Betaine, also known by the name Trimethylglycine (TMG) is well known and utilized within the Practitioner community for its important and profound effects on methylation and Homocysteine levels.

It is also known for its impact on mood and depression due to the fact when TMG helps to break down Homocysteine into Methionine, and a byproduct of this conversion is SAMe – S-adenosylmethionine, which is known to be effective in the treatment of depression, schizophrenia, demyelination diseases, liver disease, dementia, arthritis, and other conditions.

Recently, the Journal of Neurochemistry reported the brain levels of SAMe in Alzheimer’s patients are severely decreased.

Perhaps not as well-known is TMG’s significant impact on inflammation, which has significant potential anti-aging effects.

Following is an article from Life-Enhancement Magazine which documents this anti-inflammatory modulation.

Also we have included an article written by Nicholas Rupcich, PhD (McMaster – Biological Chemistry).

But first let’s review some of the more well-known potential benefits of TMG supplementation:

From Dr. Wilson’s article on TMG:

FUNCTIONS OF TMG

A powerful and safe methyl donor. TMG easily donates three methyl groups to the body. Methyl groups (CH3) are required in millions of biochemical reactions in human and animal bodies. Here are just a few of the best studied examples:

- Lowering homocysteine.
- Helping with liver detoxification.
- Alleviating depression.
- Reducing the chances of diabetes.
- Avoiding genetic problems.

TMG has an overall parasympathetic effect. TMG seems to help restore balance to the autonomic nervous system, especially in those who are following a complete nutritional balancing program. This may be one of its most important benefits.

TMG is good for those with an MTHFR defect
Anti-oxidant and anti-inflammatory effects.
Profound effects on the brain, digestion and other body systems.

Elevated Homocysteine Levels increase risk factors for:
BIOLOGICAL BENEFITS OF TMG (Trimethylglycine)

Betaine /TMG (not to be confused with Betaine HCL) works along with Vitamin B6, folic acid and Vitamin B12 to augment the formation of SAMe, an amino acid in the brain. Amino acids are proteins.

It helps with the Methylation process which is necessary for life

TMG (Betaine Anhydrous) is a primary methyl donor with the following applications in human nutrition:

- By raising level of beneficial SAMe (S-Adenosyl-Methionine).
- **Body building:** In the animal husbandry field, TMG is used to decrease fat and increase meat yield. While human studies have just started, a 200 pound individual with 20% body fat can expect to lose as much as 5 pounds of fat and gain as much as 12 pounds of muscle.
- **Cardiac protection:** Conversion of homocysteine to Methionine. General Health Preventative: As part of a formula for maintaining good health or disease prevention.
- **Glutathione Elevation:** In several different studies, TMG has been shown to increase hepatic Glutathione, the body's most important antioxidant.
- **Homocysteine Lowering:** Specific for that purpose. The supplement of choice for lowering homocystenuria
- **Liver Disorders:** As a part of liver-healing and protection formulas. Increases SAM levels in the liver, enables the liver to metabolize fat and protect against many challenges such as alcohol induced cirrhosis. TMG will also decrease bilirubin, alkaline phosphatase, and several other liver enzymes related to a large variety of liver disorders. Significant liver benefits have been shown in 20 studies.
- **Longevity Formulations:** As a part of a life extension formula. TMG has shown ability to protect interrogate of cellular DNA through methyl donation.
- **Methyl Donor Formulations:** Along with B12, Folic acid, and Choline.
- : Due to its bi-polar nature, helps osmotic pressure in cells. For example it is used in salmon farming to protect fish against the problems of changing salt content. In humans, TMG maintains normal cellular electrolyte concentrations despite water and electrolyte
losses during exercise. TMG also helps metabolize fats, which allows the body to burn fat rather than protein or muscle during exercise. The result is less cramping, increased endurance, and better utilization of fat stores.

Here are some highlights from Nicolas Rupcich’s article on the potential exercise benefits of TMG consumption:

**The Power of Trimethylglycine (TMG) Supplementation**

What benefits can be derived from supplementing with Trimethylglycine?

