

MD+ JOINT SUPPORT VERSION VI



Joint Support is formulated to support the complete musculoskeletal system in many ways.

1. By maintaining tissue integrity, helping to prevent musculoskeletal problems.
2. By providing the mechanisms and stimulus for repair of injured or damaged musculoskeletal tissue, whatever the cause.
3. By decreasing osteoarthritic pathology
4. By offering relief for aches and pains.
5. By improving recovery from training and competition.
6. By improving body composition and exercise performance.
7. By improving cognition and brain function.

Multiple ingredients in Joint Support work along synergistic and additive pathways to decrease inflammation and pain by promoting the body's natural synthesis and maintenance of joints, ligaments, muscles, and tendons, it protects, prevents, and helps in the repair of musculoskeletal inflammation and injuries regardless of the cause.

But as you'll see below it also does much more.

In fact, because of its many beneficial effects, I consider Joint Support the Swiss Army knife of nutritional supplements.

<https://metabolicdiet.com/product/joint-support/>

Information on Joint Support was updated on January 4, 2024, by Mauro Di Pasquale, B.Sc. (Hons), M.D.

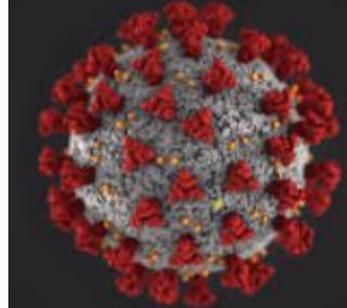


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The information below on the new Joint Support version VI is continually in draft form, being constantly expanded and revised

several times a year. For now, this latest information will give you the flavor of just what Joint Support will do for you in helping you achieve your health, body composition, performance, and anti-aging goals.

Joint Support version VI Nutritional Panel

Supplement Facts:		Serving Size: 6 Tablets		Servings Per Container: 30	
	Amount Per Serving	%Daily Value		Amount Per Serving	%Daily Value
Vitamin A (as Palmitate)	2500 IU	50%	BioCell Collagen II® <small>(BioCell Collagen)</small>	1200 mg	*
Vitamin C (as L-Ascorbic Acid)	200 mg	333%	Hydrolyzed Collagen Type II	720 mg*	
Vitamin D3 (as Cholecalciferol & Calcifediol)	400 IU	100%	Chondroitin Sulfate	240 mg*	
Vitamin E (as d-Alpha Tocopheryl Succinate)	150 IU	500%	Hyaluronic Acid	120 mg*	
Vitamin B3 (as Niacinamide & Inositol Hexanicotinate)	50 mg	250%	Glucosamine Sulfate	500 mg	*
Vitamin B6 (as Pyridoxine HCL and Pyridoxal-5 Phosphate)	10 mg	500%	Lignisul MSM (Methyl-Sulfonyl-Methane)	1000 mg	*
Vitamin B12 (as Methylcobalamin)	500 mcg	8,333%	Shark Cartilage	800 mg	*
Folate (as Folinic Acid)	500 mcg	125 %	Stinging Nettle Extract (Urtica dioica) (leaf)	300 mg	*
Pantothenic Acid (as D-Calcium Pantothenate)	10 mg	100%	Quercetin Dihydrate	300 mg	*
Vitamin K (50% K-1 and K-2)	50 mcg	63%	Turmeric Extract (Curcuma Longa) (root)	300 mg	*
Calcium (as Calcium Phosphate)	500 mg	50%	Rutin	100 mg	*
Magnesium (as Magnesium Phosphate)	250 mg	50%	Joint Support™ Proprietary Complex 5740 mg		
Potassium (as Potassium Aspartate)	99 mg	3%	Green Tea Leaf Extract, Type I, Type II, and Type III Collagen - Native and Hydrolyzed (Fish and Chicken), Ginger Root, Phosphate (as Calcium Phosphate),		
Zinc (as Monomethionine) (OptiZinc®)	10 mg	67%	Gelatin Hydrolysate, Hydroxycitric Acid, Ashwagandha Root Extract, Taurine,		
Copper (as Copper Gluconate)	100 mcg	5%	Boswellia Serrata Extract (gum resin), Thyme Leaf, Yucca Extract, Betaine HCl,		
Selenium (as Selenomethionine)	25 mcg	35%	Jujube Berry Extract, Bromelain, Papain, Ginger (Zingiber officinale), L Arginine		
Manganese (as Manganese Sulfate)	5 mg	250%	HCl, L-Methionine, Cayenne Fruit, Devil's Claw Root Extract, Pau D'Arco Bark,		
Chromium (as Amino Acid Chelate)	25 mcg	21%	Proline, Acetyl-L-Carnitine, Silicon Dioxide, Borage Oil Powder (contains GLA),		
Bioperine (Piper Nigrum)	5 mg	*	N-Acetyl L-Cysteine, L-Histidine, Ginkgo Biloba, Glutathione (Reduced),		
Boron (as Amino Acid Chelate)	2 mg	*	Carnosine, Alpha Lipoic Acid, L-Trypsin, Co-enzyme Q10, Glycine,		
Other Ingredients: Cellulose, Stearic Acid, Modified Cellulose Gum, Hypromellose, Hydroxypropyl Cellulose					
*Daily Value not established					

General Introduction

Over six decades ago I took what supplements were available back then along with other nutritional ingredients I found useful in order to optimize my weight training, body composition and sports goals which included track, wrestling, gymnastics, and lifting weights. In my mid-twenties I honed my nutritional supplement protocols in order to help me excel in powerlifting, which I succeeded in doing.

Back then I knew how important it was to optimize the function and health of the musculoskeletal system, not only for sports success but for lifelong wellness.

In the last forty plus years I formulated or helped formulate nutritional supplements for over two dozen nutritional supplement companies, some of which are still major players today.

The problem was that in all cases my formulations were cut back to decrease manufacturing prices and as such were less effective than they should have been.

Over two decades ago I decided to start my own nutritional supplement company and unlike the lip service that all nutritional companies hand out about their products, the line of products I had manufactured spent less on lip service and much more on effectiveness. All products are updated to new versions with changes to the ingredients, both in number and amounts, to reflect new research and information from the trenches.

Introduction to Joint Support

Musculoskeletal problems are ubiquitous with conditions that affect the bones, muscles, joints, tendons, and ligaments, including injuries, both chronic and acute, and degenerative conditions including the many phases of arthritis. The result is both acute and chronic loss of physical and mental performance.

While lifestyle factors such as diet, proper sleep, avoiding smoking and recreational drugs, and avoiding unnecessary stress are important, the proper blend of nutritional ingredients can provide another essential layer for both avoiding and treating musculoskeletal problems.

Over the last few decades previous versions of Joint Support were already the leader in musculoskeletal support products. The new Joint Support version VI dramatically improves the protective, supportive and tissue

building effects and creates a new paradigm in musculoskeletal support formulas.

However, even though I targeted the formulation for Joint Support to improve all aspects of the musculoskeletal system, it's been proven to have several additional benefits, some comes from research on the ingredients in Joint Support, and some gathered from the trenches by those using Joint Support over the last few decades.

Joint Support besides the protective and therapeutic musculoskeletal system effects, also has the following beneficial effects, as attested to by many who have used Joint Support over the last few decades, especially with the newest version Joint Support version VI.

- **Decreasing damage and improving recovery after exercise, including high-intensity and eccentric exercise.**
- **Treatment for sunburn – used before and in the case of vitamin D, also within an hour of excessive sun exposure. For more information see the sunburn section in my currently updated [Vitamin D](#) article.**
- **Improving pollution damaged, photo damaged, ageing skin, as well as improving hair and nail health. Joint Support increases the strength and elasticity of skin and stimulates the production and regeneration of new skin cells and skin matrix.**
- **Minimizing hangovers – taken prior to drinking, right after, and the next morning.**
- **Help the prevention and healing of stretch marks.**
- **Improving protection from pathogens, including bacterial and viral infections.**

Overall, several ingredients in Joint Support have significant immune, antioxidant and anti-inflammatory, as well as anabolic and trophic, giving credence to the beneficial effects of Joint Support in all of the above. You can find most of this information below under various headings and the individual ingredients.

For example, vitamin D is included in Joint Support as it is crucial for musculoskeletal functioning, athletic performance, body composition and many internal cellular processes including hormonal and immune system regulation.

A recent study found that vitamin D supplementation had a beneficial effect on body composition in elite male college athletes.¹ The study found that vitamin D supplementation was effective in maintaining athletes' body fat percentage, which normally would increase under circumstances where sports activity has decreased.

A study published in late 2022 concluded that a vitamin D deficiency/insufficiency increases the risk of muscle loss by 78% in older people.² I would surmise that it would also apply to all ages to one extent or another since vitamin D deficiency/insufficiency is common and involves all age groups.

Joint Support and the Covid-19 Pandemic

It's likely that Joint Support, because of its beneficial effects on the immune system and innate immunity, and antioxidant and anti-inflammatory effects, would prove useful in the prevention and treatment of the coronavirus responsible for the Covid-19 pandemic.³

The many ingredients in Joint Support that support and optimize the immune system to fight off infections including MSM, shark cartilage, ashwagandha, curcumin, bromelain, taurine, carnosine, CoQ10, vitamin D, zinc, vitamin C, vitamin E, folic acid B6 (and the rest of the B-complex), astaxanthin, selenium, reduced glutathione, ginger, turmeric, polyphenols and flavonoids including green tea extract, and several other ingredients that have antioxidant and anti-inflammatory properties.

Although as mentioned above vitamin D is included in Joint Support as it is crucial for musculoskeletal functioning, athletic performance, body composition and many internal cellular processes including hormonal and immune system regulation.

However, adequate levels of vitamin D, besides improving body composition and performance, are also important for decreasing the rate of infection and treatment of Covid-19, including increasing the immunity to covid by increasing the vaccine response.⁴⁵⁶⁷⁸⁹

Another recent study found that the combination of bromelain and curcumin, **both in Joint Support**, have a synergistic effects against severe Covid-19.¹⁰ The bromelain not only increases the absorption of curcumin, but also inhibits and may be useful for the treatment of Covid-19 infection.¹¹¹²

As well as bromelain, the inclusion of Bioperine (see below) in Joint Support increases the absorption of curcumin and many of the other ingredients in Joint Support.

A recent study found a positive impact of nutritional supplementation on vaccination response, increasing host immune defenses, and reducing side effects.¹³

The ingredients in Joint Support are also useful in avoiding and treating other infections conditions whether viral, bacterial, fungal, or parasitic. There are also several other benefits which I will outline below.

Abstracts of Interest

Nutrients

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doi: 10.3390/nu15081807.

Effectiveness of Nutritional Supplements for Attenuating the Side Effects of SARS-CoV-2 Vaccines

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PMID: 37111026 PMCID: [PMC10141698](#), DOI: [10.3390/nu15081807](#)

Abstract

Supplementation is known to enhance the immune response and reduce infection. Therefore, the association between immune nutrients and vaccine side effects needs to be investigated. Our aim was to analyze the relationship between vaccination side effects and supplement intake among the Italian population. The study included a questionnaire asking for personal data, anthropometric information, COVID-19 infection and immunity response, and COVID-19 vaccination and supplementation. The survey was conducted from 8 February to 15 June 2022. In the study, 776 respondents were included, aged between 18 and 86 (71.3% females). We observed a statistically significant correlation between supplement consumption and side effects at the end of the vaccination cycle ($p = 0.000$), which was also confirmed by logistic regression ($p = 0.02$). Significant associations were observed between supplement intake and side effects of diarrhea and nausea at the end of the vaccination cycle ($p = 0.001$; $p = 0.04$, respectively). Significant associations were observed between side effects and omega-3 and mineral supplementation at the start of the vaccination cycle ($p = 0.02$; $p = 0.001$, respectively), and between side effects and vitamin supplementation at the end of the vaccination cycle ($p = 0.005$). In conclusion, our study shows a positive impact of supplementation on vaccination response, increasing host immune defenses, and reducing side effects.

