



## GLYCINE POWDER

SOURCE OF AN AMINO ACID INVOLVED IN MUSCLE PROTEIN SYNTHESIS

180 G | NPN80095031 | GLY180-CN

Designs for Health's **Glycine Powder** offers the amino acid glycine in a pure powder form for flexible dosing and patient convenience. Glycine is a conditionally essential amino acid used for structural protein synthesis, detoxification pathways, and neurotransmitter function. It is the smallest amino acid, with a side chain consisting of just a single hydrogen atom. Although glycine is synthesized from serine in the human body, endogenous synthesis has been shown to fall far short of meeting the many biological and metabolic demands for this amino acid in healthy adults.<sup>1</sup> The need for supplemental glycine may be even greater during times of acute emotional or physiological stress, and among individuals recovering from physical trauma.

### STRUCTURAL AND TRANSPORT PROTEINS

Glycine is a primary constituent of collagen, making up over one third of the total amino acids in this key structural component of blood vessels, skin, bones, cartilage, tendons, ligaments, and other connective tissue. A reaction between glycine and succinyl-CoA resulting in  $\delta$ -aminolevulinic acid is the rate-limiting first step in the synthesis of the heme constituent of hemoglobin, myoglobin, and the cytochrome proteins.<sup>2</sup> Glycine is also required for nucleic acid synthesis. For these reasons, glycine supplementation may be beneficial for supporting protein synthesis, tissue repair, and wound healing.<sup>3</sup> In rat models of tendonitis, a high-glycine diet resulted in reduced inflammation and improved tissue repair, including higher concentrations of hydroxyproline and glycosaminoglycans.<sup>4</sup> Rats undergoing laparotomy who were supplemented with a 1% glycine diet (plus arginine) had greater overall nitrogen retention, higher ratios of type III/type I collagen, and more hydroxyproline than unsupplemented controls, mostly due to increased collagen synthesis in the wounds.<sup>5</sup> Mouse models of cancer cachexia indicate that glycine (injected subcutaneously) reduced loss of muscle and fat mass, and blunted increases in inflammatory markers. Similar improvements were not seen with isonitrogenous doses of alanine or citrulline, suggesting that the beneficial effects on tissue sparing are glycine-specific.<sup>6</sup>

### DETOXIFICATION, GLUTATHIONE SYNTHESIS, AND LIVER FUNCTION

Glycine is one of the amino acids that make up the glutathione tripeptide (a.k.a. gamma-glutamyl-cysteinyl-glycine). Reductions in glycine concentration from protein malnutrition, sepsis, or increased glycine oxidation due to diabetes or high glucagon levels may impair synthesis of adequate amounts of glutathione (GSH). Glycine availability is a determining factor in erythrocyte GSH synthesis in burn patients and children recovering from malnutrition; supplemental glycine improves hepatic GSH concentrations in protein-deficient rats.<sup>7</sup>

Oxidative stress associated with aging may be due in part to reduced glutathione synthesis. Compared with younger individuals, elderly individuals have markedly lower red blood cell concentrations of glycine ( $486.7 \pm 28.3$  versus  $218.0 \pm 23.7$   $\mu\text{mol/L}$ , respectively, according to one study).<sup>8</sup> Two weeks of supplementation with glycine and cysteine with no other changes to the habitual diet fully restored glutathione concentrations and rate of synthesis, and lowered levels of oxidative stress in elderly subjects.<sup>8</sup> In the elderly subjects, glycine supplementation restored glutathione levels to those of younger people (who were not supple-

mented). Sustained hyperglycemia is another state associated with reduced glutathione levels. Compared with healthy controls, type-2 diabetics have lower erythrocyte concentrations of glycine ( $514.7 \pm 33.1$  vs.  $403.2 \pm 18.2 \mu\text{mol/L}$ , respectively), lower concentrations of GSH ( $6.75 \pm 0.47$  vs.  $1.65 \pm 0.16 \mu\text{mol/g Hb}$ , respectively), and lower GSH synthesis rates.<sup>9</sup> Results of two weeks of glycine and cysteine supplementation in diabetic subjects mirror those found in elderly subjects: GSH synthesis and concentrations increased significantly, with concomitant reductions in plasma oxidative stress.

