N-Acetyl-L-Cysteine

designs for health®

Amino acid precursor to the potent antioxidant glutathione

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Designs for Health offers N-Acetyl-L-Cysteine in 900 mg per one capsule serving. N-Acetyl-L-Cysteine (NAC) is a potent amino acid precursor to glutathione (GSH), one of the body's most powerful intracellular antioxidants, which supports optimal phase II hepatic biotransformation (liver detoxification).* It is the most stable nutritional supplement form of the amino acid L-cysteine. NAC also plays a critical role in supporting lung health for respiration, is used for rapid muscle recovery post-workout, and as a cytoprotectant against a vast array of pro-oxidative insults and inflammatory etiopathology. Furthermore, due to the presence of a sulfhydryl group (-SH), NAC is beneficial for protection against exposure to heavy metals and other harmful toxicants. NAC is prominently found in *Allium* plant species, especially onions, and is more bioavailable than supplemental GSH itself.[1]

Liver Detoxification

NAC is a potent amino acid that increases GSH levels for not only liver detoxification of heavy metals and other xenobiotics but also for systemic antioxidant support to protect against oxidative stress and free radical accumulation. NAC has been shown in research to protect the liver from the damaging effects of excessive alcohol use and from acetaminophen poisoning.[2] Supplementation of NAC prevents this toxicity by inhibiting acetaldehyde build-up and also prevents hepatocyte necrosis from acetaminophen poisoning by raising glutathione levels and preventing severe oxidative damage.[2] L-Cysteine has a high affinity for mercury and other heavy metals such as copper, lead, and cadmium, thus can bind to them and aid in their removal from the body.[2,3] When GSH levels are low, the liver is vulnerable to damage from these toxins.

Reproductive & Metabolic Health

NAC has been shown to be an effective adjunctive therapy for both male and female infertility and reproductive health parameters as it enhances enzymatic antioxidant activity.[4,5] Several studies from a systematic review showed that 600 mg of NAC reduced reactive oxidative species (ROS) levels and significantly improved sperm motility, volume, and viscosity compared to placebo.[5] Another review found that supplemental NAC significantly improved insulin sensitivity in PCOS women with hyperinsulinemia, and after 46 weeks of supplementation, NAC increased ovulation rate, HDL-C levels, and decreased weight, BMI, fasting blood glucose, total cholesterol, LDL-C, and HOMA-IR levels.[6]

In a recent *in vitro* experimental study of hyperglycemia-induced injury of cardiomyocytes, treatment with NAC showed similar mitochondrial energetic and cellular viability effects as metformin; however, NAC demonstrated more noticeable effects in mitigating ROS production within the cytosol and mitochondria and increased the production of CoQ10, which was significantly reduced by high glucose exposure.[7] A systematic review exploring the ameliorative effects of NAC in obesity-associated metabolic complications such as metabolic syndrome showed NAC to limit oxidative damage, improve abnormal pro-inflammatory responses, inhibit lipid accumulation by targeting adipogenic transcription factors (e.g., PPARγ), and improve insulin sensitivity via enhancing the PI3K and AKT pathways in both in vitro and *in vivo* models of obesity.[8]

Lung Health

N-Acetyl Cysteine works to break up the sulfide bonds that are responsible for thickening mucus, thus, by thinning mucus viscosity, NAC improves respiration patterns and supports healthy lung function.[1] In Europe, NAC is used as a mucolytic drug, as it has been shown to improve symptoms and decrease the frequency of chronic bronchitis (CB) aggravations.[2] A recent review found evidence to support NAC as a mucoactive agent in the symptomatic relief of cough by aiding in mucus elimination.[9] In a meta-analysis examining the influence of NAC on chronic bronchitis and chronic obstructive pulmonary disease (COPD) exacerbations, the results showed that NAC was well-tolerated by patients treated with NAC and had significantly fewer COPD or CB aggravations, and its protective effect was more evident in those with no signs of airway obstruction.[10] A review investigating the use of NAC in treating biofilm-related respiratory infections, such as CB, COPD, and rhinosinusitis, found NAC to effectively inhibit biofilm formation, disrupt pre-existing mature and infant biofilms, and reduce bacterial growth within biofilms.[11] The researchers state that biofilm formation is responsible for many acute and chronic pulmonary events and that there is a need for non-antibiotic therapy as many biofilm strains are resistant to conventional antibiotics.[11] Animal studies have shown that NAC has a significant antioxidative effect on airway hyper-responsiveness (AHR), which is caused by a consistent presence of pro-inflammatory mediators and immune cells in the airways, and steroid-resistant inflammation in acute asthma.[2]

Brain & Central Nervous System Health
Studies show that the accumulation of mercury in the brain has the ability to increase lipid peroxidation, mitochondria breakage, depletion of GSH, and protein DNA oxidation, and are critical factors in the development of neurodegenerative diseases, such as Alzheimer's disease and Parkinson's disease.[12] Oxidative damage is considered to be the common linkage between these factors. A review finds NAC to be a helpful therapy in counteracting neurodegenerative and mental health diseases due to NAC's ability to cross the blood-brain-barrier, provide the brain with cysteine for glutathione production to then protect neuronal mitochondria from programmed cell death, ROS, and memory loss seen in cognitive aging dementias, as well as enhance brain synaptic and non-synaptic activity within mitochondrial complex I.[2,13,14]

Supplement Facts

Serving Size 1 capsule

Amount Per Serving		% Daily Value
N-Acetyl-L-Cysteine	900 mg	*

*Daily Value not established.

Other Ingredients: Cellulose (capsule), stearates (vegetable source), microcrystalline cellulose.

NAC also has neuroprotective benefits against stroke and traumatic brain injuries (TBIs), which are shown to be mediated by its ability to protect against oxidative stress and free radicals, and pro-inflammatory mediators.[15] After 7 days of NAC treatment, soldiers who experienced TBIs after blast exposure had significantly improved symptoms resolution compared to the placebo group.[15] Relating to the effect NAC has on neuropsychiatric health, in a pilot study, six months of NAC supplementation increased functional connectivity within the cingulate cortex in early psychosis patients compared to controls, suggesting that increased brain GSH via NAC supplementation has a positive effect on functional connectivity within the brain and may be an effective alternative to antipsychotic medications.[16] Because NAC modulates the amino acid glutamate, a systematic review investigated the effects of NAC in the treatment of obsessive compulsive disorder (OCD) which showed that 2,400 - 3,000 mg/day for an average of 12 weeks demonstrated positive results in reducing the severity of OCD symptoms with minimal adverse effects and good tolerability.[17]

Muscle Recovery & Pain
After a strenuous workout, damaging free radicals abound as a natural result of vigorous muscle contractions. While glutathione diligently works to scavenge the excess free radicals, NAC quickly rebuilds the body's glutathione supply. Studies show that NAC can improve muscle performance and support efficient muscle recovery post-workout and during periods of muscle exertion as NAC is a potent scavenger of free radicals and oxidative stress, which play a causal role in muscle fatigue.[2] In an *in vivo* and *in vitro* animal model of osteoarthritis (OA), oral NAC therapy significantly down-regulated the expression of type II collagen in chondrocytes, which is indicative of OA, and significantly inhibited ROS accumulation and pro-inflammatory cytokine expression, suggesting that NAC may be an effective treatment for preventing the development of OA.[18]

Recommended Use

- As a dietary supplement, take one capsule per day, or as directed by your health care practitioner.

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