

Growth Hormone Booster



GHboost, a research driven nutritional supplement, is a unique growth hormone stimulating product that optimizes natural growth hormone (GH) secretion more effectively than any other GH boosting product on the market.

GHboost also optimizes serum and tissue levels of the potent anabolic growth factor, insulin-like growth factor I (IGF-I) and its major isoforms as well as working productively and synergistically with other hormones and growth factors, both local and systemically. The result is an increase in protein synthesis, a decrease in muscle breakdown and an increase body fat loss leading to significant anabolic, body composition and performance effects.

GHboost version VI - <https://metabolicdiet.com/product/ghboost/>

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GHboost is manufacture in a GMP and NSF certified pharmaceutical grade facility.

Table of Contents

Introduction	2
Information for Drug Tested Athletes	3
Nutrition Panel GHboost version VI	4
What can I expect from the use of GHboost?.....	5
History of GHboost	6
What's Changed in GHboost version VI?	8
The Problems with Exogenous Growth Hormone.....	9
Effects of GH on Body Composition and Athletic Performance.....	10

GH, IGF-I, Insulin and Amino Acids Synergism	11
Myostatin	12
GH and Myostatin	13
GHboost and Testosterone	13
Nutrient and Hormone Delivery to Muscle.....	15
GH and Exercise	15
GH and Endurance Athletes.....	16
Effects of GH on Core Temperature and Performance	17
Effects of GH on Intramyocellular Triacylglycerol/Triglyceride Content	17
Regenerative and Cognitive Effects of GH and IGF-I.....	18
Effects of GHboost on Aging	18
GHboost formulation includes:	18
Individual Amino Acids.....	18
Bovine Colostrum	19
Acetyl-L-carnitine	19
L-tyrosine and acetyl-L-tyrosine	19
Alpha Glycerolphosphorylcholine	20
CDP choline	20
Melatonin.....	20
Taurine	20
Turmeric	24
Antioxidants.....	24
Alpha Lipoic Acid	25
Resveratrol	25
Coenzyme Q10.....	25
Pyridoxine and niacin	26
Bioperine®	26
How to Use GHboost	27
References.....	29

Introduction

While it's mostly known as a hormone that is involved in the growth of children growth hormone is vitally important in adults as well. That's because it plays a central role in body composition, metabolism, protein synthesis and exercise performance, roles that are mediated by growth hormone's actions on multiple gene expressions.¹

Growth hormone deficiency at any age, whatever its cause and whether its acute (as in certain instances of short or long-term overtraining) or chronic (due to aging, stress and other factors) can have significant adverse effects on body composition, performance, mood, cognition, cardiovascular function, bone mineral density, health, aging and quality of life.

GHboost stacks a number of different growth hormone optimizing compounds that maximize natural GH secretion. Many of these compounds optimize GH secretion by different methods (for example the mechanisms by which L-dopa and arginine stimulate GH secretion are different) and in some cases act synergistically (for example, arginine pyroglutamate and lysine have been shown to work

synergistically to release growth hormone), resulting in an increased GH secretion. Stacking a number of these compounds also allows smaller doses to be used with a decrease in any potential side effects.

GHboost effectively suppresses somatostatin the hormone that inhibits GH secretion, while at the same time increasing GH secretion through various direct and indirect pathways including the stimulation of growth hormone releasing hormone (GHRH).

But that's not all as GHboost also increases that anabolic hormones IGF-I and insulin sensitivity, decreases the catabolic hormone cortisol, helps maintain thyroid function and increases nutrient delivery to muscle, all of which are necessary to maximize body composition and exercise performance, as well as maintaining energy levels, health and feelings of wellbeing.

The previous version of GHboost was already the leader in GH boosting products. The new GHboost version VI significantly improves the anabolic and fat burning effects of GHboost and creates a new paradigm in boosting endogenous GH and IGF-1 levels. And as you'll see below it does much more.

Information for Drug Tested Athletes

The Use of GHboost Absolutely Will Not Result in a Positive Drug Test

Let me assure you that the use of GHboost is 100% legal under 2020 WADA/IOC guidelines (see https://www.wada-ama.org/sites/default/files/wada_2020_english_prohibited_list_0.pdf and https://www.wada-ama.org/sites/default/files/wada_2020_english_summary_of_modifications.pdf).

GHboost optimizes endogenous growth hormone and IGF-1 levels, correcting anything that may be involved in decreasing natural optimal production.

GHboost does not contain growth hormone or any other hormones, peptides, or any banned substance. It does not result in supraphysiological levels of either growth hormone or IGF-1. What it does is to allow your body to reach its natural and optimal potential for endogenous production.

But it does much more than optimize GH and IGF-1 levels, including improving health, the function and efficacy of other hormones, and providing immune and other effects that improve body composition and physical and mental performance.

Nutrition Panel GHboost version VI

Supplement Facts: Serving Size: 6 Tablets Servings Per Container: 30

	Amount Per Serving	% Daily Value		Amount Per Serving	% Daily Value
Vitamin A (as Retinyl Palmitate)	1000 IU	33%	Velvet Bean Extract	600 mg	*
Vitamin C (Ascorbic Acid)	500 mg	556%	L-Dopa	90 mg	*
Vitamin D3 (as Cholecalciferol)	600 IU	75%	Trimethylglycine (Betaine)	500 mg	*
Vitamin B2 (Riboflavin)	10 mg	769%	Acetyl L-Carnitine (as HCl)	500 mg	*
Vitamin B3 (Niacin)	15 mg	94%	GABA (Gamma-Aminobutyric Acid)	500 mg	*
Vitamin B6 (as Pyridoxine HCl & Pyridoxal-5-Phosphate)	10 mg	588%	L-Arginine Pyroglutamate	500 mg	*
Vitamin B12 (as Methylcobalamin)	100 mcg	4,167%	L-Arginine Alpha Ketoglutarate	500 mg	*
Biotin	300 mcg	1,000%	L-Ornithine HCL	400 mg	*
Calcium (as Calcium Phosphate)	300 mg	30%	Taurine	400 mg	*
Magnesium (as Magnesium Aspartate)	300 mg	72%	L-Carnitine (as L-Carnitine L-Tartrate)	400 mg	*
Potassium (as Potassium Citrate)	99 mg	3%	Turmeric Root Extract	350 mg	*
Zinc (as Zinc Monomethionine)	10 mg	91%	N-Acetyl L-Tyrosine	300 mg	*
Copper (as Copper Gluconate)	200 mcg	22%	Alpha Lipoic Acid	200 mg	*
Chromium (as Amino Acid Chelate)	25mcg	71%	Resveratrol	40 mg	*
Selenium (as Selenomethionine)	25 mcg	70%	Coenzyme Q10	20 mg	*
 BIOPERINE ® (Piper nigrum, fruit) (Standardized to min 95% piperine)	5 mg	*	Melatonin	3 mg	*
Bovine Colostrum (IgG 400 mg)	1600 mg	*	GHboost™ Proprietary Complex 3428 mg *		
L-Lysine	800 mg	*	Milk Protein Isolate, Glutamine Peptides (from Casein), L-Leucine, L-Methionine,		
L-Citrulline-Malate	750 mg	*	L-Histidine, L-Phenylalanine, L-Tyrosine, L-Glycine, Uridine Monophosphate, CDP		
L- Glutamine	600 mg	*	Choline, Alpha Glycerol Phosphorylcholine (Alpha GPC), L-Glutathione (Reduced).		

Other Ingredients: Hypromellose, Hydroxypropyl Cellulose, Silicon Dioxide.

***Daily Value Not Established**

The information below on GHboost version VI is in a constant draft form as revisions are made as new information becomes available on a research level and in the trenches. This latest information will give you the flavor of just what GHboost will do for you in helping you achieve your health, body composition and performance goals.

What can I expect from the use of GHboost?

