Taurine SAP

Science-based taurine for mitochondrial support and cardiovascular health

Taurine SAP contains high-quality taurine that can be clinically used in combination with **Mito SAP** to support optimal mitochondrial metabolism. Taurine is a conditionally essential amino acid that plays a significant role in mitochondrial health by maintaining the mitochondrial pH buffering capacity and electron transport chain activity, regulating the expression and translation of respiratory proteins, and protecting mitochondria against oxidative stress. Taurine is involved in key physiological processes such as bile-acid conjugation, osmoregulation, calcium homeostasis, detoxification, neuroprotection, and cell-membrane stabilization. Taurine deficiency leads to mitochondrial dysfunction, cardiovascular diseases, retinal degeneration, suboptimal brain health, and diabetic complications. Therefore, **Taurine SAP** can be very useful to promote cardiovascular, neuronal, and retinal health.

ACTIVE INGREDIENTS

Each non-GMO vegetable capsule contains:

Taurine. . . . . 750 mg

Other ingredients: Vegetable magnesium stearate in a vegetable capsule composed of vegetable carbohydrate gum and purified water.

This product is non-GMO.

Contains no: Gluten, soy, wheat, corn, eggs, dairy, yeast, citrus, preservatives, artificial flavour or colour, or starch.

Taurine SAP contains 120 capsules per bottle.

DIRECTIONS FOR USE

Take 2–4 capsules daily with a meal or as directed by your healthcare practitioner. **For mitochondrial support:** Take 2 capsules of **Taurine SAP** in combination with 3 capsules of **Mito SAP**.

INDICATIONS

Taurine SAP can be used:

- To support healthy mitochondrial metabolism.
- To promote cardiovascular health.
- For optimal functioning of the central nervous system.
- To support eye health.
- To help manage diabetes.
- To enhance healthy inflammatory responses and antioxidant status.

CAUTIONS AND WARNINGS

Consult a healthcare practitioner prior to use if you are pregnant or breast-feeding.

PURITY, CLEANLINESS, AND STABILITY

All ingredients listed for all **Taurine SAP** lot numbers have been tested by an ISO 17025–accredited third-party laboratory for identity, potency, and purity.

Scientific Advisory Panel (SAP): adding nutraceutical research to achieve optimum health

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TAURINE: A CONDITIONALLY ESSENTIAL AMINO ACID

Taurine (2-aminoethane-sulfonic acid) is a free sulfur amino acid that contains a sulfonic group in the place of the carboxylic acid group.[1] Due to this unique structure unlike other amino acids, it is not utilized for protein synthesis, and it is the most abundant free amino acid in mammalian tissues.[1] Intracellular concentration of taurine ranges from 5–20 µmol/g wet weight in tissues, with the highest concentrations found in the neutrophil and the retina, and largest pools existing in skeletal and cardiac muscles.[2, 3] In humans, taurine is endogenously synthesized in the liver from cysteine and methionine via the cysteine sulfinic acid pathway, strictly dependent on the requirement of pyridoxal-5'-phosphate.[1, 3] Taurine is excreted by the urine or in the form of bile as bile salts.[2] Endogenous synthesis of taurine is highly variable between individuals, and is independently associated with nutritional state, the amount of protein intake, and cysteine availability.[1]

PHYSIOLOGICAL ROLES

Taurine plays an important role in a number of physiological processes such as serving as a conjugating agent for bile acids, osmoregulation, modulation of calcium homeostasis and signaling, detoxification of xenobiotics, cell membrane stabilization, and modulation of neuronal excitability.[1, 2] In addition, taurine has been recognized to act as an endogenous antioxidant and as anti-inflammatory compound in various tissues.[4, 5, 6] Taurine is structurally related to the inhibitory neurotransmitter γ-aminobutyric acid (GABA) and also has an agonistic effect on GABA.

