first endurance

MULTIV RESEARCH PACKET

SUPPLEMENT FACTS

30 servings per container

Use Directions: Take 3 tablets daily with a meal

Serving Size	**3 Tablets**
Amount Per Serving	% Daily Value*
Vitamin A (100% as Beta Carotene) 900 mcg RAE	100%
Vitamin C (as Ascorbic Acid) 400 mg	444%
Vitamin D (as Cholecalciferol) 20 mcg (800 IU)	100%
Vitamin E (as d-Alpha Tocopherol from Mixed Tocopherols) 30 mg	200%
Vitamin K (as Phylloquinone) 75 mcg	62%
Vitamin B1 (as Thiamin Mononitrate) 4 mg	333%
Vitamin B2 (as Riboflavin) 5 mg	385%
Niacin (as Niacinamide) 20 mg NE	125%
Vitamin B6 (as Pyridoxine Hydrochloride) 4 mg	235%
Folate (as 6S-5-Methyltetrahydrofolate Glucosamine Salt)[1] 400 mcg DFE	100%
Vitamin B12 (as Cyanocobalamin) 30 mcg	1250%
Biotin 300 mcg	1000%
Pantothenic Acid (as d-Calcium Pantothenate) 20 mg	400%
Choline (as Choline-L-Bitartrate)(VitaCholine®)[2] 55 mg	10%
Calcium (as Dicalcium Phosphate Anhydrous) 90 mg	7%
Iron (as Ferrous Bisglycinate)(Ferrochel®)[3] 18 mg	100%
Iodine (as Potassium Iodide) 150 mcg	100%
Magnesium (as Oxide and Dimagnesium Malate) 250 mg	60%
Zinc (as Oxide and Bisglycinate) 22 mg	200%
Selenium (as L-Selenomethionine) 55 mcg	100%
Copper (as Gluconate) 2 mg	222%
Manganese (as Gluconate) 1.15 mg	50%
Chromium (as Chromium Picolinate)(Chromax®)[4] 400 mcg	286%
Molybdenum (as Sodium Molybdate) 45 mcg	100%
Vitamin K2 (as Menaquinone-7)(K2Vital® Delta)[5] 45 mcg	**
Boron (as Bororganic® Glycine) 1 mg	**
Ginkgo biloba Extract (Ginkgo biloba) (leaf) (24% Ginkgoflavone glycosides, 6% terpene lactones) 120 mg	**
Green Tea Extract (*Camellia sinensis*) (leaf) (60% polyphenols) (decaffeinated) 200 mg	**
Spectra® Total ORAC5 Blend[6] 50 mg	**
Yeast Beta Glucan (Immudyne Nutritional NQ™) 30 mg	**

*Percent Daily Values are based on a 2,000 calorie diet **Daily Value Not Established

Other Ingredients: Microcrystalline Cellulose, Croscarmellose Sodium, Stearic Acid, Hypromellose, Silica.

[1] Quatrefolic® is a registered trademark of Gnosis S.p.A.
[2] VitaCholine® is a registered trademark of Balchem Corporation.
[3] Ferrochel® is a registered trademark of Albion Laboratories, Inc., U.S. Patent 5,516,925
[4] Chromax® is a registered trademark of Nutrition 21, LLC. Chromax® is patent protected.
[5] K2Vital® is a registered trademark of Kappa Bioscience AS.
[6] Spectra® is a trademark of VDF Futureceuticals, Inc.

MULTIV UPDATED TO BE BETTER THAN EVER

MultiV Performance & Health Benefits

- Unique formula – beyond essential micronutrients – nothing like it
- Maintain healthy exercise performance, body composition & recovery
- Everyday immune support & wellness
- Everyday optimal health
- Contains specific, carefully chosen forms of micronutrients
- Balanced essential micronutrient levels for endurance athletes
- Bioavailable forms with minimal competition for absorption, uptake, and bioavailability
- Maximizes benefits of additional nutrients

DEEPER INSIGHTS, DEEPER FORMULA

MultiV has been updated to take into account emerging research on micronutrient needs of endurance athletes, so it works as hard as you perform. Ever-expanding data from the fields of nutrigenomics, metabolomics, cell/tissue signaling, and integrative systems have given deeper insights and understandings into how micronutrients work together to keep you healthy and performing maximally. The simple take-away is that a chain is only as strong as its weakest links, and there are many links in attaining and keeping optimal health and performance. This new thinking argues strongly for a comprehensive, high-potency, multiple vitamin-mineral (MVM) .

A comprehensive, balanced MVM formula maintains optimal health during physically and mentally stressful conditions; high-calorie, high-carbohydrate diets; strenuous exercise workloads; oxidative stresses; metabolic overdrives; musculoskeletal integrity burdens; immune system attacks; multitasking mental functions; frequent pain; and accounting for your specific genetic constituency, both genome and epigenome.

Vitamins and minerals are essential micronutrients that drive fuel through old-fashioned intermediary metabolism (converting food to propulsive energy and motive force) to power all of your bodily functions. Vitamins and especially minerals are cofactors that bring life to enzymes and other functional proteins. Without their presence, life itself would not be possible.

Thus, vitamins and minerals are guarded, hoarded, stored, and worshipped by your body. A complex network for each micronutrient exists to keep their functions available for use, even in the face of excess, temporary dietary absence or insufficient intakes for full throttle. Your body can dial up (or down) absorption, storage and excretion in order to maintain adequate status with a reserve.

In actuality, micronutrients exhibit toxicity only with difficulty and can maintain some functions even with low, deficient intakes over long periods of time. Some activity is better than the alternative. Although our bodies are programmed to make do with variable intakes of micronutrients, all systems work best when they are all available all the time. Again, a chain is only as strong as its weakest link. That is why MultiV has all the essential vitamins and minerals, and more.

NOTABLE CHANGES TO UPDATED MULTIV

Unchanged

Most of the letter vitamins (A, Bs, C, D, E, K1), most of the minerals, Ginkgo and Green Tea extracts remain the same.
The amber bottle also protects light-sensitive micronutrients so you can take MultiV with you anywhere, anytime, all the time.

MultiV kept the 400 mg per serving dose of Vitamin C for the following reasons:

1. A comprehensive multivitamin/mineral should be comprehensive, and that means ensuring each and every essential micronutrient deficiency can be prevented;
2. Insufficient Vitamin C intakes are not uncommon and easily occur with a high-carb diet, a high-keto diet, or a diet low in fresh fruit;
3. The amount of Vitamin C in MultiV, including dietary intakes, is below that linked to pro-oxidant issues with exercise;
4. Vitamin C intake near 500 mg daily has important benefits for the immune system – always a concern for endurance athletes;
5. Nothing can replace Vitamin C for being a cofactor in important enzymes involved in collagen synthesis and neurotransmitter synthesis (see Reason #1).

Additions: Beta Glucan, Boron, Calcium, Choline, Vitamin K2 MK7

New to MultiV is Choline (finally recognized as an essential micronutrient), the ultratrace element Boron, and Vitamin K2 Menaquinone-7 (MK7) as K2VITAL® Delta, specially engineered for stability in multivitamin-mineral tablets with calcium and magnesium (like MultiV). Also new are Spectra® Total ORAC5 Antioxidant Blend and a highly refined yeast beta glucan (Immudyne Nutritional NQ™), included for additional specific immune support important for endurance athletes. Calcium does double duty as a tableting excipient and as an active essential nutrient, and it is newly listed since it is over the minimum 5% Daily Value (DV) amount as required by regulatory labeling of dietary supplements.

Deletions: Digestive Enzyme Blend, Polyphenol Antioxidant Blend, Vitamin K2 MK4

Gone are Vitamin K2 (Menaquinone-4), the Digestive Enzyme blend, and Polyphenol Antioxidant blends to make room for the newbies that offer more features. New ingredients that were previously unavailable spurred the changes.

Changes - Amounts

Daily doses were changed to improve interplay and balance between micronutrients – most were unchanged, some were decreased, and some were increased. Some amounts look different because of updated Daily Values and redefined units. The reasons behind amount changes were to prevent conflicts and to maximize positive interdependent activities of essential micronutrients. Amounts were also changed to take into account increased potency of some nutrients (MTHF Folate and L-Selenomethionine, for example)

Changes - Forms - Minerals

Most typically used forms of micronutrients have room for improvement, especially minerals. We switched some of the mineral forms based on better absorption, uptake, bioavailability, and less interference with other forms in MultiV and your dietary intakes. For example, plant foods contain both inorganic borate and multiple organic "chelate" boron forms. Boron in MultiV is an organic "chelate" that acts as a time-release borate in your body, extending boron actions longer than sodium borate salts.

Changes - Forms - Vitamins

Vitamins are a hodge-podge of structurally weird molecules that need to survive being pulled apart, snapped back into shape, and other molecular mayhem when they are in position on their specific enzymes. Each vitamin has different forms that are commercially available, and the choice can make a big difference in functionality and even safety. For example, Folate was changed from inactive Folic Acid to the predominant bioidentical, active Folate form in foods and our bodies (Calcium-L-Methyltetrahydrofolate or MTHF). This change looks minor but is a huge difference maker for long-term health, as explained in more detail below.

WHY YOU NEED AN ENDURANCE MULTIVITAMIN/MINERAL (MVM)

REASONS WHY YOU NEED AN ENDURANCE MVM (PROBLEMS & SOLUTIONS)

MVM Problems:

- Micronutrient Intake Gaps (Insufficiencies & Deficiencies)
  - Athletes do not get enough intake of all the MVMs from their diet (low and/or variable intakes);
  - Athletes show prevalence of low levels and/or higher turnover of critical MVMs for exercise performance;
  - Low micronutrient density diets, strict or low-calorie diets;
  - "Vitamin-rich" & "mineral-poor";

- Imbalanced Micronutrient Intakes & Ratios
  - Strenuous exercise places additional nutritional demands on some MVMs;
  - Daily Values may not be adequate for exercising athletes to maintain high workloads;
  - A functional deficiency of even one MVM will detract overall performance and imbalance other MVMs;
  - Don't need 100% of everything;
  - Dietary intakes considered, too;

- Comprehensive (Avoiding Weakest Link In The Chain)
  - Sufficient Amounts/Doses;
  - Forms of Each Nutrient;
    - ◊ Nutrient-nutrient interactions;
    - ◊ Absorption, uptake, bioavailability, functionality;

- Compliance (Consistent, Daily Use)
  - Genetics & Epigenetics

MultiV Solutions:

- MultiV is designed unlike other MVMs;

- Fill micronutrient intake gaps from your diet (comprehensive);
  - Improve dietary micronutrient density;
  - Prevent insufficiencies and deficiencies;

- Balance micronutrient intakes for optimal functionality;

- Comprehensive (26 vitamins & minerals)
  - Sufficient doses of each micronutrient to cover losses greater than non-exercising persons (for example: heavy exercise workloads, sweat losses);
  - Best forms of each micronutrient that account for common genetic variations and gender differences;
  - Provide individual micronutrients with superior absorption/bioavailability;
  - Provide individual micronutrients with less interactions among other nutrients;
  - Compliance for consistent daily intakes
  - Keep pill number per serving and size of pills as low as possible with easiest shape for swallowing;

- Genetics & Epigenetics
  - Forms and doses of micronutrients balanced to account for genetic variations;

- MultiV adds additional nutrients with benefits for exercisers;

WHY DO I NEED A MULTIVITAMIN (MVM)?

Because you want to give yourself the best chance to train, perform, recover, rest and repeat again, at your peak.

MultiV Is Designed Unlike Other MVMs
Rather than meet cost constraints or pill number/size goals, MultiV was designed to be the best for intense endurance exercise. That means MultiV provides solutions for your essential micronutrient needs – not compromises.

Essential micronutrients (vitamins and minerals) are molecules and compounds that your body cannot make itself, and thus, need to come from your diet – whatever you eat and swallow. There are at least 24 essential micronutrients to consider (and many more helpful but not so-called essential micronutrients). Keep in mind that electrolytes sodium, chloride, potassium , phosphate and calcium are a different story – they are not micronutrients, but are macronutrients, meaning a gram or more per day is a necessary intake. Magnesium is a borderline macro/micronutrient and should be in an endurance MVM since dietary intakes are highly variable day-to-day and usually insufficient or deficient. To keep your body replete with all those micronutrients, there are certain requirements for a MVM to ensure you are not letting essential micronutrients be a problem.

Taking Exercise Into Account - You're Not Normal (But That's OK)

The Daily Values (DVs) of Calories, Protein, Fats, Carbohydrates, Vitamins, and Minerals are generated for the nutritional sufficiency needs of the overall US population, not for intense, long-duration exercise demands. Your exercise load, training frequency, daily scheduling, and mental toughness are not "normal." Your typical nutrient intakes are also not normal, with a lower micronutrient density (micronutrients per Calorie ratio), and intakes are heavily weighted to carbohydrate sources and often low or absent of micronutrients.

Day-to-day variability of meeting nutrient needs is high – not conducive to maintaining status of nutrients that are not stored and/or are excreted easily. Training causes a myriad of physiological changes in your metabolism (cellular energy production), cardiovascular dynamics, muscular repair processes, nervous system functions, connective tissue turnover and bodyfat content. You spend long time periods of gut hypoxia, altering your absorption, uptake, bioavailability, excretion of micronutrients throughout the day, and perhaps altering your gut microbiome adversely. Exercising in the heat also leads to increased loss of minerals not found in non-exercising persons.

You need a MVM that is suited to your needs and lifestyle. Let's look at some of the problems and the solutions that MVMs can fix.

Problem: Endurance Athletes and Micronutrient Intake Gaps

Most studies of endurance athletes find low intakes of key nutrients such as Vitamin D, calcium, magnesium, iron, iodine and seriously low intakes and status of omega-3 fatty acids. These are also the nutrients with big issues for the US population (excepting, perhaps, iron). But endurance athletes are often below their needs for protein and especially carbohydrates, and coupled with long-duration, intense exercise, that means an energy deficit – quite the opposite of average Americans.

Compared to the rest of the population, serious endurance athletes are semi-starved and somewhat malnourished. But micronutrient deficiencies are like pulling spark plugs out of your engine. It becomes obvious that all nutrients, including calories, need to be adequate and balanced for optimal performance.

Another hidden source of micronutrient gaps is nutrient density (ratio of micronutrients to calories). You eat a high-carb diet most of the time, and likely fuel adequately during training, events, and recovery with water, calories, and electrolytes, but those calories are not micronutrient-dense. Simply put, you are not getting enough micronutrients to help process increased fuel loads efficiently.

You don't need 100% Daily Value (DV) of every essential vitamin and mineral in MVMs. You will not see sodium, chloride, phosphorus (phosphates), or potassium at a meaningful dose in MVMs, if present at all – they are needed in multigram amounts. MVMs are intended to prevent micronutrient deficiencies – this means non-caloric nutrients with intakes of milligrams or micrograms daily. A MVM with 100% of all essential vitamins and minerals is unfeasible – a pill the size of a softball.

You also eat foods that contain vitamins and minerals, and you often reach 100% DV intakes from foods alone for some, but never for all vitamins and minerals. You also do not get near 100% DV for calcium and magnesium in MVMs because of the large amounts needed. MVMs can help magnesium intakes significantly if designed properly. With the First Endurance System, regular use of EFS, EFS-PRO, and/or Ultragen provide gap-filling amounts of calcium and magnesium in highly absorbable forms.

Solution:

Provide enough of each micronutrient to make low intakes and low nutrient density dietary intakes reach functional sufficiency for each and every essential micronutrient. No weak links in the chain of micronutrient sufficiency and function!

Citations for Endurance Athletes & Micronutrient Intakes: *ARS 2018; Baranauskas 2015; Beerman 2020; Block 2007; Bohl 2002; Brilla 2012; Bucci 1993; Burke 2019 73, 2019 117; Clarkson 1995 831, 1995 S31; Costa 2019 130, 2019 166; da Silva 2020; Deldicque 2015; Deuster 2006; DGAC 2019; Dias 2021; DiSilvestro 2017; Driskell 2006; Gatrich 2020; Grozenski 2020; Haymes 1998; Heaney 2010; Heffernan 2019; Kisters 2019; Laires 2001, 2008, 2014; Lee 2017; Lukaski 1983, 2000, 2004, 2006; Martin 2007; Maughan 2018 104, 2018 439; McDonald 1988; Mehlenbeck 2004; Moshfegh 2009; Nebl 2019; Newhouse 2000; Nica 2015; Nielsen 2006, 2019; Nikolaidis 2018; Oullette 2012; Parnell 2016; Peeling 2018, 2019; Rakhra 2017; Ranchordas 2012; Razzaque 2018; Rogerson 2017; Singh 1990, 1993; Stendig-Lindberg 1987, 1989, 1991, 1992, 1995, 1999; Tardy 2020; Tiller 2019; Vitale 2019; Volpe 2015; Wierniuk 2013; Williams 2005; Williamson 2016*

Problem: Micronutrient Balance

So you think that taking a MVM takes care of your micronutrient needs? Consider this sobering fact from 2021: over 50% of Americans take a MVM regularly, but more than 95% of us are not getting enough of all the essential vitamins and minerals. This startling fact also shows how imbalanced most MVMs really are ("vitamin-rich, mineral poor").

Balance means using the right amounts and the right forms of each micronutrient – and considering how they work together. This does not mean supplying 100% DV of everything.

No micronutrient is an island, which is how DVs were determined – individually. Vitamins and minerals work in concert to operate your cellular machinery to keep you healthy, active for peak performance and recovery. Your body has a multitude of interactive ways to meet its demands for physical and mental performance. But like any fine-tuned system, even a single missing, excessive or dysfunctional part can limit overall peak performance.

Each essential vitamin has its own range of intakes for deficiency, insufficiency, a wide range of sufficiency, excessive amounts that interfere with health, and finally, toxicity. Minerals have wider ranges of deficiency and insufficiency, smaller ranges of sufficiency, lower thresholds for interference from excessive amounts, and less margin of safety than vitamins. Defining a deficiency or insufficiency or sufficiency is a moving target that is still debated. Water-soluble vitamins have different ranges for sufficiency/toxicity than fat-soluble vitamins.

Because your body adapts to regular exercise training, more exercise does not necessarily mean needing more of everything. Your body tends to hang on to essential micronutrients by lessening excretion capacity and releasing stores if necessary. Also, essential micronutrients activate the function of the protein they inhabit, and it takes longer than your exercise event timeframe to make more protein and attach or append the right micronutrients to gain additional function immediately after nutrient intake. MVMs are proactive, not reactive.

Exercise performance (energy metabolism) and recovery after strenuous exercise are both several chains of events (cycles) that are intimately linked. And each micronutrient has to go through its own chain of events to fit into the proteins for each of their participatory cycles. In fact, it is seldom realized or acknowledged that vitamins and mineral forms in MVMs are usually inactive. And even bioidentical vitamin forms for B vitamins, and especially mineral forms, are stripped down to what you get in MVMs. Fortunately, each micronutrient goes through complicated transformations and metabolic steps to fit into its ultimate molecular usages. This forgotten control factor is something seldom considered for designing MVMs, but it is a key design feature of MultiV. For example, if you took the ultimate, most active Vitamin D form (Calcitriol instead of Cholecalciferol) at the Vitamin D 10% DV, it would be seriously toxic and even deadly. Also, activated vitamins are less stable than forms in MVMs, meaning a short shelf-life in tablets before they degrade into oxidized anti-vitamins or indigestible mineral forms like rust for iron.

Another part of balance is not getting excessive – too much of a good thing. MultiV does not have megadoses. [Note: the % DVs are not always a good indicator of megadoses.] Taking a large dose of a single micronutrient may lead to unexpected problems, as megadose practices have discovered, usually by imbalancing the function of other micronutrients. Taking high doses of micronutrients also makes your body decrease the percentage absorbed, and worse, get better at disposing of excess, so if your intake suddenly drops to normal levels, you may get a rebound effect of functional insufficiency before your body adjusts to the new intake. Balance also means timing of nutrient functionalities.

Solution:
Balancing MVMs, especially for a specific use like exercise performance, is more of an art based on many fields of science. Deeper knowledge and more experience mean better and more efficient balance. Give enough of each and every micronutrient and then give it time to work with your body's homeostatic mechanisms to utilize the bounty of micronutrients. With MultiV, based on the extremely large database of micronutrient intakes, especially in endurance athletes, we can safely predict you will have improved intakes and adequate status of essential micronutrient vitamins and minerals. MultiV also opts on the side of caution for maintaining sufficiency with long-term safety.

Problem: Comprehensive Formula - Everything All The Time
The goal of a MVM for persons engaged in strenuous, exhausting physical and mental exercise is to supply all essential micronutrients, even if some are more necessary then others – preventing weak links in the chain of nutritional sufficiency. Having each and every essential micronutrient is not often seen in MVMs.

