

GLYCINE

A Versatile Formulation Ingredient

Animal Feeds



pH Buffering



Flavor Masking/Enhancement



Chemical Intermediate



G E O[®]
SPECIALTY CHEMICALS

GLYCINE – A Simple Amino Acid with Complex Functionality

Glycine, also known as aminoacetic acid, is the simplest amino acid. Found naturally in many foods, glycine is also synthesized in the human body, where, among other functions, it helps improve glycogen storage, is utilized in the synthesis of hemoglobin, collagen, and glutathione, and facilitates the amelioration of high blood fat and uric acid levels.

In addition to the important metabolic functions glycine performs, this versatile substance is widely used in a range of applications, such as flavor enhancers and maskers, pH buffers and stabilizers, ingredients in pharmaceutical products, and as a chemical intermediate.

At Home in a Host of Applications

Flavor Masking/Flavor Enhancement

Glycine has a refreshingly sweet taste, and is one and a half times as sweet as sugar. In addition to its sweetness, glycine also has the ability to mellow saltiness and bitterness. The bitter after-taste of saccharin, for example, is masked by glycine. Carbonated soft drinks and flavor concentrates based on saccharin may contain up to 0.2 percent glycine based on the finished beverage. Glycine is also used to mask the bitter tastes of some hydrolyzed proteins and other food substances, especially in applications such as animal and aquaculture feed.

Thanks to its sweet, cool taste and its ability to mask bitterness, glycine is also used to enhance the consumer appeal of oral medications and hygiene products such as tablets, lozenges, mouthwashes, and cough syrups.



Buffering/pH Stabilization

With acidic and basic properties in the same molecule, glycine acts to buffer or stabilize the pH of those systems containing it. Many of the uses for glycine depend on this ability.

Glycine's efficiency in stabilizing pH has resulted in its wide usage as a buffering agent in many pharmaceutical products. Antacid and analgesic products are often formulated with glycine to stabilize the acidity of the digestive tract and prevent hyperacidity. Glycine has been shown to promote the gastric absorption of certain drugs, including aspirin.

When formulated in an aluminum-zirconium tetrachlorohydrate complex, glycine buffers the high acidity of active ingredients in antiperspirants. It is also an effective buffer in cosmetics, toiletry products and nasal sprays.

Other Pharmaceutical Applications

Glycine is used as a component of amino acid mixtures for oral and parenteral use and as a resorbable amino acid for the treatment of diarrhea and animal scours. It is a versatile intermediate in the chemical synthesis of pharmacologically active compounds. Glycine has antimicrobial preservative properties and has been shown to stabilize Vitamin C.

Chemical Intermediate

The simple multifunctionality and low cost of glycine give it exceptional utility as a chemical building block in a variety of industrial, technical, and synthetic applications. These include rubber foam sponge production, metal plating baths, and chemical synthesis, among others.



Product Grades Available

GEO is the leading manufacturer of glycine in North America. GEO offers five grades of glycine – USP-NF Pharmaceutical grade, USP-NF grade, Electronics grade, Technical grade and Industrial grade. The USP-NF Pharmaceutical grade is used for Intravenous (IV) Injections and propriety specifications. The USP-NF grade is suitable for antiperspirant, animal feed, pH buffers, and sweeteners. All grades offer exceptional purity, including low chloride levels, to meet the demanding requirements of food, pharmaceutical,

and personal care product formulations. All grades have earned Kosher & Halal certifications. Additional testing of pyrogen content and aluminum is available for specific customer requirements. The technical grade product is suitable for most industrial and technical applications; in agricultural uses it improves the efficacy and delivery of nutrients. For more information on Electronics and Industrial grade glycine, please contact Customer Service.

Chemical and Physical Properties

Appearance	white, crystalline powder	
Molecular Weight	75.07	
Melting Point	245°C with decomposition	
CAS Registry Number	56-40-6	
pK ₁	2.34	
pK ₂	9.60	
Isoelectric Point	5.97	
pH of 0.1 Molar Solution	6.06	
Solubility in 100 ml Water	25.0g @ 25°C	39.1g @ 50°C
	54.4g @ 75°C	67.2g @ 100°C
Solubility in 100g Absolute Ethanol	0.06g @ 25°C	

GEO Glycine Aminoacetic Acid, Technical Grade

Formula	H ₂ N—CH ₂ —COOH
Description	white to off-white crystalline powder
Assay	98.5% minimum calculated on a dry basis
Loss on Drying	0.2% maximum
Residue on Ignition	0.1% maximum
Sulfate	200 ppm maximum

GEO Glycine Aminoacetic Acid, USP 34-NF 29 Grade

Formula	H ₂ N—CH ₂ —COOH
Description	white, odorless, crystalline powder with sweet taste
Assay	98.5–101.5% calculated on a dry basis
Loss on Drying	0.2% maximum
Residue on Ignition	0.1% maximum
Chloride	70 ppm maximum
Sulfate	65 ppm maximum
Heavy Metals	20 ppm maximum
Hydrolyzable Substances	passes test
Identification	passes test
Residual Solvents	meets the requirements

The specifications listed above conform to standards set by the United States Pharmacopeia 34 and National Formulary 29, through the Second Supplement.

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GEO Glycine Aminoacetic Acid, USP-NF Pharmaceutical Grade

Formula	$\text{H}_2\text{N}-\text{CH}_2-\text{COOH}$
Description	white, odorless, crystalline powder with sweet taste
Assay	98.5–101.5% calculated on a dry basis
Loss on Drying	0.2% maximum
Residue on Ignition	0.1% maximum
Chloride	70 ppm maximum
Sulfate	65 ppm maximum
Heavy Metals	10 ppm maximum
Hydrolyzable Substances	passes test
Identification	passes test
Residual Solvents	meets the requirements
Endotoxins [Pyrogens]	3.69 EU/g maximum
Silicon	0.5 ppm maximum
Iron	Run & Record
Aluminum	Run & Record

The specifications listed above conform to standards set by the United States Pharmacopeia 34 and National Formulary 29, through the Second Supplement.