There have been several recent studies exploring the potential benefits of TMG supplementation, and most of them have yielded some impressive results. Nearly all studies examined a daily dosage of 2.5 grams of TMG. In many cases the dose was split with 1.25g twice per day.

While study designs varied between the clinicals, several benefits were perceived from supplementation with TMG at this level. Here’s a quick summary:

- Weight-trained athletes taking 1.25g TMG twice daily increased muscle strength & power.
- TMG supplementation increased markers of protein synthesis vs. placebo.
- TMG enhanced endurance: allowing for more bench press reps, extended sprint capacity and more cycling power.
- TMG has also demonstrated positive influence on anabolic environment – increased GH and IGF-1 levels, yet decreased cortisol.
- Test subjects have increased muscle mass, arm size and decreased body fat.
- Many studies were 10-15 days in nature, demonstrating the potential for rapid benefits.
- One of the most recent studies in 2013 was 6 weeks long and showed that longer term TMG supplementation improved body composition, arm size, muscle power output and bench press work capacity.

So what’s net effect from all these results? Whether by means of improved cellular hydration, methyl donation or improved hormonal balance, trimethylglycine supplementation works. It improves muscle power output and endurance to enhance your workouts and maximize your time spent training. It is a vital supplement for those seeking optimal muscle power and performance.

Here is the article from Life-Enhancement Magazine:

**Betaine Suppresses Inflammation During Aging: Possible Antiaging Effect**

Betaine (also called trimethylglycine) is a nutritional component of many foods, including wheat, shellfish, spinach, and sugar beets. It is also available as an inexpensive dietary supplement. The function it serves in the plants that make it is to protect against osmotic stresses, such as drought, high salinity, or temperature stresses.
Earlier studies hypothesized that betaine contained in red wine and whole grain may play a role in the cardiovascular protective effect of those foods. It is also an important part of a major pathway for decreasing homocysteine in humans and other animals by contributing a methyl group for remethylating homocysteine to methionine.

Betaine can be synthesized from choline, hence taking a betaine supplement is a way to spare choline for its other uses, such as to make acetylcholine and phosphatidylcholine. The authors of the paper (Ref 1) suggest that “… combined ingestion of folic acid and betaine may be the most effective method of lowering homocysteine.”

They also note that some of the studies in which betaine supplementation lowered homocysteine concentrations and improved some clinical conditions (including heart disease and glucose tolerance in both diabetic and nondiabetic subjects) lasted for 13–16 years, and betaine dosage was typically 6 grams per day.

A new study now reports that betaine suppresses certain pro-inflammatory signaling factors during aging, including NF-kappaB. NF-kappaB controls the transcription of a number of inflammatory molecules, including tumor necrosis factor (TNF), interleukins (ILs), chemokines, adhesion molecules, and inducible enzymes, such as cyclooxygenase-2 (COX-2) and inducible nitric oxide synthase (iNOS). All these inflammatory signaling agents are involved in conditions such as cancer, arthritis, and atherosclerosis.

[They are also involved in certain conditions where inflammation is on net beneficial, especially fighting infections. Therefore, one should be cautious in using powerful drugs that block these signaling pathways—unless one has a serious medical condition that requires that degree of inhibition—that’s why you need a knowledgeable doctor familiar with both prescription drugs and nutrition.

Otherwise, mild suppression of inflammation via appropriate dietary supplements would be the way to go for healthy people or those with only a non-severe degree of inflammatory pathophysiology (such as mild arthritis).]

This study is interesting because it looked at aging rats (Sprague-Dawley), which, like humans, have increasing levels of NF-kappaB in association with age, as well as with atherosclerosis, cancer, and other processes associated with oxidative stress and inflammation.

“Recent reviews show that upregulated NF-kappaB activity seems to be a widespread biological phenomenon in aged animals and that NF-kappaB is a critical transcription factor involved in the pathogenesis of many disorders, including inflammatory diseases.”

Betaine was added to regular rat chow at levels of 0.01%, 0.02%, or 0.04% and fed to 21-month-old rats for 10 days. On the basis that each rat ate on average 3 mg, 6 mg, or 12 mg of betaine, they ate 30, 60, or 120 mg/kg of body weight of betaine per day.