Full text in PDF format available at:

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10141698/pdf/nutrients-15-01807.pdf>.

bioRxiv 2020 Sep 16;2020.09.16.297366. doi: [10.1101/2020.09.16.297366](https://doi.org/10.1101/2020.09.16.297366). Preprint

Bromelain Inhibits SARS-CoV-2 Infection in VeroE6 Cells

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Abstract

Coronavirus disease 2019 (COVID-19) is caused by severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2). The initial interaction between Transmembrane Serine Protease 2 (TMPRSS2) primed SARS-CoV-2 spike (S) protein and host cell receptor angiotensin-converting enzyme 2 (ACE-2) is a pre-requisite step for this novel coronavirus pathogenesis. Here, we expressed a GFP-tagged SARS-CoV-2 S-Ectodomain in Tni insect cells. That contained sialic acid-enriched N- and O-glycans. Surface resonance plasmon (SPR) and Luminex assay showed that the purified S-Ectodomain binding to human ACE-2 and immunoreactivity with COVID-19 positive samples. We demonstrate that bromelain (isolated from pineapple stem and used as a dietary supplement) treatment diminishes the expression of ACE-2 and TMPRSS2 in VeroE6 cells and dramatically lowers the expression of S-Ectodomain. Importantly, bromelain treatment reduced the interaction between S-Ectodomain and VeroE6 cells. Most importantly, bromelain treatment significantly diminished the SARS-CoV-2 infection in VeroE6 cells. Altogether, our results suggest that bromelain or bromelain rich pineapple stem may be used as an antiviral against COVID-19.

Full text in PDF format available at:

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7523097/pdf/nihpp-2020.09.16.297366.pdf>.

Metabol Open. 2020 Dec;8:100066. doi: [10.1016/j.metop.2020.100066](https://doi.org/10.1016/j.metop.2020.100066). Epub 2020 Nov 13.

The combination of bromelain and curcumin as an immune-boosting nutraceutical in the prevention of severe COVID-19

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Abstract

The coronavirus disease 2019 (COVID-19) pandemic is still ongoing, while no treatment has been proven effective. COVID-19 pathophysiology involves the activation of three main pathways: the inflammatory, the coagulation and the bradykinin cascades. Here, we highlight for the first time the joint potential therapeutic role of bromelain and curcumin, two well-known nutraceuticals, in the prevention of severe COVID-19. Bromelain (a cysteine protease isolated from the pineapple stem) and curcumin (a natural phenol found in turmeric) exert important immunomodulatory actions interfering

in the crucial steps of COVID-19 pathophysiology. Their anti-inflammatory properties include inhibition of transcription factors and subsequent downregulation of proinflammatory mediators. They also present fibrinolytic and anticoagulant properties. Additionally, bromelain inhibits cyclooxygenase and modulates prostaglandins and thromboxane, affecting both inflammation and coagulation, and also hydrolyzes bradykinin. Interestingly, curcumin has been shown in *silico* studies to prevent entry of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) into cells as well as viral replication, while a recent experimental study has demonstrated that bromelain may also inhibit viral entry into cells. Notably, bromelain substantially increases the absorption of curcumin after oral administration. To the best of our knowledge, this is the first report highlighting the significance of bromelain and, most importantly, the potential preventive value of the synergistic effects of bromelain and curcumin against severe COVID-19.

Full text in PDF format available at:

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7661945/pdf/main.pdf>.

J Med Virol. 2020 Apr;92(4):424-432. doi: 10.1002/jmv.25685. Epub 2020 Feb 7.

Coronavirus infections and immune responses.

[Li G](#)^{1,2}, [Fan Y](#)³, [Lai Y](#)³, [Han T](#)³, [Li Z](#)², [Zhou P](#)¹, [Pan P](#)², [Wang W](#)¹, [Hu D](#)⁴, [Liu X](#)⁵, [Zhang Q](#)^{1,6}, [Wu J](#)^{1,4}.

Abstract

Coronaviruses (CoVs) are by far the largest group of known positive-sense RNA viruses having an extensive range of natural hosts. In the past few decades, newly evolved Coronaviruses have posed a global threat to public health. The immune response is essential to control and eliminate CoV infections, however, maladjusted immune responses may result in immunopathology and impaired pulmonary gas exchange. Gaining a deeper understanding of the interaction between Coronaviruses and the innate immune systems of the hosts may shed light on the development and persistence of inflammation in the lungs and hopefully can reduce the risk of lung inflammation caused by CoVs. In this review, we provide an update on CoV infections and relevant diseases, particularly the host defense against CoV-induced inflammation of lung tissue, as well as the role of the innate immune system in the pathogenesis and clinical treatment.

Full paper in PDF format available at:

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7166547/pdf/JMV-92-424.pdf>.

Int J Mol Sci; . 2020 Apr 28;21(9):E3104. doi: 10.3390/ijms21093104.

Functional Role of Dietary Intervention to Improve the Outcome of COVID-19: A Hypothesis of Work

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Abstract

On the 31 December 2019, the World Health Organization (WHO) was informed of a cluster of cases of pneumonia of unknown origin detected in Wuhan City, Hubei Province, China. The infection spread first in China and then in the rest of the world, and on the 11th of March, the WHO declared that COVID-19 was a pandemic. Taking into consideration the mortality rate of COVID-19, about 5-7%, and the percentage of positive patients admitted to intensive care units being 9-11%, it should be mandatory to consider and take all necessary measures to contain the COVID-19 infection. Moreover, given the recent evidence in different hospitals suggesting IL-6 and TNF- α inhibitor drugs as a possible therapy for COVID-19, we aimed to highlight that a dietary intervention could be useful to prevent the infection and/or to ameliorate the outcomes during therapy. Considering that the COVID-19 infection can generate a mild or highly acute respiratory syndrome with a consequent release of pro-inflammatory cytokines, including IL-6 and TNF- α , a dietary regimen modification in order to improve the levels of adiponectin could be very useful both to prevent the infection and to take care of patients, improving their outcomes.

Full paper available at: <https://www.mdpi.com/1422-0067/21/9/3104/htm>.

Nutritional status, diet and viral respiratory infections: perspectives for SARS-CoV-2.

Br J Nutr 2020 Aug 26;1-32. doi: 10.1017/S0007114520003311. Online ahead of print. PMID: 32843118.

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Abstract

COVID-19, caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was recognized by the World Health Organization (WHO) as a pandemic in 2020. Host preparation to combat the virus is an important strategy to avoid COVID-19 severity. Thus, the relationship between eating habits, nutritional status, and their effects on the immune response and further implications in viral respiratory infections are important topics discussed in this revision. Malnutrition causes the most diverse alterations in the immune system, suppressing of the immune response and increasing the susceptibility to infections as SARS-CoV-2. On the other hand, obesity induces low-grade chronic inflammation caused by excess adiposity, which increases angiotensin-converting enzyme 2 (ACE2). It decreases the immune response favoring SARS-CoV-2 virulence and promoting respiratory distress syndrome. The present review highlights the importance of food choices considering their inflammatory effects, consequently increasing the viral susceptibility observed in malnutrition and obesity. Healthy eating habits, micronutrients, bioactive compounds, and probiotics are strategies for COVID-19 prevention. Therefore, a diversified and balanced diet can contribute to the improvement of the immune response to viral infections such as COVID-19.

What's Changed in Joint Support version VI?



Joint Support has been the leader in joint support nutritional supplements since it first came out in 1999. Version VI represents the fifth evolution of this supplement. Each formulation is an improvement over the previous one, taking into consideration my experience with the previous version and the most recent research and findings, and applying these to make Joint Support even more effective.

I added several ingredients as well as fine tuning some of the ingredients already in Joint Support version VI. I tried several dozen variations of ingredients and dosages to determine the optimum number and dosages of ingredients necessary to improve on the already unparalleled effects of Joint Support on musculoskeletal tissue.

The result of the additions and fine tuning has resulted in a more effective product.

Although much more expensive to manufacture I've kept the retail price as low as possible considering the expense in manufacturing Joint Support with the highest standards and quality of the ingredients, as an incentive to the serious supplement user to use the very best Joint Support formula on the market at a value product price. Just compare the number and dosages of the ingredients in Joint Support (see the Supplement Facts Panel below) with any other joint support formula on the market and you'll be convinced just how much of a value product Joint Support really is.

History of Joint Support

As an in the trenches athlete and medical doctor involved in dealing with degenerative diseases and sports injuries for over five decades, I've tried all kinds of ways to both prevent and treat musculoskeletal problems, dealing with both acute and chronic inflammation, pain and repair that are part and parcel of musculoskeletal problems and diseases.

The underlying common factor in these conditions, whether acute or chronic, is inflammation. Inflammation, although a normal and necessary response to injury, is responsible for a range of acute and chronic diseases. That's because if it's excessive or inappropriate it gives rise to many inflammatory compounds that in turn cause ongoing damage to tissues and hinders healing.

For example, inflammatory compounds such as the pro-inflammatory cytokines tumor necrosis factor-alpha (TNF- α), the interleukins IL-1, IL-6 and IL-8, and pro-inflammatory eicosanoids such as PGE2, cause a catabolic response in tissues, promote degeneration and hinder healing. Using compounds that mitigate or block the effects of these pro-inflammatory compounds, several of which are included in Joint Support, can both prevent the progression and help heal even the damage seen in degenerative joint disease.¹⁴

Another aspect of maintaining healthy joints has to do with anabolic influences such as locally controlled growth factors. For example, several studies have shown the importance of insulin-like

growth factor as a promoter of growth and extracellular matrix (ECM) synthesis by chondrocytes in healthy articular cells.^{15,16,17}

Over the years, I searched for natural ways to deal with musculoskeletal problems, ways that replaced or at least complimented traditional ways of dealing with these problems, including drugs and surgery.

I was also looking for something natural that had minimal side effects, was convenient to use and that worked.

All my knowledge and research has finally come to fruition in Joint Support, a supplement that really works and is safe. In fact, not only safe but a supplement that naturally increased musculoskeletal health and helped deal with injuries and degenerative conditions such as arthritis.

This amazing, patent-pending formula produces an entirely new level of effectiveness when compared to all the other Joint Support products on the market. In fact, it is the first product ever to look at all aspects of preventing and healing musculoskeletal problems and contains dozens of ingredients that work synergistically to produce

The ingredients in this evidence-based, research-driven formula have been proven to decrease inflammation, increase healing, and maintain without causing any negative health effects.

Joint Support is a product of my five decades of research and involvement in the medical and sports fields. It is a true Joint Support breakthrough that is unequalled in its ability to provide significant recuperative and regenerative effects.

Joint Support is useful for anyone into exercise or sports or wanting to prevent or help heal musculoskeletal problems.

It's so good that Joint Support is **used by elite Olympic, MMA, power athletes, Pro and amateur bodybuilders, and many other pro and amateur athletes. In fact, Joint Support is used by anyone interested in improving and/or maintaining the integrity of their musculoskeletal system.** It's used to optimize musculoskeletal health, prevent overtraining effects, and help heal injuries, prevent and help improve muscle aches and pains. Overall, Joint Support improves overall health, and is instrumental in improving body composition and physical and mental performance.

When used consistently, Joint Support offers the advantages of some of the more potent anti-inflammatory, pain reducing, healing, and anabolic drugs, as well as various procedures, without any of the side effects.

Joint Support can also be used to complement other treatments and to help heal from surgical and other procedures.

What can I expect from the use of Joint Support?

Joint Support is not just another one-dimensional joint support product. It's a nutritional breakthrough designed to attack and decrease inflammatory and catabolic processes, while at the same time increasing anabolic processes. By influencing multiple pathways, it helps support, maintain, and rebuild the whole musculoskeletal system.

Joint Support, unlike medications, while effective over the short term, works even better over the long term to both help deal with acute and chronic problems and to optimize the musculoskeletal system. However, because of the complex additive and synergistic ingredients, it also does much more.

Joint Support:



- 1. Supports and maintains musculoskeletal health**
- 2. Supports cartilage regeneration**
- 3. Reduces injuries and joint degeneration**
- 4. Accelerates healing and decreases down time**
- 5. Reduces inflammation**
- 6. Eases musculoskeletal aches and pains due to acute and chronic injury and degeneration such as arthritis**
- 7. Reduces joint and muscle stiffness**
- 8. Helps heal injuries by reducing catabolic influences and promote tissue rebuilding**
- 9. Enhances mobility and flexibility**
- 10. Enhances recovery time for those who train hard and compete**
- 11. Offers a safer and more effective alternative to the chronic use of prescription drugs**

Joint Support supplies nutritional support to the various joint and muscle structures by supplying nutrients known to be involved in the maintenance, repair, and reformation of these structures.

As such, it's an excellent supplement for supporting the musculoskeletal system as both a preventative supplement to help you prevent joint injury in the first place, and as a supplement to help to decrease pain and heal injuries and other musculoskeletal problems including the rebuilding of joint cartilage.