GHboost will naturally:

1. Increase GH and GH-receptor and other receptors number and binding
2. Increase IGF-I and IGF-1 isoforms number and receptors binding
3. Increase insulin function and sensitivity for improved body composition
4. Increase testosterone secretion and effect
5. Decrease cortisol
6. Optimize thyroid health and function
7. Increase nutrient delivery to muscle

As a result, you can expect:

1. Increased muscle mass
2. Decreased body fat
3. Increased energy
4. Increased exercise performance including power and endurance (yes even endurance benefits from increased levels of GH²)
5. Increased recovery
6. Increased well-being
7. Anti-aging effects

GHboost increases the anabolic, body composition, and fat burning effects of exercise. It does this by optimizing and integrating the beneficial effects of various factors, including growth hormone, IGF-1, testosterone, and cortisol both during training and in the recovery process.³⁴ All of these effects are further magnified by the simultaneous use of TestoBoost and Metabolic).

No two people will react to GHboost in exactly the same way since phenotypically (a combination of genetics, transgenerational epigenetics, and environmental epigenetics to produce the person we are right now) we're all different. However, in a number of follow-ups on those using GHboost on a regular basis, including myself, everyone using GHboost increased their serum levels of both GH and IGF-I.

Overall, GHboost version VI resulted in an average increase of about 10% to 25%, depending on the individual, over and above the results seen with the previous version of GHboost.

As well, GHboost resulted in significant changes in body composition. There was a significant decrease in overall body fat, and particularly so in problem areas such as abdominal fat and areas prone to cellulite, and a maintenance of lean body mass in those losing weight. And in those wishing

to maximize body composition and/or athletic performance, there was a shifting of body composition to decreased body fat and increased muscle mass.

Since GHboost works naturally in the body, the potential for side effects is insignificant when compared to the use of GH injections. That's because the exogenous use of GH and GH analogs decreases the natural production and make the body dependent on the exogenous use for its GH. When the GH is discontinued it can result in a state of GH deficiency at least until the body revs up its own GH production, something that may take some time and in some never goes back to normal.

Having a problem with producing endogenous levels of GH doesn't happen when you go off GHboost since it works by increasing natural GH production, and thus puts the body's manufacturing capability in high gear. While GH levels drop when you discontinue its use, they will not drop to below the levels that existed prior to the use of GHboost. In some cases, lab results showed that GH levels remained slightly higher after the use of GHboost than they were prior to its use.

As well, using GHboost only optimizes GH and IGF-1 rather than producing above normal levels for both. As such, even in the elderly, GHboost only increases GH and IGF-1 to appropriate levels for any age group, thus circumventing any adverse effects of using exogenous GH, popularly used to sustain lean muscle mass and vigor in aging, but with consequences beyond optimizing endogenous GH levels appropriate for the age group.⁵

History of GHboost

I've been involved in all aspects of sports medicine, sports performance, body composition, weight loss, nutrition, and nutritional supplements both academically and in the trenches for over six decades. For most of that time, besides being an elite athlete in several sports, especially in Powerlifting, I've incorporated my ideas and protocols in my practice, in my Bariatric Medicine clinic and in the world of exercise and sports.

During the last five decades I've helped athletes in all sports, from professional bodybuilders to Olympic 100- meter gold medalists, optimize their body composition for maximum performance.

As well I've researched and written books and hundreds of magazine and more recently Internet articles (in top fitness, sports and bodybuilding magazines and sites including my own site at www.MetabolicDiet.com) about ways to optimize health, body composition and both physical and mental performance for over five decades.

During this time, I was fully aware of the effects of GH and how it is an important hormone for health, weight loss and for maximizing body composition. Unfortunately, I found that the people that needed it most didn't produce enough physiologically. And even in those that did, optimizing GH, insulin-like growth factor 1 (IGF-1) production, and insulin and their effects, are an important part of the body composition and performance solutions.

Using exogenous GH wasn't an option because of potential adverse effects including but not limited to shutting down endogenous GH production. That was when I started looking for a something natural that had minimal side effects, was convenient to use and that worked.

All of my knowledge and research finally came to fruition in GHboost, a supplement that really works and is safe. In fact, not only safe but a supplement that naturally increased health and wellbeing, provided some anti-aging benefits as well as the main reason I formulated GHboost, helping recreational and competitive athletes to reach their performance, weight and body composition goals.

My GHboost formulations produced an entirely new level of effectiveness when compared to all of the other GH boosting products on the market. In fact, it is the first product ever to look at all aspects of optimizing GH levels and contains dozens of ingredients that work additively and synergistically to optimize GH and IGF-1 levels and their effects both systemically and locally.

Systemic elevations are secondary to stimulating the endogenous systemic GH generating system that involves the supra-hypothalamic, hypothalamic and pituitary pathway (SHPP), while the local involves the formation in different tissues including skeletal muscle and nervous system of IGF-1 in various isoforms which include insulin like growth factor-1Ec (mechano growth factor/MGF) IGF-1Ea, and IGF-1Eb) and the various GH and IGF-1, and insulin receptors.⁶⁷⁸⁹¹⁰¹¹¹²¹³

The ingredients in this evidence-based, research-driven formula have been proven to affect your GH and IGF-I levels and result in significant anabolic and fat burning effects without causing any negative health effects.

GHboost is a product of my more than five decades of research and involvement in the medical, sports and weight/fat loss fields. It is a true GH boosting breakthrough that is unequaled in its ability to provide significant performance, anabolic and body composition effects, culminating now in the new GHboost version VI.

GHboost has been and is **used by both several hundred elite Olympic athletes (many gold medal winners in their respective fields, and top bodybuilders)** to optimize body composition and performance. With GHboost they're able to maximize muscle mass while taking body fat levels to the absolute minimum for their needs.

They're finding that GHboost is the perfect supplement to complement their diet and training efforts. And with the emphasis on drug testing in many of these sports, GHboost offers the advantages optimizing the endogenous production and naturally increasing their effects on body composition and performance without any of the adverse effects of using exogenous peptides and hormones.

There are several ways that I made sure that GHboost version VI is safe for drug tested athletes. The first is that I had GHboost manufactured in a pharmaceutical level facility that is GMP and NSF certified. Each ingredient and the final product were tested to make sure they were safe to use and contained no contaminants that would result in a positive test.

I then had a half dozen athletes use 6 tabs of GHboost twice a day (12 tabs in all) for two weeks and had their urine and blood tested in a laboratory using WADA/IOC standards of detection. All the results showed that GHboost version VI is 100% safe for drug tested athletes.

As an aside I discovered from an acquaintance at WADA that GHboost, along with TestoBoost and the rest of my MD+ nutritional supplement products, have been tested by WADA/IOC in the past few years and their testing found no banned substances thus complimenting my diligence in formulating GHboost. As well, no drug tested athlete has even tested positive from using GHboost, or any of my nutritional supplement products since I started formulating and selling my line of products over 25 years ago.

What's Changed in GHboost version VI?

I first formulate GHboost in 1997 and when it came out it was immediately popular among bodybuilders and other athletes, and those looking to lose weight and maximize body composition. Version VI of GHboost represents the fifth evolution from the original formulation of GHboost. Each formulation is an improvement over the previous one, taking into consideration my experience with the previous version and the most recent research and findings, and applying these to make GHboost even more effective.

Version VI of GHboost is a major upgrade from version V. So much so that instead of 150 tabs per bottle and one dose being 5 tablets, GHboost version V1 contains 180 tablets with one dose being 6 tablets.

I added several ingredients as well as fine tuning some of the ingredients for GHboost version VI. I tried several dozen variations of ingredients and dosages to determine the optimum number and dosages of ingredients necessary to dramatically improve on the anabolic and body composition effects of GHboost and further boosting GH and IGF-I levels both systemically and locally.

Among other ingredients, I added

1. Pyridoxyl-5-phosphate
2. Alpha GPC
3. L-tyrosine
4. Resveratrol
5. Selenium
6. Vitamins A, D3, B2, B12
7. Biotin
8. Magnesium
9. Potassium
10. Milk Protein Isolate

And I increased the amounts of

1. Velvet bean
2. GABA
3. Acetyl-L-tyrosine
4. L-Carnitine
5. Bovine colostrum
6. Turmeric

All were increased significantly, some more than four-fold over the previous formula.

The result of the additions and fine tuning is a much more effective product. The dose is now 6 tablets and a bottle of GHboost now contains 180 tablets, quite a jump from the original GHboost dose of three tablets and 90 tablets per bottle.