We suggest that, if you are not already taking betaine, you add it to your daily regimen. We both take it (Sandy takes 500 mg four times a day, and Durk takes 1 g four times a day).
Here is Nicholas Rupeich’s full article:

The Power of Trimethylglycine (TMG) Supplementation

So what is Trimethylglycine?

Trimethylglycine or TMG is also more commonly referred to as betaine (BEET-ah-een). For the chemists, as the name implies it is a trimethyl derivative of the common amino acid glycine. TMG is commonly found in our diet in beets (that’s where the name betaine came from), whole grains, spinach and shellfish.

TMG can also be made in the body naturally via oxidation of choline-containing compounds. One of its primary functions in the body is to act as an ‘osmolyte’ and increase water retention of cells. It migrates in and out of cells to preserve cellular hydration state. Like creatine, a higher cellular trimethylglycine concentration can help preserve cell structure and make the cell more resilient to stress.

Another important function of TMG is that it also acts as a methyl group donor in creatine synthesis as well as conversion of homocysteine to methionine. Some studies have shown that TMG supplementation may lower plasma homocysteine levels, this is important since elevated homocysteine levels can lead to blood vessel inflammation, making it a risk for heart disease.

Beyond its potential heart health benefits, TMG has also been the subject of a range of studies for its performance benefits. These human trials demonstrate a significant improvement in physical performance, especially in muscle strength, power and endurance.

What benefits can I get from supplementing with Trimethylglycine?

There have been several recent studies exploring the potential benefits of TMG supplementation, and most of them have yielded some impressive results. Nearly all studies examined a daily dosage of 2.5 grams of TMG. In many cases the dose was split with 1.25g twice per day.

While study designs varied between the clinicals, several benefits were perceived from supplementation with TMG at this level. Here’s a quick summary:

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• One of the most recent studies in 2013 was 6 weeks long and showed that longer term TMG supplementation improved body composition, arm size, muscle power output and bench press work capacity.

So what’s net effect from all these results? Whether by means of improved cellular hydration, methyl donation or improved hormonal balance, trimethylglycine supplementation works. It improves muscle power output and endurance to enhance your workouts and maximize your time spent training. It is a vital supplement for those seeking optimal muscle power and performance.

When is it optimal to take TMG? How much?

It’s quite evident from the consistency of the literature that the appropriate dosage of TMG is about 2.5 grams per day. Ideally it should be split in two doses 1.25g each; the first dose taken prior to training and the second either during or after your workout to replenish cellular stores.

There are no known serious side effects of trimethyglycine supplementation, and the longer term 6 week study supports that. It is important to note that you should look closely at the source of the TMG in products you may be considering and ensure that is listed as ‘Trimethylglycine’ or ‘Betaine Anhydrous’ and NOT ‘Betaine Hydrochloride (HCl)’ which is commonly used as fish food or for low stomach acid related digestion issues.

Nicholas Rupcich

Dr. Nicholas Rupcich holds a PhD in Biological Chemistry from McMaster University. He has over 10 years of experience in product development and formulation chemistry in the pharmaceutical and nutritional supplement industry, and has published numerous scientific paper and patents.

Here is another article excerpt from Jim Stoppani, PhD on this topic:

Jim Stoppani's Expert Guide to Betaine

By Jim Stoppani, Ph.D.

What are the Performance and Physique Applications?

In the last few years, clinical studies have looked at betaine supplementation in a number of modalities, from strength, to muscle growth, to endurance and sprinting performance. What do
they all have in common? Betaine left the placebo in the dust.

One of the first studies to look into betaine's performance-supporting effects was done in my old lab at the University of Connecticut in 2010. The UCONN researchers found that weight-trained athletes taking 1.25 grams of betaine twice per day increased their muscle strength by 25 percent, and their muscle power by 20 percent.* They also determined that betaine significantly increased markers for muscle protein synthesis following a workout as compared to the placebo.*

Since this initial study, other researchers have found that betaine supplementation helped lifters complete more total reps in bench press workouts, pedal with more power in cycling workouts, and sprint for almost 40 seconds longer than subjects drinking just water. Like the similar-sounding beta-alanine, it has also been suggested to significantly lower levels of lactate, which can delay muscular fatigue and allow athletes to train harder, for longer.*

Researchers have found that betaine supplementation helped lifters complete more total reps in bench press workouts.