Low levels of taurine have been associated with cardiomyopathy, retinal degeneration, and growth and developmental retardation.[6, 7] Taurine has been effectively used as a therapeutic agent for the treatment of mitochondrial dysfunction, cardiovascular diseases (CVD), retinal disorders, diabetes, and neurological disorders.[1, 5, 6, 7]

ROLE OF TAURINE IN MITOCHONDRIAL SUPPORT

Mitochondrial diseases are a heterogeneous group of disorders characterized by diminished respiratory chain activity resulting from mutations in either the mitochondrial or nuclear genome.[8] Interestingly, these diseases are also characterized by a drop in both cellular and mitochondrial taurine content.[8] Taurine deficiency is thought to profoundly reduce the respiratory chain complex activity, accompanied by a 30% reduction in oxygen consumption.[9] Hence, it is very likely that taurine plays a significant role in maintaining the health of the electron transport chain. In a recent in vitro study, taurine supplementation was found to alleviate mitochondrial dysfunction in patient-derived pathogenic cells and prevented stroke-like episodes in MELAS (mitochondrial myopathy, encephalopathy, lactic acidosis, and stroke-like episodes) patients.[10]

A key factor that leads to a reduction in electron transport chain integrity is a decline in the synthesis of mitochondria-encoded proteins, as they are essential for the assembly of active respiratory chain complexes.[9] Taurine is an important component of modified uridine residues in mitochondrial tRNA, and is thereby directly involved in the translation and expression of the mitochondrial respiratory proteins and mitochondrial integrity.[8, 9, 11] Taurine helps preserve mitochondrial function and thus forestall the damaging oxidative burst frequently observed during reperfusion.[9, 11] Taurine also aids in mitochondrial pH buffering capacity.[11] Taurine also regulates mitochondrial permeability by blocking calcium overload–mediated apoptosis and protecting against glutamate-induced toxicity.[9] Taurine can be used in combination with other nutraceuticals such as *R*(+)-α-lipoic acid, thiamine, D-ribose, CoQ_{10}, quercetin, grape seed extract, and *N*-acetyl-L-carnitine for effective mitochondrial support.

TAURINE IN CARDIOVASCULAR HEALTH

It is well documented that taurine deficiency is associated with the development of dilated cardiomyopathy.[12] Taurine is considered to be a safe and effective therapeutic agent in the prevention and management of CVD.[12] Daily taurine administration of 3–6 g to patients suffering from chronic heart failure (CHF) resulted in improved cardiac output and alleviation of key symptoms of CHF.[13, 14] Also, exercise capacity of CHF patients was found to improve with taurine administration.[15] Intracellular calcium imbalances in cardiac muscle can lead to cell death and subsequent myocardial damage.[2] Taurine protects the cardiac muscle against such imbalances by regulating intracellular calcium levels.[2, 12]

Taurine aids in the prevention of obesity—one of the major risk factors of CVD—by increasing energy expenditure through regulation of fatty acid oxidation and decreasing lipogenesis.[16] In a randomized, double-blind, placebo-controlled study conducted with 16 women with obesity and 8 women with normal weight, plasma taurine levels were decreased by 41% in the obese volunteers, and the taurine-supplement group showed significant increase in plasma taurine and adiponectin.[17] Taurine has been shown to aid in mitigating hypertension. In one study, 120 eligible prehypertensive individuals were randomly assigned to receive either taurine supplementation (1.6 g/d) or a placebo for 12 weeks. Results from this study showed that taurine supplementation markedly reduced the clinic and 24-hour ambulatory blood pressures, especially in those with high-normal blood pressure.[18] Taurine supplementation studies in animal models of hypercholesterolemia has established taurine's potential role in the treatment of hypercholesterolemia.[14, 15]

ROLE OF TAURINE IN DIABETES

Taurine plays a crucial role in the management of diabetes. Type 1 and 2 diabetic patients exhibit significantly lower concentrations of taurine.[5, 16] The protective effect of taurine in diabetes has been well-established through animal studies; however, the exact mechanisms through which taurine acts remain unclear.[5] Only a few human studies exist, and in one study, where twice a dose of 500 mg/d of oral taurine was supplemented for one month, significant reductions in average daily plasma glucose levels and glycosuria were observed in type 1 diabetic patients.[18] These reductions were independent of the insulin administration. In addition, reductions in cholesterol and triglycerides levels were also observed.[19] Another study demonstrated the effectiveness of taurine supplementation against the impairment of insulin sensitivity in overweight nondiabetic men.[19]