Although much more expensive to manufacture I've kept the retail price at a reasonable level given the cost of manufacturing GHboost due to the expensive ingredients used in the formulation, testing for contaminants and WADA banned substances, and having my products produced in a pharmaceutical grade facility. GHboost is by far the best GH booster on the market at a bargain price compared to the other, relatively ineffective, GH boosters on the market.

The Problems with Exogenous Growth Hormone

In my view, increasing your own natural endogenous levels of growth hormone is more effective for maximizing body composition than using exogenous GH. There are two main reasons for this view.

First, the use of recombinant or synthetic GH (the only kind available since 1985 when the possibility of prion infection resulting in Creutzfeldt-Jakob disease,¹⁴ a variant of mad cow disease, halted the use of GH harvested from the pituitaries of cadavers) only provides limited GH exposure.

That's because human GH represents a family of proteins rather than a single hormone. In fact, the circulation contains over a hundred GH forms.¹⁵ And because we have yet to discover enough about the various forms, the net biological activity of this mixture is difficult to predict since the exogenous recombinant GH represents only 20 percent or so of the mix.

Thus far, most of the research has been largely confined to monomeric 22K, the same GH that is available for exogenous use. However, while it is certainly effective for its original intended purpose, namely growth promotion, it's not known if it's sufficient for optimal growth. It's unlikely that it can fulfill all the functions of the GH family that are naturally present in the body. As well, the use of one GH variant likely decreases the production of the other variants in the body¹⁶ thus limiting the normal biological activity of GH.

But there's more to GHboost in that it also stimulates insulin release and increases insulin sensitivity in the tissues such as skeletal muscle where it produces an anabolic effect. But in adipose tissue it actually causes an increase in fat breakdown and beta-oxidation, and a decrease in lipolysis.

The combination of increased GH, IGF-I and insulin levels results in a synergistic anabolic effect on muscle while at the same time maintaining significant fat burning effects since the action of GH and IGF-I minimize insulin's effects on body fat.

The anabolic and fat burning effects of GHboost is accomplished by the use of several of the ingredients in GHboost, including arginine, glutamine, taurine, alpha lipoic acid, and dozens of other ingredients (see the info on some of the ingredients below).

The second reason is that the use of exogenous GH shuts down your own growth hormone production. And that's a bad thing as it takes time for your body to ramp up the GH machinery once you discontinue the GH injections. In some cases, the body decreases the natural production of GH permanently, often making it necessary for you to go back on the injections to feel normal.

That doesn't happen with GHboost since it acts by increasing your natural GH secretion. It acts by ramping up your GH producing machinery rather than shutting it down. So if you go off GHboost you're still in business, even if your levels go back to what they were before using GHboost. In other words, unlike the use of exogenous GH, you don't become a "GH Eunuch" when you discontinue taking it.

The bottom line is that the use of GHboost is more natural, more effective, and has no adverse effects, especially when compared to the significant problems secondary to the use of injectable GH.

Effects of GH on Body Composition and Athletic Performance

Growth hormone and IGF-I have various anabolic and ergogenic effects including increasing protein synthesis, decreasing protein catabolism, increasing lipolysis and utilization of fatty acids for energy, increasing skeletal muscle blood flow, and increasing non contractile musculoskeletal tissue. The various mechanisms involved are still being worked out and there are several theories as to their modes of action.

For example, one paper postulated that the ergogenic effects of GH, and the associated levels of IGF-I are due to their effects on connective tissue.¹⁷ In this paper the authors state that **“a strengthened connective tissue would give a stronger and more strain-resistant muscle and tendon and this could, in part, fit with the claimed effect of rhGH on athletic performance. Furthermore, an anabolic effect of rhGH in connective tissue could also suggest a potential for rhGH in treatment of muscle and tendon injuries, which are common problems in many sports.”**

This is an interesting hypothesis and the authors do make a creditable presentation that's supported by other studies.¹⁸¹⁹²⁰²¹ However, in light of the many studies showing the anabolic and other metabolic effects of GH and IGF-I there's much more involved.

A recent study stated that **“Molecular and functional studies provide evidence that GH stimulates the anaerobic and suppresses the aerobic energy system, in turn affecting power-based functional measures in a time-dependent manner. GH exerts complex multi-system effects on skeletal muscle function in part mediated by the IGF system.”²²**

Adults with growth hormone deficiency (GHD) who receive GH replacement have been reported to significantly increase total lean body mass and muscle mass.²³²⁴²⁵²⁶ It's also been shown that long term continuous replacement therapy in patients with GHD results in a sustained increase in total body nitrogen²⁷ and that even low-dose regimens of GH result in improvements in body composition, fatigue, bone mineral density and lipid profiles.²⁸

As well, other studies have shown that the use of GH stimulates amino acid uptake and protein synthesis in skeletal muscle and enhances nitrogen retention.²⁹³⁰³¹

However, until recently, there has only been a few studies documenting the anabolic effects of GH in normal adults,³² even though increases in growth hormone production are known to have significant effects on carbohydrate, fat, and protein metabolism, have been shown to enhance recovery after exercise and stimulates IGF-I production in muscle.

Several studies have shown that GH and IGF-I have significant anabolic, anti-catabolic, lipolytic, regenerative and other effects that impact on body composition and athletic performance.³³³⁴³⁵ It seems that GH and IGF-I can act directly on their own, and also have shared effects, likely due to cross-talk between the GH and IGF-I transduction pathways.³⁶

While there is evidence from animal models that the effects of GH may be mediated through circulating and/or local production of IGF-I, there is additional evidence to suggest that the mechanisms by which IGF-I and GH promote protein anabolism are distinct.

As such, although studies have shown that insulin and IGF-I decrease protein degradation and GH results in enhanced protein synthesis, recent work has shown that under certain circumstances they can both enhance protein synthesis and decrease protein degradation.³⁷

For example, an early study looked at the effects of an acute dose of GH on amino acid metabolism in 15 young healthy males while controlling for the effects of other confounding hormones (i.e. via simultaneous infusion of somatostatin and replacement of insulin, glucagon, and GH).³⁸

This study demonstrated direct effects of GH in terms of increased anabolic effects via inhibition of amino acid oxidation and stimulation of whole body protein synthesis. The direct effect of GH for this action was supported by the fact that insulin, glucagon, cortisol, IGF-I, catecholamine and glucose concentrations were not different between the control and GH treatment groups.

We know that increases in local IGF-I expression is associated with increased muscle protein and DNA synthesis, and exhibits both GH and insulin like effects.^{39,40} Local production of IGF-I also stimulates satellite cells to multiply and fuse with existing muscle fibers to enlarge muscle mass.⁴¹

GH, IGF-I, Insulin and Amino Acids Synergism

It's been known for decades that insulin, growth hormone, glucocorticoids, insulin-like growth factor 1, thyroid hormones, and other hormones regulate body protein metabolism. It's been known for decades that insulin,⁴² IGF-I,⁴³ and GH⁴⁴ each has acute, anabolic actions on skeletal muscle protein while the glucocorticoids (for example cortisol) have a catabolic effect.

A recent study found that increased IGF-1 levels were associated with higher bone mineral density and lean mass, lower fat percent, and increased physical performance.⁴⁵

Increasing levels of GH, IGF-I and increasing insulin production and sensitivity (by the use of **arginine**,⁴⁶ **ornithine**,⁴⁷ **alpha lipoic acid**, **chromium** and **zinc**.⁴⁸) results in powerful synergistic effects on body composition.^{49,50,51,52,53} This is evidenced by the exogenous use of all three hormones and peptides by power athletes and bodybuilders. The substantial decrease in body fat and increase in muscle mass, strength and performance attests to their effectiveness.^{54,55,56,57,58,59,60}

Unfortunately, their use results in significant and sometimes debilitating side effects both while taking them and after, including permanent dysfunction in the regulating systems.⁶¹ Reproducing their synergistic effects by increasing endogenous production and effects with GHboost produces similar results without the side effects.

GHboost not only increases the effectiveness of endogenous GH, IGF-I, insulin and thyroid, but also provides other boosting effects secondary to the interaction of the select amino acids in the formulation.