And then there's the latest study on betaine, which comes from the College of Springfield in Massachusetts. Weight-trained males followed an undulating periodized weight-training program for six weeks.

One group supplemented with 1.25 grams of betaine twice per day and one group supplemented with a placebo twice per day. They reported that the subjects supplementing with betaine increased muscle mass by 4 pounds and arm size by 10 percent, all while decreasing body fat by 7 pounds.* The placebo group experienced no increase in muscle mass or arm size and no loss of body fat.

What's to explain these incredible results? A recent study from UCONN indicated that these increases in muscle strength, power, and endurance may be due to betaine's ability to increase levels of important anabolic substances while supporting a healthy balance of the catabolic hormone cortisol.*

Previous research also suggests that betaine supplementation increases nitric oxide and helps regulate cellular fluid volume, which could further promote muscle pump and overall muscle size.*

TMG is a compound which offers a spectrum of benefits ranging from mood modulation to cardiovascular health, exercise benefits and many more: it certainly warrants consideration as a core nutrient that most individuals could benefit from.

**Biotics offers a Trimethylglycine Powder product, as well as a couple of other formulations which include TMG:**

**TMG Powder**
Categories:
Amino-Acids, AntiInflammatory, Antioxidants, Anxiety-Support, Brain-Support, Cellular-Metabolism, Detoxification-Liver, Immune-Support, Liver-Detox, Metals-Detoxification, NPN, Neurological-Support, New-Products, Powders, Seasonal-Promotions

Quantity: 8 oz. (240 g)

Description: TMG Powder (TRIMETHYLGLYCINE) Methyl Donor.

http://drlwilson.com/ARTICLES/TRIMTHYLGLYCINE.htm

Indications:

Use for Heavy Metal detoxification, especially Mercury and Copper, ADHD, neurological function and to reduce seizure activity. Helps to handle stress, improves oxygen utilization and enhances liver activity. Also used to enhance athletic performance. Also used to improve immune response, reduce tumours and to enhance anti-viral and anti-tumor defenses.

Benefits those with chronic fatigue, allergies, respiratory disorders, alcoholism and drug addiction. Also helps to reduce serum cholesterol and triglycerides and to normalize hypertension/glucose levels. It has been found beneficial to aid in sleep disorders. It is very important in the formation of collagen and is beneficial for connective tissue disorders of the ligaments, cartilage, arteries and veins. Helpful in reducing homocysteine levels.

Use if Hair Tissue result indicates a "sympathetic dominance" profile as this profile may be consistent with a "fight or flight" scenario. Also used for those with an MTHFR genetic or methylation defects.

Ingredients:

Trimethylglycine (Carboxmethyl) 3 grams per teaspoon

Suggestion:

Up to 1 teaspoon (3 grams) daily with food or as directed.

TMG is a compound which offers a spectrum of benefits ranging from mood modulation to cardiovascular health, exercise benefits and many more: it certainly warrants consideration as a core nutrient that most individuals could benefit from.

Bio-GGG-B

Categories: Adrenal-Support, AntiInflammatory, Cardiovascular-Support, Cellular-Metabolism, Digestion, Energy-Boost, Folic-Acid, Immune-Support, NPN, NeoNatal-Glandulars, Stamina, Vitamins
Quantity: 60 tablets

Description:

Phosphorylated B Vitamin Support. This product consists of 3 parts G fraction (riboflavin, niacin, folic acid, PABA and lipotrophic factors of choline, inositol & betaine and one part B fraction (thiamine, pantothenic acid and B12).

Indications: Use for inflammation, muscle spasms, and migraine headaches for increased riboflavin in hypertension, hyperlipidemia, night sweats, palm or sole of feet redness, edema, digestive difficulties, non-toxic goiter, inflammation, muscle spasms. Also indicated for those who "can't get to sleep" at night.

