

Taurine

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summary

Taurine is a naturally occurring amino sulfonic acid, notable for its diverse roles in human physiology and its presence in various dietary sources. First isolated in 1827 from ox bile, taurine derives its name from the Latin "taurus," meaning bull.^[1] This compound is particularly abundant in animal products such as seafood, dark poultry meat, and dairy, making it essential for certain dietary needs, especially in cats, which cannot synthesize it adequately.^{[2][3]} Given its physiological significance,

taurine has garnered attention for its potential health benefits, particularly concerning cardiovascular health, exercise performance, and metabolic regulation.[\[4\]](#)

The multifaceted functions of taurine include bile acid conjugation, osmoregulation, and modulation of calcium homeostasis in muscle tissues, thus highlighting its importance in muscle and cardiac function.[\[5\]](#) Research suggests that taurine supplementation may improve outcomes in individuals with heart disease, enhance exercise performance, and aid in managing diabetes.[\[6\]\[7\]](#) However, despite its benefits, the relationship between taurine deficiency and certain health conditions, particularly in pets on grain-free diets, has sparked significant controversy and concern within the veterinary community.[\[8\]\[9\]](#)

In addition to its health implications, taurine's status as a dietary supplement has led to widespread use among athletes, driven by studies indicating its potential to boost exercise capacity and recovery.[\[10\]](#) Nonetheless, while many studies support taurine's benefits, variability in research methodologies has created some debate regarding the efficacy and safety of taurine supplementation, necessitating further exploration in both human and veterinary contexts.[\[11\]\[12\]](#)

Overall, taurine represents a critical compound in nutrition and health, with ongoing research continuing to unveil its complex roles and potential therapeutic applications, amidst discussions of its dietary importance and safety considerations.[\[13\]](#)

History

Taurine, an amino sulfonic acid, was first isolated in 1827 by the German chemist Friedrich Tiedemann and his colleague Leopold Gmelin from ox bile, from which its name is derived (from the Latin word "taurus," meaning bull) [\[1\]](#). The structural formula of taurine was later elucidated, revealing its unique properties and functions within the body.

Throughout the 19th and early 20th centuries, taurine was recognized for its role in various physiological processes, including bile salt formation and osmoregulation [\[2\]](#). Research expanded in the mid-20th century as scientists began to investigate taurine's potential benefits for athletic performance and overall health, leading to its popularization as a dietary supplement among athletes [\[3\]](#).

The first significant studies on taurine's effects on physical performance were conducted in the 2010s, highlighting its positive influence on endurance activities, such as running and swimming [\[4\]](#). For instance, Balshaw et al. (2013) reported that acute taurine ingestion could enhance 3-km running performance in trained middle-distance runners, while Batitucci et al. (2018) demonstrated improvements in elite swimmers' performance due to taurine supplementation [\[1\]\[4\]](#).

As research continued, the understanding of taurine's multifaceted roles expanded, with investigations into its potential benefits for cardiovascular health, neurological function, and metabolic processes [\[2\]\[5\]](#). This growing body of evidence has contributed to the increased interest in taurine as a vital nutrient in both sports nutrition and general health contexts.

Sources

Taurine is an amino sulfonic acid that is naturally found in a variety of animal products and certain sea foods. It is particularly abundant in shellfish, such as scallops and shrimp, as well as in various types of fish, with cold-water fish like tuna and sardines being especially rich in taurine content[\[6\]\[7\]](#). For example, tuna can contain up to 964 milligrams of taurine per 100 grams, while squid and octopus also provide substantial amounts[\[8\]\[9\]](#).

In addition to seafood, taurine is present in various meats, especially in dark-meat poultry such as turkey and chicken. A 4-ounce serving of roasted chicken thighs contains about 222 milligrams of taurine, whereas lighter cuts like chicken breast have significantly less[\[10\]\[9\]](#). Other meats like beef and pork also contain taurine, albeit in lower concentrations, with beef providing around 33 milligrams per 3-ounce serving[\[9\]](#).

Dairy products, particularly cow and goat milk, are additional sources of taurine. Goat's milk has a taurine concentration ranging from 5.3 to 8.3 milligrams per 100 grams, while cow's milk has lower amounts[\[11\]\[8\]](#).

For those following a vegetarian or vegan diet, it is important to note that taurine is primarily obtained from animal sources, and thus supplementation may be necessary to meet dietary needs[\[12\]](#). However, taurine can also be taken as a dietary supplement for individuals looking to enhance their intake without consuming animal products[\[8\]\[13\]](#).

Biological functions

Taurine, a sulfur-containing amino acid, plays a variety of essential roles in mammalian physiology. Its functions encompass bile acid conjugation, detoxification, osmoregulation, membrane stabilization, and regulation of calcium homeostasis, particularly in muscle tissues[\[1\]\[14\]](#).

Role in Muscle Physiology

Taurine is crucial for maintaining contractile function in both skeletal and cardiac muscle. It influences calcium dynamics, a key factor in muscle contraction and relaxation processes. Inherited muscular dystrophies, such as Duchenne muscular dystrophy (DMD), exhibit significant alterations in calcium homeostasis, largely due to the absence of dystrophin, which leads to increased passive calcium entry into muscle fibers[\[4\]\[14\]](#). Research suggests that taurine supplementation may counteract some of these deficiencies by restoring proper calcium signaling and excitability in muscle fibers[\[4\]\[3\]](#).

Cardiovascular Functions

In the cardiovascular system, taurine has been shown to have cardioprotective effects, particularly under conditions of stress such as hypertension and heart

failure. Numerous studies indicate that taurine supplementation can improve cardiac function and reduce the risk of oxidative damage, potentially through its antioxidant properties[15][3]. Furthermore, taurine's ability to modulate the activity of ion channels involved in cardiac excitability further emphasizes its importance in heart health[14][15].

