Feeling Swell:
Understanding, preventing, and treating chronic inflammation

By Tamara Mitchell

Most people have experienced the redness, warmth, swelling, and pain of inflammation when we hit a finger with a hammer, twist an ankle or experience some other similarly unpleasant injury. These are all normal reactions of your body as it starts to repair the damaged body tissues. They are signs that the immune, circulatory and hormonal systems have begun to fix the injured tissues.

For over 2,000 years, four symptoms have been associated with inflammation, first identified by the Roman physician Aurelius Celsus. More recently a fifth symptom was added:[1]

- Pain (dolor)
- Redness (rubor)
- Heat (calor)
- Swelling (tumor)
- Loss of function (torpor) – recent addition

Inflammation is a process where white blood cells and plasma leave the blood vessel and go into the surrounding tissues where they release chemicals that protect the body from infection, bacteria and viruses.[2,3] Inflammation actually serves a purpose. But it creates illness when it continues beyond normal limits.[3,4] With some diseases, the body's immune system triggers an inflammatory response when there are no foreign substances to fight.[4] The body responds as if normal tissues are infected. In this case, the immune system damages its own tissues.[4] This is true in autoimmune diseases such as rheumatoid arthritis and lupus.[4] Inflammation is also a major component of musculoskeletal disease (e.g., Repetitive Strain Injury), osteoarthritis, and tendinitis.

It is important to differentiate between "acute" inflammation that results from sudden traumatic injuries and "chronic" inflammation that is abnormal and goes on beyond the immediate response to sudden injury.[2] In the less severe cases, acute inflammation resolves itself within a few hours, or it could take a few days for the body to recover. If not, it develops into chronic inflammation or, in severe cases, it can take over the whole body and become fatal (sepsis).[3]

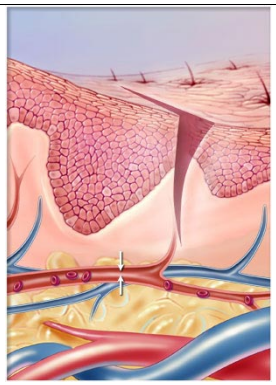
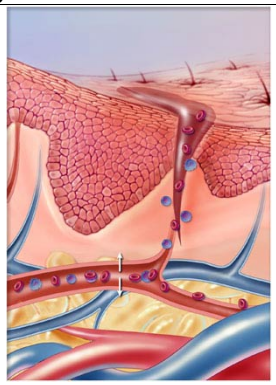
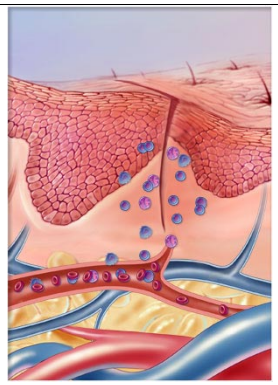
Acute Inflammation

Process

Acute inflammation starts with a brief phase of arterial constriction followed by artery dilation that increases blood flow to the injured area.[2] The capillaries become more permeable and leak protein-rich plasma into the tissue. Blood flow then slows, allowing white blood cells called neutrophils to line up and stick to the cells of the damaged blood vessels and red cells to pack the small blood vessels.[2] At the same time, the plasma-derived proteins undergo various changes that lead to the immune response and the formation of fibrin, a framework for eventual scar tissue.[2]

The increased fluid in the tissue causes an increased flow of lymph which carries the immune complexes to the lymph nodes. When the neutrophils (white blood cells) arrive at the site of injury, they work to deactivate infection and kill dead tissue debris. This whole process is orchestrated by several chemical mediators derived from the injured tissues, bacteria, plasma proteins, and leucocytes (other white blood cells).