Regarding arthritis Joint Support is designed to decrease inflammation and thus aid in the relief of pain and slow the onset of the degenerative effects of osteoarthritis. In the case of injuries adding Joint Support to your supplement regimen can increase healing and speed recover, thereby reducing downtime after an injury.

The bottom line is that Joint Support will help you to maintain the health of your joints and muscles, and deal with a variety of musculoskeletal problems due to injury, aging and disease.

Joint Support and Joint Overload

Mechanical joint overload is a problem with many recreational and competitive athletes. Chronic overload, if not addressed adequately, can cause progressive failure of joint components, injuries, and arthritic changes.

While overload and arthritic changes can affect any joint, the knees, hips, back and shoulders are among the joints most affected in those who chronically load/overload their joints, most notably recreational and competitive athletes.

Let's take the knee joint as an example. Being aware of the state of your knees is vital for prevention of degenerative changes. I consider knee pain as the simplest way to determine overloading and should never be ignored even if it's of short duration.

One of the criteria of early degenerative changes in the knee is the presence of at least two episodes of knee pain lasting 10 or more days in the last year.¹⁸ As such, to prevent ongoing joint degeneration, any indication of knee pain should immediately result in a period of unloading,¹⁹ first as complete rest then when the discomfort disappears a tamping down on the load to the knees with a progressive increase of loading.

The full use of Joint Support, at higher levels while the joint mends, and lower levels thereafter, helps attenuate any degenerative changes, and speeds up the healing process and thus the time needed to strengthen the knee joint so it can again take the needed load that will help you achieve your exercise and competition goals.

Keep in mind that it's also important to maintain correct form and to be careful to correct any problems in execution so as to help minimizing overloading of the knees.

An Added Benefit of Joint Support

While I formulated Joint Support for the various reasons mentioned above it's also turned out to be a multipurpose supplement that supports and enhances all the layers of the skin, hair and nails, and the supporting structures. The result is healthier, stronger, more vibrant skin; hair and nails that can better resist damage due to wear and tear, regardless of the cause.

By providing ingredients that are essential for the body's natural synthesis and maintenance of the skin, hair and nails, and supporting layers, Joint Support helps heal and protect all three from all manners of stress and trauma, including sun exposure and aging. As well, a recent study found that oral hyaluronic (in Joint Support) is an effective treatment for dry eyes.²⁰

Joint Support doesn't cosmetically cover up skin damage and aging but intervenes at the origin of the problem and helps rebuild and strengthen skin, hair, nails and supportive tissues.

Used consistently, **Joint Support improves skin health, helps** prevent acute and chronic skin damage and reverses damaged skin and inflammation.

Because of its photo protectant effects, Joint Support can be useful for decreasing the harmful effects of exposure to the sun, adding an extra dimension to widely used sunscreen protection and the use of protective clothing. An example of just one ingredient, vitamin D can be found in my recent comprehensive article on [vitamin D](#).

That article also shows the benefits of vitamin D on health and metabolism, including immune system effects that help counter infections including those caused by bacteria and viruses, including the coronavirus responsible for the current **Covid-19 pandemic**.

It's also useful to strengthen the skin and thus decrease the side effects of various cosmetic procedures thus decreasing the resulting pain, inflammation, scarring, and other side effects as well as decreasing down time after the procedure.

Joint Support will safely reduce stress on skin and subcutaneous tissue and speed up recovery without the side effects associated with many of the drugs and surgeries used today.

One of the main ingredients in Joint Support is BioCell Collagen, which has been shown to improve facial epidermis and connective tissue.²¹ It has also been shown to enhance blood circulation and reduce facial aging signs.²²

I'll be adding information on the various ingredients in Joint Support and how they impact on skin, hair and nails from the inside out rather than used topically. Much of this information is already in this paper.

For example, I've already mentioned BioCell Collagen (see more information below under BioCell Collagen II or click on that ingredient in the Table of Contents).

And as mentioned below turmeric has also been shown to have protective effects against chemical damage to human skin and connective tissue.²³ In fact, most of the ingredients in Joint Support are useful in improving the structure and health of the skin, hair, and nails.

Similarly, many of the ingredients in Joint Support also have beneficial effects on skin, hair and nails and I'll be presenting more information on these effects in my next revision of Joint Support and in separate articles.

Also because of Joint Support's ability to decrease the detrimental effects of hangovers, it may also be useful in decreasing the incidence of drunkorexia, a combination of excessive drinking combined with anorexia or bulimia. Although a condition more common in college age females, it also occurs in males. The term generally involves extreme weight control methods to compensate for reducing the impact of the extra calories involved in planned binge drinking.

Athletes and Joint Support



The human body can be likened to a very complicated piece of machinery with pulleys, rubber bands, hinges, and joints throughout. And while most of the time it functions magnificently, it can be stressed and even broken in places. In fact, muscle and connective tissues are major sources of physical discomfort and disability, especially in athletes.

This is not surprising, considering the stress that training imposes on muscle and connective tissues, the most abundant and widely distributed tissues in the body.

We can all understand the importance of muscle tissue in athletes; however, the role of connective tissue is often under appreciated. It shouldn't be since it forms our bones, surrounds our organs, holds our teeth in place, forms cushions, and lubricates our joints, and connects the muscles to our skeleton. In fact, collagen is the most abundant protein, comprising of ~30% of total protein in the body.

Soreness from exercising is a familiar experience, often an accepted incidental result of training. Most soreness results from muscle tissue trauma, but stress is also induced upon the tissues connected to the muscles: bones, tendons and ligaments. These tissues are also subject to aging.

Most connective tissue injuries involve damage to the structural components of the tissue. In sports activities, injuries are classified into two types: acute and overuse injuries. Acute trauma occurs from lacerations and partial or complete rupture of the tissue. Overuse injuries, the most common category, result from chronic overloading or repetitive motion. The capacity of the tissue for repair greatly exceeds degradation and cellular metabolism is altered such that damage occurs at the cellular and structural levels.

Inflammation is the most prominent symptom of both types of injuries. While inflammation is a natural part of the healing process in any injury, chronic inflammation may lead to increased tissue degradation and impair the repair process. Indeed, chronic inflammation is a major factor in several connective tissue diseases, especially within articular joints.

Pharmaceuticals are often used to manage or alleviate symptoms occurring with connective tissue inflammation. However, many of these substances may alter the healing and repair process and offer only temporary relief. In fact, many of the medications used cause side effects, such as gastrointestinal upset and may even accelerate joint degradation in the long run.²⁴

Many natural ingredients and remedies have been used over the centuries that have not only alleviated symptoms of tissue stress, but also shown to help rebuild tissue and restore function in joints. Many of these natural substances aid in recuperation, help heal sore muscles and joints, increase recovery from injuries such as strains and sprains as well as surgical procedures, and help strengthen musculoskeletal support tissues.

For example, many natural products have significant anti-inflammatory activity and beneficial effects on the immune system and are included in Joint Support.²⁵

The use of these substances, as well as various vitamins, minerals, antioxidants, amino acids, and others, if used in a proper and timely fashion, have a positive effect on the immune system, recovery from exercise, especially for those who train hard and want to recover better and faster, overtraining and both preventing and treating injuries. They can also be useful in treating musculoskeletal pain, inflammation and degenerative/arthritis conditions.

Joint Support is the best example of a comprehensive, multifaceted, synergistic supplement that can be useful for these conditions.

Joint Support is formulated to support muscle, cartilage and joint function. It helps maintain healthy joints and relief for aches and pains after exercise. By providing ingredients that are essential for the body's natural synthesis and maintenance of joints, ligaments, muscles and tendons, it aids in protection against the effects of excessive exercise, and aids in the healing of musculoskeletal injuries and degeneration.

Joint Support is also effective for improving healing from surgical procedures as well as mitigating problems down the road such as posttraumatic arthritis.

Ingredients in Joint Support version VI.

Joint Support is effective for musculoskeletal health because of its large number of proven ingredients that work both additively and synergistically to provide preventative and healing benefits. One of the many ingredients includes a variety of collagen compounds that have been shown to have beneficial effects on the musculoskeletal system as well as improving exercise performance.²⁶²⁷²⁸²⁹³⁰³¹³²

BioCell Collagen II™



Water and large molecules fill the spaces in-between the cells and collagen fibers. Its viscosity acts as a lubricant due to the high-water content. One of the major components of the ground substance are the proteoglycans and structural glycoproteins, which trap water molecules and lend strength, rigidity and resiliency to the extracellular matrix.

Proteoglycans are large molecules formed by many linear chains of polysaccharide units called glycosaminoglycans (GAGs). GAG chains radiate out from a protein core like bristles of a bottlebrush. Sulfation and the complexes of the GAGs determine their biological activity. These complexes, which may contain hundreds of attached proteoglycan aggregates, constitute a significant role in cartilage tissue.

Proteoglycans act as a molecular sieve moderating the movement of cells, and nutritive and inflammatory substances. They are also responsible for attracting and maintaining water balance within the tissue. The high density of negative charges of these molecules attracts and binds water molecules. Because they attract and hold water, they form a 'sponge' that, when compressed, absorbs force and distributes it equally. This is how cartilage protects structures in the joint from mechanical (stress and weight) damage.

BioCell Collagen II™ provides low molecular weight compounds, which are readily and easily absorbed into the bloodstream. The components of BC II including **chondroitin sulfate**, **hyaluronic acid (HA)**, and **glucosamine sulfate** can support proteoglycans and glycosaminoglycans (GAG's) in the joint matrix thereby increasing synovial (joint) fluid and supporting cartilage synthesis in the joints.

The low molecular weight compounds present in BioCell Collagen II™ are more biologically available and more effective than the higher weight compounds present in many other preparations. For example, one study found that low molecular weight preparations of chondroitin sulfate had preventive effects on arthritis in a murine model.³³

The amino acid profile of BioCell Collagen II™ is rich in the primary amino acids, such as **arginine**, **proline** and **glycine** that make up the type II collagen molecule and as such is conducive to collagen formation and repair not only in the musculoskeletal system but also in skin. The amino acid composition along with the low molecular weight collagen peptides promote increased elasticity and reduced skin wrinkling.³⁴³⁵³⁶

BioCell Collagen™ has been clinically shown to significantly reduce pain syndromes in subjects with various forms of arthritis, spinal pain and other joint pain.³⁷

It's also been shown that BioCell Collagen™ has beneficial effects on connective tissue protection and recovery from exercise.³⁸

For more information on BioCell Collagen™ go to <http://biocellcollagen.com/>. As well, to see the benefits of BioCell Collagen for both Joints and Skin go to <https://www.biocellcollagen.com/science-of-biocell-collagen>.

Native/Undenatured and Hydrolyzed Collagens Type 1, 2 and 3 derived from fish and chicken collagen

Studies have shown that these collagens have anti-inflammatory, pain relieving, and regulatory effects on musculoskeletal tissue.³⁹⁴⁰⁴¹ They work additively with the BioCell Collagen to further enhance the trophic, healing, and protective effects of Joint Support.⁴²⁴³⁴⁴⁴⁵

A recent study found that supplementation with collagen peptides, hyaluronic acid, vitamin C, manganese, and copper (**all in Joint Support**) represents a valid option in patients with chronic low back pain, as it ensures pain relief and improvement in quality of life and in lumbar spine functionality.⁴⁶

Glucosamine Sulfate

Glucosamine sulfate is one of the basic substrates for synthesis of these important macromolecules in connective tissue. The synthesis of glucosamine from glucose and glutamine is the rate-limiting step in GAG production, and hence in repairing cartilage.

Following cartilage trauma or tearing, the body may not be able to make enough glucosamine for optimal healing. In addition, the ability to convert glucose to glucosamine declines with age because of a reduction in the amount of the enzyme glucosamine synthetase.

Taking glucosamine supplements can increase GAG levels significantly.⁴⁷ Clinical trials have shown that glucosamine sulfate attenuates arthritic changes, relieves the pain and inflammation of osteoarthritis and improves locomotor function.^{48,49,5051} It also represents a safe alternative to nonsteroidal anti-inflammatory medications (e.g., ibuprofen), which have been shown to inhibit repair and accelerate destruction of cartilage.⁵²

Several studies and reviews have concluded that glucosamine is effective and safe to use,⁵³ better tolerated than most other NSAIDs such as ibuprofen, naproxen, or piroxicam, and in clinical trials, glucosamine provided effective symptomatic relief for patients with osteoarthritis of the knee. In addition, glucosamine has shown promising results in modifying the progression of arthritis over a 3-year period.⁵⁴

Several studies have shown the beneficial effects of glucosamine on articular cartilage.