The so-called nonessential vitamins and minerals are and always have been essential for our bodies, but a regulatory framework for disease prevention by nutrients rather than health promotion keeps scientists and bureaucrats as opponents. For example, choline was not considered "essential" until 1998 on the basis of a deficiency of intake and levels causing fatty liver was verified beyond a doubt – and even then, it was not allowed to be listed as essential on supplement labels until after 2020.

Boron has incontrovertible evidence it can do what no other nutrient can do because of its unique atomic structure that supports health, but again, scientists and regulators are still debating the details of how essential it is. For both choline and boron, insufficiency leads to deficient functions of other micronutrients – folate and B12 for choline and calcium, magnesium and vitamin D for boron. A similar story for Vitamin K2 MK7 will be discussed later. We are not even getting into silicon or lutein/zeaxanthin and lycopene carotenoids yet.

Comprehensive also means dose sufficiency that takes into account all factors, not just nutrient in/nutrient out data. Balance fine tunes the amounts of each nutrient, but each needs to be helpful, too. Studying nutrient intakes and status in athletes is one guide to be suited to meeting comprehensive needs of exercisers, but exercise is only one variable to consider for micronutrient, and other unavoidable factors are at work.

One study showed being comprehensive is better (Block 2007). Compared to a no supplement group and a one-a-day multivitamin supplement group (100% DV or less), another group took more supplements, including higher doses of vitamins and minerals with omega-3s – a MVM with additional nutrients. The group taking the MVM with benefits showed significantly better results for reaching healthy biomarker levels, felt better and had better physical functions. The one-a-day MVM was seldom better than not taking a MVM supplement. ***Point is that you need enough of each and every MVM all the time for a long time period to see results.***

Compliance Matters

Consistent intakes are part of being comprehensive – a MVM can't help at all if you don't take it or can't help enough if you don't take it often enough or at full strength. Ideally, you want to supplement your diet so that your consistent average daily intake from diet and supplements remains in the upper part of the sufficiency zone of intake for each nutrient. This prevents any variability into the lower intakes of insufficiency without getting into safety issues for spikes of increased intakes from variations in dietary food intakes.

Nutrient Forms Matter

The specific form of each micronutrient is crucial. For many vitamins, the typical forms used have been well-tested and used in human clinical studies, and their metabolic pathways worked out, so that an effective dose is known and supported. Especially for minerals, there are big differences in absorption, uptake, bioavailability and interactions with other nutrients among the various forms available.

Another comprehensive benefit is the forms of vitamins and minerals. Sometimes the forms are the same everybody uses (like most B Vitamins), sometimes we choose the best forms (like trace mineral chelates).

The usual forms that have less bulk, size and weight also have less usefulness to your body than expected. They also interfere more with other micronutrients and your food intake for uptake into your body. MultiV takes this issue into account seriously, using vitamin and mineral forms with superior capabilities, but more bulk and size, which is why there are three pills per serving. For example, if we used only inorganic mineral forms, we could squeeze everything into two tablets daily instead of three. But at what cost? Your health and performance.

An example of healthy attention to detail for forms of vitamins is Folate, normally supplied as Folic Acid. Folic acid is an inactive synthetic form of the Folate molecular backbone that is not normally found in foods or your body. In Nature, folic acid is briefly formed and converted as an intermediate in the production of MTHF by microbes and plants. Folic acid requires activation by several metabolic steps in your body to become the active, coenzymatic MTHF form. If folic acid intakes are high, and/or you happen to be one of the ~30% of us who have one or more of the several common genetic polymorphisms in enzymes involved in folate metabolism, the ability of folic acid to be converted into MTHF is slowed. Worse, unmetabolized folic acid (UMFA) piles up in blood and cells, where it blocks MTHF, meaning a decrease in folate function. Since folate function depends on MTHF and is required for your body, being critical for blood cell formation, making numerous important compounds, and detoxifying homocysteine as well as controlling gene expression, UMFA can be a detriment to health, including causing birth defects. MultiV does not take that chance with your health. MTHF is the most active and best form of folate.

Citations for MTHF Folate: Cornet 2019; EFSA 2009, 2010, 2013; Fenech 2005; Fohr 2002; Kalmbach 2008; Knowles 2016; Pietrzik 2010; Prinz-Langenohl 2009; Scaglione 2014; Selhub 1996, 2016; Ulrich 2006

Solution:

MultiV has 26 different micronutrient vitamins and minerals, excluding sodium, chloride, potassium and phosphorus, including Boron and Vitamin K2 MK7. MultiV is designed to be as easy to take as possible while delivering useful amounts and forms of multiple essential micronutrients. Forms of each micronutrient were carefully chosen to provide your body with the best absorption, uptake, bioavailability, lack of unwanted interactions, integration into metabolic pathways, function, and increased safety.

Problem: Your Genetic Achilles Heels

Many more good reasons to regularly take a MVM are you, yourself, and your genetics. Modern genetics research has advanced to understand that each one of us has hard-wired genetic differences that are not ideal. Some nutrient functions are commonly affected adversely – Folate, Vitamin D, Iron, Omega-3 Fatty Acids, B12, Magnesium, Calcium, Biotin for starters. For every nutrient, there are many key proteins that help that nutrient fulfill its metabolic perfection. Genetic protein malfunctions exhibit a functional deficiency of a vitamin or mineral even if levels and intakes are normally enough according to the Daily Values. Again, the Chain of Nutritional Functions is Only As Strong As the Weakest Link.

Less is known about the magnitude of even more numerous epigenetic effects of silent changes in DNA sequences, but the cure is the same as for genetic changes. And let's not forget that some genetic changes are improvements, but who knows which ones you may or may not have? And which adverse changes would be actuated by increased intake or status of a particular nutrient? Unless you perform expensive and extensive genetic testing, you may never know you could have better health and performance by ameliorating genetic changes.

Solution:

Genetic variations themselves are unalterable (this might change in the future), but you can correct most functional deficiencies by simply increasing your affected nutrient intake and/or its form. By taking enough of the right form of micronutrient with common genetic changes, you can usually optimize your nutrient functions, which is the bottom line. A MVM should supply the best forms of nutrients to further increase chances for success (Folic Acid is the poster child for using the wrong form). MultiV supplies specific nutrient forms with better functionality to bypass common genetic variation effects.

CRITICAL MICRONUTRIENT UPDATES FOR ENDURANCE EXERCISE

Focusing on just a few vitamins illustrates why you need to take a comprehensive MVM. An explosion of human research on exercising individuals has catalogued real-life benefits for exercise performance by ensuring adequate intake of normal, everyday vitamins and minerals. It's not only cycling, running, or swimming faster – it's the Big Picture that keeps you training hard and recovering better so you can make performance gains during competition. Researchers are digging deeper to find new insights into the humble MVM.

Vitamin A Update - Defense Against Outside

Endurance athletes have shown both high, normal, and low levels of Vitamin A intake from food and in blood (Vitamin A status). Ultra-endurance events are associated with decreased levels of circulating Vitamin A (as retinyl esters) after the event. To satisfy giving enough Vitamin A to prevent deficiencies and also to prevent excesses, MultiV uses provitamin A as Beta Carotene to avoid any possibility of active Vitamin A (retinol) overload while ensuring a sufficient status for normal Vitamin A activity. The form of Beta Carotene in MultiV is natural, since large doses of the synthetic version has been associated with adverse pro-oxidant issues. MultiV avoids the tarnish wrongly given all Beta Carotene from misguided human studies and parroted reviews. No risk of antioxidant overload is possible from the daily amount of Beta Carotene in MultiV, even when combined with high fruits/vegetable intakes (natural dietary source of Beta Carotene).

All Vitamin A forms can be derived from Beta Carotene. Beta Carotene in MultiV provides a normal amount of Vitamin A activity for people who do not eat their fruits and vegetables (the usual dietary source of Beta Carotene). Your body converts Beta Carotene into retinal/retinol forms of Vitamin A as needed. Vitamin A as retinal is used by eyes for vision, important for sports requiring visual acuity.

Vitamin A as retinol (which becomes retinoic acid) is a major signal for promoting normal cell growth and differentiation, especially for epithelial tissues that replenish their cells regularly because they are exposed to the outside environment of air, wind, and sun. Immune system cells, GI tract, skin, eyes, lungs (respiratory tract), and kidneys all receive and protect us from environmental exposures, orchestrating constant tissue renewal. Normal Vitamin A status is also required for normal production of red and white blood cells, working in conjunction with iron.

Bone health and maintenance is another important and overlooked role for Vitamin A (retinol) and Beta Carotene. Vitamin A is also instrumental in normal recovery of minor, everyday injuries to skin and musculoskeletal tissues.

A bonus is what Beta Carotene can do that preformed Vitamin A (retinol) cannot – be an antioxidant. Specifically, Beta Carotene quenches singlet oxygen and peroxide radicals in fat-soluble areas. Beta Carotene also protects against sun exposure in skin and eyes.

Citations for Vitamin A (Beta Carotene) Need in Athletes: Al Tanoury 2017; Bucci 1993 23, 1995; Charkos 2022; Fenech 2005; Heinonen 2012; Houtkooper 2005; LeBlanc 1998; Leung 2009; Michelazzo 2013; Neubauer 2010; Stacewicz-Sapuntzakis 2006; Wald 1942; Weber 2012

Vitamin D Update - Performance Enhancement?

You want to fulfill your potential? Here is D way. Vitamin D is ergogenic. What the D? Yes, you read right – Vitamin D can help you exercise better. Numerous unanimous reviews are saying this, so it's not a figment of imagination. Recent research has found that higher levels of Vitamin D show improved exercise performance compared to lower levels. Performance gains (ergogenic effects) have been found with Vitamin D supplementation, especially in those with low and borderline/"insufficient" Vitamin D blood levels.

Dozens of human studies have shown high prevalence of low or "insufficient" blood levels in serious exercisers in apparent good health. Low or "insufficient" Vitamin D levels have been shown to be less than ideal for bone, musculoskeletal and immune health and worst of all, physical performance. Here's D massive but unseen elephant in D room about the huge importance of Vitamin D for healthy exercising athletes – it's fulfillment of potential. With advances in understanding of Vitamin D3 (cholecalciferol) as a pluripotent, hormone-like trigger for overall health in virtually every cell in your body, a surge in human studies on exercise and Vitamin D has found some eye-popping results.

Vitamin D has a ton of human research, but until recently, virtually none was on healthy, exercising persons. Everyone assumed they were outside getting plenty of sunlight to make their own Vitamin D (the major way we humans get Vitamin D) or eating enough foods to reach the DV. Wrong! Unfortunately, in most temperate and higher latitudes, there is not enough sunlight to activate Vitamin D for half a year or more. And dietary Vitamin D is a very poor way to get Vitamin D – unfortified foods have virtually no D3 and plant foods have none. Fortified foods (dairy product and breakfast cereal, mostly) more often add Vitamin D2 (ergosterol), but only contribute low amounts to your dietary intake. So forget about getting enough Vitamin D in your D-iet.

What to do about D? First, you need to use the right form of Vitamin D. There are two forms of Vitamin D in supplements with bioactivity after oral ingestion – D2 (ergosterol) and D3 (cholecalciferol). MultiV uses the more bioactive, more bioavailable D3

form – what your body makes from the sun. Much research has shown D3 is superior to D2, so this was an easy decision. In fact, D2 failed in human studies to improve muscle strength in humans, whereas D3 worked. But D3 has fallen out of favor in supplements because of the vegan trend, fostering increasing use of less-potent, less-functional D2, derived from plant sources, or more often, from easy chemical synthesis, just to be labeled as vegetarian or vegan. Only recently has plant-based D3 become available.

D3 is found in animals and a few lichens/algae and D2 is found in plants (mostly mushrooms). Almost all commercially available D3 is from sheep's wool lanolin (superseding fish liver oil sources). Lanolin can be obtained without the demise of animals, by giving them a haircut. Sheep's wool lanolin is vegan-friendly, but not vegetarian or vegan. This is why MultiV is not able to be Certified Vegan, but is "vegan friendly." Everything else in MultiV is vegan-compliant.

It's easy to see that normalizing a healthy level of Vitamin D year-round is a vital way to ensure you are meeting your performance potential. And getting 100% of the newly increased DV of D3 from your MVM (like MultiV supplies) is enough to push most people into sufficiency, and performance fulfillment.

Citations for Vitamin D Need in Athletes: *Abrams 2018; Araujo 2021; Beaudart 2014; Bollen 2023; Brancaccio 2022; Bucci 1993 23, 1995; Butscheidt 2017; Byers 2020; Cannell 2009, 2018; Chiang 2017; Dahlquist 2015; de la Puente Yague 2020; Farrokhyar 2015, 2017; Feng 2023; Grant 2020; Han 2019; Harju 2022; Iolascon 2021; Ip 2022; Knechtle 2020, 2021; Ksiazek 2019; Neal 2015; Nho 2018; Ogan 2013; Rockwell 2022; Shoemaker 2022; Sikora-Klak 2018; Stojanovic 2022; Todd 2015; Tomlinson 2015; von Hurst 2014; Willis 2008; Wojtys 2021; Yoon 2021*

Choline Update – Too New for Other MVMs

Although choline was classified as an essential nutrient in the US since 1998, there was no agreed-upon Daily Value (DV) until recently. Choline is another "vitamin" that has multiple forms in foods and our bodies, but choline is not easy to put into supplements. MultiV uses a dry, soluble and stable choline salt form – Choline-L-tartrate, aka Choline bitartrate. Choline salts are extremely hygroscopic (attracts water from even low humidity air), and they are a disaster for shelf life of MVMs with other choline salts. Lecithin forms of choline have low potency and are another gooey mess to put into tablets at the large amounts required. That leaves Choline bitartrate as the most potent, stable, and acceptable form of Choline for tablets. Tartrate is tartaric acid, the major acid in grapes, and a common food flavor/acidifier. The amount of Choline per serving in MultiV is a whopping 10% - rarely seen in MVMs. It's that important. [Note: see the HALO Research Packet for information on Choline and Exercise Performance.]

Citations for Choline in MultiV: *Atzler 1935; Bjorndal 2018; Buchman 1998, 1999, 2000; Conlay 1986, 1992; de la Huerga 1951, 1952; Deuster 2002, 2006; Ernst 1960; Ganz 2017; HALO Research Packet 2022; Hirsch 1978; Hoeg 2020; Jager 2007; Martinez 2016; Mies 1958; Modinger 2019; Naber 2015; Newsom 2016; Penry 2008; Sandage 1992; Spector 1995; Staton 1951; Storsve 2020; von Allworden 1993, 1995; Wallace 2018; Warber 2000; Wurtman 1977*

Iron Update – Hepcidin Link to Exercise

Iron is widely regarded as the #1 problem with micronutrients and exercise, and rightly so. In spite of widespread attention to getting adequate iron, 15-50% of women and 5-30% of men who exercise regularly show iron deficiency. Most are consuming at least the DV of iron (18 mg daily), but signs of deficiency exist. By combining dietary iron intakes with 18 mg of iron from Ferrochel® (ferrous bisglycinate), MultiV provides the best form of iron. But the Iron Enigma is not only about getting enough iron – recent research has found that low energy availability during exercise and relative energy deficiency in sport causes low iron stores and iron deficiencies.

Why is energy intake affecting iron status? Because iron is a double-edged biological sword. Strenuous exercise, especially with low energy stores, causes inflammation that releases iron from its proteins (myoglobin, hemoglobin and many other iron-containing enzymes, storage, and transport proteins). Iron unbound catalyzes an extremely nasty free radical called hydroxyl radical that

accounts for a lot of the muscular damage from overexertion and intense exercise. This inflammatory milieu triggers an iron regulatory protein called hepcidin, unknown until recently. Hepcidin is the master regulator of iron metabolism, making sure iron does not cause problems. When problems occur from exercise, hepcidin comes out and sequesters iron, reducing the problem. But also reducing status of iron – causing a deficiency syndrome even with plenty of iron around.

Same thing happens if you take too much iron in foods and/or supplements – hepcidin steps in and prevents iron absorption and increases iron excretion. Hepcidin actually depresses iron delivery to your body's iron performance centers: bone marrow and muscles. Less inflammation and damage from iron, but also less performance from less hemoglobin and iron proteins involved in muscle energy production. So simply taking more and more iron (like many human studies on iron and exercise have done) is not the best answer and can backfire, not improving decreased exercise performance.

This new-found knowledge of why iron is so tricky to maximize performance does have a solution! First, ensure sufficient water/electrolyte/carbohydrate supply during exercise to delay/reduce iron-caused inflammation and hepcidin triggering. Muscles need adequate energy to prevent mitochondria from spewing hydroxyl radicals trying to make more ATP. Human studies have shown that high carb diets and high carb intakes during exercise lower hepcidin levels. Low carb diets (keto diets) increase hepdicin levels.

Second, a consistent, steady, non-exorbitant intake of iron from a true organic chelate is vital. Ferrochel® ferrous bisglycinate is the best-studied iron chelate in humans, and has advantages over less expensive, higher potency iron compounds such as reduced iron, ferrous sulfate, ferrous fumarate, and other iron sources. Ferrochel® has been shown to provide less iron absorption if you have a sufficiency, and more iron absorption if you are deficient, reducing the risk of triggering hepcidin release. Furthermore, Ferrochel® has less interference with other minerals for absorption, improving overall mineral uptake and status.

Another benefit from MultiV is the rich polyphenol content from Ginkgo, Green Tea, and Spectra® that reduce hepcidin levels by reducing the free radicals and binding loose iron produced by extreme exercise.

MultiV helps solve the Iron Enigma to provide the best possible form of iron in the right amount, supplying sufficient iron to normalize stores and status without triggering a hepcidin response. This keeps you training and performing at your best. Again, it's all about balance.

Citations for Iron in MultiV: Alfaro-Magallanes 2022; Badenhorst 2015 2215, 2015 2521, 2022; Bonilla 2022; Brzeszczynska 2008; Bucci 1993 63; Dominguez 2018; DiSilvestro 2017; Drakesmith 2012; Fischer 2023; Ganz 2012; Grijota 2022; Hertrampf 2004; Layrisse 2000; Lippi 2012; McKay 2019 548, 2019 635, 2020; Nemeth 2006; Olivares 2001; Peeling 2008, 2009, 2014, 2017; Pineda 2003; Pizarro 2002; Robach 2014; Sim 2014, 2019; Tom 2008

Comprehensive Endurance Multivitamin

So, yes, you need a comprehensive, well-designed, well-balanced multiple vitamin-mineral with additional benefits, unless you like being mired in metabolic mediocrity. A well-designed MVM can prevent functional insufficiencies from variable dietary intakes and genetic variations, providing sufficient micronutrients for handling surges of need (intense exercise). The trick is to boost what needs boosting without upsetting the balance of nutrient ratios. This takes a deep understanding of nutrition that only comes from experience and familiarity with biological and chemical sciences. This is what MultiV is and does.

Literature Quotes for why you need an Endurance Multivitam

"The diet of highly trained endurance athletes does not fully meet their requirements and in this situation cannot ensure maximum adaptation to very intense and/or long-duration physical loads. ... Particular attention should be focused on female athletes."
Baranasukas 2015, Abstract

"According to recent studies, vitamin D deficiency reduces muscle function and strength, and can increase the risk of fractures due to stress and diseases that may have a detrimental effect on training and performance."
Brancaccio 2022, p.6

"We conclude that serum and urinary magnesium concentrations decrease significantly, consistent with the possibility of at least transient magnesium deficiency. ... Serum iron concentration increases during endurance running."
Buchman 1998, p.126

"Researchers suspect that levels above 50 ng/ml are required for athletes to achieve maximal physical performance." ... *"This concentration is associated with a protective effect and enhancement of physical performance."*
Butscheidt 2017, Abstract

"In conclusion, vitamin-mineral supplementation was found to attenuate cardiac and muscle damage markers, enhance antioxidant levels, and reduce membrane LPO levels in response to 1 month of swim training."
Cavas 2004, p.144
[Note: 30 swimmers (11-13 years old) were given a placebo or One-A-Day Junior MVM, with less number and amounts of nutrients as in MultiV.]

"The absence of an increase in blood levels of cobalamin, folate, zinc and ascorbate during periods of supplementation to the level of the RDA, and the lack of improvement in MVO2 and time to exhaustion during these periods, suggest that the RDA's for these nutrients are insufficient for optimal performance in endurance athletes."
Colgan 1991, p.26
[NOTE: This double-blind, crossover study of 27 endurance runners (men and women) used a One-A-Day type of MVM as the placebo, which in theory should make all subjects replete for essential vitamins and minerals all the time. The intervention was adding extra C, B6, B12, folate, iron, zinc to the RDA intake. This study confirmed that a 100% RDA-level MVM did not affect exercise performance, as echoed by other human studies, and that relatively high doses of hematopoietic MVMs were needed to maximize performance. When switched from high to RDA-level MVM, subjects' performance suffered. This unique study has never been repeated, but answers questions seldom asked by other MVM exercise studies.]