A Proven Performer in Flavor Applications

The flavor performance of glycine is well documented in controlled laboratory tests as well as in actual product applications. Glycine's ability to mask bitter flavors while imparting a cool, sweet taste helps formulators enhance the appeal and palatability of products such as mouthwashes, tablets, syrups, and lozenges. The test data shown below provides an example of glycine's ability to improve flavor.



Flavor Enhancement of Zinc Acetate Solution (Lozenge)

In tests conducted by an independent laboratory, glycine's effect on flavored zinc acetate solutions was studied. After establishing a taste profile for a reference solution containing only cherry flavor and sucrose, a ten-member panel of ASTM-trained judges evaluated two additional formulations containing 0.25% zinc acetate. One of the additional formulations contained glycine, the other did not. As illustrated by the data shown below, glycine improved the flavor of the formula containing zinc acetate.

Flavored Zinc Acetate Formulations

	Base %	With Glycine %	Without Glycine %
Zinc acetate, dihyd, USP	—	0.25	0.25
Glycine	—	0.25	—
Sucrose	12.0	12.0	12.0
Citric acid, anhyd	0.1	0.1	0.1
Cherry flavor (Hagelin)	0.2	0.2	0.2
Sodium benzoate	0.1	0.1	0.1
Water	q.s.	q.s.	q.s.
	100.0	100.0	100.0

Results

Flavor Profile Rating Summary (Mean Scores N = 20)

Attribute	Base %	With Glycine	Without Glycine
Aroma	5.0	4.5	4.3
Cherry flavor	5.2	4.0	2.9
Astringency	2.0	4.5	5.5
Metallic flavor	1.7	4.3	5.2
Sweetness	5.6	3.5	2.4
Mouthfeel	2.3	4.1	4.6
Aftertaste	2.2	4.9	5.6

Scale: 1 = None 2 = Slight 4 = Definite 6 = Strong 8 = Very Strong

Conclusion: Glycine improves the overall flavor of a product containing zinc acetate.

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GLYCINE – a Multifunctional Product

Flavor Modification

- Soft drinks
- Lozenges and tablets
- Syrups
- Mouthwashes
- Livestock feed

Buffering

- Antacids
- Analgesics
- Cosmetics
- Antiperspirants
- Toiletries

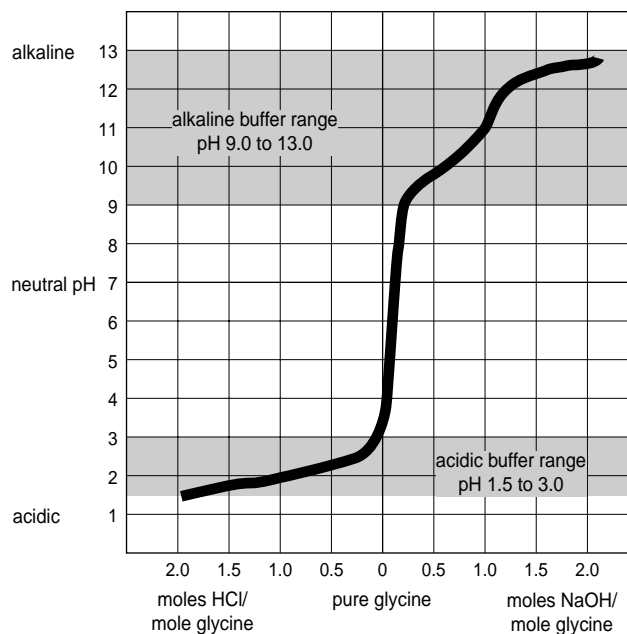
Chemical Building Block

- Pharmaceuticals
- Agricultural chemicals

Unique Buffering/pH Stabilization Properties

Unlike most other buffering compounds, which are capable of stabilizing pH in only one pH range, glycine has two pH buffering or stabilizing regions. The accompanying graph illustrates the change in pH after addition of acid (HCl) or base (NaOH) to glycine. As you can see, glycine exhibits excellent buffering action between pH 1.5 to 3.0 and between pH 9.0 to 13.0.

Buffer Characteristics of Glycine



Quality Products and Quality Support

GEO produces glycine in a modern, ISO 9001:2008 certified, high capacity manufacturing facility adhering to current Good Manufacturing Practices (cGMPs) established by the U.S. Food and Drug Administration (FDA). Our unique process technology offers unsurpassed purity, outstanding economy, and long-term cost stability. GEO has a glycine Drug Master File registered with the FDA.

Whether you are investigating the use of glycine in a personal care product, a pharmaceutical application, an animal feed, or other application, the GEO technical team is standing by to offer the assistance and technical support you need to successfully and cost-effectively incorporate glycine in your product formulation. Our research into the chemical reactions of glycine, its precursors, and derivatives is ongoing, and our growing body of knowledge on amino acid chemistry is at your disposal.

Want More Information?

For flavor masking, flavor enhancement, buffering action, or one of the other functional contributions outlined in this bulletin, glycine can deliver the performance you require at economical addition rates. To learn more about using glycine in your application, or for other sales or technical assistance, call 888-519-3883 or fax: 215-773-9310. To place an order, or for the name of the distributor of GEO products nearest you, call our customer service center at 888-519-3883.

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