Stages in Acute Inflammation

		
Vasoconstriction following injury	Vasodilation following injury	Tissue swelling and cells passing out of the blood vessels to help heal tissues

Illustrations courtesy of Reference 3

After the first phase of inflammation, as early as the second or third day of acute inflammation, macrophages (a different type of white blood cell) accumulate in increasing numbers.[2] These enter the tissue in a similar manner as the neutrophils in the first phase and they proceed to digest cell debris, dead neutrophils, and fibrin.[2]

Treatment

We've all heard through doctors and sports medicine literature that we need to apply ice and compression as soon after injury as possible to avoid inflammation and to promote healing. Taking nonsteroidal anti-inflammatories (NSAIDs) is also generally recommended. The acronym used in sports injuries is P.R.I.C.E. which stands for Protect the injured area, Rest to allow healing, and Ice, Compression, and Elevation to reduce swelling and inflammation.[5]

If inflammation is a normal part of healing, why would we want to inhibit it? The argument for reducing inflammation is that healthy tissue is not inflamed, so if we stop inflammation in an injured tissue it will be healthier.[6] There are also theories that inflammation may cause damage to surrounding tissues or that some of the hormones, proteins, and other agents released during inflammation may injure healthy surrounding tissues. Certainly inflammation following traumatic injuries is not comfortable. It's hot, painful, sometimes throbbing, and looks terrible. However, there is not universal agreement that acute inflammation should be reduced or that reducing inflammation aids healing.[3] Some of the inflammatory response may be more helpful in open wounds with broken skin such as surgery, cuts, punctures, or burns where the white blood cells are mustered to kill potentially invading bacteria and viruses. In fact, suppressing inflammation and the associated immune system activity may boost secondary infections or mask the symptoms of infection.[7] Inflammation may be less helpful with internal acute injuries like sprains, strains, and bruises.

Local cooling has not been shown to be beneficial in preventing inflammation from injuries or burns, though it does appear to be effective in reducing pain, especially when used in conjunction

with compression and it does reduce swelling (edema).[8,9,10,11] One study on rats found that the permeability of small blood vessels was significantly reduced following ice therapy in the treatment of muscle injuries.[12] This effect actually inhibits healing since reducing the permeability restricts the release of protein into the damaged tissue.[12]

Use of ice has also been shown to reduce the temperature of bone and joints by several degrees in addition to superficial cooling of tissues.[12] This causes cooling of the synovial fluids, which probably affects the growth rate of some proteins in the synovial fluid (cytokines).[13] It has not been proven if this effect is beneficial.

With regard to the use of aspirin and non-steroidal anti-inflammatories (NSAIDs) to reduce acute inflammation, a recent review of studies on strains, contusions, and delayed-onset muscle soreness revealed minimal benefit of NSAIDs when compared with a placebo.[6] There are also serious questions about the safety and toxicity of NSAIDs and corticosteroids.[7] Research is actually finding that while NSAIDs speed the healing of muscle and other soft tissues and decrease the damage to surrounding areas from inflammation, long-term effects on tissue healing, structure, and function suffer.[6,14, 15] Interestingly, the use of anabolic steroids has been shown to *increase* inflammation and simultaneously, hasten the healing of muscle injuries.[6] In general, research is lacking to either prove or disprove NSAIDs effectiveness in treating musculoskeletal injuries, but at best it appears that it is an effective pain reliever and as such, may facilitate the healing of ligament injuries by encouraging activity.[6]

Bottom line, localized acute inflammation is the body's natural response to injury and healing. As long as inflammation is temporary and localized and as long as the pain and discomfort are tolerable, it's probably best to let it run its course. It's very tempting to want to alleviate discomfort and we have been trained for decades that we need to do something immediately to stop acute inflammation, research seems to be backing the argument that we should let acute inflammation run its course.

Chronic Inflammation

Chronic inflammation can go on for months or years.[16] In chronic inflammation, the feedback systems break down and it can lead to several diseases or conditions where body tissues are destroyed, there can be thickening or scarring of connective tissue, and cell death.[16] For this reason, reduction of chronic inflammation is very important in the promotion of health.