TAURINE AND RETINAL HEALTH

Taurine deficiency has been shown to cause visual defects and abnormal ERG patterns.[7, 21] Also, low retinal concentrations of taurine have been linked with increased phototoxicity, a risk factor for eye diseases and photoreceptor degeneration leading to retinitis pigmentosa.[21] The direct protective effect of taurine on isolated retinal ganglion cells has been recently demonstrated,[21] thereby implying a crucial role of taurine in maintaining retinal health and treatment of retinal disorders.

TAURINE AND CENTRAL NERVOUS SYSTEM DISORDERS

Taurine is able to cross the blood-brain barrier and exhibits a plethora of functions in the central nervous system (CNS).[22] It plays a major role in CNS, including neuromodulation, membrane stabilization, osmoregulation, and calcium homeostasis; and as an antioxidant, anti-inflammatory, and neuroprotective agent.[1, 2, 22] Besides, taurine acts as a trophic factor during CNS development. Substantial evidence from in vitro and animal studies underscore the protective effects of taurine against conditions such as ischemia-induced brain damage and glutamate-induced excitotoxicity.[22] The activation of calpains and caspases results in apoptotic and necrotic cell death and evidently liked to result in ischemia-mediated cell death.[22] In one study, taurine has been shown to attenuate the amount of caspase-9 associated with ischemia.[23] Recently, the therapeutic potential of taurine in the treatment of CNS disorders such as Alzheimer's, Parkinson's, and Huttington's diseases has been elaborated.[24] Importantly, taurine is suggested to exert its neuroprotective mechanism by protection against mitochondrial reactive oxygen species and regulate the mitochondrial respiratory chain.[19] Taurine supplementation was shown to mitigate seizure in epileptic patients; however, the results from various studies have not been consistent.[25] Regardless, taurine can be potentially used alone or in combination for the treatment of seizure disorders.

ANTIOXIDANT AND ANTI-INFLAMMATORY EFFECTS OF TAURINE

One of the many mechanisms through which taurine is believed to impart beneficial health effects is due to its role as a potent antioxidant.[1, 2, 5, 7, 22] The anti-inflammatory effects of taurine is also well-known.[1, 6, 7, 17] These traits of taurine makes it an effective nutraceutical for supporting optimal immune health.

SAFETY

Taurine administration is found to be safe, even at higher doses, and dosage for adults usually ranges from 500 mg to 3 g daily in a divided-dosage regimen.[1, 7, 12]