For example, GH levels are increased by specific amino acids⁶² and other compounds, and in turn the GH acts synergistically with amino acids, such as **arginine**, **ornithine**, **glutamine**, **GABA**, **lysine**, **glycine**, **tyrosine** and **taurine** to increase IGF-I levels even further than GH acting alone.⁶³ Also IGF-I levels, which are controlled by growth hormone and insulin, rise even higher because of the increase in insulin sensitivity.

This synergistic effect of several ingredients in GHboost results in an increase in IGF-I levels that is out of proportion to the increase in GH levels, and thus provides a more potent anabolic and fat loss stimulus than either one alone.⁶⁴⁶⁵⁶⁶⁶⁷

As well, increasing levels of GH has been shown to decrease the catabolic effects of cortisol by decreasing its formation from inactive cortisone,⁶⁸ to decrease myostatin expression and increase testosterone effects in the body.

Myostatin

Myostatin inhibits muscle growth and is a negative regulator of muscle mass. Inhibiting myostatin, either at the genetic level, or by inhibiting its effects in the body, can result in marked increases in muscle hypertrophy.

Information on myostatin was first published in 1997 in a paper describing enhanced muscle hypertrophy in myostatin deficient mice.⁶⁹ Later that same year myostatin was reported as being responsible for double muscled cattle.⁷⁰ I reported on the myostatin story featuring these mighty mice and cattle in my Research Update column in September of 1997 in Muscle Media 2000.

Since then research on myostatin has validated its role in regulating muscle mass, regeneration of muscle tissue, and in regulating body fat, with myostatin promoting increased formation of adipose tissue.⁷¹ Decreases in myostatin levels and/or effects results in increased skeletal muscle mass and decreased levels of body fat while increases result in decreased muscle and increased body fat.⁷²⁷³⁷⁴⁷⁵⁷⁶

As well, some elite bodybuilders have validated the real world results of inhibiting myostatin through various means and have thus achieved massive levels of muscle hypertrophy in part through this inhibition.

Various degrees of natural inhibition of myostatin secondary to genetic polymorphisms likely explains some of the differences naturally seen in muscular hypertrophy and in the ability to attain significant increases in muscle mass.



7 Months

An extreme example of this is seen in a child that was born in Berlin with a loss of function mutation that turns off the myostatin gene.⁷⁷ The base-pair alteration in the gene results in the missplicing of myostatin messenger RNA, thereby reducing the production of mature myostatin protein. At 4.5 years, this boy is reported to have the physique of a mini-bodybuilder with markedly increased muscle mass and reduced levels of body fat.

At 7 months of age muscle hypertrophy was pronounced in all muscles as can be seen by the hypertrophy of the thigh and calf muscles in this picture (from Bouley 2005). The arrowheads indicate the protruding muscles of the patient's thigh and calf.

In one study done on double muscled Belgian blue bulls, muscle biopsies revealed that this deletion in the myostatin gene altered the muscle fiber composition by increasing the fast-twitch glycolytic

muscle fiber proportion inducing a higher proportion of fast-twitch glycolytic fibers and, to a lesser extent, a lower proportion of slow-twitch fibers.⁷⁸

An important function of myostatin is inhibition of satellite cells. Thus one would expect that in the absence of myostatin there would be enhanced muscle regeneration. This appears to be true from studies of acute and chronic muscle injury.⁷⁹⁸⁰⁸¹⁸²⁸³⁸⁴⁸⁵⁸⁶⁸⁷ For example, muscle from myostatin null animals that were acutely injured regenerated large-diameter myofibers earlier than injured controls with normal myostatin.⁸⁸

GH and Myostatin

Studies have shown a negative correlation between GH and myostatin. It appears that deficits in GH may result in increased myostatin expression and a disassociation in autocrine IGF-I effects on muscle protein synthesis and that myostatin likely represents a potential key target for GH and IGF-I induced anabolism.⁸⁹

Interestingly enough, decreasing myostatin can also result in an increase in the expression of the androgen receptor. This results in an increased anabolic stimulus due to increased binding of testosterone to the androgen receptor.

GH potentially can have multiple effect son body composition due to:

- its direct action, and actions secondary to
- increases in IGF-I
- decreases in myostatin and subsequently
- increased testosterone activity

GHboost and Testosterone

Besides increasing testosterone activity, GHboost also may increase testosterone secretion. Part of this ability, besides the interaction of various hormones and systems, is the effects of two of the ingredients in GHboost.

These two ingredients may increase testosterone secretion by decreasing estrogen production secondary to the inhibition of aromatase. Inhibiting aromatase decreases systemic estrogen and thus the inhibiting effects that estrogen has on testosterone production. As such, inhibiting aromatase signals the body to produce more testosterone.

Melatonin and **resveratrol (both in GHboost)** have been shown to inhibit aromatase activity, decrease the synthesis of gonadal estrogens, downregulate the expression of the estrogen receptor and inhibit the binding of the estradiol-estrogen receptor complex to the estrogen response element in DNA. The overall result is an increase in testosterone and a decrease in estrogen production and adverse effects.^{90 919293}

As well, the effects of GHboost in increasing insulin sensitivity and effects may secondarily increase testosterone levels through one or several mechanisms. For example it may work synergistically with luteinizing hormone (LH), the pituitary hormone that dictates testicular testosterone production. It may do this by stimulating a testes enzyme called 11 beta-hydroxysteroid dehydrogenase which has been

shown to relieve steroid-dependent inhibition of Leydig cell function and thus increase testosterone secretion.⁹⁴

Nutrient and Hormone Delivery to Muscle



On top of the direct anabolic, fat burning, performance and body composition effects, GH, insulin and IGF-I also increase nutrient delivery to skeletal muscle. While exercise is known to dramatically increase muscle blood flow, studies have shown that IGF-I⁹⁵, GH⁹⁶ and an improvement in insulin sensitivity⁹⁷⁹⁸⁹⁹ can also increase muscle blood flow.

The improvement in blood flow by the nutrient route (as against the non-nutritive route) can have anabolic and performance enhancing effects by increasing oxygen, hormonal, and nutrient delivery to exercising muscle.¹⁰⁰

GHboost, besides achieving increased nutrient delivery by increasing GH, insulin and IGF-I levels, also increases tissue levels of nitric oxide, a gas formed from **L-arginine** and oxygen. The combination of **arginine alpha ketoglutarate** and **arginine pyroglutamate** results in an optimum increase in NO production, which in turn can further increase oxygen and nutrient delivery to muscle, and athletic performance.¹⁰¹¹⁰²

GH and Exercise



Both aerobic and anaerobic exercise have a dramatic effect on serum GH and IGF-I levels, and tissue IGF-I levels in both men and women.¹⁰³¹⁰⁴¹⁰⁵

This effect is influenced by several variables, including the type of exercise, training state, body composition, age and gender.

For example, all out rowing performance results in dramatic post exercise increases in

GH.¹⁰⁶ And studies have shown that a single 30-s sprint elicits a marked GH response.¹⁰⁷

However, repeated exercise can result in an attenuation of that response. For example, repeated 10-min bout of high-intensity submaximal exercise has been shown to result in a dramatic attenuation of the exercise-induced GH response.¹⁰⁸

It's also been shown that although a single both of intense exercise results in a marked increase in serum GH, repeated bouts separated by 60 minutes of recovery results in a lower GH response.¹⁰⁹ A

later study found that repeated bouts separated by up to four hours of recovery still resulted in an attenuated GH response whereas there was no adverse effect on serum GH levels in bouts of intense exercise done on consecutive days.¹¹⁰

Another study looked at the GH responses to two consecutive 30-min cycling sessions at 80% of individual maximal oxygen consumption ($\dot{V}O_{2\max}$) in amateur competitive cyclists.¹¹¹ Subjects were tested on three occasions with different time intervals between the two bouts: 120 min, 240 min and 360 min.

The GH response to the second bout was significantly lower at the 120 and 240 minute time intervals between bouts but not with the 6 hour interval.

Other studies have shown that even repeated bouts of aerobic (submaximal) exercise resulted in an increase in serum GH that was greater when the recovery period between bouts increased.¹¹²

The reason for the attenuated serum GH and IGF-I responses (likely also tissue levels of IGF-I) seen in these studies are not known but it could be due to several factors, including autoinhibition at the level of the pituitary secondary to increased levels of GH and/or IGF-I,¹¹³ to an increase in serum free fatty acid levels¹¹⁴ secondary to exercise and GH effects on lipolysis.