Chronic inflammation is strongly suspected in many degenerative diseases, such as:[3,17]

- Alzheimer's and Parkinson's disease
- Cancer
- Heart disease
- Inflammatory bowel disease
- Asthma
- Inflammatory skin problems (e.g., eczema and psoriasis)
- Depression
- Bi-polar disorder
- Multiple sclerosis

There are several factors that have been identified in association with chronic inflammation. Persistent inflammation is termed metaflammation because of its links to the metabolic system.[1] It tends to be:[1]

- Low grade

- Persistent and chronic
- Systemic rather than local
- Less likely to have foreign or infectious pathogens involved
- Perpetuates rather than resolves disease
- Associated with a reduced metabolic rate

Metaflammation has been associated with many chronic diseases:[1]

- Type 2 diabetes
- Depression
- Heart disease
- Cancer
- Dementia

Metaflammation appears to develop as an intermediate immune system response that leads to chronic disease. Factors which induce chronic inflammation appear to be linked to nutritional, behavioral, and environmental variables which are linked to modern lifestyles.[1] Man-made environments, their by-products, or lifestyles which have a detrimental effect on human health are called "anthropogens".[1] This type of disease contrasts with the historic fight against disease which was focused on fighting infectious diseases.[1] Metaflammation is chronic, noncommunicable disease with no single underlying factor.[1] The figure below shows a timeline of the inflammatory and anti-inflammatory agents on a timeline depicting the rapid introduction of pro-inflammatory anthropogens in recent decades.[1]

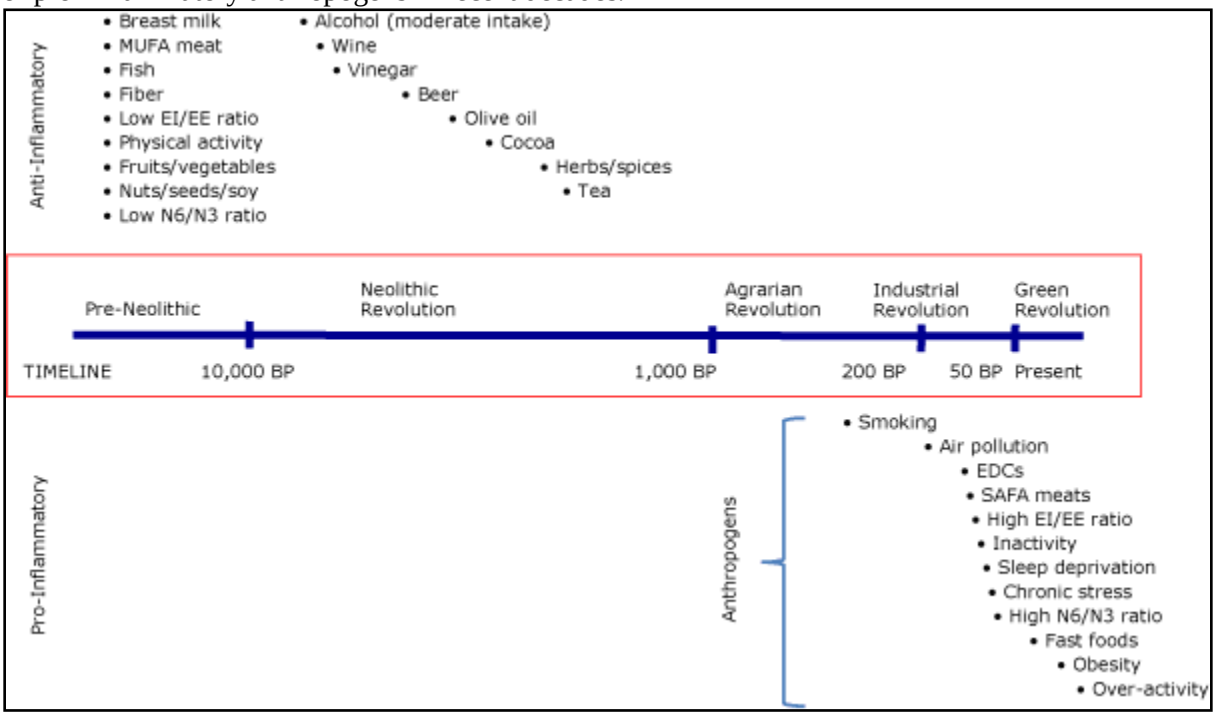


Illustration courtesy of Reference 1

The table below shows a listing of various pro- and anti-inflammatory agents along with the level of evidence found by research. A few of these, like aging, cannot be controlled, but many are lifestyle choices and by becoming aware of the factors involved in inflammation, it's possible to minimize things in the Pro-Inflammatory column and maximize the factors in the Anti-Inflammatory column.