Neurological Functions

Taurine also functions as an inhibitory neurotransmitter in the central nervous system (CNS). It interacts with specific receptors to modulate neuronal activity, which is important for maintaining excitability and preventing neurotoxicity[4][14]. Preclinical evidence suggests that taurine may have protective effects against seizure activities, indicating its broader significance in neurological health[4][14].

Health benefits

Taurine, a sulfur-containing amino acid, has been associated with several potential health benefits, particularly concerning cardiovascular health, diabetes management, and exercise performance.

Cardiovascular Health

Research suggests that taurine may significantly improve heart health. It has been shown to regulate blood pressure, enhance heart function, and manage blood fat levels, potentially preventing heart disease and improving outcomes in individuals with heart failure[16][15]. Supplementation with taurine has been linked to protective effects against hypertension, heart failure, and atherosclerosis, with studies indicating that it may help in treating high blood pressure and atherosclerosis[17][18]. In clinical settings, taurine supplementation has been observed to ameliorate cardiac function and decrease cardiovascular risk factors[19][15].

Diabetes Management

Taurine may also play a role in diabetes management. Animal studies have demonstrated that taurine can decrease insulin resistance and improve glucose tolerance, suggesting potential benefits for individuals with diabetes[5][4]. In a controlled study, taurine supplementation improved psychotic symptoms in patients with first-episode psychosis, highlighting its broader therapeutic potential[5]. Moreover, taurine has shown promise in enhancing nephroprotective effects in diabetic models, indicating a potential protective role against diabetes-induced kidney damage[5].

Exercise Performance

Taurine is noted for its ability to support athletic performance. It may enhance exercise capacity and improve recovery post-exercise by reducing muscle damage and inflammation[20]. This effect is thought to be related to its role in calcium homeostasis

and its antioxidant properties, which may help mitigate oxidative stress during intense physical activity[\[21\]](#)[\[15\]](#).

Additional Benefits

Other potential benefits of taurine include neuroprotective effects, which may protect against stroke-induced neuronal injury[\[5\]](#), and its role in promoting nerve growth, which could benefit individuals with neurodegenerative conditions[\[21\]](#). Additionally, taurine supplementation has been associated with improvements in fat metabolism and body composition, particularly in obese populations, by increasing markers like adiponectin, which are linked to metabolic health[\[20\]](#)[\[5\]](#).

Dietary considerations

Taurine is an essential amino acid for various animals, notably cats, which have specific dietary requirements that differ from those of other species. Unlike dogs and omnivorous mammals, cats cannot synthesize sufficient taurine, making its dietary intake crucial for their health[\[1\]](#)[\[22\]](#). A deficiency in taurine can lead to serious health issues in cats, including cardiomyopathy, retinal degeneration, and reproductive failures[\[23\]](#)[\[24\]](#). The National Research Council (NRC) recommends a dietary taurine intake of 1000 mg/kg for dry feed and 1700 mg/kg for wet feed to ensure optimal health in cats[\[23\]](#).

Moreover, the ability of cats to adapt to different protein levels in their diets is unique. They exhibit less sensitivity to imbalances in most amino acids compared to other animals, such as dogs and pigs, which may experience significant health issues from similar dietary deficiencies[\[1\]](#). However, certain amino acids like arginine, methionine, and lysine remain critical for cats, and their dietary needs during pregnancy and lactation further emphasize the importance of adequate amino acid intake[\[1\]](#).

Cats are also known to selectively consume certain protein sources based on their amino acid profiles and chemical properties, which can influence their overall nutrient intake[\[1\]](#). This selectivity highlights the importance of formulating balanced diets for cats that meet their unique nutritional needs, particularly concerning taurine and other essential amino acids.

In contrast, a plant-based diet may not provide sufficient taurine and other essential nutrients for cats, as these diets can lack key animal-sourced nutrients[\[12\]](#)[\[22\]](#). Thus, when formulating diets for felines, it is vital to include sources rich in taurine, such as meat, fish, and certain dairy products, to prevent deficiencies and ensure their overall well-being[\[25\]](#)[\[6\]](#).

Research and controversies

Overview of Research on Taurine

Taurine, a sulfur-containing amino acid, has been the subject of various studies concerning its role in health and nutrition. Research has indicated that taurine may

be effective in treating taurine-deficiency diseases and retinal degeneration[26]. Additionally, preliminary clinical trials suggest its potential benefits in improving cardiovascular health, such as reducing blood pressure, enhancing left ventricular function, and increasing exercise capacity in certain individuals[15].

Taurine Deficiency and Heart Disease

One of the ongoing controversies surrounding taurine relates to its association with diet and specific health conditions in pets. The veterinary community has raised concerns about the potential link between grain-free diets and taurine deficiency, particularly in relation to dilated cardiomyopathy (DCM) in dogs. While several veterinary cardiologists are investigating this issue, a definitive causal relationship has not yet been established, leading to considerable uncertainty in the field[27]. The FDA has issued warnings regarding this potential connection, which has prompted pet owners to become more aware of the dietary implications for their pets[27].

Methodological Approaches in Research

The methodologies employed in taurine-related research vary significantly. For continuous outcomes, researchers typically estimate the weighted mean difference (WMD), whereas for categorical outcomes, odds ratios (OR) are used[28]. Heterogeneity among studies is often assessed using I^2 statistics, and sensitivity analyses may be conducted to determine the robustness of the findings. Visual examination of effect sizes through funnel plots is also utilized to assess publication bias[28].

Ethical Considerations and Disclosures

Research in the field of taurine does not typically require human consent or animal use approval, as indicated in some studies[1]. All authors involved in the research typically declare no competing interests, ensuring that the findings are presented without any conflicting biases[4].

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