

GPC (Glycerophosphocholine)

Highly effective form of choline for brain and nerve health, and muscle function



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Choline is a semi-essential nutrient with a recommended adequate intake (AI) of 425mg/550mg per day (for females/males, respectively).⁴⁷ Many people fail to obtain adequate amounts of choline,⁴⁰ and endogenous synthesis (from phosphatidylethanolamine) is limited. Aging, genetic polymorphisms and estrogen deficiency may increase the demand for choline even above the AI.⁴³⁻⁴⁶

Glycerophosphocholine (GPC, also known as L-alpha-glycerylphosphorylcholine or choline alfoscerate) is a naturally occurring source of choline contained in small amounts in various foods (including mother's milk) and in all human cells. GPC is a water-soluble molecule and has been proven to be a more clinically effective source of choline compared to choline or phosphatidylcholine (PC) from diet or supplements.^{9,22-25}

Oral GPC is well absorbed and is cleaved inside enterocytes into glycerol-1-phosphate and choline. Following GPC ingestion, the plasma level of choline rises rapidly and remains elevated for up to ten hours. A high plasma concentration gradient of choline stimulates its transport through the blood brain barrier with high efficiency. This increases choline reserves inside neurons, where it is used for synthesis of PC and acetylcholine.^{1, 22-25}

Research-based Benefits of GPC*

Brain Function

- Improves memory, mental focus and reaction time in elderly and young individuals^{1-3,15,51,52}
- Boosts acetylcholine (ACh) production and release from neurons and likely other cells^{22,23}
- May compensate for ACh decline due to aging, estrogen deficiency (menopause, possibly also with oral contraceptive use)^{1,54,41}
- Improves EEG patterns²⁰
- Increases production of dopamine,³⁰ serotonin³⁰ and GABA¹⁸
- Improves mitochondrial function during ischemia/oxidative stress²⁹
- Counteracts age-dependent reduction in number of brain cells⁴⁹ and ACh receptors⁵⁰

Muscle Function and Growth Hormone Production

- Boosts growth hormone production in the young and elderly^{8,27,28,55}
- Increases fat oxidation,⁵⁵ muscle strength^{26,28} and reaction time,^{51,52} potentially improving balance, especially in the elderly

Brain Repair and Alzheimer's/Dementia Support

- Improves brain recovery from stroke,⁵⁻⁷ cranial injury⁵⁶ and anesthesia (pre- and post-surgery)³⁹
- Repairs blood brain barrier tissue damaged by hypertension³³
- Improves cognition and social behavior in Alzheimer's disease,^{4,9,16,17} vascular/age-related dementia,¹⁰⁻¹² and Parkinson's disease²²⁻²⁵
- Reduces Alzheimer's-like brain volume shrinkage⁴⁸
- May be beneficial for conditions requiring myelin repair, and Duchenne muscular dystrophy¹

Functions of Choline in Human Metabolism and Unique Properties of GPC as an Efficient Source of Choline

Building block for ACh and stimulator of its synthesis and secretion

- ACh is a neurotransmitter in the brain and signal transducer in the rest of the body essential for muscle contraction, skin tone, GI motility and other tissue functions. Unlike choline/PC provided through diet or supplements, GPC supplementation was shown to have a significant stimulatory effect on ACh synthesis and its release from cholinergic cells.²²⁻²⁵ One study found that GPC supplementation in rats resulted in approximately 123% higher content of ACh in the frontal cortex compared to controls.³¹ The dose employed was equivalent to a human dose of 24mg/kg body weight, which translates to a daily dose of 1200mg for a 50kg human.

GPC supplementation results in enhanced cholinergic signaling from neurons and likely other cells that produce ACh. This is especially beneficial when the number and effective functioning of cholinergic neurons are diminished due to normal aging or various degenerative processes. GPC supplementation has the potential to partially compensate for these impairments because it produces a fast rise in plasma choline, which creates a powerful substrate mass action on enzymes and transporters in these pathways.²⁴

Building block for phosphatidylcholine (PC)

- The choline derived from GPC supplementation is partially used for PC synthesis.²⁴ PC belongs to the class of phospholipids, which are essential components of cell and mitochondrial membranes. The ability of GPC supplementation to aid in recovery from stroke,⁵⁻⁷ as well as to counteract the age-dependent reduction of nerve cells or number of ACh receptors in the brain,^{49,50} serve as additional evidence for its contribution to neuronal membrane maintenance through PC synthesis.