Evidence Level	Pro-Inflammatory ("Anthropogens")	Anti-Inflammatory (or Neutral)

Strong	• Aging
	• Exercise, too little (inactivity)
	• Nutrition
	  o Excessive energy intake
	  o Fat intake
	  ▪ Saturated
	  ▪ Trans fatty acids
	  ▪ High-fat diet
	• Obesity/weight gain
	• Particulate matter
	• Smoking
	• Sleep deprivation
	• Stress/anxiety/depression/ "burnout"
		• Exercise/physical activity/fitness
		• Intensive lifestyle change
		• Nutrition
		  o Restricted energy intake
		  o Fish/fish oils
		  o Fruits/vegetables
		  o Nuts
		• Weight loss

Moderate	• Nutrition
	  o Fast food/Western-style diet
	  o High omega 6:omega 3 ratio
	  o Fiber (low intake)
	  o Fructose
	  o Glucose
	  o High-glucose/glycemic-index foods
	  o High glycemic load
	  o Glycemic status
	• Air pollution
	• Inequality/economic insecurity
		• Nutrition
		  o Alcohol (moderate intake)
		  o Capsaicin
		  o Cocoa/Chocolate (dark)
		  o Fiber (high intake)
		  o Garlic
		  o Grapes/raisins
		  o Herbs and spices
		  o Low omega 6:omega 3 ratio
		  o Mediterranean diet
		  o Olive oil
		  o Tea/green tea
		  o Vinegar
		• Smoking cessation

Limited	• Exercise, excessive
	• Nutrition
	  o Starvation
	  o Alcohol (excessive/bingeing)
	  o Meat (domesticated)
	  o Sugar-sweetened drinks
	• Endocrine disrupting chemicals
	• Low perceived workplace fairness
	• Sick building syndrome
	• Secondhand smoke
	• Thermal comfort (eg, air conditioning)
	• Low socioeconomic status
		• Nutrition
		  o Breast milk
		  o Dairy calcium
		  o Eggs
		  o Lean game meats
		  o Low-glycemic-index foods
		  o Monounsaturated fats
		• Soy protein

Table courtesy of Reference 1

Prevention and Treatment of Chronic Inflammation

In chronic inflammation, the system has gone haywire somewhere and inflammation is continuing unchecked by our bodies. Research has discovered enough of the system to begin to understand potential ways to halt this onslaught. Drugs which interfere at certain points in the system do affect inflammation, but because the whole picture is not yet understood, they often end up with negative long-term effects on the body, including heart attack, damage to the stomach and intestines, and kidney damage.[18,19,20] Corticosteroids are often prescribed and, while they can quickly reduce symptoms, they have other serious side effects including increased

risk of infection, slow wound healing, increased blood pressure, fluid retention, bone thinning and fractures, weight gain, and mood swings.[21]

Diet has a huge impact on inflammation.[21] Chronic stress has also been implicated in interfering with the body's ability to regulate the inflammatory and the immune responses.[13,78] Through corrections in the diet and lifestyle, we are able to give the body the best possible advantage in preventing and fighting chronic inflammation. By understanding and utilizing this information, we hope that people will take advantage of these effective and safe ways to maintain a long and healthy life.

There are many, many naturally occurring herbs and substances that will reduce chronic inflammation safely. A few of these are discussed below.

1) Diet and Supplements
    a) Essential polyunsaturated fatty acids.
        i) The Omega-3/Omega-6 balance

There are two types of polyunsaturated fatty acids (PUFAs) that the body requires and cannot produce itself, Omega-3 and Omega-6 fatty acids.[22,23] The fact that the body cannot create them means that they are essential in the diet, so are termed "essential" fatty acids.[22,23] Research indicates that many chronic health disorders may be improved by adequate intake of Omega-3 fatty acids and they may prove helpful in protecting against many others.[22]

Omega-6 fatty acids tend to *promote* inflammation and the predominance of these in the Western diet has contributed to the increased incidence many disorders.[22,23] Omega-3 fatty acids have decreased in the Western diet due to agribusiness and food processing in the past 150 years.