A study published in 2002 done on athletic horses found that glucosamine inhibited cartilage catabolic responses and prevented IL-1beta-induced increases in nitric oxide production, prostaglandin E2 and proteoglycan release.⁵⁵

Several studies have shown that glucosamine was effective in improving function and decreasing pain in people who experienced knee pain likely from prior cartilage injury and/or arthritis.⁵⁶

In an early study, 68 athletes with cartilage damage in their knees were given 1500 mg of glucosamine sulfate daily for 40 days, then 750 mg for 90 to 100 days.⁵⁷ Of the 68 athletes, 52 had a complete resolution of symptoms and resumed full athletic training. After four to five months, athletes trained at pre-injury rates. Follow-up exams 12 months later showed no signs of cartilage damage in any of the athletes.

It's been shown that glucosamine sulfate provides pain relief and improved function in knee osteoarthritis (OA).^{58,59} In a 3-year study on 212 patients with knee OA glucosamine was associated with a significant reduction in joint space narrowing.⁶⁰

At present glucosamine is one of the recommendations now made by physicians for athletes and non-athletes alike in the management of injuries and arthritis. For example, in one article physicians included the use of glucosamine in the medical management of early osteoarthritis of the knee in athletes.⁶¹ An editorial asked the question whether it's time to take glucosamine seriously and the authors conclusion was **“Despite the many clinical trials performed and patients wide use of glucosamine and chondroitin, their place in the treatment of OA is still under debate. Perhaps it's time to take glucosamine and other SYSADOAs seriously while at the same time realizing that many may piggy back on the well-studied and proper preparations which may not be beneficial for patients.”**⁶²

A recent study looked at the effectiveness of glucosamine use over 2.5 year in overweight, middle aged women at risk for knee osteoarthritis and concluded that **“Glucosamine sulfate decreased the risk of developing radiographic knee OA over 2.5 years in overweight, middle-aged women at risk, as determined by medial mJSN (minimum joint space narrowing) progression. Conversely a tailored diet and exercise program exerted no preventive effect, possibly because of the lower than expected effect on weight loss.”**⁶³

Chondroitin Sulfate

Chondroitin sulfate is a major component of cartilage. It is a very large molecule, composed of repeated units of glucosamine sulfate. Like glucosamine, chondroitin sulfate has anti-inflammatory effects, attracts water into the cartilage matrix, stimulates the production of cartilage and prevents cartilage degradation.⁶⁴ It has also been shown to have long term beneficial effects.⁶⁵

Although the absorption of chondroitin sulfate is lower than that of glucosamine (lower molecular units are better absorbed), several studies have shown very good results from long-term treatment with chondroitin sulfate, reducing pain and increasing range of motion.

For example, a one-year long, double-blind clinical study gave 800 mg of chondroitin sulfate to 42 patients of both sexes, aged 35-78 years with symptomatic knee osteoarthritis.⁶⁶ The chondroitin sulfate was well tolerated and significantly reduced pain and increased joint mobility.

A review looked at the published reports with a view of determining the usefulness of chondroitin sulfate.⁶⁷ The authors concluded that chondroitin sulfate plays a role in articular and bone metabolism by controlling cartilaginous matrix integrity and bone mineralization.

Because of its anti-inflammatory effects, chondroitin sulfate has also been shown to modulate inflammation and atherogenesis in obesity.⁶⁸

There is some controversy about the absorption of chondroitin sulfate and thus its usefulness. Studies, however, have confirmed its absorption and oral bioavailability.^{69,70} It's also important to use pharmaceutical-grade chondroitin sulfate (used in Joint Support) to get the best results.⁷¹⁷²⁷³

Combined Use of Glucosamine and Chondroitin Sulfate

Several studies have shown the beneficial effects of the combination use of glucosamine and chondroitin sulfate on the musculoskeletal system in the short and long term.⁷⁴⁷⁵⁷⁶⁷⁷

They have been used as drugs to treat osteoarthritis in Europe and are now gaining popularity in the US. Clinical trials both in the US and abroad, on both humans and animals have confirmed their benefits and safety.⁷⁸⁷⁹

The GAGs have been shown to repair and improve joint function as well as providing pain relief in chronic sufferers. Studies have found that the combination of chondroitin and glucosamine was more effective than chondroitin alone and that taken together decrease joint stress and arthritic changes.⁸⁰⁸¹⁸²⁸³Bi

Several studies have shown that **the combination of glucosamine and chondroitin sulfate** was as or more effective for patients with moderate to severe pain secondary to osteoarthritis of the knee than popular prescription NSAIDs drugs such as celecoxib, a cyclooxygenase (COX)-2 inhibitor widely used for treating arthritis.⁸⁴⁸⁵⁸⁶

Other studies have found effects of both glucosamine and chondroitin sulfate on gene expression.⁸⁷ For example one study found that glucosamine had effects on pretranslational mediators of osteoarthritis, an effect that may contribute to its cartilage-sparing properties. Studies have found that both glucosamine and chondroitin sulfate when used orally may regulate expression of matrix degrading enzymes and their inhibitors at the transcriptional level,

One study looking at the effects of both glucosamine and chondroitin on cartilage cells concluded that "by enhancing the "protective" metabolic response of chondrocytes to stress, glucosamine and chondroitin sulfate may improve its ability for repair and regeneration."⁸⁸ In a later study the authors found that glucosamine had preventative effects on arthritis in rats.⁸⁹

A meta-analysis looking at all the available studies on glucosamine and chondroitin studies found that both, and especially glucosamine, were effective for the alleviation of pain, inflammation and in maintaining and improving the structural integrity of joints.⁹⁰

Thus, glucosamine alone or in conjunction with chondroitin sulfate, because of the safety profile and effectiveness, along with other supportive substances are fast becoming the first treatment of choice for many who suffer from joint and connective tissue pain and inflammation.

Hyaluronic Acid

BioCell Collagen II™ naturally contains ultra-high concentrations (min. 10%) of low molecular weight hyaluronic acid, which is vital for the health of soft connective tissue where it is a major component of the extracellular matrix (ECM), and is present in synovial joint fluid, cartilage, the eye, and in skin tissue both dermis and epidermis.

Hyaluronic acid is unique among the GAGs in that it does not contain any sulfate and is not found covalently attached to proteins as a proteoglycan. It is, however, a component of non-covalently formed complexes with proteoglycans in the ECM. Hyaluronic acid polymers are very large (with molecular weights of 100,000 - 10,000,000) and can displace a large volume of water. This property makes them excellent lubricators and shock absorbers. Hyaluronic acid may be able to slow down chondrocyte apoptosis (cartilage cell death) in OA by regulating the processes of cartilage matrix degradation.

BioCell Collagen II, besides providing HA directly, also actively inhibits hyaluronidase (as does **echinacea**), an enzyme that breaks down hyaluronic acid. This inhibition further increases HA levels in tissues.

Methylsulfonylmethane (MSM)

MSM stands for methylsulfonylmethane, a stable odorless metabolite of DMSO. MSM, a natural form of organic sulfur found in low concentrations in our bodies. Along with glucosamine sulfate, it is a basic substrate for the synthesis of connective tissue. Many claims have been made for MSM, including relief from arthritis, muscle pain, joint pain and inflammation, beneficial effects on the immune system, and scar tissue reduction, and there are a few studies that support these claims.^{91, 92}

A recent paper looked at the possibility that MSM may exert some effect on inflammation and arthritis secondary to increases in serum sulfate.⁹³

Alpha Lipoic Acid

Alpha lipoic acid (ALA) has significant biological activity and therapeutic potential secondary to its potent antioxidant and anti-inflammatory properties including its ability to increase levels of intracellular glutathione, and to recycle other antioxidants such as vitamin C, vitamin E and glutathione.^{94,95,96,97,98,99,100,101,102,103}

ALA was also added to Joint Support because of its actions on decreasing pro-inflammatory cytokines and cortisol levels, its protective and enhancing effects on many systems including the immune system, and its effects on alleviating pain.¹⁰⁴¹⁰⁵¹⁰⁶¹⁰⁷¹⁰⁸¹⁰⁹

It has been shown to inhibit cross-linking among proteins, a process that contributes to the aging process in the body and especially in collagen-heavy tissues such as skin. Alpha-lipoic acid activates a collagen-regulating factor known as AP-1 that turns on enzymes that digest glycation-damaged collagen and thus make the skin more supple and youthful looking.¹¹⁰

Besides having potent antioxidant and anti-inflammatory effects, ALA also has significant anabolic effects secondary to its beneficial effects on insulin sensitivity, growth hormone and IGF-I secretion, and energy metabolism, all factors involved in maintaining, repairing and regenerating musculoskeletal tissues.^{111,112,113,114,115}

As well, it helps neutralize and remove various toxic metals, including mercury, from the body, both alone and with other compounds such as glutathione (also in Joint Support).¹¹⁶¹¹⁷

But there even more to ALA than the above effects. ALA has also been shown to have significant anti-obesity effects. One study found that ALA decreases hypothalamic AMPK activity and causes

profound weight loss in rodents by reducing food intake and enhancing energy expenditure.¹¹⁸ More recent studies have also found that ALA significantly affects obesity and body composition in humans.^{119120 121122123} A recent study found that the combination of curcumin and alpha lipoic acid (**both in Joint Support**) exhibit an additive effect in weight and fat loss.¹²⁴

Taurine

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

Taurine has a myriad of beneficial functions in the body, including the musculoskeletal and central nervous system, from development to cytoprotection in all age groups.¹²⁵¹²⁶¹²⁷ As such, it is beneficial for improving body composition and physical and mental performance. Although it's one of the few amino acids not directly used for protein synthesis, it can indirectly increase protein synthesis.

Taurine is often considered a non-essential or hesitantly a conditionally essential amino acid for humans since it can be synthesized by the body from methionine and cysteine. However, the limiting enzyme required for biosynthesis of taurine is very low in humans and biosynthesis may not be adequate for times when the need for taurine are increased. As such, diet is the major source of taurine, while endogenous production from methionine and cysteine in the presence of vitamin B6 (also all present in Joint Support) is a minor source.¹²⁸

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

Because of its many functions and suboptimal levels in most people, I consider taurine an essential amino acids for anyone looking to improve body composition (add muscle and reduce body fat) and/or increase exercise/sports performance.¹²⁹¹³⁰

Taurine is a nutrient that enhances the training effect by its many roles in improving musculoskeletal function and protection including increasing growth hormone and IGF-1, and decreasing inflammation, muscle soreness, and injury.¹³¹¹³²¹³³¹³⁴¹³⁵¹³⁶¹³⁷¹³⁸¹³⁹¹⁴⁰¹⁴¹¹⁴²¹⁴³ A recent study concluded that **“taurine administration exhibited protective effects by inhibiting MMP-3 and CHOP expression, and subsequently alleviated the OA symptoms in experimental rat models.”**¹⁴⁴

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

Over the years, oral taurine administration has been shown to help muscle cramping in patients with liver cirrhosis and myotonic dystrophy. Several studies have suggested that it may also help to alleviate muscle soreness and cramps occurring during and after exercise.¹⁴⁵

Studies on mice and rats show that taurine is useful for reducing physical fatigue, muscle damage, and exercise induced muscle injury during exercise training, presumably due to its antioxidant effects and the beneficial effects that taurine has on metabolism and on muscle and cardiac functions.¹⁴⁶¹⁴⁷ It's also been shown to improves the electrical and contractile properties of skeletal muscle fibers.¹⁴⁸

Another study on rats has shown that oral taurine supplementation may increase muscle performance and reduce muscle injury caused by exercise.¹⁴⁹ The aim of the study was to determine if increasing muscle levels of taurine would decrease free radical damage after exercise-induced injury. The authors found that first taurine levels rose in muscle after supplementation, and secondly that running performance was improved by the taurine supplementation. Thus, it appears taurine supplementation may facilitate exercise performance and reduce some of the counterproductive muscle injury caused by exercise.