GHboost, used prior to repeated bouts, will enhance the GH response to exercise and result in anabolic and ergogenic effects for all athletes because it boosts GH and IGF-I levels, as well as boosting endogenous testosterone, enhancing the beneficial effects of insulin and controlling cortisol.

GH and Endurance Athletes



Several studies have shown that GH improves body composition and is an effective anabolic and ergogenic aid.¹¹⁵

Although many of the studies center around anaerobic training such as resistance training, GH is also effective in increasing aerobic performance in all sports and activities, including ultra-endurance events. In fact, levels of GH (and cortisol) increase more dramatically in endurance events than with anaerobic events.¹¹⁶¹¹⁷

Aerobic capacity is increased by GH. It's been shown that GH treatment displays multiple actions through several components of the oxygen transport system including increasing red cell mass, blood volume, and cardiac function.¹¹⁸¹¹⁹

Cardiac systolic function, in particular, is well documented to improve with GH treatment of both male and female GH-deficient subjects.¹²⁰

One study looked at the effects of exogenous GH in male endurance athletes. The use of GH resulted in reduced leucine oxidation by more than 50%, which suggests that the metabolic effects of GH include an anabolic effect in skeletal muscle.¹²¹

Another study found that GH use resulted in a lower exercise oxygen consumption without a drop-off in power output.¹²² The authors concluded that the use of GH may improve exercise economy.

As well, GH decreases the perception of fatigue in adults with untreated GHD and therefore may be useful in this regard as well in endurance athletes.

GHboost not only results in an increase in GH and IGF-I levels, but also decreases inappropriate cortisol levels, resulting in significant ergogenic effects for the endurance athlete.

Effects of GH on Core Temperature and Performance

Growth Hormone has other effects that can result in an increase in performance in endurance athletes.

An increase in sweat rate is associated with a greater heat loss from evaporation and a lower core temperature. Investigators have shown that growth hormone stimulates sweat production and heat loss from evaporation during exposure to heat in either the absence or presence of exercise.¹²³ Growth hormone deficiency, on the other hand, is associated with reduced sweat secretion and an increase in heat storage.¹²⁴

A study of Ironman triathletes found that those with higher GH expression had lower rectal temperatures which in turn correlated with increased performance.¹²⁵

Effects of GH on Intramyocellular Triacylglycerol/Triglyceride Content

For those following my phase shift diets (the Metabolic Diet, the Anabolic Solution and the Radical Diet) the effect of GH on the lipid content of skeletal muscle has added importance. That's because a recent study found that GH not only stimulates fat breakdown and the use of fat as a fuel, but it also increases the amount of fat in muscle cells.

In those that follow my phase shift diets, fat is the primary fuel for generating energy, including energy needed for skeletal muscle contraction.¹²⁶ Fat is stored in the muscle cells as droplets of triacylglycerols (triglycerides). The implications of their presence in muscle cells is in direct contrast to their presence in non-athletes.¹²⁷

For example, in athletes, intramuscular triglycerides (IMTG) are associated with insulin sensitivity whereas in non-athletes they are associated with insulin resistance, the metabolic syndrome and diabetes.^{128,129}

In athletes, especially those that are fat adapted, IMTG are in direct contact with mitochondria and are a dynamic source of energy that is readily available and used first after ATP and phosphocreatine to provide needed energy.¹³⁰ IMTG are used before stored glycogen and extracellular sources of fatty acids and glucose.

Interestingly a study found that GH increased levels of IMTG although their interpretation of this increase was flawed.¹³¹ However, along with the known effects of GH on increasing lipolysis and fat oxidation, the increase in insulin sensitivity coupled with the presence of IMTG forms a powerful combination for the use of fat as a primary fuel for muscle contraction in athletes.

Regenerative and Cognitive Effects of GH and IGF-I

As we've seen the anabolic, anti-catabolic, fat burning effects of GH are well established. However, there is also evidence that the HG/IGF-I axis affect cognition and the biochemistry of the adult brain.

The findings of various studies suggest that both GH and IGF-I have cognitive, neuroprotective and regenerating effects on the central nervous system.¹³²¹³³ As well, maintaining proper levels of GH and IGF-1 is paramount for improving cognitive and function in the aging brain ¹³⁴

Effects of GHboost on Aging

As we've seen GH levels decline dramatically from age 20 to age 60. This decline leads to a progressive GH deficiency. Since GH has beneficial effects on muscle mass, bone density and body fat it counters some of the age related changes in body composition.

This reduction in GH contributes to physical and psychological changes seen with aging including decreased skeletal muscle, increased body fat, thinning skin and decreased wellbeing and quality of life. Studies have shown that restoring GH levels results in improvements in all these areas as well as boosting the immune system, improving protein, lipid and carbohydrate metabolism, improving recovery, and decreasing inflammation in the body.¹³⁵¹³⁶¹³⁷¹³⁸¹³⁹¹⁴⁰

Some of these effects from increasing GH are secondary to increases in IGF-I and may also be secondary to subsequent changes in other hormones and growth factors. For example, as we've seen, GH has a direct effect on decreasing myostatin and an indirect effect of increasing the effects of testosterone in the body.

A recent study found that while exercise has been shown to downregulate myostatin expression in adults, it doesn't do so in the elderly. The authors concluded that this impaired capacity may play a role in limiting hypertrophy in older females.¹⁴¹

GHboost formulation includes:

Besides the above-mentioned beneficial effects of GHboost that are above and beyond its intended main effect of boosting GH and IGF-1, GHboost contains numerous ingredients that also impact on health, wellbeing and longevity, and have anti-aging effects.

Individual Amino Acids

Many studies have shown that specific amino acids, such as **arginine**, **ornithine**, **lysine**, **L-dopa** and **GABA** (all in GHboost) taken orally can act alone and synergistically to increase the release of growth hormone.¹⁴²¹⁴³¹⁴⁴¹⁴⁵¹⁴⁶¹⁴⁷¹⁴⁸

Studies have also shown that the increase in the body's production of growth hormone depends on the specific amino acids used and the ratios of the amino acids.¹⁴⁹ For example one study found that combining relatively small amounts of **arginine pyroglutamate** with **L-lysine** resulted in a much greater increase in GH secretion than large doses of either one alone.

A study found that a combination of **glycine** and **glutamine**, along with **niacin** (**all three are in GHboost**) enhanced growth hormone secretion in middle aged and elderly men.¹⁵⁰ Glycine has been shown to increase growth hormone secretion on its own.¹⁵¹

GHboost contains an ideal mixture (number and dosage) of the most effective GH boosting amino acids, including **L-dopa**, **arginine pyroglutamate**, **arginine alpha ketoglutarate(AKG)**, **GABA**, **glutamine**, **glycine**, **lysine** and **ornithine**. These amino acids have a stimulatory effect on GH secretion directly, through stimulating GHRH, and by inhibiting somatostatin.

Since several of these amino acids cause the release of growth hormone by different mechanisms,¹⁵² they are even more effective when taken together. The amino acids can also stimulate other hormones. For example, arginine, like other dibasic amino acids, stimulates pituitary release of growth hormone and pancreatic release of insulin. Various amino acids, for example arginine, also stimulate IGF-I synthesis, both hepatic and local.

Bovine Colostrum

Bovine colostrum, which acts as a bioavailable source of IGF-1, also contains immunoglobulins, including transferrin to bolster the immune system and promote GH secretion. Note that colostrum is not prohibited by WADA and other drug testing agencies and the levels of IGF-1 in the bovine colostrum that is in GHboost, equivalent to the amount found in a regular glass or two of milk, absolutely cannot influence the outcome of anti-doping tests.