The best ratio of Omega-6 to Omega-3 fatty acids is in the range of 1:1 to 4:1, equal amounts to just slightly more Omega-6's than Omega-3's. The Mediterranean diet is a good example. It does not include much meat, which is high in Omega-6 fatty acids and saturated fats that cause cell membranes to become rigid.[24] It emphasizes foods rich in Omega-3 fatty acids including whole grains, fresh fruits and vegetables, fish, garlic and monounsaturated fats (e.g., olive oil, almonds, cashews, macadamia nuts, and avocados) which have no effect on either insulin levels or eicosanoid synthesis.[24,25]

The current ratio of Omega-6's to Omega-3's in the Western diet is about 14 to 27 times more Omega-6's than Omega-3's.[22,23,24] We need to greatly decrease the intake of Omega-6 fatty acids from polyunsaturated fats like soy, corn, sunflower, and safflower oils and increase the intake of Omega-3 fatty acids by eating fatty fish 2-3 times a week or taking Omega-3 supplements. Some supplements are marketed as being balanced Omega 3,6, and 9. There is no reason to take Omega 9 fatty acids because they are synthesized by the body when needed and they are also widely available through dietary sources.[2126, 27] Also, since most people consume far too much Omega 6 fatty acid, adding a supplement adds to the imbalance rather than correcting it. Supplementing with Omega-3 fatty acids is all that is needed in addition to modifying diet and lifestyle to reduce the likely overdose of Omega-6 fatty acids in the body.[21,26]

ii) Omega-3 sources

Fish, mollusk, and plant oils are the primary dietary source of Omega-3 fatty acids. The three types of Omega-3 fatty acids studied to great extent are ALA, EPA, and DHA, but in reality there are several more that are known to date. More types may yet be discovered in years to come.

Common name	Lipid name	Chemical name
Hexadecatrienoic acid (HTA)	16:3 (*n*-3)	*all-cis*-7,10,13-hexadecatrienoic acid
α-Linolenic acid (ALA)	18:3 (*n*-3)	*all-cis*-9,12,15-octadecatrienoic acid
Stearidonic acid (SDA)	18:4 (*n*-3)	*all-cis*-6,9,12,15-octadecatetraenoic acid
Eicosatrienoic acid (ETE)	20:3 (*n*-3)	*all-cis*-11,14,17-eicosatrienoic acid
Eicosatetraenoic acid (ETA)	20:4 (*n*-3)	*all-cis*-8,11,14,17-eicosatetraenoic acid
Eicosapentaenoic acid (EPA)	20:5 (*n*-3)	*all-cis*-5,8,11,14,17-eicosapentaenoic acid
Heneicosapentaenoic acid (HPA)	21:5 (*n*-3)	*all-cis*-6,9,12,15,18-heneicosapentaenoic acid
Docosapentaenoic acid (DPA), Clupanodonic acid	22:5 (*n*-3)	*all-cis*-7,10,13,16,19-docosapentaenoic acid
Docosahexaenoic acid (DHA)	22:6 (*n*-3)	*all-cis*-4,7,10,13,16,19-docosahexaenoic acid
Tetracosapentaenoic acid	24:5 (*n*-3)	*all-cis*-9,12,15,18,21-tetracosapentaenoic acid
Tetracosahexaenoic acid (Nisinic acid)	24:6 (*n*-3)	*all-cis*-6,9,12,15,18,21-tetracosahexaenoic acid

Table courtesy of Reference 28

ALA conversion to DHA and EPA. Alpha-linolenic acid (ALA) is contained in plant sources and must be converted by the body to the Omega-3 long-chain fatty acids Docosahexaenoic acid (DHA) and Eicosapentaenoic acid (EPA). Vegetarians and vegans must consume a lot more ALA to obtain the required amount of Omega-3's and they should be aware of this. Women are able to convert much more ALA to EPA and DHA than men. Healthy young men can convert about 8% of ALA to EPA and 0-4% of ALA to DHA.[29] In healthy young women, approximately 21% of ALA is converted to EPA and about 9% is converted to DHA.[29] Genetic variability also plays a significant part in the ability to generate long chain PUFAs.[29] People with diabetes or schizophrenia may be unable to convert ALA to EPA and DHA, so they should supplement with these direct forms of Omega-3 or make sure they have adequate dietary sources.[22] ALA sources are plant-based oils and since a large quantity is needed to obtain appropriate levels of Omega-3 through the body's conversion, this tends to be fattening. ALA is often easily destroyed by air, heat, and light, so be sure to look for light-resistant containers, refrigerated, and marked with an expiration date.[30]