Ingredients:

- Vitamin C 60 mg
- Thiamin (B1) as cocarboxylase chloride) 2 mg
- Riboflavin (B2) as riboflavin-5-phosphate) 6 mg
- Niacin (as niacinamide) 20 mg
- B6 (as P-5-P) 12 mg
- Folate 800 mcg
- Vitamin B12 (as methylcobalamin)
- Biotin 300 mcg
- Pantothenic Acid (as calcium pantothenate) 10 mg
- Inositol
- Neonatal liver (bovine)
- Choline (as bitartrate)
- PABA (para-aminobenzoic acid)
- Trimethylglycine

Suggestion: 2-4 tablets three times daily before meals or as directed.

Nutri-Clear NEW ADVANCED FORMULATION ACTIVATES AMPK


Quantity: 29.5 oz (836.3 grams) 1.84 lb

Description: Metabolic Clearing Formula Phase 1 and 2 Liver Detox: NEW ADVANCED FORMULATION!

Indications: Use for Metals detox.

ACTIVATES AMPK. AMPK is a master control mechanism for cellular energy homeostasis. It
Determines body fat composition and has a significant impact on mitochondrial biogenesis, the diabetes spectrum and life span extension in mice models. To support hepatic detoxification and GI tract healing; use for digestive inflammation, leaky gut syndrome, ulcers, rheumatoid arthritis, and food sensitivities; use with Livotrit Plus™ for hepatic clearing. Detoxification is a complex process that demands nutrients over and above what are needed for normal daily functioning.

Detoxification is an active process that involves at least two steps:
1) Oxidation: In a process that generates free radicals, an molecule of reactive oxygen is added to the toxin that is being processed. The purpose of this first step is to make the toxin ready for the second stage of the detoxification process. If nutrient supply is insufficient, then the first oxidative step may not proceed efficiently or the free radical damage from the biochemical reactions may increase oxidative stress and lead to tissue damage.

2) Conjugation: The second phase of detoxification is the conjugation stage, wherein a molecule such as taurine, glycine, or glutathione is covalently bound to the toxin to increase its solubility in water. After the conjugation step, the toxin is ready to be excreted in the bile or urine. If nutrients are not sufficiently available for this second step, then the oxidized toxin cannot be excreted efficiently and may cause secondary damage by interacting with body tissues and DNA.

Ingredients:

- Calories 120
- Calories from Fat 20%
- Total Fat 2g 3%
- Saturated Fat 1.5g 8%
- Cholesterol 0mg 0%
- Sodium 300mg 13%
- Potassium 460mg 13%
- Total Carbohydrate 7g 2%
- Dietary Fiber 1g 4%
- Sugars 6g
- Protein 17g 34%

Serving Size: 2 level scoops (approx. 33.5 g)
Not a significant source of iron.
Percent Daily Values based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs.

Daily Value Amount Per Serving

**Ingredients:** Pea protein isolate, organic evaporated cane juice, potassium citrate, calcium magnesium citrate, medium chain triglycerides, natural flavors, magnesium citrate malate, L-Glutamine, trimethylglycine, calcium ascorbate, stevia leaf extract, zinc picolinate, N-Acetyl-L-Cysteine, natural mixed carotenoids, d-alpha-tocopheryl acetate, quercetin, natural mixed tocopherols, manganese gluconate, molybdenum aspartate, pyridoxal-5-phosphate, L-Glutathione, L-Threonine, L-Lysine HCl, niacinamide, copper gluconate, calcium pantothenate, selenium aspartate, cocarboxylase chloride, riboflavin-5-phosphate, chromium picolinate,
potassium iodide, vitamin D3, biotin, 5-methyltetrahydrofolic acid glucosamine salt, calcium folinate, and methylcobalamin.

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

ALSO CONTAINS (per serving):

**Trimethylglycine 500 mg**
**L-Glutathione 10 mg**
**N-Acetyl-L-Cysteine 50 mg**
**L-Glutamine 500 mg**
**Quercetin 25 mg**

**Suggestion:** Blend, shake, or briskly stir 2 level scoops (44 grams) of NutriClear into 8 oz. of chilled water or the beverage of your choice.

**References:** Independent research and additional information


References

*Homocysteine Levels Linked to Cognition Deficits: How Folate and Choline Help Keep You Sharp*


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