In humans, taurine supplementation in patients with heart failure increases their exercise capacity.¹⁵⁰ It's been shown that taurine decreases oxidative stress in skeletal muscle after eccentric exercise¹⁵¹ and that taurine may attenuate exercise-induced DNA damage and enhance the capacity of exercise due to its cellular protective properties.¹⁵²¹⁵³ A recent Meta-Analysis concluded that **“Human endurance performance can be improved by orally ingesting a single dose of taurine in varying amounts (1-6 g).”**¹⁵⁴ 2 other studies by the same team found that “Oral taurine can be taken prior to exercise to enhance endurance performance”¹⁵⁵ and that taurine improves power and exercise tolerance.¹⁵⁶

There is some evidence to show that taurine may enhance training further by decreasing training induced fatigue. One study found that Na⁺-K⁺-ATPase activity is depressed with fatigue, regardless of training state, suggesting that this may be an important determinant of fatigue.¹⁵⁷ Another paper associated fatigue and training with reduced Ca²⁺-ATPase activity.¹⁵⁸ Previous studies have shown that taurine stimulates Na⁺-K⁺-ATPase activity and also the pumping rate of the Ca²⁺-activated ATPase pump. One study found that taurine increased fat oxidation in endurance trained athletes.¹⁵⁹

Two recent studies in humans found that human endurance performance can be improved by orally ingesting as little as one gram of a single dose of taurine.¹⁶⁰¹⁶¹ Another recent study found that taurine supplementation increases lipolysis and contributes to energy systems, exerting its effects on increasing endurance.¹⁶²

One study found that taurine administration increased taurine concentrations in skeletal muscles, reduced the decrease in taurine in skeletal muscles that is seen with exercise, increased physical endurance by increasing the duration of running time in rats, and was considered to reduce exercise-induced muscle fatigue.¹⁶³ Also taurine supplementation has been shown to increase skeletal muscle force production, protects muscle function and reduce oxidative stress.¹⁶⁴

Taurine is one of the most abundant free amino acids in the testes and is instrumental in the production of testosterone and in fertility. A recent study concluded that taurine plays important roles in male reproduction and that a taurine supplement could stimulate the secretion of LH and T, increase the levels of testicular marker enzymes, elevate testicular antioxidation and improve sperm quality.¹⁶⁵¹⁶⁶¹⁶⁷¹⁶⁸¹⁶⁹¹⁷⁰¹⁷¹¹⁷²¹⁷³¹⁷⁴¹⁷⁵¹⁷⁶

Taurine also plays well with the branched chain amino acids (BCAA) as the combination has been shown to decrease delayed onset muscle soreness and muscle damage.¹⁷⁷ It's also likely that the beneficial effects of both taurine and the BCAA on skeletal muscle function are enhanced by other nutrients such as beta-alanine and carnosine.¹⁷⁸¹⁷⁹

Taurine is considered a potent antioxidant and cytoprotective agent that may be useful for combating the adverse effects of physical and psychological stress, and aging.^{180,181,182,183 184} A recent study found that taurine has beneficial effects on stress and depression without adverse effects.¹⁸⁵ In that study the authors concluded **“that taurine has anti-depressant effects and the mechanisms may**

involve in regulating the HPA function, promoting neurogenesis, cell proliferation, neuronal survival and growth in the hippocampus.”

In another recent paper taurine was felt to have beneficial effects on periodontal disease, a disease that is wide spread and increases inflammation, which is counterproductive for optimal health and performance.¹⁸⁶¹⁸⁷

Taurine, because of its beneficial effects on skeletal muscle functioning may also be used therapeutically for skeletal muscle disorders.¹⁸⁸¹⁸⁹

As well it is a potent antioxidant, taurine has significant anti-inflammatory properties, increases insulin sensitivity, increases cell volume and therefore protein synthesis, and acts as a cytoprotective agent in the central nervous system and muscle.

Taurine is also useful in regenerative therapies. A recent study looked at the effects of taurine in chondrogenesis when used with stem cells. However, the use of taurine may well aid in chondrogenesis when used along other ingredients present in Joint Support and as such may be useful of increasing the repair of cartilage in joints, including the vertebral column facets in degenerative spinal osteoarthritis.¹⁹⁰ The same study also looked at the beneficial effects of Taurine on telomerase and for anti-aging.

The bottom line is that taurine, while not an amino acid used in protein synthesis has significant anabolic and healing effects.

Amino Acids

Amino acids contribute to musculoskeletal health and repair in many ways. For example, **proline** and **glycine** are essential for collagen production. Both are in the BioCell Collagen II™, and extra glycine is also added to the Joint Support formula. Proline is the precursor to hydroxyproline, an essential ingredient in collagen production and thus in joint and tendon health and repair.

Methionine is a sulfur bearing amino acid and is necessary for cartilage formation. It has been shown to stabilize joint cartilage and protect joint tissue from damage, and also has shown to be useful in the treatment of rheumatoid arthritis.

Arginine aids in the release of growth hormone, a powerful hormone that aids in collagen tissue repair. As well, arginine increases nitric oxide formation, which causes vasodilatation and improves circulation promoting the healing of damaged tissues and wounds. It has also been shown to act as a mild analgesic and relieve pain. A recent report in The Lancet (Vol. 352, July 25, 1998) suggests that it may help promote healthy tendons and help promote soft tissue repair.

Histidine may also play a role in joint health by decreasing inflammation and perhaps in other ways. It's thought that people suffering from arthritis benefit from supplemental histidine because of the effects it may have in reducing inflammation associated with joint disease and other musculoskeletal disorders.

Antioxidants

Antioxidants form a front-line defense against cell damage caused by free radicals, which are involved in muscle, joint and tendon damage and inflammation, degenerative arthritis and even in the aging process. The exogenous use of antioxidants can reduce free radical damage that occurs when we exercise and can also attenuate the ongoing damage to injured tissues caused by free radicals, thus accelerating the healing process.

Antioxidants, such as **vitamins C and E** (see under Vitamins below), **alpha lipoic acid (more info below)** **selenium, green tea, astaxanthin, curcumin, Boswellia, reduced glutathione** and **N-acetyl-cysteine (NAC)**, all present in Joint Support, can play an important role in reducing inflammation and fatigue, decreasing tissue damage, and in both preventing and treating injuries.

Various antioxidants, such as vitamin E, have been found to be useful in the treatment of some forms of arthritis¹⁹¹ and in dealing with the oxidative stress of exercise.¹⁹² As well, oxidative damage has been shown to contribute to the pathogenesis of injuries and arthritis, and the use of antioxidants, such as NAC,¹⁹³ shown to have therapeutic value for reducing endothelial dysfunction, inflammation, fibrosis, invasion and cartilage erosion.

A study found that a combination of 2 antioxidants, **selenomethionine** and **epigallocatechin-gallate** (the main antioxidant in **green tea extract**), had beneficial effects on catabolic and anabolic gene expression of articular chondrocytes.¹⁹⁴ The authors of the study concluded that **“Our data provide insights into the mechanisms whereby ECGg and selenium modulate chondrocyte metabolism. Despite their differential mechanisms of action, the 2 compounds may exert global beneficial effects on articular cartilage.”**

A study published in January 2019 found that the antioxidants vitamin C, vitamin E, and alpha lipoic acid facilitated high intensity exercise IL-15 expression in skeletal muscle.¹⁹⁵ As this study rightly states **Interleukin-15 (IL-15) stimulates mitochondrial biogenesis, fat oxidation, glucose uptake and myogenesis in skeletal muscle.**

A recent study emphasized the importance of selenium in maintaining endogenous antioxidant production. Selenium is important for the selenium-dependent endogenous antioxidant glutathione peroxidase (GPx). This selenium-dependent GPx reduces lipid hydroperoxides to their corresponding alcohols and water and so maintains intracellular redox status.¹⁹⁶

Selenium is required as a cofactor for the synthesis of this enzyme, and data suggest that reduced blood selenium concentrations are associated with an increased cardiovascular incidence, certain cancers, and all-cause mortality.

I'll be covering studies on the importance of antioxidants, both exogenous and endogenous in future articles concentrating on the beneficial effects of exogenous antioxidants in priming endogenous antioxidant production, and the use of both types of antioxidants in high intensity exercise, countering some earlier studies that found that antioxidant use was counterproductive in those that exercise.

The difference is that the use of antioxidants in those that are involved in highly intensive exercise and competitive sports is beneficial while in others where the exercise is not intense it may be detrimental.

More on this in an upcoming article.

Boswellia Serrata Extract

The gum resin of boswellia serrata, also called salai guggal, has been used as an herbal treatment for rheumatoid arthritis and other inflammatory conditions for centuries in Ayurvedic medicine.¹⁹⁷ Boswellia inhibits pro-inflammatory mediators, such as inflammatory cytokines and leukotrienes, and reduces degradation of glycosaminoglycans in connective tissues.^{198,199}

Tissue and animal studies have demonstrated the anti-arthritic properties of Boswellia extracts.^{200,201} One study found that an herbal dietary supplement consisting of a natural resin extract of Boswellia serrata was effective for the symptomatic relief of osteoarthritis in dogs²⁰²

Clinical studies including humans with inflammatory conditions and administered Boswellia reported improvements after 7 days. The extracts also were well tolerated by patients.

Several studies have found a synergistic effect of curcumin and Boswellia on osteoarthritis.^{203,204} In 2018 a meta-analysis found that **“curcuminoid and Boswellia formulations could be a valuable addition to the knee OA treatment regimens by relieving symptoms while reducing safety risks.”**²⁰⁵

Bromelain, Papain, Trypsin and Rutin

Oral agents containing various natural enzymes, including bromelain, trypsin, and papain, and rutin, have been used in Europe to treat injuries and arthritis. Such enzyme combinations may reduce inflammation and cartilage damage. Several studies in animals have shown beneficial effects from the use of these enzymes.

In Joint Support I included four proteolytic enzymes that I feel are the most useful - the endopeptidases bromelain and papain, the flavonoid rutosides (rutin) and the hydrolase L-trypsin. All four are effective proteolytic enzymes and have been used in the oral treatment of injuries and arthritis.²⁰⁶

These proteolytic (protein-digesting) enzymes aid in modulating inflammation several ways. They aid increase absorption of other substances and help to degrade inflammatory debris in the body. Repair commences at a faster rate while inflammation is contained. All four have been documented as being useful for reducing inflammation, swelling and pain and increasing recovery.^{207,208,209,210,211,212,213,214,215}

Cayenne Pepper

Capsaicin, the primary active ingredient in cayenne, is involved in pain mediation and has anti-inflammatory properties. It also has a protective effect on the lining of the stomach. As well, it has beneficial effects on circulation and protective effect on the lining of the stomach.

Carnosine

Carnosine, a dipeptide made up of the amino acids alanine and histidine (histidyl-alanine) was added to Joint Support because of its many beneficial effects. It has been shown to have significant antioxidant and anti-inflammatory properties, increase healing, enhance the immune system, and provide anti-aging effects.^{216,217,218,219,220,221, 222,223}

It also inhibits glycation, a destructive protein/sugar reaction that occurs in the body and which contributes to aging through several mechanisms including the breakdown of connective tissue, a loss of elasticity, and a decrease in cellular hydration. Carnosine, along with alpha lipoic acid (also in Joint Support), provides protection against glycation and premature aging.

Carnosine, a potent antioxidant and buffering agent, is found in the highest concentration in muscle and brain, where it is felt to have an anti-ischemic effect and thus protect and buffer these tissues.

Carnosine is also believed to decrease both central and peripheral fatigue. In the brain it is also used to synthesize neurotransmitters which are involved in fatigue. In muscle, carnosine decreases exercise fatigue and contribute to recovery.

Coenzyme Q10 (ubiquinone-10, CoQ10)

Coenzyme Q10 (CoQ10), a coenzyme that is ubiquitous in animals, including humans, is a lipid-soluble antioxidant and acting as an electron carrier is a key component of the mitochondrial electron transport chain for adenosine triphosphate (ATP) production.²²⁴ It is also one of the key antioxidant nutrients that protect mitochondrial membrane lipids and proteins and mitochondrial DNA from free radical-induced oxidative damage.