"The results suggest that the initial adaptation to EIMD, associated with RBE [Repeated Bout Effort], modulates the concentration of chemical elements associated with resistance to fatigue (K, Ca, Cl) and to the inflammatory response and glucose metabolism (Zn)."
Dias 2022, p.10

"Also, in a small unpublished study (DiSilvestro, RA), the 3 mineral glycinates used in this study increase plasma readings for the iron used protein ferritin better than a combination of 3 other forms of the same minerals."
DiSilvestro 2017, p. 5
[Note: The 3 mineral chelates were all Albion® minerals: Ferrochel®, Zinc glycinate, and Copper glycinate – Iron & Zinc glycinates are used in MultiV]

"The data indicated that adequate vitamin D intake contributes to the health and athletic performance of athletes."
Feng 2023, p.9

"Prevalence of vitamin D insufficiency (<= 50 nmol/L) in elite athletes is high…"
Harju 2022, Abstract

"Vitamin D has documented effects on muscle regeneration through mechanisms and biological pathways that mainly depend on the interaction with the pool of satellite cells within muscle and that are particularly active during recovery from a traumatic event to enhance the structural and functional restoration of the muscle."
Iolascon 2021, p.6

"Vitamin D deficiency is highly prevalent in athletes."
Ip 2022, p.27

"Summarizing previous studies, many researchers have reported that consuming combined minerals and/or vitamins may be more effective way to enhance athletic performance and maintain health especially in athletic population rather than taking minerals or vitamins each."
Lee 2017, p.803

"Substantial and often persuasive scientific evidence does exist to confirm a relationship between the intake of a specific bioactive constituent and enhanced health conditions…"
Lupton 2016, Abstract

"We can conclude that physical training produces a decrease in erythrocyte concentrations of Cu, Mn, Se and Zn, which can cause a decrement in athletes' performance given the importance of these elements."
Maynar 2020, Abstract

"For the past 40 years, data consistently show that Americans have not been and are still not consuming recommended amounts of whole grains, vegetables, fruits, and dairy foods, and to a lesser extent, protein food groups [17]. This translates to significant proportions of the US population who are consuming less than the EAR or AI for essential nutrients even though ~50% of US adults take at least one dietary supplement [32-35]."
McBurney 2021, p.4

"Ferrous bis-glycinate"
"Relatively high bioavailability."
"May be less likely to cause GI intolerance than ferrous sulfate, ferrous gluconate, or ferrous fumerate [sic]."
Tom 2008, p.2

"A mineral deficiency may impair performance. In particular, correcting an iron-deficiency anemia will improve aerobic endurance performance."
Williams 2005, p.47

"For those who train intensely on a regular basis and might occasionally overdo it, pro inflammatory cytokines (tumor necrosis factor-alpha and interleukin-6) are increased when vitamin D levels are insufficient.28 The anti-inflammatory effects of vitamin D include decreased prostaglandin synthesis and decreased musculoskeletal pain.19,25"
"Female athletes appear to be especially sensitive to vitamin D deficiency. ...41% were actually categorized as deficient."
"...vitamin D supplementation appears to be essential for optimal athletic health and muscle performance."
Wojtys 2021, p.110.

"...exposure to sunlight and dietary intake may not be sufficient for vitamin D synthesis; in such cases, vitamin D supplements may be helpful."
Yoon 2021, p.23

MORE THAN JUST A MVM, MULTIV ADDS ADDITIONAL NON-VITAMIN, NON-MINERAL NUTRIENTS FOR EXERCISE PERFORMANCE

Vitamins and minerals are essential for life and also for everyday health and exercise performance. But our diets contain more than Calories, fiber, vitamins, and minerals. A healthy diet is also rich in so-called non-essential nutrients and metabolites from both animal and plant foods. More of these non-essential nutrients are better for all aspects of health, as thousands of studies have and are still showing. The only issue nowadays are which ones are the best, how much is good enough, and how do we get people to eat them every day? We have chosen the winners with exercise benefits to include in MultiV.

The Clincher Reason for Adding "Non-essential" Nutrients to MultiV

Adding potent non-vitamin, non-mineral nutrients to a person that is getting everything they need to sustain essential vitamin-mineral status means your body better utilizes the benefits of non-essential nutrients. Why? Because all the internal cellular machinery is running efficiently and maximally, with no metabolic blocks or deficiencies to impede getting the most from additional nutrients, that do things essential micronutrients cannot do.

In short, to get benefits from non-essential nutrients, you need to have all essential nutrients working smoothly. That's what a targeted, comprehensive MVM can do.

This simple, apparent metabolic concept has not been illuminated before, but is an obvious corollary to adequate status of all essential micronutrients. This concept also explains the large interpersonal differences between individuals for effects of non-essential nutrients, which has caused confusion in the scientific literature. As we have already seen, most of us, if not all of us, have some sort of non-ideal vitamin-mineral status. Sooner or later, that lack, however minor it may seem by itself, will ultimately define how you use the nonessential additional nutrients you eat or take as supplements. That leads to increased variability of outcomes when giving a bunch of people a single amount of nonessential ingredients, also making it difficult to reach statistical significance in clinical studies on nutrient effects.

The bottom line is to interpret human studies of additional ingredients very carefully, realizing most of the subjects, even healthy ones, have all sorts of different limitations to their metabolism and ability to utilize those additional dietary ingredients. This is where personal bias creeps into research publications, where one can say the evidence is weak, nonexistent, not compelling, blahblahblah. That is hiding behind statistical fabrication skirts to say a definite maybe. Your body knows what to do with additional ingredients just like it knows what to do with essential micronutrients, calories, water, and electrolytes. Your body is an optimist about nutrients and sees and strives to take advantage of the benefits of what you ingest. Having all your essential MVMs optimal all the time can only help get the maximum from other dietary nutrients.

MultiV Addition Nutrients

The addition of non-essential nutrients to MultiV gives a new dimension of activity alongside those of essential vitamins and minerals. For MultiV, here are the additional nutrients, some of which are new and some of which are continuing inclusions from the previous MultiV:

1. Immudyne NQ™ - A highly refined form of yeast Beta Glucan is added to support immune health that is so important for maintaining normal training and recovery;
2. Ginkgo biloba extract is continued with its performance benefits;
3. Green Tea extract is continued with its performance benefits;
4. Spectra® Total ORAC5 Antioxidant Blend replaces the former Polyphenol Support Blend, providing multiple antioxidants from 29 plant extracts with human clinical study support for broad-spectrum antioxidant effects;
5. Boron (as a glycine chelate) is added to work with calcium, magnesium and Vitamin D;
6. Vitamin K2 MK7 (Menaquinone-7) replaces Vitamin K2 MK4, providing stronger activity that Vitamin K1 cannot match.

Both Boron and Vitamin K2 MK7 are considered as essential, non-essential, semi-essential, or conditionally essential, depending on who is studying them. These six additional nutrients add features and activities that complement those of the other vitamins and minerals, making MultiV more than just a MVM.

BETA GLUCAN

HIGHLY REFINED & ACTIVE BETA GLUCAN FROM BAKER'S YEAST FOR IMMUNE SUPPORT

Immune Support Rationale for Ultra-Endurance Athletes

Everyone who has trained for and competed in ultra-endurance activities has either experienced for themselves or known people who needed better immune function following strenuous, long-duration exercise & training. Much research has looked into the prevalence, severity, outcomes, and ameliorations for endurance athlete immunity. Gradually, a consensus has found that long-duration, strenuous, exhaustive training and exercise takes a toll on your immune system functionality, and can lead to common immune-related symptoms both immediately after exercise and, eventually, chronically.

URTS (Upper Respiratory Tract Symptoms) is the new name for normal, exercise-associated immune changes after strenuous and overexercise. The previous term, URTIs (Upper Respiratory Tract Infections), was abandoned by recent research because of lack of presence of infectious agents. URTS after excessive exercise are part of the normal response to the tissue damage caused by long-duration, intense overexercise that ultimately strengthens immune function over time. Some reviews proposed that nutritional problems were a major factor. Whatever it is named, the problem of URTS remains a cause for concern for exercising athletes, especially for back-to-back days.

Citations - Beta Glucan Ultraendurance Exercise Immune Reviews: Bermon 2017; Blocher 2013; Campbell 2018, 2019; Cerqueira 2020; Dhabhar 2014; Gani 2003; Gleeson 2004, 2007, 2013, 2014; Nieman 2019 201, 2019 341; Rajasekkhar 2022; Renke 2022; Schwellnus 2010; Simpson 2020; Walsh 2019; Wirnitzer 2022

Beta Glucan to the Immune Rescue!

Your immune system is highly alert, highly active, ever vigilant, and looking for trouble. Not only does this take energy, but your immune system is constantly in surveillance mode and listening to signals from all your tissues and cells. One of these signals that is quantitatively very important for overall immune function is beta glucans – the cell wall of fungi and other potentially nasty microbes. Beta glucans activate Dectin-1 receptors, Complement Receptor 3 and Toll-Like Receptors (TLRs) at least, that are always vigilant in your gut immune system. Dectin-1 system is an evolutionarily ancient system to alert and defend against microbial invasion, especially fungi (which includes yeasts and mushrooms). What better signal to specifically alert presence of fungi than their exterior? Activating these receptors starts a cascade that grows into a bodywide immune-modulating response, spilling over to all your tissues, especially the ones screaming for help or screaming about any sort of damage, including the damage normally caused by exercise and overexertion. This includes wound healing and recovery from exercise.

Yeast beta glucans are not to be confused with oat beta glucan (1,3/1,4-beta glucan). They have different molecular structures and different biological properties. Oat beta glucans have little effect on immune functions. One study considered cyclists who ingested 5600 mg of oat beta glucan daily for 14 days while keeping their normal 1-2 h/d cycling workload (Nieman 2008). For three days, the subjects increased their cycling load by 70% - 3 h/d, and then continued oat beta glucan for one day, followed by 13 more days of observation for URTS and days of illness. Oat beta glucan group showed a nonsignificant increase in sick days compared to the placebo group. Likewise, measurements of immune functions and cytokine levels were not different between the groups. Thus, oat beta glucan did not affect immune health in endurance athletes.

Citations - Beta Glucan Immune Rescue: Akramiene 2007; Batbayar 2012; De Marco Castro 2021; Dennehy 2007; Goodridge 2009; Herre 2004; Kanjan 2017; Lee 2014; Majtan 2018; Nieman 2008; Renke 2022; Sun 2007, Tsoni 2008; Vetvicka 2014, 2019; Vlassopoulou 2021

Immundyne NQ™ - Clinically-Tested Beta Glucan

First Endurance opted for a highly refined, meaning a small dose, of 1,3/1,6-Beta glucan extracted from Baker's yeast (Saccharomyces cerevisiae) by a proprietary process. Immudyne NQ™ has been used clinically for 32 years with over 80,000,000 doses, and is manufactured in a cGMP facility in the USA. Immudyne NQ™ has GRAS (Generally Recognized As Safe) status. Immudyne NQ™ is a defined extract of yeast Beta glucan with unique molecular size and degree of branching to maximize its activity. After performing a dose-response curve to ascertain the most effective dose of Immudyne NQ™ (30 mg daily), Immudyne NQ™ was shown to activate Complement, an important part of the immune system, by ex vivo human testing. Immudyne NQ™ was superior to other beta glucan preparations.

Yeast Beta Glucans, Exercise, Guts & URTS

Beta Glucans actually work by a very basic, overall enhancement of immune system response by an ancient early warning cell signaling. Your gut sends tiny amounts of what you eat to your gut immune system cells for monitoring. When gut immune cells sense yeast beta-glucan, they program and send out immune cells throughout your body looking for signs of trouble, including tissue responses to strenuous exercise. Immune cells do their thing by managing cellular and tissue stress, releasing all sorts of messenger molecules (complement, cytokines, eicosanoids, and more) locally and systemically. Net outcome is amelioration of normal exercise-induced inflammation and improved recovery along with immune support for exercising individuals.

Beta glucan preparations have generally shown reduction of URTS (Upper Respiratory Symptoms) immediately and for days after long-duration, strenuous exercise (such as marathons) when used consistently during race season. Fewer symptomatic days after a race, less severe symptoms and increased salivary IgA (a biomarker for immune function) have been reported. Overall health and mood were also improved post-exercise by yeast beta glucan. Consistent use is a major reason Immudyne NQ™ was added to MultiV taken daily – to provide consistent, long-term intake of active, highly-concentrated, yeast Beta glucan.

Citations - Beta Glucan & Exercise: Bergendiova 2011; Blocher 2013; Bobovcak 2010; Carpenter 2013; Harger-Domitrovich 2001; Jesenak 2017; Mah 2020 200, 2020 416; Majtan 2012, 2018; McFarlin 2013; Talbott 2009; Zabriskie 2020

Literature Quotes

"These substances increase host immune defense by activating complement system, enhancing macrophages and natural killer cell function."
Akramiene 2007, Abstract

"There is limited existing evidence to support the common assumption that strenuous endurance exercise bouts impair immune competency."
Campbell 2019, Title

"...the dramatic reductions to lymphocyte numbers and function 1-2 h after exercise reflects a transient and time-dependent redistribution of immune cells to peripheral tissue, resulting in a heightened state of immune surveillance and immune regulation, as opposed to immune suppression."
Capmbell 2018, Abstract

"Preventive applications of beta-glucans may decrease the frequency of various forms of respiratory tract infection, support protective immune mechanisms, and possibly yield other beneficial effects (increased well-being, decreased missed days from school or work, decreased use of other symptomatic or antibiotic therapy)."
Jesenak 2017, p.10

"Overall, consumption of dairy-based beverages containing dispersible yeast beta-glucan decreased URTI symptomatic days, severity of specific URTI symptoms, and missed postmarathon workout days due to URTI, without affecting duration and number or URTU episodes."
Mah 2020
[Note: 357 subjects ran in the 2017 Austin Texas Marathon. They took Beta-Glucan or placebo for 45 days before and after the run. The wording of results of this and other studies shows the prevailing trend that URTS were previously named "URTI symptoms," not URTI – notice the careful wording of reducing symptoms without saying illness or infection.]

"One of the most promising nutritional supplements is beta-glucan, a well-known immunomodulator with positive effects on functioning of immunocompetent cells. "
Majtan 2012, Abstract

"In summary, the present study provides confirmation of the observations from other investigators that this commercially available sources of baker's yeast BG decreases URTI symptom prevalence postmarathon. Here we add the novel insight that salivary IgA concentration following a strenuous exercise session is improved in subjects supplementing with BG."
McFarlin 2013, p.182

"Taken together, the best evidence supports that high exercise training workloads, competition event, and the associated physiological, metabolic, and psychological stress are linked to immune dysfunction, inflammation, oxidative stress, and muscle damage."
Nieman 2019, p.203

"Key Points
- *Beta-Glucan supplementation maintains immune function in endurance athletes.*
- *Beta-Glucan supplementation reduces post-exercise URTIs in marathon runners.*
- *Maintenance of post-exercise immune function is associated with improved mood state, including reduced fatigue and increased vigor in athletes."*

Talbott 2009, p.514
[Note: 75 subjects ran in the 2007 Carlsbad Marathon, and started to take Beta Glucan right after the run for the next 45 days.]

"Mood state analysis (POMS) indicated a significant improvement in vigor and reduction in anger in the YBG group in conjunction with a greater reduction in total mood disturbance in comparison to PLA. [placebo]
Zabriskie 2020, p.19

GINKGO BILOBA

ALTITUDE, ANTISTRESS, CIRCULATION, ENERGY METABOLISM, EXERCISE PERFORMANCE & RECOVERY, FAT METABOLISM, GUT MICROBIOME, OXYGEN, NITRIC OXIDE, RECOVERY

Why Ginkgo for Endurance Excercise?

When First Endurance added a Ginkgo biloba extract to MultiV, eyebrows were raised. Why add something to a MVM that had not been studied yet in endurance performance, taking up valuable room for other essential nutrients? Did we have secret knowledge or information? The answer required an educated leap of faith about what Ginkgo does based on use in older humans with poor cardiovascular, mental, and physical health. The leap of faith has turned out to be inspired genius. Although Ginkgo was a promising good idea years ago when MultiV was first launched, scientific research has since been catching up to its promise of cardiovascular and energy metabolic support, with more than 1000 human clinical trials published, mainly focused on mental health in the elderly. New research methods are providing more evidence on how the unique polyphenols in Ginkgo have far-reaching beneficial effects that also help maintain endurance performance and improve recovery, additive effects that are not found by any other single ingredient. In other words, synergy with adequate status of all essential micronutrients, which MultiV supplies.

Ginkgo's Secret

Ginkgo trees are oddly unique. They have distinctive, fan-shaped leaves and tiny apricot-looking seeds. Now a commonplace ornamental tree originally from East Asia, Ginkgo trees are living fossils – the oldest tree on Earth and the only member of its taxonomic Order, a rare occurrence in Nature. Ginkgo trees appeared 290 million years ago, preceding anything except ferns and cycads on land. Even its name is a mistake by Europeans mispronouncing the original Japanese name (gin kyo) while categorizing Asian plants in the 1600s. Because Ginkgo is unique, it is no surprise its longevity (some trees are over 1500 years old) is due to something unusual. Ginkgo trees hundreds of years old within 1-2 km of the atomic bomb ground zero at Hiroshima survived and are still growing. Testimony to powerful, secret compounds?

Ginkgo Biflavone Chemistry Secrets

Ginkgo leaves contain a series of common and unique polyphenols (flavonoids), including quercetin glycosides, found in many fruits, vegetables, and herbs. 653 flavonoid metabolites and 8146 metabolites have been identified in Ginkgo leaves. But its previously secret, unique ingredients are classified as biflavones (two polyphenols stuck together) and double flavonoid glycosides. Cocoa, tea, and wine are other sources of similar biflavonoids, and all have well-known biological benefits. This general class of biflavonoid plant compounds have better absorption and stronger effects than common monoflavonoids like quercetin. Ginkgo also contains unique ginkgolide and bilobalide terpene trilactones with complicated 3-D structures that mimic endogenous nutrients and signaling compounds in our bodies, activating receptors for cell signaling in beneficial ways, especially in blood vessels.

Because Ginkgo chemistry was unusual and also showed already known, common flavonoids with known antioxidant effects, the secret actives were missed for years. Human studies of Ginkgo extracts have been hit or miss for biological effects because of the different extraction fates, and thus potencies, of biflavones and flavonoids. Empirical evidence settled on a particular extraction method that is now the most common source of Ginkgo biloba extracts used as dietary supplements (and herbal medicines in other non-US countries), and these contain biflavones and the other more common flavonoids. This extraction method also removes ginkgolic acids, potentially troublesome compounds.

Ginkgo biloba Extract Research Myopia – Looking in the Wrong Places?

Based on traditional herbal medicine usage from Asia, standardized Ginkgo extracts were developed into herbal medicines in Europe and used for improving circulation in older persons in need of improved blood circulation for mental and physical functioning. Overall, summaries of many human studies have been less than enthusiastic about Ginkgo extracts used as medical treatments, but many human studies and reviews have found significant improvements in blood circulation and real-life mental and physical functions. With over 1000 human clinical trials published, one can find scientific support for any viewpoint they wish (cherry-picking). We prefer to let repeated and reproducible data and other experts speak (See Literature Quotes for Ginkgo biloba Extracts below after the References). We did not rely on studies of normal elderly, diseased elderly, or diseased populations, instead focusing on young, healthy adults. Like most natural products that show efficacy, one can find polarization of opinion – both glowing advocacy and ruthless trashing in the research literature. A lot of differences in results can be explained by methodological issues – it is much easier to not find significance than to hit conditions that enable finding efficacy. Still, there's something good about Ginkgo that only a negatively biased cherry-picker would ignore or not believe.

Thus, the bulk of published human studies on Ginkgo are less relevant to aerobic exercise performance in regularly-exercising, normal, healthy persons. What all the mouthwash means is that using Ginkgo supplements looks better suited to healthy persons that can accommodate the now known effects of those unique and common compounds at realistic doses, like those in MultiV.