REFERENCES

1. De Luca, A., S. Pierno, and D.C. Camerino. "Taurine: the appeal of a safe amino acid for skeletal muscle disorders." *Journal of Translational Medicine* Vol. 13 (2015): 1–18.
2. Huxtable, R.J. "Expanding the circle 1975-1999: Sulfur biochemistry and insights on the biological functions of taurine." *Advances in Experimental Medicine and Biology* Vol. 483 (2000):1–25.
3. Schaffer, S.W., et al. "Physiological roles of taurine in heart and muscle." *Journal of Biomedical Science* Vol. 17, Suppl. 1 (2010): S2 (1–8).
4. Wu, J.Y., and H. Prentice (2010) "Role of taurine in the central nervous system." *Journal of Biomedical Science* Vol. 17, Suppl. 1 (2010): S1 (1–6).
5. Sirdah, M.M. "Protective and therapeutic effectiveness of taurine in diabetes mellitus: A rationale for antioxidant supplementation." *Diabetes and Metabolic Syndrome* Vol. 9, No. 1(2015): 55–64.
6. Caetano, L.C., et al. "Taurine supplementation regulates Ik-B protein expression in adipose tissue and serum IL-4 and TNF-α concentrations in MSG obesity." *European Journal of Nutrition* (2015) [Epub ahead of print].
7. Ripps, H. and W. Shen. "Review: Taurine: A 'very essential' amino acid." *Molecular Vision* Vol. 18 (2012): 2673–2686.
8. Schaffer, S.W., et al. "Role of taurine in the pathologies of MELAS and MERRF." *Amino Acids* Vol. 46, No. 1 (2014): 47–56.
9. Jong, C.J., J. Azuma, and S. Schaffer. "Mechanism underlying the antioxidant activity of taurine: prevention of mitochondrial oxidant production." *Amino Acids* Vol. 42, No. 6 (2012): 2223–2232.
10. Rikimaru, M., et al. "Taurine ameliorates impaired the mitochondrial function and prevents stroke-like episodes in patients with MELAS." *Internal Medicine* Vol. 51, No. 24 (2012):3351-3357.
11. Hansen S.H., et al. "A role for taurine in mitochondrial function." *Journal of Biomedical Science* Vol. 17 Suppl. 1 (2010): S23.
12. Ito, T., S. Schaffer, and J. Azuma. "The effect of taurine on chronic heart failure: Actions of taurine against catecholamines and angiotensin II." *Amino Acids* Vol. 46, No. 1 (2014): 111–119.
13. Jeejeebhoy, F., et al. "Nutritional supplementation with MyoVive repletes essential cardiac myocyte nutrients and reduces left ventricular size in patients with left ventricular dysfunction." *American Heart Journal* Vol. 143, No. 6 (2002): 1092–1100.
14. Ito, T. and J. Azuma. "Taurine depletion-related cardiomyopathy in animals." In: Veselka, J., ed., *Cardiomyopathies—from basic research to clinical management.* Rijeka: InTech, 2012, 814 p. (here p. 537–552; available at http://cdn.intechweb.org/pdfs/27287.pdf)
15. Beyranvand, M.R., et al. "Effect of taurine supplementation on exercise capacity of patients with heart failure." *Journal of Cardiology* Vol. 57, No. 3 (2011): 333–337.
16. Chen, W., et al. "The beneficial effects of taurine in preventing metabolic syndrome." *Food and Function* Vol. 7, No. 4 (2016): 1849–1863.
17. Rosa, F.T., et al. "Oxidative stress and inflammation in obesity after taurine supplementation: A double-blind, placebo-controlled study." *European Journal of Nutrition* Vol. 53, No. 3 (2014): 823–830.
18. Sun, Q., et al. "Taurine supplementation lowers blood pressure and improves vascular function in prehypertension randomized, double-blind, placebo-controlled study." *Hypertension* Vol. 67, No. 3 (2016): 541–549.
19. Elizarova, E.P. and L.V. Nedosugova. "First experiments in taurine administration for diabetes mellitus. The effect on erythrocyte membranes." *Advances in Experimental Medicine and Biology* Vol. 403 (1996): 583–588.
20. Xiao, C., A. Giacca, and G.F. Lewis. "Oral taurine but not *N*-acetylcysteine ameliorates NEFA-induced impairment in insulin sensitivity and β cell function in obese and overweight, non-diabetic men." *Diabetologia* Vol. 51, No. 1 (2008): 139–146.
21. Froger, N., et al. "Taurine: The comeback of a neutraceutical in the prevention of retinal degenerations." *Progress in Retinal and Eye Research* Vol. 41 (2014): 44–63.
22. Menzie, J., H. Prentice, and J.Y. Wu. "Neuroprotective mechanisms of taurine against ischemic stroke." *Brain Science* Vol. 3, No. 2 (2013): 877–907.
23. Takatani, T., et al. "Taurine inhibits apoptosis by preventing formation of the Apaf-1/caspase-9 apoptosome." *American Journal of Physiology. Cell Physiology* Vol. 287, No. 4 (2004): 949–953.
24. Menzie, J., et al., "Taurine and central nervous system disorders." *Amino Acids* Vol. 46, No. 1 (2014): 31–46.
25. Oja, S.S. and P. Saransaari. "Taurine and epilepsy." *Epilepsy Research* Vol. 104, No. 3 (2013): 187–194.

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