As such it is necessary for proper energy metabolism. For example, myocardial CoQ₁₀ content is reduced by cardiac failure and aging. It is also reduced by statins, the popular cholesterol lowering drugs. Studies have suggested preventative supplementation of CoQ10 for cardiac health and for those on statins.²²⁵²²⁶²²⁷²²⁸²²⁹²³⁰

CoQ10 has been shown to decrease oxidative stress and mitochondrial damage leading to increases in mitochondrial mass in many tissues.²³¹²³² As well, CoQ10 has been shown to affect the expression of genes involved in human cell signaling, metabolism and transport. As such since many neurodegenerative disorders, diabetes, cancer, and muscular and cardiovascular diseases have been associated with low CoQ10 levels, supplementation may be beneficial in many conditions and diseases^{233234235 236237238} including alleviating intervertebral disc degeneration.²³⁹

For example, CoQ10 supplementation has been shown to have anti-aging and beneficial effects on semen parameters, fertility, testicular damage, and reproductive hormones including testosterone.²⁴⁰²⁴¹²⁴²²⁴³²⁴⁴²⁴⁵²⁴⁶²⁴⁷²⁴⁸ In a recent study CoQ10 while not found to directly increase testosterone, CoQ10 supplementation **“was found to ameliorate the reduction in testosterone induced by chemical reproductive toxicants, mainly by neutralizing the damaging effect of the generated free radicals.”**²⁴⁹

CoQ10 has also been shown to have beneficial effects on oxidative stress, inflammation, the immune system, and on exercise performance.²⁵⁰²⁵¹²⁵²²⁵³²⁵⁴²⁵⁵²⁵⁶²⁵⁷²⁵⁸²⁵⁹²⁶⁰

CoQ10 also regenerates and extends the action of vitamin E thus further protecting against membrane lipid peroxidation. Under the various forms of stress and inflammation, demand for coenzyme Q10 increases which must be met by dietary intake in order to optimize mitochondrial function.

As well, it has been shown that the reduced form of CoQ10 is an important physiological lipid-soluble antioxidant that scavenges free radicals generated chemically within liposomal membranes.^{261,262} It has also been shown that it reduces oxidative stress associated with strenuous exercise in rats, healthy adults and young athletes.^{263,264,265,266,267} As noted above, vitamin E and ubiquinone increase physical working capacity of experimental animals.²⁶⁸

Generation of free radicals and subsequent lipid peroxidation have been proposed to contribute to delayed tissue damage. One study has found that ascorbate and ubiquinol levels were decreased after trauma.²⁶⁹ In this study, changes in tissue levels of ubiquinol, but not ascorbate reflected the degree of trauma. The authors suggest that ubiquinol levels may provide a useful marker of the oxidative component of the secondary injury response.

A recent study found that a combination of CoQ10 and selenium (both in Joint Support) had significant effects on reducing inflammatory biomarkers.²⁷⁰ Another recent study found that CoQ10 supplementation **“significantly recovered mitochondrial function and concurrently decreased the generation of reactive oxygen species and lipid peroxides, inhibited the accumulation of lipid droplets and the formation of the NOD-like receptor family pyrin domain-containing three (NLRP3) inflammasome, and reduced interleukin-1 β release and cell death.”** Also, the authors concluded that their results clarified **“the causal role of CoQ10 in coupling the electron transport chain with β -oxidation”**.²⁷¹

Joint Support also contains **acetyl-L-carnitine**, the acetyl form of **L-carnitine** which are interchangeable in the body. While one forms from the other and have similar effects in the body, each also has specific effects. Studies have shown that under certain conditions CoQ10 plus L-carnitine and in some cases L-carnitine alone, significantly increases total antioxidant, LH and testosterone levels as well as improving semen parameters.^{272,273,274,275,276,277,278,279,280}

Devil's Claw Root (Uncaria Tomentosa)

Africa is home for this traditional herbal medicine. Growing wild in desert soils, its large, sharp, claw-like fruit is a nuisance and danger to grazing cattle, hence its name. The root of the Devil's Claw plant is harvested at the end of the rainy season. Today it is widely used alone or in combination with other herbs to treat arthritis, rheumatism, gout and other inflammatory diseases.

Devil's Claw possesses anti-inflammatory properties that are derived from its active ingredients of harpogoside and beta-sitosterol. In its traditional uses, patients report relief of pain, swelling and joint discomfort.

The modern research on Devil's Claw is less than complete, however it is well recognized and prescribed in many European medical clinics. Some lab studies have reported that it possessed anti-inflammatory and analgesic properties like the drug phenylbutazone, but some other studies failed to observe this action. This inconsistency may stem from a lack of understanding on the exact mechanism of its medicinal actions.

Side effects are rare, but it is not recommended for pregnant women or those suffering from ulcers. A standardized extract is 5% harpogosides and 100 mg daily is a typical dosage.

Ginger

Ginger (*Zingiber officinale*) is described in Ayurvedic medicine to be useful in inflammation and rheumatism. Sources suggest that one of the mechanisms by which ginger shows its therapeutic effects could be related to inhibition of prostaglandin and leukotriene biosynthesis, thereby working as a dual inhibitor of eicosanoid biosynthesis.²⁸¹ The bioactive constituents (the main one being [6]-gingerol) have been shown to inhibit the enzymes that facilitate production of several pro-inflammatory factors. A study has shown a favorable comparison between ginger and ibuprofen (a popular arthritis medication).²⁸² Ginger has also been shown in a small clinical study to decrease pain, increase mobility and reduce swelling and stiffness.

Besides its anti-inflammatory effects, ginger has been shown to be a powerful antioxidant with anti-viral activity^{283,284} and a recent study suggests that ginger by way of reducing oxidative stress helps to reduce muscle loss.²⁸⁵

Ginkgo Biloba

Ginkgo biloba herb is extracted from the Ginkgo biloba tree and has many useful effects including increasing blood flow to various tissues, and works against free radicals. It has been shown to improve blood circulation to the skin, brain, hands, feet and legs.²⁸⁶ It's also a potent antioxidant and has significant anti-inflammatory effects.²⁸⁷

Terpenes in ginkgo biloba appear to block Platelet Activating Factor. PAF is a chemical messenger that causes inflammation and problems with blood vessels. It's also a potent antioxidant and as such helps protect tissues from oxidative damage.

Green Tea Extract

The constituents of green tea are polyphenolic compounds termed catechins. The most abundant catechin in green tea is (–)-epigallocatechin 3-gallate (EGCG) although others are also present in lesser quantities.

Green tea extract, besides being rich in antioxidants, also has significant effects on inflammation and the musculoskeletal system.^{288, 289, 290} For example green tea catechins have been shown to inhibit inflammation and cartilage degradation, and have therapeutic effects on a variety of musculoskeletal problems including arthritis.^{291, 292, 293, 294, 295}

Green tea extract may well prove to be more useful than green tea itself. One study found that green tea extract supplements retain the beneficial effects of green and black tea and allow larger doses of tea polyphenols to be used without the side effects of caffeine associated with green and black tea beverages.²⁹⁶

A recent study found that the use of green tea leaf extract (the extract in Joint Support) counteracts the dysfunction of adipose tissue in overweight post-menopausal and class I obese women.²⁹⁷ Other studies support the benefits of green tea in decreasing body fat and improving body composition.^{298,299,300,301}

Several studies have also shown that green tea reduces anxiety, improves cognition and brain function, is useful for some gynecological disorders, is useful in treating and preventing infectious diseases and cancer.³⁰²³⁰³³⁰⁴³⁰⁵³⁰⁶

Melatonin

Melatonin, a hormone produced by the pineal gland located at the base of the brain, has many important properties and effects, including regulating the sleep/wake cycles, and increasing growth hormone secretion.

Several studies have shown that melatonin increases growth hormone secretion through complimentary pathways³⁰⁷ for as long as 24 hours.³⁰⁸ Melatonin has also been found to enhance exercise-induced growth hormone secretion.³⁰⁹ As well it's been shown that melatonin induces normal sleep patterns which in turn are conducive to maximizing night time growth hormone secretion.

Melatonin has also been shown to have significant antioxidant effects. In one study it was found to have greater antioxidant effects than vitamins E and C, and reduced glutathione.³¹⁰

In a recent study the authors concluded that "Evidence shows that intense exercises disturb antioxidant status of competitive athletes, whereas supplementation with melatonin strengthens antioxidant status in trained athletes in various sports as the compound showed high potency in reduction of the oxidative stress and inflammation markers generated during intense and prolonged exercise."³¹¹

It has also been shown to be useful in treating insomnia and sleep disturbances related to conditions like fibromyalgia (**vitamin D, also in Joint Support**, may have some potential in the prevention and management of fibromyalgia³¹²) and depression. As such it is useful for decreasing the stress that often accompanies musculoskeletal injuries and other problems These effects can result in significant effects on injury prevention and healing.

Also, aspirin and other NSAIDs, which are often used to treat injuries, arthritis and other inflammatory conditions, can decrease melatonin levels and thus increase the need for melatonin supplementation.

Omega-3 and Omega 6 Oils – GLA, DHA and EPA -

Synthesis of collagen involves a cascade of biochemical modifications of the original building blocks. Many enzymes, cofactors and growth promoters influence these modifications, which are crucial to the structure and function of mature collagen and other tissues so important to integrity of joints and other connective tissue.

Dietary fatty acids are precursors for hormones and determine the composition of our cell membranes, influencing the production of pro- and anti-inflammatory substances. Omega-3 fatty acids, found in fish oils (mainly **EPA** and **DHA**) and flaxseed oil, have been shown to reduce oxidant stress³¹³ (oxidative stress or free radical damage is a factor of importance in the development of musculoskeletal inflammatory events) and suppress the production of pro-inflammatory compounds in the body³¹⁴ and therefore influence inflammatory conditions such as arthritis.³¹⁵

The literature documents relief of tender joints and morning stiffness associated with arthritis, thus reducing the need for non-steroidal anti-inflammatory drugs (NSAID).^{316,317} Also, there was no gastrointestinal upset that is typically associated with chronic NSAID use.

A review paper concluded that the available data show consistent and reproducible beneficial effects of omega-3 (n-3) fatty acids on bone metabolism and bone/joint diseases.³¹⁸ European clinical trials have shown a synergistic effect of fish oil and vitamin E in reducing pain in patients with rheumatoid arthritis.³¹⁹

Gamma linolenic acid (GLA) has shown anti-inflammatory properties and decreases some of the pro-inflammatory cytokines such as TNF-alpha and IL-1 beta.³²⁰ In one study arthritic patients using GLA had reduced joint pain and stiffness and improved grip strength.

Pau D'Arco

Pau d'arco, or the inner bark of the tabebuia avellanadae tree, is native to Brazil, where it is used traditionally to treat a wide range of conditions including pain, inflammation and arthritis.

Preliminary laboratory research examining the properties of pau d'arco is beginning to suggest that the traditional uses may have scientific merit. Such laboratory studies have shown that pau d'arco has pain killing, diuretic, anti-inflammatory, anti-infectious, anti-psoriatic, and anti-cancer abilities. Taking this early data, combined with information collected about traditional uses Pau d'arco may reduce inflammation of the musculoskeletal system associated with injury and arthritis.

Rutin and Quercetin

These two flavonoids have been shown in several studies to have significant anti-inflammatory activity in cases of both acute and chronic inflammation.³²¹³²²³²³

A review article concluded that there is evidence to suggest that flavonoids may be beneficial to connective tissue for several reasons, which include the limiting of inflammation and associated tissue degradation, the improvement of local circulation, as well as the promoting of a strong collagen matrix.³²⁴ These compounds also have significant antioxidant properties. Quercetin may have properties that downregulate or inhibit cyclooxygenase-2 safely.³²⁵

Quercetin is even more effective for decreasing inflammation and loss of functional cells when used with high dose glucosamine (**both present in Joint support**).³²⁶

Quercetin has also been shown to enhance exercise/sports performance and increase mitochondrial biogenesis thus positively affecting energy metabolism.³²⁷

Recent studies have expounded on the beneficial effects of quercetin including neuroprotection, senolytic effects, and a reduction of aging-associated disc degeneration.³²⁸³²⁹

S-Adenosyl-L-methionine (S-AdoMet) – Increasing Endogenous Production

Methyl donors are important for the methylation reaction, which adds a methyl group (one carbon atom and three hydrogen atoms), on proteins, enzymes, chemicals, DNA, and amino acids like

homocysteine. Methylation is important for maintaining many functions in the body including genetic expression, and neurological and musculoskeletal function.

Usually, this methylation process occurs through a compound called S-adenosyl-L-methionine (SAME). However, SAME, because of its volatility and incompatibility, can't be incorporated into a multi-ingredient formula such as Joint Support so the alternative is to include ingredients that have been shown to increase endogenous production and at the same time reduce the increased levels of homocysteine that can follow.