Recent and exciting (for us researchers, at least) metabolomic/metabonomic studies in humans and in animals have found new ways that Ginkgo extracts can affect exercise performance. Looking at the core mechanisms of action of the unique and common flavonoids/terpenes in Ginkgo show improved cardiovascular performance and blood circulation by multiple ways, similar to their close chemical polyphenolic cousins in green tea (MultiV), cacao/cocoa/chocolate (PreRace, anyone?), and grape seeds/wine that also have a large number of positive results in thousands of human clinical studies. For Ginkgo extracts, a combination of antioxidant activity, gut microbiome health, increased cellular omega-3 fatty acids, increased lipid (fat) metabolism, insulin signaling, membrane fluidity, nitric oxide effects, and best of all, improving energy metabolism has been shown as how it works. Also, metabolomic studies have found how Ginkgo does all those different benefits by helping to restore healthy levels of fatty acids, sphingolipids, phosphoglycerides and glycerides (fats) that are part of the normal cellular repair processes after damage caused by ischemia, ischemia-reperfusion, and oxidative stress. This is also a large part of the metabolic profile of exhaustive aerobic exercise. All these mechanisms favor improved aerobic exercise performance, or at least longer maintenance of normal performance, as well as more robust recovery. This is why Ginkgo extract is in MultiV!

Ginkgo extracts exhibit many mechanisms of action that are beneficial for exercise performance and recovery: antioxidant activity, cellular repair, energy and fat metabolism, microvascular blood vessel function, neuroprotective actions – all are important for healthy,

Citations for Ginkgo Mechanisms of Action: Blume 1996; Cao 2019; Diamond 2013; Dubey 2004; Field 2011; Fransen 2010; Guo 2022; Horsch 2004; Kashcel 2009; Li 2018; Lorca 2022; Nash 2015; Nicolai 2013; Noor-E-Tabassum 2022; Roe 2021; Scholey 2013; Singh 2017; Tian 2017; Tao 2022; Wang 2016; WHO 1999; Xiong 2014; Yan 2022; Yang 2016; Zhang 2009 1674

GINKGO BILOBA & EXERCISE PERFORMANCE IN HEALTHY PERSONS

Exercise Performance

The effects of 6 weeks supplementation with 80 mg daily Ginkgo extract in healthy, physically active young men found increased endurance performance, improved VO2max, and increased BDNF levels (neuroprotection) (Sadowska-Krepa 2017). Antioxidant effects were also found – TBARS were reduced and superoxide dismutase activity, glutathione, and ability of blood to reduce ferric ions were all increased, showing a multifactorial improvement in antioxidant defenses within normal limits.

If you use Optygen or OptygenHP with MultiV, then the study by Zhang et al applies to you (Zhang 2009 177). Rhodiola and Ginkgo combination was given for seven weeks to male volunteers and endurance performance parameters measured at baseline and end of study. VO2max was increased from baseline and placebo group, and cortisol did not change in the Rhodiola-Ginkgo group, but it was increased in the placebo group. The testosterone:cortisol ratio was unchanged in the Rhodiola-Ginkgo group, but decreased in the placebo group, indicating increased fatigue and overtraining. Thus, Rhodiola and Ginkgo led to adaptogenic improvements in oxygen consumption, less fatigue and better adaptation to endurance exercise.

Human studies found that Ginkgo supplementation improved tissue microcirculation, decreased blood viscosity and increased serum levels of BDNF, cortisol, and endorphins in women after eight weeks of endurance swimming training,

Citations for Ginkgo & Exercise Performance: Cui 2003; Hajirezaei 2015; Goncalves 2022; Kennedy 2019; Sadowska-Krepa 2017; Zhang 2009 177

Exercise Recovery

A recent human study of young, healthy, untrained women undergoing High Intensity Interval Training (HIIT) found that after three weeks of supplementation, compared to the placebo group, the Ginkgo group showed significantly reduced levels of exercise damage biomarkers CRP, CK, and LDH at one and 24 hours post-exercise. This study exemplifies the newly found, detailed mechanisms of action from Ginkgo extracts, showing utility for endurance exercise recovery benefits.

Citations for Ginkgo & Exercise Recovery: Atashak 2021

Ginkgo biloba Extract (GBE) – Improvement in Blood Flow & Improved Oxygen Use

Looking into Ginkgo effects on blood flow in normal, healthy humans finds consistent improvements in blood flow, accompanied by vein relaxation/widening usually without changes in blood pressure or heart rate. As an example, one study measured fingernail capillary bed microcirculation for four hours after administration of Ginkgo (Jung 1990). Blood flow increased 57% one hour after Ginkgo was given, a highly significant improvement. A crossover study in 16 healthy persons 21-47 years old found a 99% increase in forearm blood flow vs. 19% in placebo period after three and six weeks (Mehlsen 2002). Measuring forefoot skin blood flow found that Ginkgo increased the change in blood flow relative to the placebo response, whether that would be an increase, decrease or no change. Metabolic fingerprinting of blood levels of Ginkgo actives correlated with the magnitude of effect, showing that Ginkgo enhanced vasoregulatory changes (Boelsma 2004). Another crossover study in 15 males aged 19-35 years found an increased blood flow in the optic nerve head (visible through the eye), indicating Ginkgo's blood flow effect was throughout the body and into the brain, which provides rationale for improved mental functions. Supporting this finding was contrast MRI brain imaging in nine normal, healthy men 50-70 years old after taking 120 mg Ginkgo extract daily for four weeks (Mashayekh 2011). Cerebral blood flow significantly increased 15% in white matter and 13% in gray matter. Previously, a SPECT scan of cerebral blood flow in 48 males aged 60-70 years found improved cerebral perfusion (blood supply) in specific areas and decreased blood viscosity

(Santos 2003). These changes were associated with improved global cognitive functions, as would be expected with better brain blood flow. Placebo groups showed opposite effects. Finally, blood viscosity in normal volunteers 18-60 years old, women and men, was reduced by Ginkgo extract (Galduroz 2007). Ginkgo was more effective than garlic extracts. Blood viscosity increases with age and overexercise, impairing circulation.

These effects are predicated by the polyphenols in Ginkgo, and mirror effects of other polyphenols from cacao, green tea, and grape seeds in human studies. Animal studies also support vasorelaxation effects from Ginkgo. The effects happen within three hours, and with consistent daily use, they lead to long-term improvements in blood flow. Effective doses range from 80-240 mg daily. Needless to say, blood flow is important for endurance exercise performance. Blood flow in healthy exercising athletes has not been measured yet.

Citations for Ginkgo and Blood Flow & Oxygen: Anonymous 2003; Boelsma 2004; Galduroz 2007; Jung 1990; Kiesewetter 1992; Mashayekh 2011; Mehlsen 2002; Field 2011; Santos 2003; Wimpissinger 2007; Zhang 2009 177

Antistress, Mental & Mood Performance

Ginkgo, both by itself and combined with other nutrients (ginseng, phosphatidyl choline or phosphatidyl serine), has reproducibly shown improvements in various aspects of mental performance – antianxiety, antifatigue, antistress, attention, calming, cognition, memory, mental speed, and vigilance at daily doses of 80-320 mg acutely and daily (up to 90 days). Validated mental tests were used to determine mental functions. These actions can be explained by general anti-stress effects on physiology (lowering blood pressure when stressed) and normalizing mental responses.

Attention-Deficit Hyperactivity Disorder (ADHD) in children, adolescents, and adults has been repeatedly examined with Ginkgo extracts and Ginkgo-Ginseng combinations. Most studies found significant improvements compared to placebo, but usually less than improvements by methylphenidate; however, side effects in the Ginkgo groups were not different from placebo but were increased by methylphenidate. One study did find that Ginkgo was more effective than methylphenidate for excitability, frustration tolerance, and mood (Lyon 2001). The evidence for Ginkgo for supporting normal mood is promising but preliminary.

Citations for Ginkgo & Mental Performance: Alge 2017; Anheyer 2017; DeFeudis 2004; Helmut 2010; Jezova 2002; Kennedy 2007 199, 2007 559, 2019; Liu 2020; Lyon 2001; Reay 2019; Salehi 2010; Sarris 2011; Schaffler 1985; Scholey 2002; Sharma 2021; Subhan 1984; Warot 1991; Wesnes 1997, 2000; Woelk 2007

GINKGO BILOBA PROTECTS OXYGEN SATURATION AT HIGH ALTITUDES

One outcome that illustrates how the multitude of Ginkgo effects can benefit aerobic endurance exercise performance is a series of human studies examining blood flow, oxygen saturation, nitric oxide metabolism, and peripheral and cerebral blood flow at high altitudes. Ginkgo's ability to improve oxygen use and peripheral circulation at high altitudes is of particular importance to winter-sport endurance athletes.

A battery of human studies administered Ginkgo to healthy humans that went from low to 10000-15000+ feet in altitude rapidly with or without taking Ginkgo. Some studies only looked for AMS (Acute Mountain Sickness) symptoms of headaches, fatigue, shortness of breath, insomnia, and anorexia, but some actually measured exercise-related physiological functions such as oxygen saturation, nitric oxide metabolism, and circulation. Studies showed mixed results for Ginkgo reducing AMD symptoms when giving Ginkgo in a narrow window of time before, during, and after ascents. Reasons for the mixed results were blamed on different preparations of Ginkgo – some worked, some did not. Scientists conducting the studies did not understand this variable and research stopped because of the difficulty of determining if they chose the right source of Ginkgo or not. Later, different years of harvest showed differences in active agents, suggesting that the most active agents of Ginkgo are not the two standardized ones (Ginkgoflavones and terpenes), in turn suggesting biflavones are important.

Although this speaks to Quality Control of Ginkgo and extraction differences among Ginkgo sources, those that mirrored or used EGb 761 produced improvements in physiological adaptations. Since these studies were published, the consistency of quality for Ginkgo products has improved. Also, the dosing regimens for Ginkgo were generally too short to take advantage of Ginkgo's mechanisms of action. Add on gut dysfunction during rapid ascent, which would decrease uptake of active agents from oral Ginkgo, and more was learned about how not to use Ginkgo properly, since we now know the metabolomics of Ginkgo becomes more effective with more time. Most subjects were not endurance athletes, and thus, more susceptible to problems with altitude. Each study fastidiously made sure their subjects were not adapted to altitude. Also, some studies found low incidence of AMS symptoms, or started too low in altitude, making it difficult to find a difference between groups (in other words, placebo groups did not show sufficient intensity of symptoms to find a difference between treatments).

The latest review of Ginkgo studies at altitude found a significant risk reduction of AMS compared to placebo by pooled risk difference (-25%, p=0.011) (Tsai 2018). Combining seven studies, Tsai et al conducted a meta-analysis on AMS prophylaxis (preventing AMS) and found a trend for prevention (p=0.08). This is where statistical difference and real-life difference means something – which group would you want to be in knowing those odds? Placebo or Ginkgo?

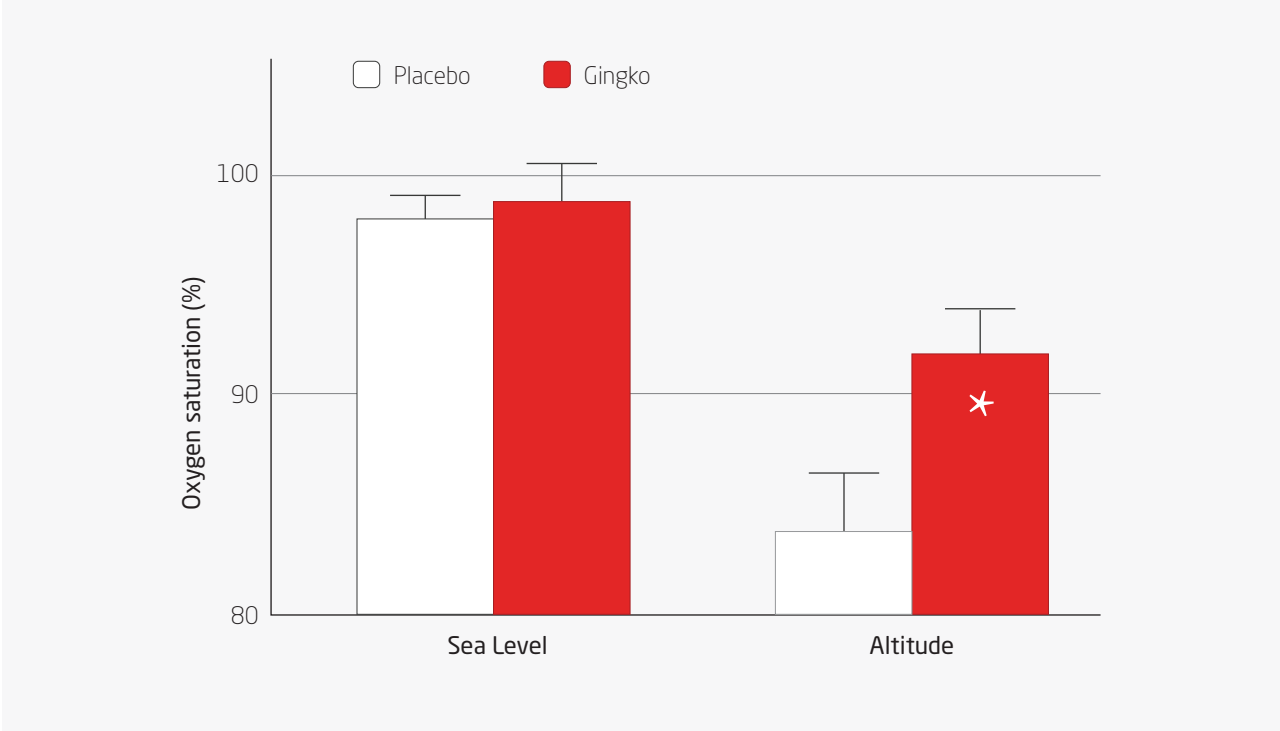
The review by Tsai also mentioned a Chinese report from Northwest Chine Defending Forces in 2003 that reported Ginkgo was the most effective of six Chinese Traditional Medicines for preventing AMS, but no details were presented (Tsai 2018). Four of seven Ginkgo/altitude human studies found that Ginkgo significantly reduced AMS incidence and symptoms, maintained better oxygen saturation (see Figures), reduced use of analgesics, oxygen or corticosteroids, reduced number of prompt transport to lower altitudes (serious AMS incidence), decreased vasomotor disorders of extremities (cold hands/feet) and improved erythrocyte deformability in altitude-adapted men and women (Gertsch 2002; Leadbetter 2009; Moraga 2007; Roncin 1996). Another marker for success was gradual ascent rather than sudden ascent, more in keeping with putative mechanisms of action and absorption for Ginkgo.

Citations for Ginkgo & Altitude: *Adams 2004; Bartsch 2004; Chow 2005; Cui 2003; Dubey 2004; Elphick 2004; Franco 2019; Gertsch 2002, 2004; Ke 2013; Leadbetter 2009; Moraga 2007; Roncin 1996; Tissot van Patot 2009; Tsai 2018*

Ginkgo and Altitude - Summary

Thus, Ginkgo extracts have shown improvements in adaptation to altitude if certain conditions are followed: 1) chronic use of Ginkgo before ascent; 2) ascent of more than 2500 meters (~7500 feet) and 3) more gradual ascents. The issue of which compounds in Ginkgo are the most important is still at large. Also, physiological measurements which Ginkgo has shown benefits for – such as antioxidant actions, cerebral blood flow, and nitric oxide metabolism – were not measured. The combination of positive results in multiple studies and the well-known effects of Ginkgo on circulation and antioxidant protection argue strongly that Ginkgo is a worthy supplement to take before ascending to high altitudes, and more attention to methodology needs to be paid in future studies.

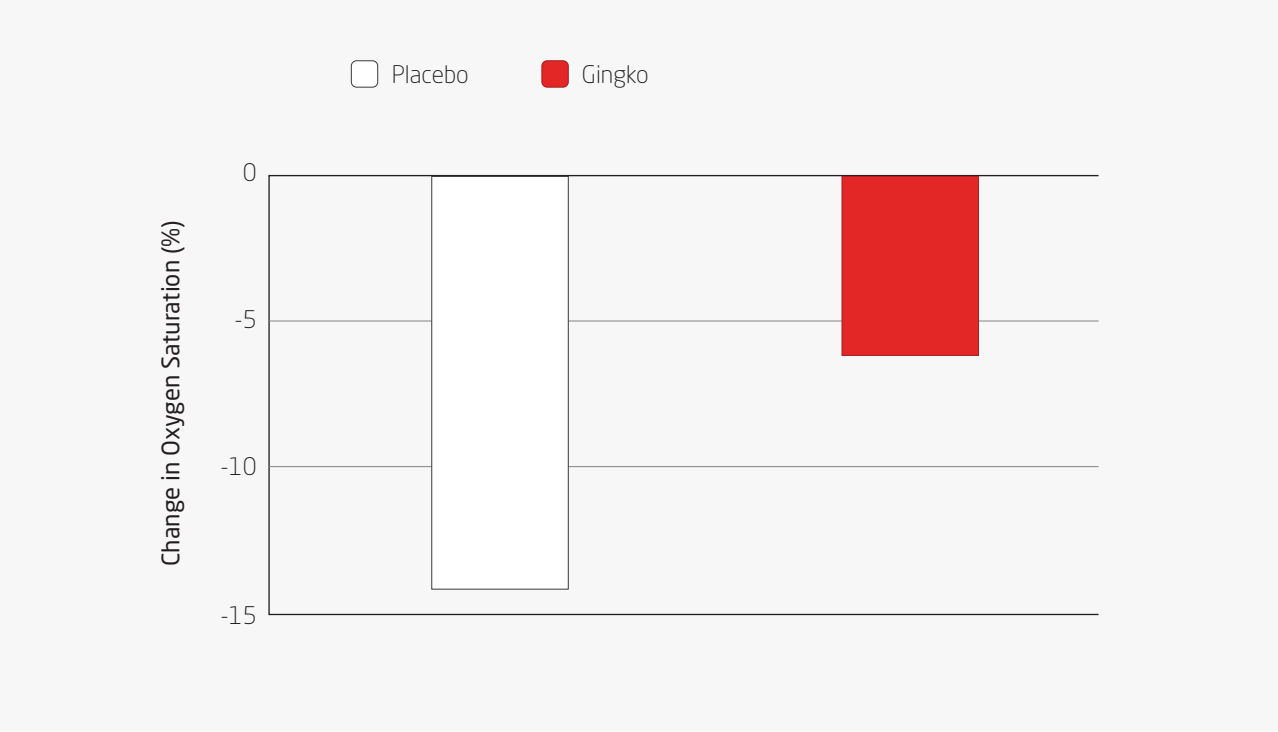
***Ginkgo biloba* Extract & Oxygen Saturations**



Oxygen Saturation at 12125 feet altitude after 3 days.
Placebo or Ginkgo (160mg/day) was given one day before and three days at altitude.
12 male subjects (~22 years old) per group. Oxygen Saturation % ± SD.

*Significant difference from placebo group, P<0.05)

Decrease in Oxyden Saturation at Altitude



Another way to look at what standardized Ginkgo biloba leaf extracts can do for maintaining Oxygen Saturation at altitude (3696 meters) – reduce the loss of Oxygen Saturation in blood.

Reference: *Moraga FA, Flores A, Serra J, Esnaola C, Barriento C. Ginkgo biloba decreases mountain sickness in people ascending to high altitude at Ollague (3696 m) in northern Chile. Wilderness Environ Med. 2007 Winter;18(4):251-7.*

Ginkgo & Exercise Summary - Ginkgo Belong

Evidence has accumulated in normal, healthy persons showing that Ginkgo delivers beneficial effects on altitude adaptation, antioxidant actions, blood flow, blood viscosity, fatigue, mental functions, mental stress, microcirculation, nitric oxide metabolism, and oxygen saturation that are favorable for endurance exercise performance. Ginkgo shows effects both acutely (after a single dose) and consistently over time (weeks to months). The few studies on healthy exercising individuals are promising, showing increases in oxygen capacity, hormone regulation, post-exercise recovery biomarkers, and improved aerobic endurance performance.

Importantly, best effects have been shown by relatively modest daily doses of Ginkgo extracts (80-120 mg daily – the dose in MultiV) and sometimes up to 240 mg daily. Higher doses of Ginkgo (300 mg and more) have not fared as well in a wide range of human clinical studies, especially when studied as a pharmaceutical at increasing dosages. This finding of an inverted-U shape dose-response curve or a bimodal curve (two peaks/troughs) mirrors effects of many other nutrients and natural products, especially multicomponent regulatory mixtures like Ginkgo (and adaptogens). Brain wave studies of Ginkgo in normal humans is a classic example of this phenomenon (Le Bars 2000). If a mixture has many activities, giving more and more might cause

interferences, imbalances or even excess efficacy that detracts from other desirable outcomes. There is a Zone of Efficacy for Ginkgo and exercise effects, and 120 mg appears to be in that zone for blood flow, mental benefits, and exercise performance. Less is more once again.

Human studies on ultraendurance activities are lacking, and a true dose-response for maximizing exercise benefits of interest remains to be done, but so far Ginkgo is showing it can help with training, racing, and recovery. Assuming that status of essential nutrients is maintained by other nutrients in MultiV, the benefits of Ginkgo may exceed those in clinical studies where subjects' nutritional status was not ideal.