Best dietary sources of ALA include: [24,30,31,32,33]

Flaxseeds (freshly ground) and flaxseed oil
Canola (rapeseed) oil
soybeans and soybean oil
pumpkin seeds and pumpkin seed oil
perilla seed oil
walnuts and walnut oil
chia seeds
hemp seeds and hemp seed oil
camelina
brewer's yeast.

It is recommended that your primary source of DHA and EPA be consumed directly in dietary or supplement form rather than relying on ALA conversion if you are able to consume fish and fish products.

Best dietary sources of EPA and DHA and other Omega-3's:[24,34]

- anchovies

- caviar
- herring
- mackeral
- sardines
- salmon
- New Zealand green lipped mussels
- organ meats

Please eat responsibly by avoiding endangered fish. Check the Seafood Watch list from the Monterey Bay Aquarium (http://www.seafoodwatch.org/) or the Environmental Defense Fund's Seafood Selector (http://seafood.edf.org/) to learn what fish have been over fished and to learn more about making the best seafood choices. Farmed salmon has been found to contain concentrated levels of several toxins, so it is best to eat wild Alaskan salmon rather than farmed when possible.[35] Eating large amounts of fish/shellfish can expose people to high levels of mercury, so in many cases it is safer to take supplements that are purified forms of Omega-3.[36]

Green lipped mussels (Perna canliculus) have been studied rather extensively because of their unique profile of fatty acids and their history of preventing osteoarthritis in native Maori people living along the coast of New Zealand and who have historically consumed them in large quantities.[37] The stabilized and standardized lipid extract of these mussels is known by the trade names Lyprinol, Seatone, or Omega XL and it contains a unique combination of 90 free fatty acids, sterol esters, polar lipids, and carotenoids.[37,38] This extract contains a potent group of Omega-3 fatty acids that block the metabolic pathway responsible for inflammation in the body.[37] In addition to Omega-3 fatty acids, there are 2 or 3 other fatty acids with unknown chemical structures that interact synergistically.[37,38] And, in addition to being a unique and powerful source of Omega-3 fatty acids, marine mussels contain up to 40 bioactive proteins, peptides, and amino acids provide benefits including antimicrobial (antibacterial and antifungal), antihypertensive, and anticoagulant properties, though it is the extracts from M. galloprofincialis and M. edulis that have been studied.[38] The two most abundant mussel genera are Mytilus and Perna.[38] Mytilus occur in temperate waters of Europe, Asia, and America while Perna species are cultured in the warmer waters of Thailand, Philippines, China, and New Zealand.[38] Mytilus edulis is the common black mussel found in Canada, the U.S., Europe, and Africa. A sauce made from this mussel is used in China for its immune strengthening properties, to treat liver and kidney dysfunctions, impotence, and menstrual problems and in fact, compounds have been scientifically identified which have antifungal and antibacterial properties.[38] Information on Mytilus species is small in comparison to the research on the Perna species especially with regard to inflammation, however it appears to have similar potential.[38]

Lyprinol is well-tolerated and actually has shown protective properties of the gastrointestinal system.[38] Green lipped mussel extracts have been shown to be much more effective at reducing symptoms of osteoarthritis than fish oil and have far less likelihood of gastrointestinal distress.[39] After just 4 weeks of treatment with green lipped mussel oil, subjects had significantly less pain, and continued to feel more relief and less stiffness with increasing time of usage.[39] Subjects using the same quantity of fish oil felt no pain relief and continued to feel no relief with continued treatment.[39] No subjects felt gastrointestinal discomfort while using the mussel oil, while several subjects needed to drop out of the study due to adverse effects from taking fish oil.[39]