SAME, is synthesized from the amino acid methionine and its level in the body is increased by dietary methyl donors such as **folic acid, B12** (especially the **methylcobalamin** that is used as the preferred form of B12 in Joint Support rather than the synthetic cyanocobalamin, the usual form of B12 found in most other supplements), **B6** and **betaine** (trimethyl glycine). These nutrients are also needed to reduce homocysteine levels and decrease cardiovascular disease.

Various clinical trials and animal studies suggest that SAME may be effective, among other things, in reducing pain and inflammation in the joints, in promoting cartilage repair, and helping with arthritic symptoms.^{330,331} It's also felt to have significant direct and indirect (by increasing glutathione synthesis) antioxidant effects.³³²

Some of these studies have shown that SAME supplements were as effective as NSAIDs in people with arthritis in diminishing morning stiffness, decreasing pain, reducing swelling, improving range of motion, and increasing walking pace. Several of the studies also suggest that SAME, while as effective as NSAIDs, has fewer side effects.³³³

A recent study found that a combination of SAME, glucosamine, and chondroitin resulted in an increase in articular cartilage, and a decrease in pain in people with knee osteoarthritis.³³⁴

Shark Cartilage

Shark cartilage may have benefits in accelerating the healing of cartilage. Studies have shown that shark cartilage can play a scavenger role for reactive oxygen species and protect against DNA lesions and as such degenerative joint diseases.^{335,336} Also shark cartilage has been shown to have some analgesic and anti-inflammatory effects.^{337,338} As well, shark Cartilage has been shown to inhibit angiogenesis and stimulating immune function.

Silicon

Silicon is considered an essential trace element and is required for the formation of skin, ligaments, tendons, cartilage and bone.³³⁹ This is thought to be due to its role in the enzyme polyhydroxylase, which is responsible for the formation of collagen in bone and elastin, cartilage and other connective tissues. Silicon is also essential for bone calcification and bone health.³⁴⁰

Stinging Nettle Extract

Nettle extracts have long been used as an adjunct treatment for arthritis in Europe and is not beginning to gain popularity in the United States. Cell studies using extracts of nettle leaf have demonstrated a variety of active substances that inhibit prostaglandin production and cytokine secretion.

Tumor necrosis factor-alpha (TNF- α) and nuclear factor are factors associated with chronic inflammatory conditions. These factors as well as other cytokines such as interleukin-1B (IL-1B) have been identified as factors that aid the destruction of cartilage in osteoarthritis and rheumatoid arthritis. Nettle leaf significantly reduces the concentration of these factors, thus improving arthritic conditions as seen evidenced in human clinical trials.³⁴¹

Turmeric

Curcumin, the active component of turmeric, is documented to have anti-inflammatory, antioxidative, and immune system benefits.³⁴²³⁴³³⁴⁴³⁴⁵³⁴⁶ As an antioxidant, curcumin reduces the activity of certain enzymes, inhibiting all branches of the arachidonic acid cascade thus reducing inflammation and as a bonus reducing counter-productive muscle damage and soreness, and enhancing recovery from exercise.³⁴⁷³⁴⁸³⁴⁹³⁵⁰

Turmeric exhibits marked anti-inflammatory action and has been shown to be as effective as some anti-inflammatory drugs. For example, in a double-blinded trial, post-surgical patients receiving curcumin experienced reductions in stiffness and joint swelling comparable to the effects of phenylbutazone, a potent anti-inflammatory drug.³⁵¹ Studies have found that curcumin is effective for reducing inflammation and pain in knee osteoarthritis and useful for the treatment of muscle damage, and tendon inflammation and injuries.³⁵²³⁵³³⁵⁴³⁵⁵³⁵⁶

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

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

As well, turmeric has also been shown to have neuroprotective activity, antioxidant and anti-inflammatory effects, protective effects against chemical damage to skin and connective tissue, and antiviral effects.³⁵⁷³⁵⁸

Piperine (see **Bioperine** info below) enhances the bioavailability of curcumin and thus enhances curcumin's antioxidant properties, and its effects on inflammation, improved recovery after exercise, and curcumin's neuroprotective effects.^{359360361 362}

See information above on the benefits of curcumin and bromelain against Covid-19.

Vitamins and Minerals

Introduction

Recovery and repair of tissues require a host of vitamins and minerals that participate in synthesis of new cells and tissue. For example, certain vitamins and minerals have anti-inflammatory and protective effects and many are also required to facilitate the formation of endogenous anti-inflammatory compounds, including **Vitamin D3, Vitamin B3, Vitamin B6, Vitamin B12, Folate,**

Vitamin K, Vitamin E, Vitamin C, niacin, zinc, potassium, copper, manganese, Pantothenic Acid, chromium, selenium and magnesium. Many vitamins and minerals also serve as antioxidants and help protect cells against the oxidative damage produced by inflammation.

Vitamin C

For example, vitamin C is necessary for collagen synthesis and is a strong antioxidant with beneficial effects on pro-inflammatory cytokines.³⁶³ Research on vitamin C shows that it may have important effects in reducing pain and inflammation secondary to exercise. In one study 400 mg daily of vitamin C reduced post exercise pain and inflammation.³⁶⁴ Vitamin C is involved in the enzymatic hydroxylation of proline to form 4-hydroxyproline, an amino acid that is an integral part of collagen and elastin.

A recent study found that the present RDA for vitamin C is insufficient to deal with collagen-related pathologies including osteoarthritis, other joint and musculoskeletal disorders.³⁶⁵ Joint Support includes 200 mg of vitamin C, an amount that I consider critical to musculoskeletal health. As well, my lineup of nutritional supplements has several other products providing additional vitamin C. For example, MVM, a companion product to Joint Support contains 500 mg of vitamin C.

Vitamin E

As well as being an antioxidant, **vitamin E**, has been demonstrated to reduce pain in arthritic patients. Both vitamins, E and C, are important in treatment of arthritic conditions, as shown in studies, possibly by reducing oxidative stress induced by TNF- α . And both vitamins are also helpful in reducing muscle soreness secondary to exercise. Clinical studies report that supplementing with vitamin E and C reduce post-exercise inflammation and pain in muscles and joints.

Vitamin B3 and B5

Several clinical studies have shown the anti-inflammatory effects of **vitamin B3** (as **niacinamide**) and its benefits of in both rheumatoid and osteoarthritis. **Pantothenate** or vitamin B5 has been shown in several studies to influence wound healing and collagen synthesis. Some studies have also shown that low levels of pantothenic acid (vitamin B5) are inversely related to increased joint pain and stiffness.

Niacinamide and **niacin** also directly increases GH secretion. Niacinamide, along with the amino acid **glycine** (which also has an effect on GH secretion), also have some relaxing effects and thus are useful before bed to help sleep.

Vitamin B6

Vitamin B6, a critical co-factor involved in macronutrient metabolism, GH and IGF-I secretion, tissue anabolism, and the production of neurotransmitters including dopamine, noradrenaline and serotonin, and is also involved in optimizing the function of the T-cell population, lymphocytes that are intimately involved in the immune response.³⁶⁶³⁶⁷

CD8+ T cells, also known as "killer cells", are cytotoxic - this means that they are able to directly kill virus-infected cells, something that is essential for decreasing the deadly effects of the Covid-19 pandemic.

As well, vitamin B6 is an essential co-factor necessary for the metabolism of protein and a useful supplement to take with any amino acid and/or protein product. Transamination of amino acids, important for many functions in the body including protein synthesis, anaplerosis, energy metabolism, is promoted by several enzymes among which are the aminotransferases, which are derivatives of vitamin B6. For example, in a deficiency of vitamin B6 the nonessential amino acids are synthesized only poorly and, therefore, protein synthesis cannot proceed normally.

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

Vitamin B12

Vitamin B12 is metabolically involved in almost every cell in the body, including the synthesis and regulation of DNA and neurotransmitters. It is vital for normal brain and nervous system functioning and for the formation of red blood cells.

B12 is involved in fatty acid and amino acid metabolism, helping to regulate protein synthesis and lipolysis/lipogenesis, thus helping to improve body composition. As well, it helps to decrease serum levels of homocysteine, cholesterol and C-Reactive proteins, markers of heart disease and inflammation in the body. B12 is also involved in adrenal and testicular function including normalizing testosterone and cortisol levels, and spermatogenesis.

In Western populations, vitamin B12 deficiency occurs in up to 40% of diets because people often consume a low quantity of vitamin B12-rich foods. In extreme cases, this deficiency can produce neurologic and hematologic signs and symptoms. However, low or marginal vitamin B12 levels (200-300 pg/mL [148-221 pmol/L]) in asymptomatic individuals is far more common.

Vitamin B12 deficiency can lead to serious problems including anemia, and damage to the brain, central nervous system, and the reproductive axis. Even marginal deficiencies can cause symptoms including cognitive decline, fatigue, depression, lower testosterone production, decreased libido, and sexual and reproductive dysfunction.³⁶⁸³⁶⁹³⁷⁰³⁷¹³⁷²³⁷³³⁷⁴³⁷⁵³⁷⁶³⁷⁷

Vitamin B12 deficiency can occur secondary to low intake relative to need, such as can happen in vegetarians and especially vegans (vitamin B12 is essentially absent from plant sources), from deficient absorption due to certain intestinal disorders and problems with intrinsic factor, and from the use of certain medications, such metformin, a common diabetic medication.³⁷⁸³⁷⁹³⁸⁰³⁸¹³⁸²³⁸³³⁸⁴³⁸⁵

Ample amounts of **vitamin B12** are included in Joint Support, at levels 10 times the amount found in most other products. As well, the B12 is in the form of **methylcobalamin**, the biologically active form of B12, which is better absorbed and used by the body compared with the synthetic cyanocobalamin, the less expensive form of B12 usually used in most nutritional supplements. As the body must change the cyanocobalamin into methylcobalamin, this process may be compromised in some people so using the metabolically active form is more efficient and improves bioavailability and function.

Methylcobalamin, as well as other methyl group donors such as **folic acid**, **betaine**, **methionine**, with the aid of **vitamin B6 (all in Joint Support)**, have multiple functions in the body including increasing the formation of SAME (see above) and the conversion of homocysteine (high levels are a risk factor for cardiovascular disease) to the essential amino acid methionine.

B12 helps to optimize macronutrient metabolism, maximize muscle mass and decrease body fat.³⁸⁶³⁸⁷ As well, it helps to decrease serum levels of homocysteine, cholesterol, TNF-alpha, and C-Reactive proteins, markers of heart CNS diseases and inflammation in the body.³⁸⁸³⁸⁹ Decreasing inflammation helps to decrease cortisol levels and thus increase the beneficial musculoskeletal effects of Joint Support.

Supplementation with folate which is in Joint Support, has recently been shown to have an impact on the epigenetic clock predicting chronologic age.³⁹⁰

Minerals

Minerals are required for normal cell function and several serve as cofactors in the many enzymatic processes involved in synthesis of connective tissue macromolecules. **Calcium** and **phosphorus** (in the form of phosphates), and **vitamin D** to regulate both, are important for joint and bone health. Vitamin D In addition to its effects on calcium metabolism, also plays a role in the normal turnover of articular cartilage.

Boron and Manganese

Boron³⁹¹ and **manganese**³⁹² are critical cofactors for collagen and GAG synthesis and metabolism. Some pharmaceuticals are known to negatively interact with some minerals. Supplementation of these minerals should ensure adequate supply in the body.

Zinc

Zinc, a trace mineral, is a constituent of more than a hundred fundamentally important enzymes, so zinc deficiency has many negative effects on almost every body function.³⁹³ As well, zinc deficiency can adversely affect the reproductive hormones adding another factor as to how it can impair athletic efforts.³⁹⁴ Zinc is also important for male fertility.³⁹⁵

Zinc is necessary for the immune system and is a potent inhibitor of various RNA viruses and may be beneficial for both prevention and treatment of the present COVID-19 pandemic.³⁹⁶³⁹⁷³⁹⁸³⁹⁹ It's interesting that like the Covid-19 virus, zinc deficiency can result in the loss of sense of smell and taste. It's possible that zinc deficiency may contribute to these losses since zinc deficiency in humans is widespread⁴⁰⁰ and athletes may be particularly prone to lower plasma zinc levels.⁴⁰¹

Exercise can lead to an increased need for certain nutrients. Problems can arise from exercise induced mineral loss, which is further enhanced by the finding that many of us don't consume adequate amounts of many essential minerals.