Literature Quotes

"Moreover, it [Ginkgo biloba extracts] can improve cerebral blood flow supply, executive function, attention/ concentration, non-verbal memory, and mood, and decrease stress, fasting serum glucose, glycated hemoglobin, insulin levels, body mass index, waist circumference, biomarkers of oxidative stress, the stability and progression of atherosclerotic plaques, and inflammation."
Barbalho 2022, Abstract

"The action of platelet activating factor is antagonized and platelet aggregation is reduced. Blood flow is increased. Release of prostacyclines and nitric oxide was shown to be stimulated."
Dubey, 2004, Abstract

"...the daily intake of Ginkgo biloba leaves (80 mg/day) by healthy and physically active young men increased their endurance performance, VO2max and blood antioxidant capacity [330]."
Goncalves 2022, p.27
[Note: Refers to Sadowska-Krepa 2017 Quote below]

"Evidence collected in normal healthy samples suggests that secondary metabolite phytochemicals from each of the main structural groups – phenolics (polyphenols), terpenes and alkaloids – may result in improvements to cognitive function and psychological state that could be relevant to sports performance."
Kennedy 2019, p.S39
[Note: Caffeine is considered an alkaloid by this author, and Ginkgo supplies unique and common polyphenols and terpenes.]

"There is consistent evidence that chronic administration improves selective attention, some executive processes and long-term memory for verbal and non-verbal material."
Kaschel 2009, Abstract
[Note: these findings included "...healthy young and elderly subjects."]

"Overall, Ginkgo biloba and its extract EGb761 show promise as a clinically significant compound for improving cognitive function in cognitively normal adults..."
Lewis 2021, p.598

"Ginkgo biloba was the most relevant nootropic regarding perceptual and motor functions."
Lorca 2022, Abstract

"It is concluded that oral treatment with a G. biloba extract (Gibidyl Forte®) is able to dilate forearm blood vessels causing increments in regional blood flow without changing blood pressure levels in healthy subjects." "...16 healthy subjects (nine females and seven males) with a median age of 32 years (range: 21-47 years)."
Mehslen 2002, Summary & p.375

"The therapeutic mechanisms of EGb 761® can be attributed to its individual constituents whose differing mechanisms of action may lead to a pharmacological synergy within the formulation."
Nash, p1

"In microvascular terms, it [Ginkgo] has several beneficial effects, namely its vasodilator and endothelial-protecting activities."
Raposo 2021, p.16

"Our results show that six weeks' supplementation with Ginkgo biloba extract in physically active young men may provide some marginal improvements in their endurance performance expressed as VO2max and blood antioxidant capacity, as evidenced by specific biomarkers, and elicit somewhat better neuroprotection through increased exercise-induced production of BDNF."
Sadowska-Krepa 2017, Abstract

"After treatment, the experimental group [Ginkgo biloba] showed a reduction in blood viscosity, improved cerebral perfusion in specific areas and improved global cognitive functioning."
Santos 2003, Abstract
[Note: Subjects were 48 normal, healthy males 60-70 years.]

"GK501 improves memory function in the hours following a single dose, with 120 mg the optimal dose."
Scholey 2013, p.144
[Note: A serving of MultiV provides 120 mg of an analogous extract as that used by Scholey.]

"First, the EGb treatment improves memory processes, particularly working memory and memory consolidation. ... Second, this improvement in functioning was clearly evident to participants throughout the trial indicating that the changes were not only statistically significant but of a magnitude that could be subjectively noticed by the participants despite the double blinding of the study."
Stough 2001, p.133
[Note: Participants were "...young healthy adults ranging in age from 18 to 40 yr."]

"...it is important to explore other bioactive flavonoids of G. biloba and the interaction between different flavonoids of G. biloba."
Tao 2022, p.7

GREEN TEA POLYPHENOLS

GREEN TEA (*CAMELIA SINENSIS*)(LEAVES)(DECAFFEINATED)(50% POLYPHENOLS)

Why green tea for Endurance Exercise?

Green tea is a well-known and common source for a class of powerful polyphenols, mostly of the catechin variety. Like other dietary polyphenols (those in Ginkgo, for example), catechins have antioxidant actions, but more importantly, they provide overlooked additional antistress benefits of their own – hormesis. These cellular pathway signaling cascade actions positively affect many inner body workings to fortify exercise metabolism, performance, and overall health.

MultiV contains a concentrated extract of Green tea (Camellia sinensis) leaves, standardized to 50% total polyphenols, without caffeine. MultiV has 100 mg of Green tea polyphenols per serving, mostly as EGCG (epigallocatechin gallate).

Green tea polyphenols are much more than mere antioxidants – they are also antistress, with multiple mechanisms of action. Green tea polyphenols activate hormesis – the body's adaptive response to physical stress. Lower doses activate normal antistress mechanisms, and high doses suppress those mechanisms. (Calabrese 2020, 2021; Mattson 2008; Schirrmacher 2021; Son 2008). Thus, modest doses of Green tea polyphenols (100 mg) cajole your body to help itself when under stress by activating several pathways that affect many important bodily processes including energy metabolism, fat burning, cardiopulmonary functions, normal exercise-induced inflammatory responses, immune functions, brain support, and more.

Another newly discovered and important way Green tea polyphenols helps your overall health is by interacting with your gut microbiome to convert polyphenols to other metabolites with healthy activities (Dingeo 2020; Perez-Burillo 2021; Reygaert 2014; Zhang 2021), another part of how hormesis works.

However, hormesis means that research examining effects of Green tea polyphenols needs to look at exercise that is really stressful, and conduct a dose-response to find the zone of efficacy – both conditions are seldom done, unfortunately. Of course, First Endurance has sifted through a mountain of research to provide the "less is more" amount of Green tea polyphenols, without caffeine or L-theanine (those are in other First Endurance products).

Thus, Green tea extracts, mostly because of those characteristic catechin polyphenols, support your body's cells and tissues in numerous ways, with more help to cells and tissues under stress, adding up to better health, and thus, better overall exercise performance and recovery.

Citations for Why Green Tea for Exercise?: Afzal 2015; Cabrera 2006; Calabrese 2020, 2021; Chacko 2010; Chopade 2008; Cisneros 2017; Cooper 2005; d'Unienville 2021; Dingeo 2020; Higdon 2013; Hodgson 2013 129; Hursel 2009, 2011; Kim 2016; Kruk 2022; Malongane 2017; Jowko 2015 123; Kochman 2020; Mattson 2008; McKinley 2009; Myburgh 2014; Namita 2012; Nobari 2022; Perez 2015; Perez-Burillo 2021; Phung 2010; Reygaert 2014; Ruiz-Iglesias 2021; Santangelo 2007; Schirrmacher 2021; Sinija 2008; Son 2008; Tipoe 2017; Williams 2004; Willems 2018 18; Zhang 2021

EFFECTS OF GREEN TEA POLYPHENOLS (CATECHINS) ON EXERCISE PERFORMANCE & RECOVERY

Effects (What)	Mechanisms (How)
ANTIOXIDANT	• Advanced Glycation End Products (AGEs) formation inhibition • COX, NADPH-Oxidase suppression • DNA damage inhibition • Endogenous antioxidant enzyme (Catalase, GPx, SOD) increase • Excess iron binding, preventing additional ROS formation • Free radical scavenging (deactivation & removal) • FoxO receptors activation (increased synthesis of endogenous antioxidant enzymes – catalase, MnSOD, selenoprotein P, ceruloplasmin) • Lipid peroxidation (fat rancidity) reduction • LDL oxidation (damage) decrease • NF-kappaB stress signaling inhibition • Oxidative stress reduction • Peroxynitrate formation reduction • Protein/enzyme damages prevented by AGEs reduction • ROS (Reactive Oxygen Species) reduction • TNF-alpha stress signaling inhibition
ANTISTRESS	• FoxO receptors (antistress) activation • Hormesis (Antistress) • Reduces NF-kappaB, AP-1 • Regulates the 'cellular thiostat' of cell signaling cascades towards antistress effects • Reduces excess pro-inflammatory cytokines/mediators
BODY COMPOSITION	• Akt/protein kinase B (Akt/PKB) regulation • AMPK receptor signaling • Appetite modification • Fat oxidation (burning) • Gene expression • Glucose control • Increased energy expenditure • Leptin regulation • Mitogen-Activated Protein Kinase (MAPK) regulation • Protein kinase C (PKC) regulation • Sympathetic nervous system activation • Tyrosine kinase signaling • Reduction in body weight in overweight persons is hit or miss – other factors help (caffeine) or hinder (cultural practices, genetic variations and long-term compliance) effects

Effects (What)	Mechanisms (How)
ENERGY METABOLISM	• Akt/protein kinase B (Akt/PKB) regulation • AMPK receptor signaling • Appetite modification • Beta receptor activation increased • Norepinephrine increased via COMT inhibition • Protein kinase C (PKC) regulation • Sympathetic nervous system activation • Increased ketones formation • Increased BCAAs into energy-producing pathways • Increased lipolysis & fat oxidation • Increased insulin sensitivity • Lipolysis stimulation • Increased muscle GLUT4 receptors (glucose influx) • PPAR receptor activation • Increased whole body energy expenditure • Synergy with caffeine • Activates FoxO receptors (fuel metabolism regulation)
EXERCISE PERFORMANCE	• Increased VO2max • Faster endurance performance times • Increased arterial-venous oxygen ratio • Increased catalase in serum • Increased energy expenditure • Increased fat utilization for energy during exercise • Increased SIRT-1 • Synergy with caffeine
EXERCISE RECOVERY (DOMS, EIMD, MUSCLE DAMAGE)	• Glucose uptake & utilization increased in muscle • Malondialdehyde (MDA), marker for oxidative stress, reduced • Markers of tissue damage reduced (CK, Myoglobin) • Mesenchymal stem cells activated to remove degraded collagen • Neutrophil/Lymphocyte ratio decreased
FAT BURNING	• Adipose cell GLUT4 receptors decrease (less glucose uptake for fat synthesis) • Beta-hydroxybutyrate serum levels increased (more fat burning during exercise) • Norepinephrine increased via COMT inhibition • Beta receptor activation increased • Glycerol serum levels increased (more fat burning) during exercise • PPAR-gamma coactivation • Sympathetic nervous system activation • Synergy with caffeine • Thermogenesis

Effects (What)	Mechanisms (How)
HEALTH (HORMESIS)	• Adaptive responses to stress improved • Epigenetic effects
IMMUNE	• Protects immune cells • Regulates T cell functions by influencing miRNAs that regulate expression of calcium channel signaling
GUT MICROBIOME	• Improves ratio of healthy microbes • Reduces unhealthy microbes • Healthy microbes produce beneficial metabolites

Green Tea Exercise Effects - How to do it right

The Table above lists some of the many ways that Green tea polyphenols can positively affect exercise performance. Green tea polyphenol/catechin extracts have multiple roles promoting endurance exercise and recovery that affect many metabolic pathways. This is why it is important to include multifactorial, broad-spectrum, active ingredients like Green tea extract or Ginkgo in a daily MVM – to ensure long-term, consistent intake of essential micronutrients (vitamins and minerals) necessary for maximal responses to non-essential nutrients like Green tea and Ginkgo polyphenols.

Green tea catechins and metabolites are well-studied antioxidants, adding to overall antioxidant status and cell signaling as part of hormesis. Like exercise training, it's important to take Green tea extracts continuously for long time periods. Weeks are better than days and months/years are better than weeks. Why? This is what an overview of Green tea extract scientific literature tells us. More often, not more. How come? Because they exert their effects by cell signaling and changing cell behavior over longer time periods built up with chronic, daily use. After a single dose, the absorption, uptake and bioavailability of Green tea catechins is spread over six or more hours, and longer for any gut microbiome effects. Green tea polyphenols are not stimulants with immediate effects like caffeine – they need time to reach and change metabolic pathways to show their potential. The same mechanisms that affect exercise performance also affect overall health, and there is plenty of evidence for better human health with long-term ingestion of green tea.

To illustrate that this process takes time to show exercise benefits because it works with your body's adaptive responses, a human study of a single dose of Green tea catechins taken immediately before a resistance training bout did not show improvements in performance or recovery (Jowko 2011, 2012). The same research group used four weeks of Green tea polyphenol supplementation with sprinters and found increased antioxidant activity without hindrance of training adaptation (Jowko 2015 783). Other studies showed that green tea polyphenols taken over 10 weeks of aerobic cycle ergometry training at 60% VO2max for 60 min/day, three days per week significantly lowered RER (Respiratory Exchange Ratio), indicating greater whole-body fat utilization during moderate exercise (Ichinose 2011). The strength of this study (and many others with long durations of intake) was the relatively long-term supplementation period, compared to other less positive studies of acute, single-dose supplementation, or duration for only a few days, not allowing Green tea polyphenols to build up adjustments to metabolism. Duration matters. For results in humans, days are better than once, Weeks are better than days, months to years are better than weeks. Again, another reason for Green tea polyphenols to be taken daily in MultiV.

Green Tea Extracts for Endurance Performance

Reviews of the human exercise findings acknowledge that Green tea polyphenols have evidence for enhancing aerobic exercise performance with more fat burning for energy (Bowden 2016; Hodgson 2013 129; Jowko 2015 123; Kim 2016; Nobari 2022; Turkozu 2017).

At least 68 separate human study reports have examined many facets of exercise performance in many types of subjects from elite athletes to sedentary obese postmenopausal couch potatoes, and results range from enhanced endurance exercise performance to no difference from baseline or placebo groups. 29 Studies used endurance exercise, 24 used HIIT or resistance training exercise, and 21 studies used overweight, obese or diabetic subjects and exercise. Thus, the large number of Green tea extract studies is scattered over a wide range of exercise types and subject types, without getting into actual measurements of performance and physiology.

In other words, by cherry-picking the published research, one can come up with any conclusion one wants about Green tea extracts and exercise performance. Research being what it is, no one study is perfect, and there are multiple endpoints to measure and report from each study, so that means pulling together the entire gaggle of studies and looking for relevant, common patterns is more important for figuring out what this means for you. We prefer to pick sweet ripe cherries from the most prolific trees. Picking anything else is sour dour cherries. As expected, the more studies that are examined, the stronger the conclusion has become that nobody can say that Green tea extracts have no benefits for exercising individuals (unless one is an ostrich with their head buried in sand). The corollary is that Green tea extracts do have significant benefits for exercising individuals.

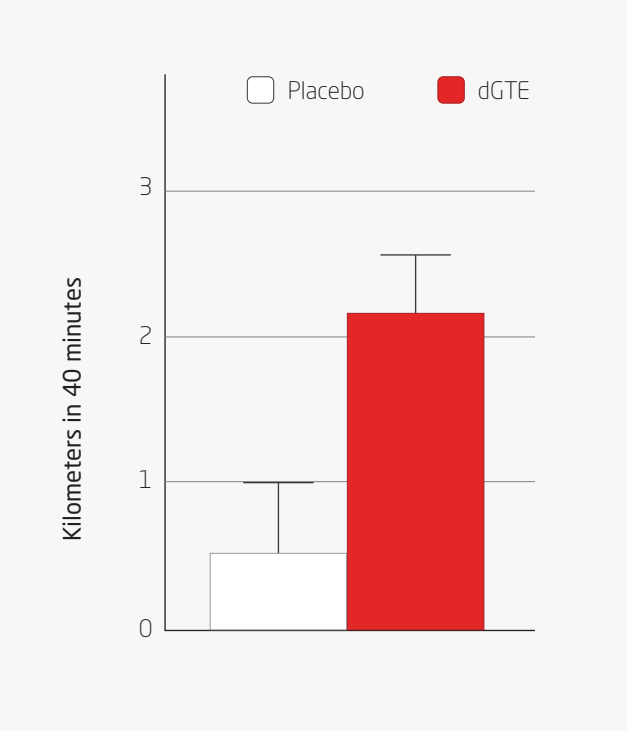
At First Endurance, we believe in being thorough when looking at published research, and acknowledge the strengths and weaknesses of each study, and synthesize the bottom line. For Green tea extracts, that bottom line is that endurance exercise performance is improved when used in moderate doses chronically (daily), which is why Green tea extract is in MultiV – so you will ingest it daily. Let's take a look at sweet cherry-picked studies showing benefits for endurance exercise performance.

Human Study Results

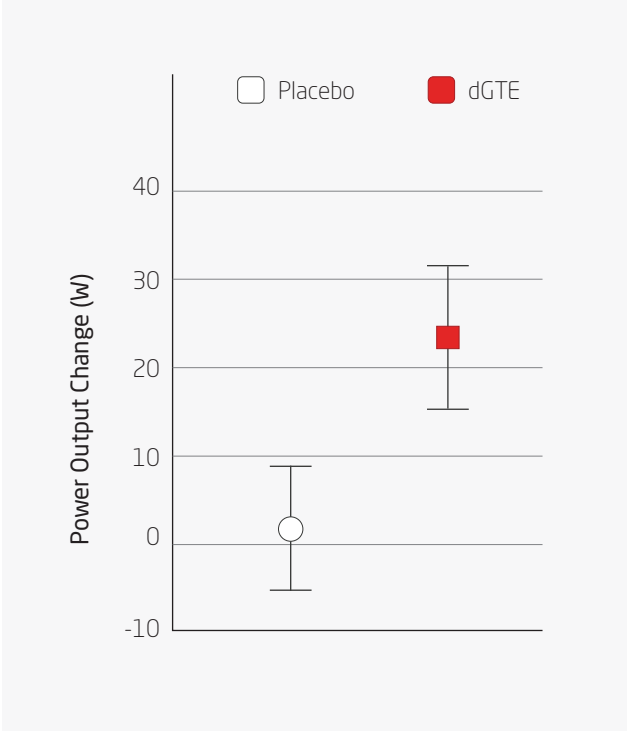
First green tea and exercise study highlighted is by Roberts from Anglia Ruskin University and University of Hertfordshire, UK (Roberts 2015). This study was originated to explore the modest results from previous findings of short-term Green tea extract studies lasting 28 days or less (Dean 2009; Eichenberger 2009, 2010; Randell 2014). A dose of 571 mg decaffeinated green tea extract supplying 400 mg EGCG given daily for four weeks was chosen. Fourteen subjects were divided evenly into two groups of seven men each – placebo and Green tea extract. Cycle ergometer exercise was conducted at 0, 2, and 4 weeks, consisting of one hour at 50% VO2max followed by a 40-minute self-paced performance trial. Diets were standardized the day before exercise testing.

Fat oxidation during exercise was significantly increased 24% by Green tea extract compared to placebo. Body fat percentage was decreased significantly more in the Green tea extract group (-1.63 vs. -0.66 %) without raising resting heart rate or blood pressure. Total and percent carbs oxidized were reduced in the Green tea group but did not change in the placebo group. Likewise, respiratory exchange ratio (RER) was reduced in the Green tea extract group, supporting the finding of more fat burning. After four weeks, distance covered in the 40-minute performance trial was significantly increased 11% by Green tea extract but not significantly in the placebo group. Similarly, average Power output (Watts) was not increased in the placebo group but significantly increased 23% in the Green tea extract group. These two measurements are illustrated in the figures below.

Distance Change 0-4 Weeks



Power Output Change 0-4 Weeks



Adapted from Roberts 2015, page 7.

Similarly, a significant improvement for run time to exhaustion was found over inactive controls, inactive controls plus Green tea extract, and a trend for improvement over exercise only group (15 vs. 8 %) by Green tea extract with exercise after four weeks of supplementation with 250 mg Green tea extract (82% catechins for 200 mg catechins per day) (Kuo 2015).

Another endurance human study in active, non-elite athlete adults found improved (4.4%) VO2max, but not other measures of exercise metabolism, after short-term (two day) supplementation with a high-dose EGCG green tea extract (Jowko 2015 123, Richards 2010). Cycling times were 10-12 minutes, which is less relevant to long-duration endurance exercise, but does illustrate that a high dose of green tea catechin has benefits for exercise performance. [EGCG is epigallocatechin-3-gallate, the predominant catechin in green tea leaves]. Other studies also found increased VO2max after Green tea extract administration.

Most studies that looked found increased fat oxidation and increased antioxidant activity/protection during exercise from Green tea extracts. Longer times of administration (at least four weeks) of Green tea extracts was more often associated with finding improved exercise parameters.

Green Tea & Excercise Studies - Tea cup shell game or looking under the wrong cup?