Consumer Labs tests ALA supplements (plant sources of Omega-3) in either softgel or liquid form as well as fish-based Omega-3 supplements.[40,41] The tests determine if the oils are fresh or rancid, fail to pass the review due to low levels of the claimed amounts of components, or if they contain dangerous levels of mercury. None of the Omega-3 supplements have tested positive for mercury. This list is renewed frequently as the lab runs new tests. Lyprinol capsules have been studied and found effective in reducing pain and stiffness associated with OA or RA, but topical preparations such as skin cream has also shown to be effective.[38]

iii) ***Omega-3 Dosages***

Dosage depends to a large extent on whether you are taking Omega-3 as a preventive supplement or if you have an inflammatory condition you are treating.[22] A common dosage found in many supplements is 0.18 grams (180 mg) of EPA and 0.12 grams (120 mg) of DHA.[22] Adults should not take more than 3 grams of fish oil and children should take no fish oil supplements without the supervision of a health care practitioner.[22] Excess fish oil can lead to bleeding or bruising and can interact with blood-thinning medications, so caution is advised. If you have heart disease, high cholesterol, or other conditions, you are likely to need more than an average dosage.

Read the Label to understand dosage!

Supplement Facts

Serving Size 1 Softgel

	Amount Per Serving	% Daily Value
Calories	10	
Calories from Fat	10	
Total Fat	1 g	1.5%
Fish Oil (18/12) (M.O.S.T.®)	1.07 g	*
Omega-3 Fatty Acids	350 mg	*
EPA (eicosapentaenoic acid)	180 mg	*
DHA (docosahexaenoic acid)	120 mg	*
Other Omega-3 fatty acids	50 mg	*
Proprietary Antioxidant Blend	3 mg	*
Rosemary extract, ascorbyl palmitate, natural tocopherols		

Percent Daily Values are based on a 2,000 calorie diet.
*Daily Value not established.

Other ingredients: Gelatin, glycerin, purified water, natural lemon flavor.

It's easy to think each softgel contains 1.07 g of Omega-3s. In reality, you are getting 350mg of Omega-3...or 0.35g. The rest is other stuff. You will need to take 7 softgels daily to have an intake of 2.5 g of Omega-3 fatty acids!

Conversion of mg to grams:
1000 mg = 1 gm

Divide the number of milligrams by 1000 to get the number of grams of Omega-3.

Omega-3 fatty acids have been found to be helpful in the **prevention** of:[22]

- High cholesterol
- High blood pressure
- Heart disease
- Osteoporosis
- Diabetes (from fish oil, not plant-based ALA)
- Rheumatoid arthritis (improves symptoms, but doesn't slow progression)
- Osteoarthritis (especially New Zealand green lipped mussel)
- Alzheimer disease
- Dementia
- Macular degeneration
- Menstrual pain

- Colon cancer
- Breast and prostate cancer

Mixed results have been found for preventing the following conditions:[22]

- Lupus
- Depression
- Bipolar disorder
- Schizophrenia
- ADHD
- Psoriasis
- Inflammatory bowel disease (fish oil supplements may cause similar symptoms of flatulence, belching, bloating, and diarrhea
- Asthma

b) Cannabis compounds

Cannabis sativa is a plant that has been recognized since 2000 B.C. in China as an anti-inflammatory agent.[42] Current research is supporting claims by these ancient healers for inflammation relief in cases of neuropathic pain, fibromyalgia, rheumatoid arthritis, celiac disease, colonic inflammation, peritonitis, and many other disorders and diseases involving inflammation.[42] There are two known types of receptors in the body that respond to compounds called cannabinoids, specifically CB1 receptors which are primarily located on nerve cells in the brain, spinal cord, peripheral organs and tissues, and CB2 receptors which are found on white blood cells, in the tonsils, and in the spleen.[43] Stimulation of the CB1 receptors produces psychoactive effects and they play a role in memory, mood, sleep, appetite, pain sensation, and metabolic homeostatis.[42,43,44] Research is investigating these types of cannabinoids in ameliorating metabolic abnormalities including insulin resistance, type 2 diabetes, dyslipidemia (blood lipid imbalances), obesity, and cardiovascular disease.[44] CB2 receptors do not produce psychoactive effects and they are involved in regulation of the inflammatory response.[43,44] Both CB1 and CB2 are important in the immune system and show promise in anti-cancer effects.[43,44]