Bovine colostrum bioactivity varies depending on the source. I sourced the bovine colostrum used in GHboost so that bioactivity was optimized.¹⁵³

Acetyl-L-carnitine

Acetyl-L-carnitine is part of a technique to increase nighttime growth hormone release, along with the amino acid **ornithine**.¹⁵⁴

It's postulated that 500 mg of acetyl-L-carnitine and 25-100 mg of ornithine taken before bed will produce increased nighttime GH release. GHboost contains 500 mg of acetyl-L-carnitine and 200 mg of ornithine. The higher level of ornithine is set for the added synergistic effect that ornithine has with some of the other amino acids, including arginine. There is evidence to show that acetyl-L-carnitine also directly increases IGF-I levels.

One study found that acetyl-L-carnitine significantly increased levels of free IGF-1 (the bioactive component of total IGF-1). As well, all the treated patients reported, an improved sense of well-being by the second and third week of acetyl-L-carnitine therapy.¹⁵⁵

L-tyrosine and acetyl-L-tyrosine

L-tyrosine is a conditionally essential amino acid and is a precursor to epinephrine, norepinephrine and dopamine, three important brain neurotransmitters involved in brain function and GH secretion. Tyrosine is also used by the thyroid gland for the production of thyroid hormone, which is important for maximizing metabolism and body composition.

Acetyl-L-tyrosine is an active metabolite of tyrosine that has some properties outside of L-tyrosine. Both tyrosine and the acetyl metabolite are precursors to the neurotransmitter dopamine, and have been found to increase GH secretion. Both ingredients have also been shown to increase cognitive function.

Alpha Glycerylphosphorylcholine

Alpha Glycerylphosphorylcholine (alpha GPC) is a precursor to acetylcholine. It's been shown that low acetylcholine levels can result in decreased levels of GH secondary to decreased cholinergic tone.¹⁵⁶ Studies have shown that alpha GPC increases GH production secondary to stimulation via GHRH.¹⁵⁷

CDP choline

CDP choline (cytidine 5'-diphosphocholine) has been shown in several studies to increase serum levels of GH and potentially luteinizing hormone in man.^{158,159}

Melatonin

Melatonin. Several studies have shown that melatonin increases growth hormone secretion through complimentary pathways¹⁶⁰ for as long as 24 hours.¹⁶¹ As well it's been shown that melatonin induces normal sleep patterns which in turn are conducive to maximizing night time growth hormone secretion and improves recovery. Melatonin has also been shown to have significant antioxidant effects.

A recent study stating that melatonin, a potent MPO inhibitor, has been noted for its anti-inflammatory, anti-oxidative, anti-apoptotic, and neuroprotective actions proposes that melatonin is a safe therapeutic agent for COVID-19 that recently, has been given a US Food and Drug Administration emergency authorized cocktail, REGEN-COV2, for management of COVID-19 progression.¹⁶²

Another recent study found that melatonin increased energy substrate availability prior to exercise, improved the exercise tolerance, accelerated the recovery of muscle energy substrates and increased maximal aerobic capacity.¹⁶³

Taurine

Taurine ((2-aminoethane-sulfonic acid), a sulfur-containing amino acid is the second most abundant amino acid in the body, the most abundant free amino acid found in skeletal muscle tissue, the heart and brain. It's also one of the most abundant amino acids in most organs in the body.

Taurine has a myriad of beneficial functions in the body, including the musculoskeletal and central nervous system, from development to cytoprotection in all age groups.^{164,165,166} As such, it is beneficial for improving body composition and physical and mental performance. Although it's one of the few amino acids not directly used for protein synthesis, it can indirectly increase protein synthesis.

Taurine is often considered a non-essential or hesitantly a conditionally essential amino acid for humans since it can be synthesized by the body from methionine and cysteine. However, the limiting enzyme required for biosynthesis of taurine is very low in humans and biosynthesis may not be adequate for times when the need for taurine are increased.

Because of these limits, and to make sure there's enough taurine available when needed, taurine has been added to infant formulas as well as to intravenous solutions used for various medical conditions.

Because of its many functions and suboptimal levels in most people, I consider taurine an essential amino acid for anyone looking to improve body composition (add muscle and reduce body fat) and/or increase exercise/sports performance.¹⁶⁷¹⁶⁸

Taurine is highest in meat and seafood and the average person, non-vegan, takes in around 60 mg per day. However, over twenty times that amount can be beneficial for improving body composition and performance, increasing health and wellbeing, antiaging effects, and as complimentary treatment for prevention and treatment of various diseases, including sarcopenia and musculoskeletal disorders.¹⁶⁹¹⁷⁰

Vegan intake of taurine is usually much lower than non-vegans and I always recommend taurine supplementation for vegans, especially vegan athletes. As an aside I always recommend other forms of supplementation for vegans, depending on how carefully a vegan structures their diets, including vitamins D, B2, B12, B6, and niacin, zinc, iron, selenium, calcium, L-carnitine, carnosine and/or beta-alanine, omega-3 fatty acids, and creatine.¹⁷¹¹⁷²¹⁷³¹⁷⁴

Effects on Performance

Taurine is a nutrient that enhances the training effect by its many roles in improving skeletal muscle function and performance, **including increasing growth hormone and IGF-1**, and decreasing inflammation, muscle soreness, fatigue, and injury.¹⁷⁵¹⁷⁶¹⁷⁷¹⁷⁸¹⁷⁹¹⁸⁰¹⁸¹¹⁸²¹⁸³¹⁸⁴¹⁸⁵¹⁸⁶¹⁸⁷¹⁸⁸¹⁸⁹¹⁹⁰¹⁹¹

As well, taurine has immune system benefits, insulin like effects as far as increasing protein synthesis and decreasing muscle breakdown and cell volumizing effects. The volumizing effect on certain nutrients on muscle cells is also felt to lead to an increase in protein synthesis.

Over the years, oral taurine administration has been shown to help muscle cramping in patients with liver cirrhosis and myotonic dystrophy. Several studies have suggested that it may also help to alleviate muscle soreness and cramps occurring during and after exercise.¹⁹²

Studies on mice and rats show that taurine is useful for reducing physical fatigue, muscle damage, and exercise induced muscle injury during exercise training, presumably due to its antioxidant effects and the beneficial effects that taurine has on metabolism and on muscle and cardiac functions.¹⁹³¹⁹⁴ It's also been shown to improve the electrical and contractile properties of skeletal muscle fibers.¹⁹⁵

Another study on rats has shown that oral taurine supplementation may increase muscle performance and reduce muscle injury caused by exercise.¹⁹⁶ The aim of the study was to determine if increasing muscle levels of taurine would decrease free radical damage after exercise-induced injury. The authors found that first taurine levels rose in muscle after supplementation, and secondly that running performance was improved by the taurine supplementation. Thus, it appears taurine supplementation may facilitate exercise performance and reduce some of the counterproductive muscle injury caused by exercise.

In humans, taurine supplementation in patients with heart failure increases their exercise capacity.¹⁹⁷ It's been shown that taurine decreases oxidative stress in skeletal muscle after eccentric exercise.¹⁹⁸

and that taurine may attenuate exercise-induced DNA damage and enhance the capacity of exercise due to its cellular protective properties.¹⁹⁹²⁰⁰

There is some evidence to show that taurine may enhance training further by decreasing training induced fatigue. One study found that Na⁺-K⁺-ATPase activity is depressed with fatigue, regardless of training state, suggesting that this may be an important determinant of fatigue.²⁰¹ Another paper associated fatigue and training with reduced Ca²⁺-ATPase activity.²⁰² Previous studies have shown that taurine stimulates Na⁺-K⁺-ATPase activity and also the pumping rate of the Ca²⁺-activated ATPase pump. One study found that taurine increased fat oxidation in endurance trained athletes.²⁰³

Two recent studies in humans found that human endurance performance can be improved by orally ingesting as little as one gram of a single dose of taurine.²⁰⁴²⁰⁵ Another recent study found that taurine supplementation increases lipolysis and contributes to energy systems, exerting its effects on increasing endurance.²⁰⁶

One study found that taurine administration increased taurine concentrations in skeletal muscles, reduced the decrease in taurine in skeletal muscles that is seen with exercise, increased physical endurance by increasing the duration of running time in rats, and was considered to reduce exercise-induced muscle fatigue.²⁰⁷ Also taurine supplementation has been shown to increase skeletal muscle force production, protects muscle function and reduce oxidative stress.²⁰⁸

