient, dietary supplement, cosmetics.
L-Tyrosine	Ext, Ferm, GMO, Enzy	Colorless, silky needles or a white crystalline powder. Soluble in water, mineral acids, alkali solutions. Slightly soluble in alcohol. MP 342° C.	Nutrient, dietary supplement.
L-Valine	Chem, Ferm, Enzy	A white odorless crystalline powder having a characteristic taste. Freely soluble in water, practically insoluble in alcohol and in ether. The pH in solution is between 5.5 and 7.0. MP: 315° C.	Nutrient, dietary supplement, sun screen.

Sources: Areki and Ozeki, 1991; Ashford, 1994; Budaveri, 1996; Food Chemicals Codex, 1981; Johnson & Peterson, 1974; Winter, 1989.

*Legend: Chem: Chemical synthesis; Enzy: enzymatic process; Ext: Extraction; Ferm: Fermentation; GMO: Genetically modified organisms; SF: Semifermentation (combination of chemical and fermentation processes)