Glutathione is the body's master antioxidant and is also a critical compound for enabling healthy detoxification processes in the liver. Beyond glycine's role as a constituent of glutathione, however, glycine itself plays a role in phase II biotransformation and conjugation of xenobiotics and endogenously produced toxins.<sup>10,11</sup> Impaired glycine conjugation may result in a buildup of compounds that adversely affect mitochondrial function, and impaired mitochondrial dysfunction is associated with a host of metabolic and neurological impairments.<sup>12</sup>

Glycine may be especially supportive of liver health after alcohol-induced damage and other forms of liver injury.<sup>13</sup> Compared to control rats on a standard diet, those on a glycine-enriched diet experienced 30% faster recovery in aspartate aminotransferase (AST) and alanine aminotransferase (ALT) levels. After one week post-ethanol-induced damage, hepatic steatosis was reduced significantly more in the glycine group than in the controls, and the glycine group also had significantly diminished numbers of infiltrating leukocytes and necrotic cells compared to controls.<sup>14</sup> Liver injury due to ischemia/reperfusion (I/R), partial resection, or transplant may also be reduced by oral glycine supplementation. Studies in rats that underwent partial liver resection with I/R injury show that oral glycine supplementation led to significant improvements in survival rate and recovery rate of the remnant liver weight compared to untreated rats.<sup>15</sup> Study authors concluded that glycine may be clinically beneficial to the prognosis of patients with liver resection, and it has also been shown to be cytoprotective for other tissues, including the kidneys and small intestine.<sup>15-18</sup>

An additional role for glycine in healthy liver function is its conjugation with bile acids in order to form the active, amphipathic bile salts necessary for the emulsification of dietary fats and the formation of micelles to facilitate digestion and absorption of fats and fat-soluble nutrients.<sup>3,19</sup>

### **FUNCTION AS AN INHIBITORY NEUROTRANSMITTER**

Glycine is a well-known inhibitory neurotransmitter and is often included in combination products to combat occasional stress. The binding of glycine to its neuronal receptor results in an influx of chloride ions, leading to membrane hyperpolarization and inhibition of the response to excitatory neurotransmitters.<sup>17</sup> Alterations in glycine receptor genes have been implicated in the pathology of autism, generalized epilepsy, and amyotrophic lateral sclerosis (ALS), while autoantibodies against subunits of the glycine receptor have been found in patients with progressive encephalomyelitis, including rigidity and myoclonus.<sup>20</sup>

### **GLYCINE MAY BE BENEFICIAL FOR:**

- Detoxification
- Stimulating Phase II conjugation reactions
- Synthesis of glutathione, bile acids and detoxification
- Stimulating glycogen storage
- Muscle wasting
- Tissue repair

### **Medicinal Ingredients (per 3 g):**

Glycine (Aminoacetic acid).....3 g

**Recommended Dose:** Adults: Take ½ teaspoon (3 g) per day or as directed by your health care practitioner. Mix product well in 1-2 cups of liquid (water, juice, etc.) immediately before consumption. Do not take within 2 hours of another medicine as the effectiveness of the other medicine may be altered. Ensure to drink enough fluid before, during, and after exercise.

### **REFERENCES**

For a list of references cited in this document, please visit: <http://catalog.designsforhealth.com/assets/itemresources/GlycineReferences.pdf>



## GLYCINE POWDER

PURE POWDER FORM OF THE AMINO ACID GLYCINE

180 G | NPN80095031 | GLY180-CN

Our Glycine Powder offers the amino acid glycine in a pure powder form for flexible dosing and convenience. Although glycine is synthesized in the human body, supplemental amounts may be beneficial to help meet the body's many biological and metabolic demands for this amino acid. Glycine powder mixes well in water or any other beverage, and may be beneficial in supporting normal muscle tissue repair after a workout.

### HEALTH BENEFITS OF GLYCINE

- **Structural Support:** Glycine is a primary constituent of collagen, a key structural component of blood vessels, skin, bones, cartilage, tendons, ligaments, and other connective tissue. It supports protein synthesis, tissue repair, and wound healing.
- **Detoxification:** Glycine is used by the body to make glutathione, the body's chief antioxidant and a critical component of normal detoxification processes in the liver. Glycine is often lacking in individuals exposed to numerous toxins, which results in an abundance of damaging free radicals.
- **Liver Health:** Glycine assists the liver in making bile salts, which are necessary compounds for adequately digesting dietary fats and eliminating toxins.

Glycine powder can be used post-workout for recovery and glycogen resynthesis, especially for those following a low-carb diet and who prefer to avoid post-workout carbohydrates.

### GLYCINE POWDER MAY BE USEFUL FOR:

- Muscle and tissue protein synthesis
- Healthy skin, joints, and bones
- Strong blood vessels
- Detoxification
- Liver health and function

**Recommended Dose:** Adults: Take ½ teaspoon (3 g) per day or as directed by your health care practitioner. Mix product well in 1-2 cups of liquid (water, juice, etc.) immediately before consumption. Do not take within 2 hours of another medicine as the effectiveness of the other medicine may be altered. Ensure to drink enough fluid before, during, and after exercise.