Taurine is one of the most abundant free amino acids in the testes and is instrumental in the production of testosterone and in fertility. A recent study concluded that taurine plays important roles in male reproduction and that a taurine supplement could stimulate the secretion of LH and testosterone, increase the levels of testicular marker enzymes, elevate testicular antioxidation and improve sperm quality.^{2092102112122213 214215216217218219220}

Taurine also plays well with the branched chain amino acids (BCAA) as the combination has been shown to decrease delayed onset muscle soreness and muscle damage.²²¹ It's also likely that the beneficial effects of both taurine and the BCAA on skeletal muscle function are enhanced by other nutrients such as beta-alanine and carnosine.²²²

Taurine is considered a potent antioxidant and cytoprotective agent that may be useful for combating the adverse effects of physical and psychological stress, cardiac dysfunction, insulin resistance, and aging.^{223,224,225,226227228229230}

Recent papers found that taurine has beneficial effects on periodontal disease, a disease that is wide spread and increases inflammation, which is counterproductive for optimal health and performance.²³¹²³²

Taurine, because of its beneficial effects on skeletal muscle functioning may also be used therapeutically for skeletal muscle disorders.²³³²³⁴

Body Composition Effects

Taurine has a several effects in the body that contribute to weight and fat loss, and body composition, including beneficial effects on lipid metabolism and protein synthesis.²³⁵

An early study showed that taurine decreases bodyweight in obese mice.²³⁶ Another study on 30 Japanese college students found that taurine is effective in reducing body weight and fat mass, possibly due to its beneficial effects on lipid metabolism.²³⁷ As well it may have an important role in cardiovascular disease prevention in overweight or obese subjects.

More recent studies have found that taurine supplementation can increase energy metabolism and expenditure in muscle, adipose tissue and liver, and the function of lipolytic enzymes, decrease body fat, especially visceral body fat, and has additive effects with exercise.²³⁸²³⁹²⁴⁰²⁴¹²⁴²²⁴³

Other recent studies have found that taurine supplementation can increase energy expenditure and the function of lipolytic enzymes, decrease body fat especially visceral body fat,, restore muscle function in overuse of exercised muscle, decrease catabolism of skeletal muscle, improve strength and endurance performance, decrease muscular fatigue, increase enzymatic antioxidants modulate cytokines, improve cognition and physical fitness, and has additive effects with exercise.²⁴⁴²⁴⁵²⁴⁶²⁴⁷²⁴⁸²⁴⁹²⁵⁰²⁵¹

Taurine has also been shown to increase glucose sensitivity and enhance mitochondrial metabolic function.²⁵²²⁵³ The data suggest that taurine administration has a marked effect on lipid metabolism and can therefore be beneficial to persons looking to lose body fat. Also, that restoration of plasma taurine level could be critical in preventing or improving obesity and age related skeletal muscle and cellular dysfunction.²⁵⁴

As well, the data suggests that taurine depletion causes inadequate β -oxidation due to decreased pH buffering capacity, which consequently leads to metabolic dysfunction.

Besides the effects on fat metabolism and mitochondrial functioning, taurine also has effects on cellular hydration that increases protein synthesis and thus decreases the loss of muscle with weight loss.²⁵⁵

Taurine has been shown to be an important amino acid in several tissues in the body, including muscle.²⁵⁶ Because of its properties in skeletal muscle it's been suggested as a treatment for various muscle disorders.²⁵⁷

Taurine, because of its effects on increasing insulin sensitivity, growth hormone levels, and protein synthesis (secondary to its effects on osmoregulation and cell volumizing^{258, 259, 260}), helps to spare muscle when dieting, with the result that weight loss is mostly from the loss of body fat. Taurine is also beneficial because of its effects on osmotic regulation of neuronal activity.²⁶¹

Taurine is also useful in regenerative therapies. A recent study looked at the effects of taurine in chondrogenesis when used with stem cells. However, the use of taurine may well aid in chondrogenesis when used along other ingredients present in GHboost and as such may be useful of increasing the repair of cartilage in joints, including the vertebral column facets in degenerative spinal osteoarthritis.²⁶² The same study also looked at the beneficial effects of Taurine on telomerase and for anti-aging.

The bottom line is that taurine supplementation significantly enhances the body composition and performance benefits of exercise as well as improving health and well-being in all age groups. Because of all these properties, taurine is an integral part of GHboost.

For the most current information on taurine see my recent online article at https://metabolicdiet.com/wp-content/uploads/2017/product_pdf/Taurine.pdf.

Turmeric

Turmeric. The active constituent in turmeric, known as curcumin, is a potent antioxidant with anti-inflammatory properties and has a wide range of therapeutic effects.²⁶³ Turmeric exhibits marked anti-inflammatory action and has been shown to be as effective as some anti-inflammatory drugs. For example, in a double-blinded trial, post-surgical patients receiving curcumin experienced reductions in stiffness and joint swelling comparable to the effects of phenylbutazone, a potent anti-inflammatory drug.²⁶⁴

Of all the spices and herbal preparations, it seems that only the spice turmeric has any anti-inflammatory effects. This was the conclusion of a study of a variety of Ayurvedic and herbal preparations, which was presented recently at the 9th Asia Pacific League of Associations for Rheumatology Congress.

In this study, a variety of herbal and Ayurvedic preparations were tested in rats. The rats were fed oral doses of the varied herbal and Ayurvedic recipes. Only turmeric showed anti-inflammatory effects when tested on irritated paws of the rats.

It works by inhibiting cyclooxygenase and lipoxygenase enzymes that catalyze the formation of inflammatory prostaglandins.

Several studies have shown the effectiveness of curcumin, especially when coupled with piperine which increases absorption of curcumin (both are in GHboost) on exercise induced muscle damage and soreness, and recovery as well as on improving body composition and exercise performance.

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In one study the combination of curcumin and piperine (**both in GHboost**) resulted in an improvement of in sprint mean power output 24 hours post-exercise.²⁷³ A recent study found that the combination of curcumin and alpha lipoic acid (**both in GHboost**) exhibit an additive effect in weight and fat loss.²⁷⁴

As well, other studies have shown the value of curcumin in the prevention and treatment of neurological dysfunction such as Alzheimer's disease and other neurological diseases.²⁷⁵²⁷⁶

Since GH secretion is compromised by acute and chronic inflammation,²⁷⁷²⁷⁸ the anti-inflammatory effects of turmeric, along with the other potent antioxidants in GHboost, such as **resveratrol, vitamin C, alpha lipoic acid, taurine, melatonin**, relieves the effects of inflammation on GH secretion and thus results in increased GH levels in the body.

Antioxidants

Other potent antioxidants such as **vitamin C, glutathione** and **resveratrol**. As mentioned above, these antioxidants suppress oxidant and stress damage to the hypothalamic pituitary axis and minimize the adverse effects of inflammation on GH secretion. Again several studies have shown that chronic systemic inflammation, including arthritis, involving cytokines such as interleukin-1 and tumor necrosis factor-alpha may be associated with a decrease in GH and IGF-I, and concomitant muscle

wasting.²⁷⁹ In one study the authors surmised that the decrease in body weight gain in arthritic rats may be, at least in part, secondary to the decrease in GH and IGF-I secretion.

Alpha Lipoic Acid (ALA)

Alpha Lipoic Acid. Besides having potent antioxidant properties,²⁸⁰ likely secondary to increasing levels of intra-cellular glutathione, ALA also increases insulin sensitivity. **ALA**, a potent antioxidant²⁸¹²⁸²²⁸³ that can recycle other antioxidants such as vitamin C, vitamin E and glutathione.²⁸⁴²⁸⁵ ALA was added to GHboost to increase GH secretion and insulin functioning and sensitivity²⁸⁶²⁸⁷ by its actions on the pro-inflammatory cytokines²⁸⁸²⁸⁹ and because of its effects on decreasing secondary cortisol elevations.