Other studies examined effects of Green tea polyphenols on endurance exercise performance and found few improvements in physiological measurements and performance, likely because supplementation was acute (not chronic) and exercise durations were too short and/or not stressful enough to illustrate antistress effects (Eichenberger 2009, 2010; Martin 2014). Other confounders were crossover periods too short to remove all effects of chronic Green tea polyphenol effects, and not allowing caloric intake during exercise, which would allow Green tea polyphenols to have more opportunity to improve carbohydrate and fat oxidation. And as is true for almost all exercise performance studies, variation in nutritional adequacy of essential micronutrients is never measured, accounting for greater variability between subjects, especially in studies with low subject numbers. This is why it is important to include broad-spectrum ingredients like Green tea extract or Ginkgo in a daily MVM – to ensure long-term, consistent intake of essential nutrients necessary for maximal responses of pathways dependent on non-essential nutrients, like fat burning. Some improvements in biomarkers of stress (CRP, serum creatine kinase levels, heart rate, serum glycerol) were found, indicating that Green tea polyphenol doses were active for their main effects, including lipolysis. Also, studies on endurance athletes with usual during-exercise nutrient intakes has yet to be performed. However, the increased stress from intense, long-duration exercise also gives Green tea extracts a chance to produce a more measurable difference in exercise measurements.

One overlooked crossover study simultaneously measured hundreds of compounds in blood or urine to track system-level metabolic changes from a green tea drink after strenuous exercise by NMR-based metabolomics (Miccheli 2009). Three blood samples and two urine samples were collected at rest, immediately after exercise and two hours after exercise around a morning rowing ergometer protocol of warm-up, 1000 meters max speed and 50 minutes of submaximal exercise to produce dehydration. Then an isotonic sports drink with green tea (~400 mg polyphenols) and fructose or mineral water placebo was administered. Multivariate analysis found an effect of green tea hydration drink on energy metabolism and glucose homeostasis, with blood glucose, insulin and ketone body production with depressed lactate and lipogenesis being significantly greater than mineral water placebo. This type of study also confirmed that variation between individuals is greater than the effect of the nutritional intervention. This means Green tea extract can make you perform better, but that might still not be enough for you to overcome your nemesis. Or it might if you are close!

Summing up, there are sufficient well-designed, well-conducted, statistically-powered studies to show endurance performance benefits from a wide range of Green tea extracts doses. Conditions for success are: 1) doses of 100 mg catechins or more daily, but less than 1000 mg; 2) chronic intakes (weeks, months years) – not once and done or 1-3 days of intake; 3) exercise intensity enough to elicit stress (long enough and/or hard enough); and 4) subjects healthy enough to not have essential micronutrient deficiencies that hold back metabolic performance.

Citations: Green Tea & Exercise Performance: Human Studies: Afzalpour 2014; Alikhani 2021; Azizbeigi 2019; Bagheri 2020; Bajerska 2010; Banitalebi 2016; Beak 2017; Blicher 2021; Bowden 2016; Chen 2020; Dean 2009; Eichenberger 2009, 2010; Fathei 2016; Fox 2020; Gahreman 2015, 2016; Ghasemi 2012, 2020; Goewanan 2013; Haghighi 2015; Hoseini 2016; Hodgson 2013 325; Hoseini 2016; Ichinose 2011; Jacobs 2014; Jo 2006; Jowko 2007, 2011, 2012, 2015 783; Jurcau 2013; Khosravi 2019; Kondori 2021; Kuo 2015; Lin 2014; Lloyd 2014; Martin 2014, 2016 1057, 2016 1282; Miccheli 2009; Moradi 2014; Nejati 2019; Ota 2005, 2016; Pourmohamadi 2020; Qu 2007; Rad 2020; Rahimi 2017 9; 2017 e55438; Randell 2013, 2014; Richards 2010; Roberts 2015; Rostamian 2017; Sadowska-Krepa 2019; Shahidi 2019; Sobhani 2020; Sugita 2016; Suzuki 2015; Tsai 2017; Vakili 2015; Venables 2008; Willems 2018 536, 2021; Zolfaghari 2018

Citations: Green Tea & Exercise Performance Reviews: Cabrera 2006; d'Unienville 2021; Goncalves 2022; Higdon 2003; Hodgson 2013 129; Hursel 2011, 2013; Jowko 2015 123; Kim 2016; Kochman 2021; Myburgh 2014; Nobari 2022; Perez 2015; Rains 2011; Rasaei 2021; Rojano-Ortega 2021; Ruiz-Iglesias 2021; Sinija 2008; Stohs 2016; Turkozu 2017; Willems 2018 18

Green Tea DOMS, EIMD, Recovery

At least 21 reports of human studies administered Green tea extracts to exercising humans and reported on Delayed Onset Muscle Soreness (DOMS), Exercise-Induced Muscle Damage (EIMD), or recovery post-exercise. Only three studies used endurance athletes (Hadi 2017; Machado 2018; Michnik 2017), and four other studies used sedentary subjects starting endurance exercises (Jordan 2007; Kuo 2015; Moradpourian 2014 192, 2014 520; Ota 2016). All seven studies had male subjects.

54 Team soccer players were studied at Day 0 and six weeks later for three muscle damage markers (serum enzymes AST, CK, LDH), Malondialdehyde (MDA, a marker of oxidative damage), and Total Antioxidant Capacity (TAC) of serum (Hadi 2017). Green tea extract dose was 450 mg (50% polyphenols) for six weeks. MDA levels were significantly lowered by Green tea extract, but no other markers were changed – the Placebo group showed no change in any marker, indicating the exercise was insufficient to elicit muscle damage. Green tea extract did reduce markers of oxidative damage – an antioxidant effect without changing or decreasing exercise effort.

16 trained competitive cyclists and/or runners were tested for Peak Power Output and then given Placebo or Green tea extract (500 mg, 37% polyphenols) for 13 days, followed two days of exhausting knee extensions and the next day, one hour cycling at 60% peak power output (Machado 2018). Measurements were made before and after non-fatiguing, one hour cycling at 60% peal power output before taking Green tea extract, and before and after the final cycle test at day 15. Compared to the Placebo group, Green tea group had less impaired neuromuscular activity, less muscle damage, and less oxidative stress. The authors stated: "Green tea extract supplementation before an event of cumulative fatigue minimizes muscle damage and oxidative stress in trained athletes. It also shows positive effects on neuromuscular parameters related to muscle activation and muscle fatigue. Therefore, GTE supplementation can be considered a valid strategy in the context of competitive endurance sport aiming at exercise recovery and performance of athletes."

Michnik and coinvestigators studied 20 CrossFit exercisers divided evenly between Placebo and Green tea extract groups (Michnik 2017). They received Placebo or 250 mg of 98% polyphenol Green tea extract (245 mg polyphenols) daily for six weeks. Before and after six weeks, all subjects performed a VO2max cycling test to exhaustion. Post-exercise blood lactate levels increased from 0-6 weeks in both groups, but creatine kinase (CK) serum levels, a marker of muscle damage, decreased in the Green tea group but increased in the Placebo group from 0-6 weeks. Serum LDH were not different between groups, but differential scanning calorimetry temperature measurements showed some changes by Green tea extract that were related to VO2max. Thus, Green tea extract reduced post-exercise muscle damage from endurance exercise after six weeks of CrossFit exercise.

Four other human studies reported on effects of Green tea extracts after sedentary persons started endurance exercise and found protective effects after downhill running stresses or aerobic training (Jordan 2007; Kuo 2015; Moradpourian 2014 192, 2014 520; Ota 2016). Eight human studies used High Intensity Interval Training (HIIT) or resistance training (RT) exercise protocols (two studies had women subjects) (da Silva 2018; Ghaedi 2021; Herrlinger 2015; Kerksick 2010; Kondori 2021; Jowko 2011, 2012; Panza 2008). All but two studies found some improvements in exercise recovery measurements. Three out of four studies found improvements post-exercise from Green tea extracts in overweight or obese subjects starting exercise programs (Alikhani 2021; Azizbeigi 2019; Martin 2016 1057, 2016 1282).

Overall, although most research efforts for exercise recovery were more focused on antioxidant or fat-burning effects of Green tea extracts, relevant studies for endurance athletes found beneficial recovery effects from chronic supplementation with Green tea polyphenol extracts at about twice the dosage as found in a serving of MultiV. Keep in mind that all these subjects were forbidden to use other supplements, which introduces variability of effects because of deficiencies of essential micronutrients that Green

tea polyphenols require for optimal effects, and which MultiV is designed to make sufficient. Interestingly, high daily doses of Green tea polyphenols (over 1000 mg daily), and acute/short-term supplementation did not show clear benefits, which fits the known mechanism of action for Green tea polyphenols as signaling molecules for muscle repair processes. Thus, Green tea extract at moderate doses has shown benefits for improving muscle recovery, even after daily exercise.

Citations for DOMS, EIMD & Recovery: Alikhani 2021; Azizbeigi 2019; da Silva 2018; Eichenberger 2009; Ghaedi 2021; Goncalves 2022; Hadi 2017; Haramizu 2013; Herrlinger 2015; Jordan 2007; Jowko 2011, 2012, 2016; Kerksick 2010; Khosravi 2019; Kondori 2021; Kuo 2015; Machado 2018; Martin 2016 1057, 2016 1282; Miccheli 2009; Michnik 2017; Moradpourian 2014 192, 2014 520; Ota 2016; Panza 2008; Rickards 2021; Rojano-Ortega 2021; Zapata 2021

Green Tea Antioxidant Effects - No problems with training adaptation

Green tea polyphenols (catechins) have a long and extensive history of providing healthy, beneficial antioxidant actions for humans, both as green tea itself and as Green tea polyphenol extracts like that in MultiV. Antioxidant effects are noticeable after one cup of green tea, and MultiV provides more catechins (100 mg), without caffeine, than a cup of green tea. Catechin antioxidant activity has been shown to be the main activity of green tea associated with long-term health, although the many other activities of green tea catechins have also shown benefits.

Most human studies of Green tea extracts and endurance exercise have found beneficial changes in antioxidant status, functions and results. These effects may be a major reason why Green tea extracts show ergogenic effects, as already presented. What about the prevailing opinions that antioxidants wreck training adaptations to exercise? Or worse, decrease exercise performance? Not with Green tea extract, even at high doses. Sedentary people given Green tea extract for a week starting a treadmill exercise program showed decreased fatigue and improved antioxidant functions, with better results after a stress exercise test than the training itself (Jurcua 2013; Kuo 2015). Another study on obese sedentary subjects starting a resistance training program also found improved antioxidant activity (Rahimi 2017). Numerous studies on post-exercise effects of Green tea extracts has not shown worsened recovery, and usually, improved recovery – an necessary part of training adaptation. Some of these studies are less relevant to intense, long-duration endurance exercise and are rather short for determining exercise training and adaptation effects, but they show that exercise training adaptation is unaffected by large doses of Green tea catechins that provide significant antioxidant activity. Green tea antioxidants are not like nutrient vitamins antioxidants. Likewise, other studies and reviews have not found a negative effect of Green tea polyphenols on exercise training or adaptation. Again, Green tea extract is not like essential nutrient antioxidants.

Citations for Green Tea Antioxidants & Adaptation: Afzal 2015; Azizbeigi 2019; Ghasemi 2012, 2020; Goewanan 2013; Goncalves 2022; Higdon 2013; Jowko 2007, 2011, 2012, 2015 123, 2015 783; Jurcau 2013; Kim 2014; Klotz 2014; Kondori 2021; Kuo 2015; Lopez-Alarcon 2009; Myburgh 2014; Nobari 2022; Rahimi 2017; Rasaei 2021; Rietveld 2003; Rojano-Ortega 2021; Sinija 2008; Talhi 2014; Tipoe 2017; Yiannakopoulou 2013; Zapata 2021

Green Tea Energy Expenditure / Fat Metabolism

Human studies have found increased fat oxidation and energy expenditure by Green tea extracts, even more so if caffeine is included, in obese, overweight, sedentary, and physically active subjects at rest and during both aerobic and anaerobic exercise. These effects are due to multiple mechanisms of action, including AMPK receptor signaling, PPAR receptor activation and antioxidant activity as well as direct effects on norepinephrine and the sympathetic nervous system (see Table above).

In addition, effects on insulin allow for more carbohydrate used as fuel by making more GLUT4 receptors appear in muscles and fewer in fat cells, decreasing fat synthesis in fat cells and increasing fat- and carb-burning in muscle. These effects have not been well-studied in endurance athletes, and the dose of Green tea catechins was generally higher than that in MultiV. These results also

suggest that Green tea extracts should be administered chronically, but not necessarily just before exercise. Again, chronic intake of Green tea polyphenols lends itself to daily MVM use rather than pre-exercise supplementation.

As an example, a study of 14 men taking tea catechins for two months while walking on a treadmill at 5 km/hour for 30 minutes three times weekly showed 32% (1.4x) better fat oxidation during exercise and at rest compared to the exercise-only group (Ota 2005). RER (Respiratory Exchange Ratio) showed a trend for a lower value, indicating more fat burning for exercise.

Citations for Green Tea Energy Expenditure / Fat Metabolism: Berube-Parent 2005; Bowden 2016; Chopade 2008; Cisneros 2017; Dean 2009; Esmaeelpanah 2021; Gahreman 2015, 2016; Hodgson 2013 129, 2013 325; Hursel 2009, 2011; Ichinose 2011; Janssens 2015, 2016; Kelemen 2009; Kim 2016; Lloyd 2014; Lonac 2011; Namita 2012; Ota 2005; Rains 2011; Roberts 2015, 2021; Sinija 2008; Stohs 2016; Turkozu 2017; Venables 2008; Westerterp-Plantenga 2010; Willems 2018 536, 2021; Yoneshiro 2017; Yun 2009

Green Tea Body Composition / Weight

Many studies have examined the effects of green tea and green tea polyphenols (especially EGCG) on body weight and body composition (decreased body fat percentage with muscle mass maintenance), mostly in overweight, obese, diabetic, elderly, and sedentary subjects. Green tea polyphenols have thermogenic actions that participate in maintenance of weight loss that counteract the decrease in metabolic rate during weight loss. Co-administration of caffeine increases these effects. Green tea polyphenol effect on body fat composition is small compared to that of caffeine in sedentary, overweight, and obese subjects, although one study found similar results for body weight from aerobic exercise or Green tea extract supplementation (Gholamreza 2013).

Effects of green tea or Green tea extracts on body composition/weight in athletes is not as well-studied in lean exercising persons. One study of 30 male wrestlers given Green tea or Oolong tea extracts (with 37 or 186 mg caffeine daily, respectively) for six weeks showed significant losses of body fat (Bajerska 2010). Endurance athletes have low body fat percentages and are possibly less responsive to the benefits of Green tea polyphenols seen for body composition in sedentary, overweight persons, but the activation of thermogenesis in cold conditions was found in lean subjects.

Citations for Body Composition / Body Weight: Alikhani 2021; Bajerska 2010; Cabrera 2006; Chacko 2010; Cisneros 2017; El-Elimat 2022; Esmaeelpanah 2021; Gholamreza 2013; Haghighi 2015; Hursel 2009, 2010, 2011, 2013; Janssens 2015; 2016; Jo 2006; Jowko 2015; Namita 2012; Phung 2010; Rains 2011; Roberts 2021; Sinija 2008; Stohs 2016; Takeshita 2013; Thieleke 2009; Westerterp-Plantenga 2010; Yoneshiro 2017; Yun 2009

Green Tea Immune

Green tea polyphenols have shown multiple activities with immune system cells to assist them to respond appropriately and without unnecessary excesses – an important, normal part of exercise recovery as well as overall health.

Citations for Green Tea Immune: Cabrera 2006; Chacko 2010; Chopade 2008; Cooper 2005; Kochman 2020; Kundu 2021; Lin 2014; Malongane 2017; Reygaert 2014, 2018; Ruiz-Iglesias 2021; Singh 2021; Sinija 2008; Sun 2022; Wang 2021

Green Tea & Exercise Summary

Green tea extracts containing catechin polyphenols have more than simply antioxidant effects. They also bolster cell signaling for burning fats (lipolysis), increasing glucose uptake into muscles and signal hormesis – the adaptive response to stress, perhaps by additional effects on the gut microbiome. In some human endurance exercise studies, increases in oxygen capacity and better utilization of fats and carbs for energy has been found. For best results, Green tea extracts need to be taken daily at moderate doses, as low and high doses do not work as well. In MultiV, a moderate dose of Green tea catechins adds to the overall dietary antioxidant supply, but also adds cell signaling properties that work towards better utilization of carbs and fats for energy and antistress effects important for exercise performance, recovery and adaption to training.

Literature Quotes for Green Tea

"The combination of GTE [Green Tea Extract] and exercise also produced greater changes in anti-inflammatory (increases in adiponectin) and metabolic (decreases in hs-CRP) markers than exercise alone.".
Bagheri 2019, Abstract

"This is why it is important to include broad-spectrum ingredients like Green tea extract or Ginkgo in a daily MVM – to ensure long-term, consistent intake of essential nutrients necessary for maximal responses to non-essential nutrients."
Bucci, 2022, preceding pages

"Tea is the most consumed drink in the world after water. Green tea is a 'non-fermented' tea, and contains more catechins, than black tea or oolong tea. Catechins are in vitro and in vivo strong antioxidants. "
Cabrera 2006, Abstract

"The review also provides a focus on the adaptive features of hormesis, i.e., its capacity to upregulate acquired resilience and how this can be mediated by numerous plant-derived extracts, such as curcumin, ginseng, Ginkgo biloba, resveratrol, and green tea, that induce a broad spectrum of chemopreventive effects via hormesis."
Calabrese 2021, Abstract

"A number of studies have observed positive effects of GTE on fat metabolism at rest and during exercise, following both shorter and longer term intake."
Hodgson 2013 129, Abstract

"...CCRTs [catechin- and caffeine-rich teas] may be useful agents that could help in preventing a positive energy balance and obesity."
Hursel 2013, p.1682S

"These results suggest that habitual GTE ingestion, in combination with moderate-intense exercise, was beneficial to increase the proportion of whole-body fat utilization during exercise."
Ichinose 2011, Abstract

"Therefore, EGCG is a typical example of a hormetic substance that does have an effect at low concentrations which is actually inverted at higher concentrations."
Klotz 2014, p.138
[NOTE: This means that less Green tea polyphenols has beneficial effects, a guidance for the dose of 100 mg Green tea polyphenols per serving in MultiV. Too much of a good thing (antioxidants) is not always good in biology – the U-shaped curve effect.]

"In any case, when discussing cellular responses to a given signal, the idea of a signaling cascade embedded in an entire network of sensors, checkpoints, controls, response elements, and feedback mechanisms and loops needs to be taken seriously."
Klotz 2014, p.128

"Moreover, endurance training combined with GTE [Green Tea Extract] not only increases antioxidant capacity without attenuating endurance training adaptations, but also further attenuates exercise-induced CK (Creatine Kinase) release."
Kuo 2015, Abstract

"Green tea extract supplementation before an event of cumulative fatigue minimizes muscle damage and oxidative stress in trained athletes. It also shows positive effects on neuromuscular parameters related to muscle activation and muscle fatigue. Therefore, GTE supplementation can be considered a valid strategy in the context of competitive endurance sport aiming at exercise recovery and performance of athletes."
Machado 2018, p.7

"In the fields of biology and medicine hormesis is defined as an adaptive response of cells and organisms to a moderate (usually intermittent) stress. Examples include ischemic preconditioning, exercise, dietary energy restriction and exposures to low doses of certain phytochemicals. ... As a result, cells increase their production of cytoprotective and restorative proteins including growth factors, phase 2 and antioxidant enzymes, and protein chaperones."
Mattson 2008, Abstract

"Due to its many properties, green tea improves physical and physiological function of the body during exercise by diminishing oxidative stress..."
Nobari 2022, p.11

"In conclusion, it was found that body fat utilization for energy expenditure was more effectively increased in both sedentary and exercising conditions by the combination of tea catechins intake and regular exercise than by the exercise alone.
Ota 2005, p.236

"Consuming polyphenol-rich foods, juices and concentrates accelerated recovery of muscle function while reducing muscle soreness in humans."
Rickards 2021, Abstract

"The administration of GTCs with caffeine is associated with statistically significant reductions in BMI, body weight, and WC; however, the clinical significance of these reductions is modest at best. Current data do not suggest that GTCs alone positively alter anthropometric measurements."
Phung 2010, Abstract
[NOTE: Reported lack of effect from Green tea catechins alone was based on only two human studies. The larger study showed significant decreases in BMI, body weight, and waist circumference. The smaller study had a large variability that made the statistical analysis not significant when both studies were lumped together. Also, later studies found improvements in body composition from Green tea polyphenols.]