Formation of sphingomyelin

- Sphingomyelin is a building block for the myelin that covers and insulates neurons and nerves.²²⁻²⁵ Thus, GPC supplementation may be useful in any condition with increased need for myelin repair, such as neuropathy, multiple sclerosis and other de-myelinating and autoimmune conditions involving nerve tissue.

Fat transport in and out of cells

- PC is required for the synthesis and secretion of VLDL particles. Triglycerides exit the liver inside VLDL particles, which explains why choline deficiency increases the risk of developing fatty liver.⁴³⁻⁴⁶ PC can be obtained from food sources or supplements; however, the PC used in phospholipids and lipoproteins is not derived directly from ingested or pre-formed PC. It is synthesized from various choline precursors, including GPC, so taking in PC is not necessarily the most effective way to increase the body's pool of PC.

Supports sperm motility

- GPC is a key factor in the attachment of DHA (docosahexaenoic acid) to make PC-DHA. The DHA-PC complex is used in highly active cell types, such as retinal light-sensing cells and sperm cells. DHA-PC increases membrane fluidity, which is crucial for healthy sperm function. Semen contains a high concentration of GPC; the epididymal cells that nurture sperm cells draw from a pool of GPC to synthesize PC-DHA. Lower levels of GPC and PC-DHA in the semen may increase risk for reduced sperm motility.^{1,57}

Comparison between GPC and acetyl-L-carnitine (ALCAR)

- In a study of patients with advanced Alzheimer's disease, GPC produced more significant improvements in most neuro-psychological parameters compared to ALCAR.¹⁶ While both compounds support increased production of acetylcholine, it is conceivable that there could be synergy between supplementation with both these compounds since GPC provides the choline while ALCAR provides the acetyl component for ACh synthesis.

Potential GPC synergy with pharmaceutical drugs*

GPC supplementation is not thought to interfere negatively with any medication designed to improve brain function. In fact, due to its benefits on cholinergic pathways and improvement of neuronal cell membrane function, it may actually enhance their benefits. GPC may enhance the effect of acetylcholinesterase AChE inhibitors because it likely increases the amount of ACh in the synaptic cleft where these pharmaceutical drugs slow its degradation. This may be especially helpful for patients who have experienced limited benefit from AChE inhibitors.²³ Additionally, based on animal studies that show GPC may enhance dopamine, serotonin or GABA production in the brain, GPC may enhance the action of reuptake inhibitors of these neurotransmitters.

Supplementation with 1200mg GPC (400mg TID) for 180 days produced significant improvements in symptoms characteristic of Alzheimer's disease in a human trial where the researchers qualified the degree of improvement obtained with GPC to be similar to Donepezil and superior to Rivastigmine, both of which are known inhibitors.¹⁷ One trial showed that, compared to a cohort treated with Donepezil alone, the group taking Donepezil in combination with GPC had reduced brain shrinkage characteristic of Alzheimer's.⁴⁸

These statements should be evaluated by a healthcare practitioner for each patient.

GPC Capsules

Supplement Facts

Serving Size 1 capsule

Amount Per Serving	% Daily Value
Glycerophosphocholine (from soy lecithin)	300 mg *

*Daily Value not established.

Other Ingredients: Cellulose (capsule), microcrystalline cellulose, dicalcium phosphate, vegetable stearate, silicon dioxide.



GPC Liquid

Supplement Facts

Serving Size 2 mL (approx. 2 droppers full)

Servings Per Container about 30

Amount Per Serving	% Daily Value
Glycerophosphocholine (from sunflower lecithin)	600 mg *

*Daily Value not established.

Other Ingredients: Vegetable glycerine, purified water.



How to Use

- **GPC Liquid** – As a dietary supplement, take 2 mL (approx. 2 droppers full) per day, or as directed by your health care practitioner.
- **GPC Capsules** – As a dietary supplement, take one capsule per day, or as directed by your health care practitioner. The typical oral doses of GPC used in most trials were 1200 mg per day in divided doses, to maintain an elevated plasma level throughout the day.
- Consider using GPC along with other Designs for Health products formulated to support brain, nerve function and nervous tissue regeneration, such as Brain Vitale™, CogniAid™, OmegAvail™ Ultra DHA, Acetyl-L-Carnitine, Keto-Nootropic™ and Mitochondrial NRG™.

For a list of references cited in this document, please visit:

http://catalog.designsforhealth.com/assets/itemresources/GPC_References.pdf

*These statements have not been evaluated by the Food and Drug Administration. This product is not intended to diagnose, treat, cure or prevent any disease.

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