Alpha lipoic acid has also been shown effective for weight loss and decreasing hip circumference in conjunction with EPA and on its own.²⁹⁰²⁹¹²⁹²²⁹³²⁹⁴²⁹⁵²⁹⁶²⁹⁷ As well, alpha lipoic acid has been shown to decrease inflammation and have a beneficial effect on muscle strength exercise recovery²⁹⁸, on serum lipids and cardiovascular health.²⁹⁹³⁰⁰³⁰¹

Resveratrol

GHboost contains **resveratrol**, a potent antioxidant with significant anti-aromatase activity.³⁰²³⁰³ Researchers in Italy have shown that resveratrol may have significant anti-aging effect and extend lifespan.³⁰⁴

The authors of this study conclude that "the observation that its supplementation with food extends vertebrate lifespan and delays motor and cognitive age-related decline could be of high relevance for the prevention of aging-related diseases in the human population."

As well, resveratrol has been shown to decrease fatigue, improve recovery, enhances body composition and both physical and mental performance, and improves testicular function.³⁰⁵³⁰⁶³⁰⁷³⁰⁸³⁰⁹³¹⁰³¹¹³¹²³¹³³¹⁴³¹⁵³¹⁶³¹⁷³¹⁸³¹⁹³²⁰ A recent study outlined the neuroprotective effects of resveratrol secondary to its antioxidant, anti-inflammatory and anti-apoptotic properties.³²¹

Another recent study concluded that the use of resveratrol could effectively reduce muscle pain, increase exercise performance, and decrease muscle damage.³²²

Studies have also shown that resveratrol, and the B vitamins in GHboost, can counteract some of the detrimental effects of environmental pollution especially first, second, and third hand cigarette smoke and air pollution from several other sources including the burning of fossil fuels and organic material.
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Coenzyme Q10

Coenzyme Q10 (CoQ10) is a lipid-soluble antioxidant and a key component of the mitochondrial electron transport chain for adenosine triphosphate (ATP) production.³²⁶ As such it is necessary for proper energy metabolism. For example, myocardial CoQ₁₀ content is reduced by cardiac failure and aging. It is also reduced by statins, the popular cholesterol lowering drugs. Studies have suggested preventative supplementation of coenzyme Q10 for cardiac health and for those on statins.³²⁷³²⁸³²⁹³³⁰

CoQ10 has been shown to decrease oxidative stress and mitochondrial damage in many tissues. As well, CoQ10 has been shown to affect the expression of genes involved in human cell signaling, metabolism and transport. As such since many neurodegenerative disorders, diabetes, cancer, and muscular and cardiovascular diseases have been associated with low CoQ10 levels, supplementation may be useful in many diseases.

For example, CoQ10 supplementation has been shown to have anti-aging and beneficial effects on semen parameters, fertility, testicular damage, and reproductive hormones including testosterone.³³¹³³²³³³³³⁴³³⁵³³⁶³³⁷³³⁸³³⁹ It's also been shown to have beneficial effects on inflammation, the immune system, and on exercise performance.³⁴⁰³⁴¹³⁴²³⁴³

The combined use of **CoQ10** and **selenium** (both in GHboost) dietary supplement ingredients has been shown to have significant effects on cardiovascular health and inflammation.³⁴⁴³⁴⁵³⁴⁶³⁴⁷³⁴⁸

The combined use has also been shown to increase IGF-1 levels thus adding to the anabolic and body composition effects of GHboost.³⁴⁹

Pyridoxine and niacin

Pyridoxine (vitamin B-6) and **niacin (vitamin B3)** are water-soluble vitamins that are needed in the body's production of GH. Niacin also directly increases GH secretion. Niacin, along with the amino acid glycine, also have some relaxing effects and thus are useful before bed to help sleep.

GHboost has both **pyridoxine** (in the form of HCL) and **pyridoxal-5-phosphate (P5P)** in it. P5P is the metabolically active form of vitamin B6. Pyridoxine HCL, while as easily absorbed as P5P has to be converted to P5P in the body in order to be used by the enzymes involved in protein metabolism and various hormonal processes. P5P is the preferred form of vitamin B6 as it can be used directly in the body without relying on the livers conversion of other forms of vitamin B6 into P5P. As well, less is needed to achieve the same cofactor effects.

Pyridoxal-5-Phosphate (P5P) is an active form of vitamin B6 involved in macronutrient metabolism as well as the production of neurotransmitters including dopamine, noradrenaline and serotonin.

Zinc. increases the synthesis of growth hormone and the number of its receptors thus mediating increased GH-receptor binding resulting in increased functional GH and IGF-1.³⁵⁰ Supplemental zinc has resulted in an increase the secretion of growth hormone and IGF-I.³⁵¹

Niacin has been shown to increase GH secretion and to act synergistically with other GH releasing ingredients.^{352 353}

Bioperine®

Bioperine in GHboost . significantly enhances the bioavailability of supplemented nutrients through increased absorption and decreased metabolic inactivation.³⁵⁴³⁵⁵³⁵⁶³⁵⁷

Bioperine® is the only product sourced out of piperine to obtain a patented status for its ability to increase the bioavailability of nutritional compounds. Secondly, it is the only source from piperine to have undergone clinical studies in the U.S. to substantiate its safety and efficacy for nutritional use.

The subtle, yet potent properties of Bioperine® have been measured in several clinical studies with healthy volunteers in the U.S. These studies measured the absorption of three distinct categories of products. The categories evaluated with and without Bioperine® were fat- soluble (beta-carotene), water-soluble (vitamin B 6) and a mineral (selenium, in the form of selenomethionine). Gastrointestinal absorption of all the studied nutrients, as measured by amounts present in the blood, increased dramatically when administered with Bioperine® as compared to the control group receiving the nutrient alone. Selenium levels increased by 30%, beta-carotene increased by 60%, and the vitamin B 6 increase was slightly higher than beta-carotene.

Bioperine improves bioavailability of ingredients in LipoFlush but it also has several other beneficial properties, including thermogenic effects, reducing cholesterol and protecting against neurodegeneration and cognitive impairment. As well, it has been shown that it may have immunomodulatory, anti-oxidant, anti-asthmatic, anti-carcinogenic, anti-inflammatory, anti-ulcer, and anti-amoebic properties.³⁵⁸³⁵⁹³⁶⁰³⁶¹³⁶²³⁶³³⁶⁴

For current information on the beneficial effects of piperine as the trademark Bioperine go to <https://www.bioperine.com/index.php/aboutbioperine>.

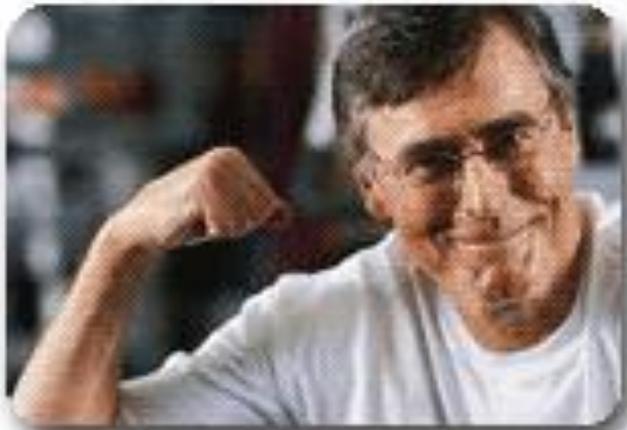
How to Use GHboost

Since up to 90 percent of growth hormone is released two hours or so after falling asleep, GHboost is best used before bed as it results in an increase in the GH nighttime peak as well as increased GH levels throughout the day. The nighttime peak of GH also acutely stimulates IGF-I levels for several hours giving elevated levels over a 24 hour period.

GHboost can also be used before exercising to maximize the anabolic and fat burning effects of exercise. It's also useful before bed for increasing growth hormone and IGF-1 levels as well as improving sleep and recovery. As well, GHboost works synergistically with other MD+ nutritional supplements.

For example [NitAbol Chocolate](#) and [NitAbol Vanilla](#), the nighttime anabolic, fat burning combos combines [TestoBoost](#) with [GHboost](#) and [Myosin Protein](#). NitAbol is perfect for those that want to lose weight, but would prefer to maintain the muscle they have and strictly lose bodyfat.

GHboost works synergistically with [LipoFlush](#) and with [Amino](#) to decrease body fat and maximize muscle mass and performance. This combination is used by competitive bodybuilders and fitness competitors, as well as elite level Olympic athletes to hone their bodies and performance.



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