Studies have shown that many athletes, and female athletes in particular, consume diets that have been found to be inadequate for certain key minerals such as zinc, magnesium, copper, and iron. The combination of strenuous exercise and compromised mineral status ultimately leads to low endurance capacity, depressed immune function, and the development of a variety of disease conditions.

One study looked at the effects of zinc deficiency on physical performance and found that low dietary zinc was associated with impaired cardiorespiratory function and impaired metabolic responses during exercise.⁴⁰²

Zinc deficiency adversely affects protein synthesis. In one study the effects of zinc deficiency in rats, on the levels of free amino acid in urine, plasma and skin extract were investigated.⁴⁰³ Zinc deficiency adversely affected skin protein synthesis. Especially where a deficiency may be present, supplemental zinc has resulted in an increase the secretion of growth hormone and IGF-I,⁴⁰⁴ and testosterone⁴⁰⁵ and to raise plasma testosterone and sperm count.^{406,407}

A study looking at the effects of zinc supplementation on wrestlers found that the results obtained at the end of the study indicate that zinc supplementation (as well as several other ingredients in Joint Support including NAC and ALA (both in Joint Support) prevents production of free radicals by activating the endogenous antioxidant system.⁴⁰⁸

This activation is important as it coincides with the effects of exercise, which also activates the endogenous antioxidant system and leads to increased endogenous antioxidants that enhance the beneficial effects of exercise on body composition and performance. The authors concluded that “physiologic doses of zinc supplementation to athletes may beneficially contribute to their health and performance.”

It's been shown that there is an improvement in insulin resistance with zinc supplementation and that zinc is involved in controlling some of the aspects of obesity.⁴⁰⁹ Zinc also improves calcium metabolism and thus the beneficial effects that calcium has on fat metabolism.

While some believe that high levels of zinc are needed for the multitude of benefits that it offers⁴¹⁰ that is not the case in my experience. Increasing levels of zinc in Joint Support above the RDA showed no improvements in the effects of Joint Support..

The amount of zinc in Joint Support augments zinc found in several diverse foods to provide above RDA levels of bioabsorbable zinc. For example, lamb (3 ounces contains half the recommended daily value), beef, and pumpkin seeds, are rich in zinc content.

Clinical evidence suggests that **zinc** deficiencies have a high impact on connective tissue synthesis. **Zinc** primarily acts as cofactor in many enzyme systems that regulate cell proliferation and growth and in immune integrity. Diminution of collagen synthesis and strength as well as impaired healing is seen in animal tissues with zinc deficiencies.

Copper

Copper is a co-enzyme for lysyl-oxidase, which is essential for the conversion of collagen and elastin, and subsequently for joint function. It also has anti-inflammatory properties and may ease pain in arthritic and damaged joints. As well, adequate serum copper levels are critically important for bone health.⁴¹¹

Magnesium

Magnesium is an essential trace element that is important for cellular and tissue health and recovery. Over two thirds of magnesium in the body is found in bone and it has been shown that magnesium deficiency impairs bone strength and is a benefit both in terms of bone mineral density and fracture risk.⁴¹²⁴¹³⁴¹⁴

Magnesium, besides complementing the effects of calcium on bone health⁴¹⁵ and obesity⁴¹⁶ also has several other important functions. Magnesium deficiency, which has been on the rise in the past few decades, results in significant adverse musculoskeletal, neurological, cardiovascular and metabolic effects.⁴¹⁷

Magnesium is involved in numerous processes that affect muscle function including oxygen uptake, energy production, electrolyte balance, testicular function, and protein synthesis. Low levels of magnesium promote inflammation⁴¹⁸⁴¹⁹ and impact on the body's ability to handle stress.⁴²⁰ These functions are useful in alleviating the release of pro-inflammatory cytokines and decreasing both insulin resistance and inappropriate cortisol secretion.

There is evidence that marginal magnesium deficiency impairs exercise performance and increases oxidative stress. As well, strenuous exercise increases urinary and sweat losses that may increase magnesium requirements.⁴²¹

Recent surveys have shown that a significant number of individuals are magnesium deficient based on their intake. Athletes in sports with weight classes are especially vulnerable to magnesium deficiency due to their weight loss practices. As such, in these athletes, and others who are magnesium deficient or whose levels are marginal, magnesium supplementation would have beneficial effects on exercise performance.

Magnesium, because of its many functions has potential as an ergogenic aid.⁴²²⁴²³⁴²⁴ A recent study found that magnesium supplementation improved alactic anaerobic metabolism, even though the athletes were not magnesium deficient.⁴²⁵ Another study found that magnesium supplementation increased strength performance.⁴²⁶ As well, magnesium may prove effective for muscle cramps⁴²⁷ and has a protective effect on muscle damage.⁴²⁸

Magnesium has been shown to influence testosterone levels as well as the anabolic peptide IGF-1.⁴²⁹⁴³⁰ One study found that supplementation with magnesium increases free and total testosterone values in sedentary and in athletes.⁴³¹ In this study the increases were found to be higher in those who exercise than in sedentary individuals. As well, magnesium has been shown to work along with zinc and B6 (both of which are present in Joint Support) to produce a significant anabolic effect.⁴³²

Magnesium is also important in enhancing mTOR signaling which has anabolic effects by enhancing muscle strength and regeneration, and performance.⁴³³⁴³⁴

White Willow Bark

Salicin, a glycoside present in most willow tree bark, has been a known source of pain relief since Hippocrates. Derivatives of salicylates are widely used for their analgesic and anti-inflammatory properties. Aspirin is the best known of these compounds, and salicin is its precursor. The most accepted mechanism of action proposed for the salicylates is inhibition of prostaglandin biosynthesis. Aspirin and other salicylates inhibit cyclooxygenase enzymes, which are responsible for conversion of arachidonic acid to prostaglandins, mediators of inflammation.

A recent study showed that aspirin and fish oil together had a more favorable effect on the pro- and anti-inflammatory factors than aspirin alone.⁴³⁵ Also, the natural sources of salicin have fewer side effects than aspirin.

Yucca Leaf Extract

Yucca contains natural steroid like compounds that have anti-inflammatory, analgesic and antioxidant properties.⁴³⁶ These saponins also block the release of toxins from the intestines that inhibit normal formation of cartilage. Yucca has also been shown to have some anti-tumor effects.

Astaxanthin

Astaxanthin is a carotenoid, a powerful lipid based antioxidant found naturally in certain plants and animals. The astaxanthin used in nutritional supplements comes from a type of algae that makes astaxanthin. Astaxanthin complements and adds to the many beneficial effects of Joint Support as it works with other ingredients in Joint Support to improve health and decrease morbidity, enhance exercise performance, increase fat metabolism during exercise, decrease oxidative stress and muscle injury, delay exhaustion, increasing improve body composition, enhance recovery, prevents redox imbalances, improves immune function, and attenuates muscle damage, counterproductive inflammation and fibrosis induced by rigorous physical training as well as immobilization.⁴³⁷⁴³⁸⁴³⁹⁴⁴⁰⁴⁴¹⁴⁴²⁴⁴³⁴⁴⁴⁴⁴⁵⁴⁴⁶⁴⁴⁷⁴⁴⁸⁴⁴⁹⁴⁵⁰⁴⁵¹⁴⁵²⁴⁵³⁴⁵⁴⁴⁵⁵⁴⁵⁶

Some of the benefits of Astaxanthin deserve special attention. For example, astaxanthin has a protective effect on mitochondria, the cellular powerhouses that produce the energy we need to live and function optimally. Protecting the mitochondria is especially important during exercise since destructive free radical production increases almost exponentially and can damage not only the mitochondria, thus impairing energy systems, but also skeletal muscle impairing performance and recovery and increasing the chance of injury.⁴⁵⁷

But that's not all because astaxanthin, through its effects on decreasing mitochondrial damage in other parts of the body such as the testes, also increases testosterone production and thus increases the anabolic effects of exercise, and has also been shown to have positive effects on sperm parameters and fertility.⁴⁵⁸

Unlike some other antioxidants, astaxanthin not only has intrinsic antioxidant and anti-inflammatory properties but it also increases the endogenous production of natural antioxidant defense mechanisms such as SOD and heme oxygenase-1.⁴⁵⁹ As well it works synergistically with other ingredients in Joint Support. For example, in horses it's been shown that continuous dietary administration of astaxanthin and L-carnitine (acetyl-L-carnitine is in Joint Support) attenuates exercise-induced muscle damage.⁴⁶⁰

So, with the use of astaxanthin, as with several other antioxidant ingredients and anti-inflammatory ingredients in Joint Support, there is not only antioxidant and anti-inflammatory effects of the ingredients, but also an increase in endogenous production of antioxidants and a boost to endogenous anti-inflammatory pathways. The overall effect is a decrease in counterproductive damage and inflammation secondary to strenuous exercise and competition and also quicker recovery from mental and physical exercise induced stress.

For all these reasons astaxanthin plays a prominent part in the beneficial effects that Joint Support has on maintaining musculoskeletal health, decreasing injuries, improving recovery, and helping in the healing of musculoskeletal dysfunction due to stress and injuries.

Bioperine

Joint Support contains **piperine** marketed as **Bioperine**, which significantly enhances the bioavailability of supplemented nutrients through increased absorption and decreased metabolic inactivation.⁴⁶¹⁴⁶²⁴⁶³⁴⁶⁴

The Advantages of Bioperine®

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

The subtle, yet potent properties of Bioperine® have been measured in several clinical studies with healthy volunteers in the U.S. These studies measured the absorption of various substances with and without Bioperine®. Gastrointestinal absorption of all the studied nutrients, as measured by amounts present in the blood, increased dramatically when administered with Bioperine® as compared to the control group receiving the nutrient alone.

Bioperine also has several other beneficial properties, including thermogenic effects, reducing cholesterol and protecting against neurodegeneration and cognitive impairment. As well, it has been shown that it may have immunomodulatory, antioxidant, anti-asthmatic, anti-carcinogenic, anti-inflammatory, anti-ulcer, and anti-amoebic properties.⁴⁶⁵⁴⁶⁶⁴⁶⁷⁴⁶⁸⁴⁶⁹⁴⁷⁰⁴⁷¹ For current information on the beneficial effects of Bioperine go to <https://www.bioperine.com/index.php/aboutbioperine>.

Other Ingredients

Lemon Myrtle Leaf is used by the Aborigines of Australia for arthritis because of its anti-inflammatory properties.

Thyme-Leaved Gratiola is an herb is traditionally used in inflammation and rheumatism.

Withania Somnifera (ashwagandha) also known as Indian Ginseng, has significant anti-inflammatory activity and is often used to reduce arthritic pain and inflammation.⁴⁷²⁴⁷³ It has been shown to have beneficial effects on the immune system and decrease levels of pro-inflammatory cytokines.^{474,475} As well, it's been shown to have beneficial effects on arthritis, and strength training adaptations and recovery.⁴⁷⁶⁴⁷⁷⁴⁷⁸⁴⁷⁹

There are several other ingredients in Joint Support that I've still to mention as to how they add to its beneficial effects. Every ingredient in Joint Support's formulation has been carefully chosen for its complimentary effects to the benefits of Joint Support. I'll add these to this information piece in the upcoming months.

Summary

MD+ Joint Support will safely reduce stress on musculoskeletal tissues and speed up recovery without the side effects associated with many of the drugs used in modern medicine. The many natural ingredients in Joint Support may also reduce many such side effects when used along with NSAIDs as well as act in concert with other treatments to prevent acute musculoskeletal damage and potentially reverse chronic injuries and inflammation. As such, **Joint Support** not only gives symptomatic relief, but also intervenes at the origin of the problem and helps rebuild tissue.

For recreational and competitive athletes where injuries and sore muscles reduce and may even interrupt training time and participation in sports events, Joint Support will reduce healing time and increase recovery and performance. As well, the use of Joint Support when training hard helps prevent injuries and decrease the chances of overreaching turning into overtraining.

Joint Support plus EFA+

Joint Support works in tandem with other nutritional supplements in my lineup to provide additional benefits. For example, [EFA+](#) and [MVM](#) are both worthwhile to further increase the effects of Joint Support . Both offer beneficial effects on health, body composition, and performance, and also as an aid to help your body fight off the effects of pollution. For information on how pollution is actually devolution of our species see my recently updated article, first written in 2016 – [Pollution as Devolution](#).

Both [TestoBoost](#) and [GHboost](#) also enhance the effects of Joint Support as well as having significant anabolic, anti-catabolic, body composition and mental and physical performance.

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