"A dose-response relationship to stressors, according to the hormesis theory, is characterized by low-dose stimulation and high-dose inhibition. It is non-linear with a low-dose optimum. Stress responses by cells lead to adapted vitality and fitness. Physical stress can be exerted through heat, radiation, or physical exercise."
Schirrmacher 2021, Abstract

"There is hardly any other food or drink reported to have as many health benefits as green tea."
Sinija 2008, pp.232-3

"Because green tea diet has an inhibiting effect on insulin, green tea diet therefore helps keep sugar from being stored as fats and, instead, sends them directly into the muscles for immediate use."
Sinija 2008, pp.232-3

"...the majority of human epidemiological and intervention studies demonstrate beneficial effects of green tea or green tea extracts, rich in EGCG on weight management, glucose control and cardiovascular risk factors."
Thieleke 2009, Abstract

"Overall, pre-clinical and clinical studies have shown that body weight and fat mass of human subjects and animals given green tea catechins decreased significantly."
Yun 2009, p.142

"It is interesting to note that EGCG significantly stimulated the glucose uptake for the antiobesity action, which was accompanied by a decrease in translocation of glucose transporter 4 (GLUT4) in adipose tissue, while it significantly stimulated the glucose uptake with GLUT4 translocation in skeletal muscle."
Yun 2009, p.143

"TPs [Tea Polyphenols] can act indirectly on the central nervous system by affecting the "microflora–gut–brain axis", in which the microbiota and its composition represent a factor that determines brain health. Bidirectional communication between the intestinal microflora and the brain (microbe–gut–brain axis) occurs through a variety of pathways, including the vagus nerve, immune system, neuroendocrine pathways, and bacteria-derived metabolites. This axis has been shown to influence neurotransmission and behavior..."
Zhang 2021, Abstract

SPECTRA® TOTAL ORAC5 ANTIOXIDANT BLEND

Why Antioxidant Blend for Endurance Exercise?
SPECTRA® Total ORAC5 Antioxidant Blend provides broad-spectrum antioxidant benefits that do not interfere with training adaptation or recovery, simulating antioxidant benefits from a healthy diet.

Antioxidants & Excercise Research Conundrum
At present, there is an ongoing back-and-forth dialogue about exercise and antioxidant supplementation. Extreme long-distance running (Marathon of Sands) led to decreases in blood levels of antioxidant vitamins and enzymes 72 hours after the race was over – a severe deficiency of normal antioxidants. Blood markers of oxidative damage (TBARS) were also still elevated 72 hours after the race (Machefer 2004). At first, after it was found that strenuous exercise also increased oxidative species (free radicals, etc.) that cause physical damage to tissues, which increases inflammatory markers, that then starts the repair/recovery cycle of tissues, the rush was on to defeat this mechanism and prolong performance and speed recovery. A lot of free radicals are generated by exercise, so a lot of antioxidants were given to try and prevent exercise damage to extend performance. Sure enough, free radicals and even some damage can be prevented by ingesting more antioxidants – so far, so good.

After a decade or more of ambivalent results from ever-increasing doses of antioxidants (Yes! ... Hold on, wait... Maybe! er, um, ... No?), the consensus pendulum has swung towards not using large doses of antioxidants during exercise. Squelching oxidants also squelches the release of normal inflammatory signals to initiate the normal post-exercise recovery and repair processes in muscle. High antioxidant intakes also showed slower adaptation to training effects, and sometimes even poorer exercise performance and longer recovery times – an antioxidant backfire. Antioxidants and exercise studies have not panned out from the original findings of benefits. So what's the deal with antioxidants and exercise?

Without spewing pages of scientific gobbledy-gook, here is the very short version. Most antioxidant and exercise studies used single antioxidant nutrients like Vitamin C, Vitamin E, or the combination, at ever-increasing dosages. Then sulfhydryl antioxidants (L-Cysteine, N-Acetyl-L-Cysteine (NAC), Methionine and Glutathione (GSH)) had their turns with the escalating dose syndrome typical of short-term, single-agent, pharmaceutical studies but ill-advised for a multi-system endpoint – exercise performance. Many other antioxidants were applied singly with unexpected failures to help performance and/or recovery. Same story – there is a zone of inadequate intake and status for these antioxidants that worsens exercise performance and recovery, then a zone of amounts that appears to have some positive effects, then excessive doses that worsen exercise performance and recovery – the Antioxidant Conundrum.

Citations for Antioxidants & Exercise Conundrum: Elkington 2015; Henriquez-Olguin 2020; Knez 2007; Machefer 2004; Neubauer 2008, 2015; Lewis 2015; Pinho 2010; Sachdev 2008; Vina 2000

Antioxidant Research on Excercise has been Shortsighted
There have been fatal flaws in antioxidants and exercise research from the beginning. First and foremost has been the utterly dumb idea of giving a big amount of a single or even a few antioxidants and expecting benefits. Dumb? Yes, very dumb. Why? Our bodies have a network of antioxidant systems to counteract the many types of free radicals and oxidative agents. In fact, using lots of one or a few antioxidants imbalances the networked system, and because of what oxygen and antioxidants are, that causes more problems than solutions. Here's an allegory: you have a roomful of people undergoing happy conversations, and all of a sudden, one of them breaks out their electric guitar with amp and shreds at 150 decibels, then communication and happy conversations are gone and bad things ensue. Or if you duct-tape everyone's mouths and shove in earplugs, same effect – no communication or happy conversations and bad things ensue.

Another big issue has been the ignorance of what antioxidants really are. An axiom about antioxidants is that they are molecular double-edged swords. Free radicals/oxidative species are constantly formed because we breathe and burn oxygen, are super reactive chemically and permanently alter and destroy the molecules that make up you, and they live on as a string of damaged molecules until they either run into an antioxidant, which takes the molecular hit, sacrificing its molecular structure for you, or they obliterate themselves on one of your structural molecules like collagen, enzymes, proteins or cell phospholipid membranes fatty acids, or worse, DNA or RNA.

In low doses, antioxidants break the chain of free radicals to prevent cell damage. A relatively few antioxidants work strongly on each of many types of free radicals, thus slowing or stopping the damage wreaked by free radicals. But those antioxidants that took the free radical hit are damaged, and some can morph into pro-oxidants if not converted to a safer molecular form. Thus, damaged antioxidants are either quickly recharged, repaired, or removed from the body by an elegant systems network that culminates in using energy metabolism (i.e., calories) to fully make free radicals completely disappear. However, at high megadoses, antioxidants cannot be recharged, repaired, or removed fast enough, and they behave as pro-oxidants, becoming free radicals or oxidative species themselves, and overwhelm other parts of the antioxidant system network, causing damage, but only at excessive doses of the antioxidant in question. This is why less is more for antioxidant dosing.

Another issue with antioxidant research is how to measure oxidative and antioxidative effects. Usually, only a few markers per study were looked at, and the big systems network picture was lost – and so were most pieces for putting together the antioxidant/exercise puzzle. Like the seven blind men feeling different parts of an elephant, all sorts of myopic conclusions have been published based on incomplete data being poorly interpreted. Today, we know that pumping up Vitamin C or Vitamin E or Selenium or NAC or any single antioxidant too much is as bad as not having enough – maybe worse.

Citations Antioxidants & Research: *Henriquez-Olguin 2020; Klotz 2014; McLeay 2017; Neubauer 2008, 2015*

Think of antioxidants as money. You are King of the World, but your people suffer from starvation and predation (free radicals as wolves, for instance). So you provide an antioxidant fix that feeds and protects by giving a very few people a million dollars. You expect that to work for everyone. Depending on where you look (your few beneficiaries or the population as a whole), you can claim success or utter failure. But if you spread those millions around to everyone, then starvation and predation is better counteracted countrywide, and everybody is healthier and resistant. So it goes with antioxidant research, necessitating careful interpretation of context of each individual scientific report. Keep the big picture in mind when it comes to antioxidant research findings. What's the focus and intent?

Redox State

The redox state (balance of free radicals and antioxidants) influences your energy metabolism, which uses molecular oxygen (O2), which itself is a diradical. Yes, vital oxygen has two unpaired electrons (aka free radicals) all the time and is the root of all redox evil. Can't live without it, can't live with it. Oxygen's normal diradical state makes it easy to generate metabolic energy and water in mitochondria so you can exercise, think, and live. To illustrate the importance of staying alive by actively taking up free radicals, how long can you live without oxygen? Minutes. Without water? Days to weeks. Without food? Weeks to months. So, as you live and breathe is due to handling free radicals. The ubiquity of oxygen as a double free radical is why oxidative damage is synonymous with free radical damage – it's the biggest source of free radicals in our bodies.

Exercise consumes more oxygen (heard of VO2max?) and thus generates more free radicals that your body compensates for, but to what extent? Pushing yourself to past the point of exhaustion and getting normal delayed onset muscle soreness is all about oxidative stress.

Also, almost all antioxidants are more than just about suicide bombing of free radicals. Antioxidants and their breakdown products also are signaling molecules themselves to your tissues and your microbiome – so your body can sense and try to rectify an imbalance by increasing or decreasing enzyme antioxidants or energy metabolism – something your body can control without an instant dietary intake of the right antioxidants.

Citations Redox & Exercise Research: *Henriquez-Olguin 2020; Klotz 2014; Lewis 2015; Margaritelis 2020*

How antioxidants work is complicated, many-splendored, but well controlled and constantly adjusting to keep you running, cellularly and literally:

"In any case, when discussing cellular responses to a given signal, the idea of a signaling cascade embedded in an entire network of sensors, checkpoints, controls, response elements, and feedback mechanisms and loops needs to be taken seriously." Klotz 2014, p.128

Blueprint for Benefits from Antioxidants

By interpreting and understanding well-researched findings about antioxidants and health from other research areas (like mortality), it is obvious there is a sweet spot of having enough of many kinds of antioxidants, without too many of any one kind, to derive max benefits from antioxidants. Which is why healthy diets rich in all sorts of antioxidants (mostly from plant foods) are associated with less mortality and better health. It's about balance and networking – communications and conversations going on inside your body.

Taking a cue from the lessons learned by medical studies on antioxidants and health, those benefits are from increased fruit and vegetable intakes in healthy, diverse diets, not from massive doses of supplemental Vitamin C or E or Beta Carotene or any other antioxidant. This means that hundreds of different kinds of antioxidants at a collective moderate intake of each – and more than most people normally consume – is the blueprint for antioxidant benefits, along with ensuring normal, adequate antioxidant actions from the nutritionally essential vitamin and mineral antioxidants (which is what MultiV does with Vitamins C & E, Beta Carotene, and trace minerals that run antioxidant enzymes (Copper, Iron, Manganese, Selenium, Zinc)). The other vitamins and minerals operate your energy metabolism to fuel antioxidation, cell repair, exercise performance, and overall health.

Citations Antioxidants & Exercise Blueprint: *Aune 2019; Jayedi 2018; Neubauer 200, 2015; Sheng 2022; Visioli 2015*

Antioxidant Answer – SPECTRA® TOTAL ORAC5 Blend

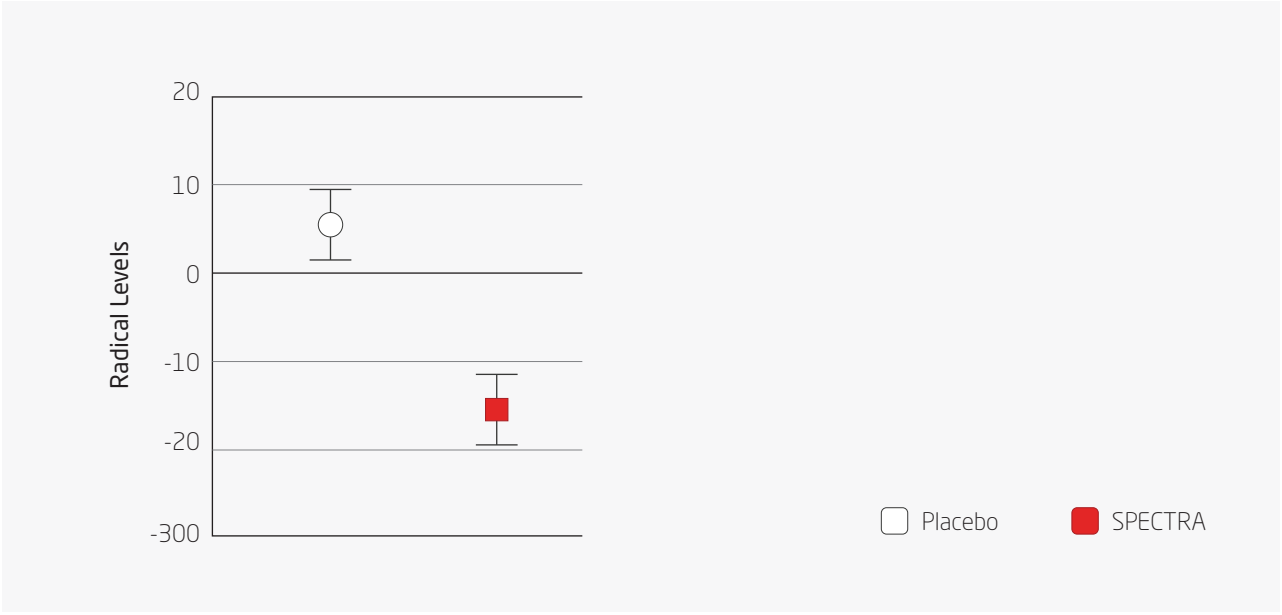
One way to optimize your redox state is to get enough amounts and types of antioxidants from real foods. That's exactly what SPECTRA® TOTAL ORAC5 Blend (SPECTRA) does. Developed by VDF Futureceuticals®, a leader in scientifically researched food extracts and concentrates, SPECTRA is a blend of 29 different food sources of concentrates and extracts with hundreds of different types of antioxidants from fruits, vegetables, seeds, herbs, and spices – matching a healthy diet rich in fruits, vegetables, herbs, and spices.

SPECTRA® TOTAL ORAC5 Blend Composition

Coffea arabica Extract, Green Tea Extract, Broccoli Sprout Concentrate, Onion Extract, Apple Extract, Quercetin, Tomato Concentrate, Broccoli Concentrate, Camu Camu Concentrate, Maltodextrin, Acerola Extract, Acai Concentrate, Turmeric Concentrate, Garlic Concentrate, Basil Concentrate, Oregano Concentrate, Cinnamon Concentrate, Carrot Concentrate, Elderberry Concentrate, Mangosteen Concentrate, Blackcurrant Extract, Blueberry Extract, Sweet Cherry Concentrate, Raspberry Concentrate, Spinach Concentrate, Chokeberry Concentrate, Kale Concentrate, Blackberry Concentrate, Silicon Dioxide, Bilberry Extract, Brussels Sprout Concentrate, Sunflower Lecithin.

The next trick is to show that SPECTRA actually has antioxidant activity in humans at a reasonable dose. VDF Futureceuticals has done this too. Two separate human studies of healthy adults at a dose of 100 mg per day (MultiV has 50 mg per serving) found significant broad-spectrum antioxidant effects. First, free radical levels in serum were reduced significantly ($P<0.005$) (see Figure below). Next, each of the five major oxidative species were effectively quenched in vitro by SPECTRA supplementation, and those antioxidant effects, especially nitrosative effects, were significantly improved in circulating blood by SPECTRA supplementation. Antioxidant effects were significant after one hour and continued for three hours (Nemzer 2014 647, 2014 828).

% Change in Fee Radical levels in serum after one hour



Adapted from Nemzer 2014 p. 652

Other human studies of endurance athletes with different intakes of total dietary antioxidants have found benefits for exercise physiology and performance. For example, a recent publication correlated total dietary antioxidant intake with antioxidant actions and oxidative stress by a treadmill test to exhaustion in 24 ultramarathoners/triathletes – 12 women, 12 men (Devrim-Lanpir 2020). Interestingly, coffee intake accounted for 1/3-1/2 of the total antioxidant intake from diet by the FRAP test, but was excluded from the FRAP score of the rest of the diet as researchers have been doing for a long time because of questions about whether roasted coffee antioxidants get absorbed into the body. The non-coffee total dietary antioxidant score was moderate-to-high for all subjects, and was compared to measurements from the exhaustive treadmill exercise. More total dietary antioxidant intake led to lower oxidative damage markers and higher blood antioxidant status. Men, but not women, showed better lactate clearance with higher blood antioxidant status. The researchers concluded that total dietary antioxidant intake positively improved exercise performance and post-exercise recovery.

Human studies on fruit/vegetable powders to exercising subjects found lowered biomarkers of oxidative damage (protein carbonyls, malondialdehyde, oxidized glutathione, total oxidative stress) without changing DOMS symptoms (Bloomer 2006; Lamprecht 2015).

Citations Spectra Antioxidant Effects: Bloomer 2006; Devrim-Lanpir 2020; Lamprecht 2015; Nemzer 2014 647, 2014 828

Antioxidants & Exercise Summary

A lot of antioxidant/redox water has gone under the research bridge, and the take-home message is to get a decent but not excessive amount of as many types of antioxidants from healthy plant foods as possible, along with ensuring adequate status of essential vitamins and minerals. By using SPECTRA, a plant-based, concentrated mixture of many antioxidants, MultiV adds the right mix of total dietary antioxidants supported by human clinical research to provide antioxidant functions and benefits.

Literature Quotes for Antioxidants, Excercise & SPECTRA

"Dietary antioxidant intake including antioxidant and polyphenolic content may positively improve both exercise performance and post-exercise recovery..."
Devrim-Lanper 2020, p.12

"In any case, it is clear considering the positive and negative effects of free radicals, and that the right balance between these and antioxidants is necessary for health and optimal training effectiveness. ... Meanwhile, few practical recommendations can be made, other than to realise that, at least for endurance athletes, antioxidant supplementation is not a case of 'the more, the better'."
Gross 2015, p.119

"Users of antioxidant supplements in both the half and full Ironman races had significantly ($P < 0.05$) elevated MDA after races compared with nonsupplementers."
Knez 2007, Abstract

"A well-balanced mixture of phytonutrients, vitamins, minerals and other bioactives from a variety of FV may lead to additive and synergistic interactions in human metabolism that result in health benefits. Hence, to bring as many as possible of these FV bioactives together in one supplement might be superior to supplements containing only vitamins, phytochemicals, juice or powder from just one or a few fruits and/or vegetables."
Lamprecht 2015, p.184
[NOTE: FV = Fruits & Vegetables, as in SPECTRA]

"In summary, the evidence to date points to biomarkers of ARH showing a moderate to strong relationship with several measures of performance in athletes."
Lewis 2015, p.403
[NOTE: ARH = Alterations in Redox Homeostasis – normalizing biomarkers showed better performance]

"Moderately dosed and timely limited antioxidant supplementation and/or the use of specialized sports products (e.g. beverages, carbohydrate-rich bars, gels, etc.) fortified with antioxidants may be warranted in specific situations such as during acute bouts of intense endurance exercise lasting several hours and in the early recovery period (within ca. 24 hours) thereafter, or during energy restriction/weight loss programs. However, high dosed antioxidant supplementation, i.e. >>100% of the recommended dietary allowance (RDA)/dietary reference intake (DRI), in addition to the dietary intake of antioxidants, should be avoided."
Neubauer 2015, p.56

"In conclusion, the IR [Ironman triathlon Race] induces changes in oxidative damage biomarkers and in the antioxidant enzymes."
Pinho 2010, p.310

"Diet with a higher antioxidant capacity in midlife was associated with a lower risk of all-cause, cardiovascular and respiratory disease mortality in the Singapore Chinese population, supporting the public health recommendation of consuming more plant-based foods that are rich in antioxidant nutrients."
Sheng 2022, Abstract

"In other words, we do not have sufficient experimental evidence to suggest the intake of pharma-nutrition preparations based on antioxidants. In fact, the converse might be true and we probably should discourage their use. However, epidemiological studies are quite clear: higher intakes of antioxidants (vitamins, but also polyphenols) are associated with better prognosis."
Visioli 2015, p.104

BORON

Why Boron for endurance excercise?

Why Boron for endurance exercise? Do you like strong bones and joints, and more efficient use of steroid hormones, including Vitamin D? Thought you would! Boron supports long-term integrity of bones, joints, steroid hormone levels, Vitamin D actions and more.

Boron is subtle but not boring

Boron is a weird element, very unlike any others, even the elements nearest it in the Periodic Table of Elements (Carbon, Aluminum, Silicon). Boron is a metalloid solid in pure form, and it likes to make very specific polyhedral bonds with oxygen (as in Sodium Tetraborate) and with cis diol groups (hydroxy groups) on other molecules, like polyphenols, hormone receptors and sugars (obviously this is important for what it does to you – read on). Its super unique atomic bonding possibilities make it useful (and essential) for vascular plants to build their hard structures. This attribute of Boron gives it several super-powers for mammals, too (humans included). But Boron has been a victim of its own success – confusing regulatory agencies with too many ways to be essential, but not curing a single deficiency disease like scurvy by Vitamin C. In fact, Boron has much more data on how it is essential compared to other trace minerals already listed as essential – chromium, for example. So far, attempts to have Boron recognized as an essential nutrient have not become official because it is so weird and mysterious to regulatory scientists, and difficult to measure. But your body knows what to do with Boron.

Citations - Boron Is Not Boring: Bita 2022; Bolanos 2004; Devirian 2003; Expert Group 2002; Hunt 1999, 2007, 2012; Khaliq 2018; Meacham 2010; Nielsen 1990 45, 1990 319, 1991 274, 1991 2661, 1998 319, 2006, 2008, 2011, 2014, 2017, 2020; ODS 2020; Pizzorno 2015; Rondanelli 2020; Weber 2022; WHO 1996 Wimmer 2019

How Boron works - It's a molecular slipstitch

Part of the problem with understanding Boron is that how it works has been figured out, but nobody except the leading researchers in the field (Borologists – and yes, that's a real word) are studying human effects of Boron in a way that looks for its strengths. Boron – by its unique, non-metallic, bonding chemistry – increases Vitamin D and steroid hormone molecules binding to their receptors, causing more signaling to a cell, and more hormone effects (but not too much). Borate salts form unique, pyramid-shaped molecules that activate cell receptors and in plants are essential for building cell walls (i.e., growing and repairing structures like roots, stems, leaves, tree trunks, etc.). This also works to make heat-resistant borosilicate glass (e.g., Pyrex) by stitching together the silica chains, preventing expansion with heat or compression with cold. Boron literally loosely connects growing plant structures on a molecular level to form the scaffold that gets finalized quickly thereafter – like a quick slipstitch that holds together sewing or quilting pieces before the tight stitching is done. Human steroid hormone receptors (including Vitamin D forms which are really secosteroids) use this same molecular connection to make a steroid molecule stay longer on its receptor, generating a larger signal, and thus, more effect if needed (the crucial feedback part has been misunderstood by much research). Your cells carefully monitor hormone receptors, so Boron effects don't get out of control.

Citations Boron - How It Works: Bolanos 2004; Khaliq 2018; Nielsen 1991 274; 1991 2661, 1998 319, 2011, 2014, 2017, 2020; Pizzorno 2015; Scorei 2013

Getting more Boron

The goal with Boron nutriture is first, prevent a deficiency. Not only does calcium & magnesium status suffer, but also Vitamin D activity is decreased when Boron intakes are below 1 mg daily. MultiV uses a longer lasting, plant form of Boron – Bororganic™ Boron Glycinate at a daily dose of 1 mg Boron per serving. MultiV adds to typical Boron intakes from food and water, closing the gap between typical intakes and clinically studied doses of 2.5-6 mg/day, preventing deficiencies and pushing into performance-gains territory.

A lot of overlooked research has found an average intake in US adults of Boron as ~1 mg daily, about half as Borate salts and half as plant chelate forms. Boron intakes in US women and men show most are not getting an adequate intake (at least 1 mg/day). Fortunately, Boron intakes of 2 mg or more daily are considered by experts to be a healthy intake for adults.

In plants, borate Boron complexes with sugars, amino acids, and organic acids in plants to form a number of Boron complexes. This is why food sources of Boron are plant foods and not animal foods. Raisins, grapes, nuts, seeds, plums, fruits, and wine are top sources for dietary Boron. Drinking water adds borate forms of Boron, but intakes are very location-specific, meaning getting Boron from drinking water is unreliable. Plant boron sources are also dependent on the local water content of Boron, but plants concentrate available Boron and converts it into chelated forms.

Research in humans has shown that plant Boron compounds are a time-release form of borate salts in the bloodstream. Both Borate salt and Boron compounds work similarly, but plant Boron compounds have longer-lasting effects at lower doses since Borate is so soluble it gets lost into urine quickly. This means that, compared to Boron chelates, a higher daily intake of Borate is necessary for Boron to exert its full effects.

Citations - Getting More Boron: *Hunt 2012; Hunter 2019; Khaliq 2018; Meacham 2010; Nielsen 1987, 1988, 1990 319, 1991 274, 1991 2661, 1998 319, 2006, 2008, 2011, 2014, 2017, 2020; ODS 2020; Pizzorno 2015; Rainey 1999; Simsek 2003; Sutherland 1998; WHO 1996*

Boron & Exercise

What was missed by many in the epiphanic 1987 study were the positive effects of Boron for retaining calcium and magnesium body-wide – this is vital for muscular performance and exercise recovery, but even more so for connective tissues – bones especially.

Boron is an indirect potentiator for endurance exercise physiology and recovery, given its obvious role with steroid hormones and Vitamin D. Using boron supplements to increase steroid hormone levels predictably failed in strength athletes, but endurance athletes are unstudied for boron effects, except for one study that found serum Boron levels in professional Spanish athletes were similar to sedentary controls (Maynar 2017). MultiV uses a form of boron found in plant foods, which acts as a time-release borate, extending the utility of boron supplementation.

Although there is a paucity of human studies on Boron for endurance exercise performance, there are studies showing that Boron dietary or supplement intakes of ~2 mg daily or more benefit factors that are important for exercise performance. These include: 1) increased levels and/or efficiency of steroid hormones; 2) improved Vitamin D functions; 3) improved retention of calcium and magnesium; 4) improved cardiometabolic measures such as CRP and biomarkers of heart health. The data on reducing biomarkers of stress (like CRP) is in older adults, but it has been consistent with how Boron works. Also, by enhancing active Vitamin D levels (calcitriol), another normal mechanism is operative – Vitamin D also has a strong effect on muscle repair and recovery. Boron works with Vitamin D to sooth overworked muscles.

One exercise performance study, using Calcium Fructoborate (FruiteX-B®) in combination with other known ergogenic aids (creatine, coffee, fruit extract, and Vitamin D) found significantly improved golf drive distances vs. placebo (Ziegenfuss 2015), even though 1-RM bench press and body mass changes were not different between groups. The other ingredients mean that performance improvements in golf swing cannot be attributed solely to the Boron compound, and golf as a sport is less relevant to endurance exercise performance.

Citations - Boron & Exercise: Bita 2022; Bolanos 2004; Chiang 2017; Dzik 2019; Ghozali 2022; Heffernan 2019; Hunt 1998, 1999; Maynar 2017; Moran 2013; Naghii 1997, 1999; Nielsen 1987, 2006; Pietrzkowski 2013; Pizzorno 2015; Tomlinson 2015; Weber 2022; Ziegenfuss 2015

Boron - A hormone helper

This means that your normal hormonal responses to exercise are optimized. Your hormone levels keep their usual changes in blood levels, except that your receptors work more efficiently. These steroid hormones include the following series: 1) corticosteroids; 2) estrogens; 3) androgens (testosterone); 4) mineralocorticoids; and 5) calciferols (Vitamin D). Net effect of normal hormonal responses being optimized is to reduce normal, exercise-induced inflammation, thus improving recovery and adaptation from intense exercise, and assisting calcium and magnesium redistribution.

Yes, an early study on Boron given to postmenopausal women found small but significant increases in blood levels of estrogen and testosterone after weeks of supplementation, but the experimental setting carefully controlled diet and activity to pinpoint Boron effects (Nielsen 1987). Nevertheless, this finding was taken out of context and for a short period, Boron was being touted for building muscle mass via more testosterone. These product promoters did not realize that these women also showed increased estrogen (estradiol), which is anathema to bodybuilding (but good for postmenopausal women). Needless to say, later studies did not find muscle-building effects in men with even large doses of boron salts, perhaps because of an increase in estrogens. Boron supplementation to normal, healthy males led to significant increases in blood levels of estrogen (estradiol), with a statistical trend for an increase in testosterone.

Another study of the same type and dose of Boron (10 mg) supplemented for seven days showed opposite results in eight healthy male volunteers (academic staff and students, obviously sedentary) (Naghii 2011) in a placebo-controlled, crossover study. Six hours after the first Boron dose, rapid decreases in sex hormone binding globulin (SHBG), C-Reactive Protein (hsCRP) and TNF-alpha were significantly decreased, with a trend for cortisol lowering. Testosterone, free testosterone, estradiol, and Vitamin D levels were unchanged. These analytes did not change during the placebo period. After seven days, free testosterone was significantly increased along with free/total testosterone, free estradiol, and total estradiol ratios. Estradiol levels were significantly decreased. hsCRP, IL6, TNF-alpha showed trends for decreased levels. Vitamin D levels did not change. Thus, in healthy young males, a higher Boron dose may achieve similar effects as 3 mg doses in postmenopausal and elderly subjects. This study illustrates the importance of performing dose-response and time curves instead of random intakes at a time when the pharmacokinetics are not known – a sound research practice seldom encountered with nutrients. Thus, there is strong evidence that a high Boron dose in young, sedentary men has beneficial effects on hormones and biomarkers of normal inflammation.

To bring home the known effects of Boron on hormones into real life, a human study of over 100 collegiate women with primary dysmenhorea (PMS) were given placebo or 10 mg of sodium tetraborate from two days before the end of their cycle until the third day of menstrual flow for five days (Nikkah 2015). Boron reduced pain severity by ~20% compared to 7-9% for the placebo group. These results fit both the hormonal and low magnesium mechanisms of causations for PMS pain.

Boron has exhibited several Mechanisms of Action to help make steroid hormones and Vitamin D more active, within normal ranges – not excessive. Human clinical findings give evidence for the known Mechanisms of Action for hormones and cytokine mediators having biological benefits from Boron supplementation.

Citations - Boron, Hormones & Vitamin D: Bello 2018; Benderdour 1998; Eskin 2015; Ferrando 1993; Green 1994; Hunt 2012; Khaliq 2018; Meacham 2010; Naghii 1993, 1997, 1999, 2011; Nikkah 2015; Nielsen 1987, 1990 319, 1991 274; 1991 2661, 1998 319, 2006, 2008, 2011, 2014, 2017, 2020; ODS 2020; Pizzorno 2015; Scorei 2013; Ziegenfuss 2015

Boron & Musculoskeletal health

In humans, bone has the highest concentration of Boron. The link between Boron and calcium, magnesium and Vitamin D enhancements has shown that Boron plays an important role in maintaining healthy bone mass at all ages. Short-term studies (relevant to the one-year bone turnover time) have shown improvements that predict better bone health. Also, people with higher bone levels of Boron show higher bone mass – a direct correlation between more Boron = more bone.

Comparing effects of Boron supplementation in college-age sedentary and athletic women for ten months found minor changes in blood and urine levels of calcium, magnesium and phosphorus with exercisers showing lower blood levels of magnesium and phosphorus. Bone density increased, but given the subjects' ages, bone growth is normally increasing. This study had several other confounders – small subject numbers per group (5-10) coupled with large variability and less sensitive bone mass measurement (lumbar spine), meaning it was underpowered (Meacham 1994, 1995).

Boron supplementation to postmenopausal women reproducibly showed benefits for bone mas and status of calcium and magnesium. Similarly, several studies have found improvements in older persons with everyday joint discomfort, even in relatively short time periods (eight weeks). The consensus of these two lines of research is that Boron has beneficial effects on bone and joint health in older persons, but the relevancy to younger women and men is not well known as of yet.

Citations - Boron & Musculoskeletal Health: Bita 2022; Bolanos 2004; Devirian 2003; Eskin 2015; Hunt 1999, 2012; Hunter 2019; Khaliq 2018; Mahmood 2016; Meacham 1994, 1995, 2010; Miljkovic 2004; Naghii 1993, 2011; Newnham 1994; Nielsen 1987, 1990 45, 1990 319, 1991 274; 1991 2661, 1992, 1998 319, 2006, 2008, 2011, 2014, 2017, 2020; ODS 2020; Pizzorno 2015; Price 2012; Rondanelli 2020; Scorei 2013; Volpe 1993

Boron & Exercise Summary

Boron clearly has long-range health benefits for maintaining musculoskeletal system health. Boron does this in many-splendored ways, such as specific and unique roles supporting healthy levels and functions of steroid hormones and Vitamin D, positively affecting calcium and magnesium status. Supplementation with Boron showed positive results in healthy young women with PMS. There are hints of other metabolic roles and repairing tissue damage, which would be handy for exercise recovery. However, no studies specifically studied endurance exercise performance effects of Boron in persons of any age. Judging from the unique mechanisms of action for boron, it is an optimizer to overall health rather than a stimulator regardless of condition (like caffeine is). One clear finding is that Boron intakes of 2 mg or more daily, which is what MultiV is designed to assure, have long-term benefits for bone health and other musculoskeletal systems, including joints and muscles. Since endurance athletes often have low Vitamin D status and intakes, and are prone to musculoskeletal stress, ensuring an adequate Boron intake is a healthy way to support the musculoskeletal system to help maintain continued exercise performance.

Literature Quote for Boron & Exercise

"Boron may have a beneficial effect on the function of such hormones as vitamin D, estrogen, thyroid hormone, insulin, and progesterone. ... Boron clearly plays many important roles in enhancing human health..."
Eskin 2015, p.1

"Mounting evidence suggests that boron is essential to human beings."
Expert Group on Vitamins and Minerals 2002, p.2

"In vertebrates, the borates are essential for their unique bonding and structural characteristics. ... Furthermore, it is beneficial for different organs, because of its interactions with calcium, vitamin D, and magnesium."
Khaliq 2018, p.31

"Recent findings have reinforced the significance to health of adequate boron status. The effects of boron are multiple and versatile. ... When administered at an effective dose, boron shows remarkable properties, and its nutritional value cannot be underestimated.
Khaliq 2018, pp.44-5

"Current research implicates boron as an essential nutrient in humans demonstrating healthful effects in cellular functions.... Proposed mechanisms of action implicate that boron, found in cells as boric acid, participates in important membrane functions and intracellular signaling cascades."
Meacham 2010, Abstract

"The formation of steroid hormones from precursors involve one or more hydroxylations of the steroid structures and it is hypothesized that boron enhances the rate of hydroxylation. It appears that enhancement in the rate of hydroxylation by boron followed by the increase in the hormone levels support the proposal."
Naghii 1999, pp.35-7

"The findings support the contention that boron has a biological function that affects calcium metabolism, and thus bone formation and maintenance in humans. ... The findings suggest that boron is an essential trace element for humans."
Nielsen 1990, pp.52-3

"As indicated in the preceding, the two human experiments described yielded a bewildering and surprising array of significant findings when it is considered that boron apparently has a biochemical role so subtle that it was considered unimportant in nutrition until the 1980s. However, if one closely analyzes the findings, the results from the first two human experiments indicate that boron affected many variables affected by calcium, and suggest that the similarity between the effects of boron and calcium occurred because they affected a similar system, or systems, which indirectly affect many variables."
Nielsen 1991 274, p.279

"Recent findings indicate that a significant number of people do not consistently consume more than 1 mg B/d; this suggests that B could be a practical nutritional or clinical concern."
Nielsen 1998 319, Abstract

"Now that the opinion about the nutritional importance of boron is changing, a question that has come to the fore is: Why wasn't this recognized sooner? A reasonable answer to that question is that boron apparently has a biochemical function that is very subtle. Moreover, this role apparently is one that allows optimal functioning of other nutrients or hormones and thus is overlooked as attention is directed toward altering the intake of the substance whose suboptimal metabolism is directly involved in a pathologic consequence (e.g., calcium supplementation to prevent bone loss)."
Nielsen 2000, p.512
[NOTE: The inability of calcium supplementation with or without Vitamin D to actually build bone mass in older persons just screams the need for more boron and magnesium! This has relevance for bone mass maintenance in endurance athletes too.]

"Growing evidence from a variety of experimental models shows that boron is a bioactive and beneficial (perhaps essential) element for humans."
Nielsen 2011, Abstract

"Evidence that boron is a beneficial bioactive trace element is substantial. The evidence has come from numerous laboratories that have used a variety of experimental models, including humans. In nutritional amounts, boron promotes bone health and brain function, modulates the immune or inflammatory response, and influences the response to oxidative stress. Boron apparently has diverse effects through influencing a cell signaling system or the formation and/or activity of an entity involved in many biochemical processes. Based on findings from both animal and human experiments, an intake of boron near 1.0 mg/day would be a reasonable suggestion for an adequate intake that would assure the benefits provided by boron."
Nielsen 2017, Abstract

"Because boron may be bioactive through forming diester complexes with phosphoinositides, glycoproteins, and glycolipids that contain cis-hydroxyl groups in membranes, recent research has examined whether these boroesters influence membrane receptors and signal transduction and may thus be the basis for boron enhancement of insulin, vitamin D, and progesterone effects."
Nielsen 2020, p.462

"Interestingly, in the same study, it was found that treatment with CFB increased blood levels of endogenous calcitriol, an active form of vitamin D. ... This activity could be beneficial for muscles damaged due to overtraining and remaining under inflammatory conditions."
Pietrzkowski 2013, p. 483

"Physicians are less likely to be aware that dietary insufficiencies of magnesium, silicon, Vitamin K, and boron are also widely prevalent, and each of these essential nutrients is an important contributor to bone health."
Price 2012, Abstract

VITAMIN K2 MK7 (MENAQUINONE-7)

Why Vitamin K2 for endurance excercise?
Vitamin K comes in two basic forms (K1 & K2) with primary functions of activating proteins that bind and transport calcium for specific uses, ensuring proper blood clotting, pliable blood vessel structure, and bone & joint health. For exercise, Vitamin K2 increases maximal heart output, reduces muscle cramps, supports muscle mass, and plays a backup role in metabolic energy production.

The difference between K1 and K2 is in the length of the fat-soluble side chain sticking off of vitamin K forms, ranging from 1 to 14 side chain units. The most common forms of K2 in foods and you are MK4 and MK7. Because MK7 is more fat-soluble, it has more hang time in the body and stays around longer, giving it stronger actions than K1 and K2 MK4. K1 is stored in the liver and not used for much else than to ensure clotting can happen. That leaves bone and cardiovascular health up to K2, and K2 MK7 has shown superior activity for bone and cardiovascular health than K1 or K2 MK4.

MultiV adds together K1 and K2 MK7 to reach 100% Daily Value for overall Vitamin K (120 mcg). The dose of K2 MK7 is 45 mcg, exceeding the lowest clinically-tested amount shown to protect long-term bone and cardiovascular health (Geleijnse 2004; Maresz 2015 21; 2015 34). In order to ensure that Vitamin K2 MK7 is stable in tablets containing calcium and magnesium salts (like MultiV), we use K2VITAL® DELTA from Kappa BioSciences that has been tested to prevent the loss of K2 stability in tablets.

Human studies using K2 MK7 have found reductions in idiopathic and hemodialysis muscle cramps (not yet tested for exercise muscle cramps) and increased maximal cardiac output during cycle ergometry with lowered lactate at higher doses than in MultiV. Other potential uses are under active investigation, especially for improving circulation during exercise, improving arterial flexibility, maintaining bone mass in endurance athletes, and even assisting mitochondria in energy production. Adequate Vitamin D status is crucial for K2 MK7 to exhibit its biological benefits, and vice versa.

Right now, the science is clear for benefits of K2 MK7 for bone and cardiovascular health not found with K1. As human studies continue to show efficacy for exercise performance, First Endurance is proud to give MultiV an effective dose of Vitamin K2 MK7 to maintain long-term cardiovascular and bone health.

Citations - Vitamin K2 MK& & Exercise: Brancaccio 2022; Crintea 2021; Dahlquist 2015; Geleijnse 2004; Jadhav 2022; Marez 2015 21, 2015 34; McFarlin 2017; Mehta 2010; Vermeer 2012; Vidula 2022; Volpe 2016; Xu 2022

Literature Quotes

"...vitamin K is a leading player in the blood clotting process and ensures the functionality of proteins involved in bone remodeling. Low levels of this vitamin have been associated with increased bone turnover and fracture risk."
Brancaccio 2022, p3

"Through its involvement in cardiovascular and nervous system function, and bone metabolism, vitamin K supplementation could improve exercise capacity."
Crintea 2021, Abstract

"Furthermore, it is possible that dosages exceeding the recommendations for vitamin D ... in combination with 50 to 1000 mcg/day of vitamin K1 and K2 could aid athletic performance."
Dahlquist 2015, Abstract

"Various clinical trials for determination of the appropriate dose of vitamin K2 have been performed; also its bioavailability and efficacy have been investigated ... Further, in many trials, vitamin K2-7 is combined with vitamin D as an intervention to augment the beneficial effects."
Jadhav 2022, p.21

"...vitamin K2 is associated with the inhibition of arterial calcification and arterial stiffening. An adequate intake of vitamin K2 has been shown to lower the risk of vascular damage ..."
Maresz 2015, Abstract

"The fact that under-carboxylation of key Gla-proteins is common in the general population suggests that increased vitamin K intake may be an important factor in improving public health."
Vermeer 2012, p.4

"...it seems that a low vitamin K intake may relate to a high bone turnover in athletes."
Volpe 2016, p.33

MULTIV 83005 REFERENCE CITATIONS

WHY YOU NEED AN ENDURANCE MULTIVITAMIN/MINERAL (MVM)?

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