THC (tetrahydrocannabinol) and CBD (cannabidiol) are two of the approximately 80 cannabinoids identified in cannabis. Both have been researched extensively and have been found very beneficial in a wide variety of inflammatory conditions.[42] CBD is usually the most abundant non-psychoactive cannabinoid in the plant and it appears that it counteracts some of the undesirable effects of THC when ingested together (sedation, psychotropic effects, tachycardia).[42,46] Research is ongoing to study the exact mechanisms by which cannabinoids are used and metabolized by the body in isolation and in combination.[45,46] Of course the pharmaceutical industry is getting involved in generating isolates and synthetic versions of cannabis compounds such as ajulemic acid, but it is our feeling that, as with most natural substances, it is likely safer and more effective to employ the whole plant.[45,47,48] More than 400 trace compounds likely act synergistically so that medical impact is greater than the sum of its parts.[47,48] This synergistic effect is termed the "Entourage Effect" and it is important to note that the various strains of cannabis have very different profiles, so they will result in a variety of physiological and psychological results.[47] The blend of compounds in any CBD product varies depending on the soil, climate, growing conditions, and method of extraction.[48] Ingestion of CBD (as opposed to inhalation) interacts with many other pharmaceuticals by inhibiting the

activity of liver enzymes involved in the metabolism of a wide variety of compounds.[46] Some drugs are deactivated while others become more potent, so it's important to understand what the effect is when CBD is ingested and adjust the timing and dosage of other pharmaceuticals accordingly.[46] CBD is fat soluble and is stored by the body for weeks, so after taking CBD for a while, it is likely that a smaller dose will be required to gain similar benefits.[48] Almost all CBD products contain only trace amounts of THC, they will not produce psychoactive effects, and they are completely legal in all 50 states in the U.S..[48] Industrial hemp is the common source of CBD since marijuana has been largely bred into strains with high THC and very low CBD content.[48,MedicalJane] There is more recent interest in breeding marijuana with low THC and high CBD, so it is likely that more efficient plants will be hybridized in the coming years.[48]

Dosage. The table below is a suggested dosage based on body size and severity of symptoms. After a few days of usage, move up or down from these dosages. It should be noted that pain relief is sometimes experienced within 15 minutes and tapers off over a period of hours, but the long-term anti-inflammatory effects are probably cumulative.

Condition	Person Size 2-25 lbs.	Person Size 26-45 lbs.	Person Size 46-85 lbs.	Person Size 86-150 lbs.	Person Size 151-240 lbs.	Person Size 240+lbs.
Mild Range	4.5 mg	6 mg	9 mg	12 mg	18 mg	22.5 mg
Mid Range	6 mg	9 mg	12 mg	15 mg	22.5 mg	30 mg
Severe Range	9 mg	12 mg	15 mg	18 mg	27 mg	45 mg

Table courtesy of Reference 49

c) Turmeric/Curcumin

Turmeric is a flowering plant in the ginger family. It is used as a food coloring and is a principal ingredient in curry powder and Indian curry dishes.[50] Studies have found that elderly villagers in India have the lowest rate of Alzheimer's disease in the world; less than 1 percent of people over age 65 are affected.[20,51] It is speculated that curcumin, a chemical compound in turmeric, which has powerful antioxidant and anti-inflammatory properties, may play a role because Indians eat turmeric with almost every meal.[20,51] Ayurvedic and Chinese medicine have used turmeric extracts for thousands of years in the treatment of inflammatory conditions such as arthritis, digestive disorders, liver problems, skin diseases, and wound healing.[20,50]

Turmeric has proven to be quite powerful as both an anti-inflammatory and an antioxidant agent.[20,50,52] Research studies have found turmeric may be helpful for the following conditions:[20,50,51,52]

- digestive disorders
- osteoarthritis
- atherosclerosis
- Alzheimer's disease
- cancer
- roundworms and intestinal worms
- liver disease
- bacterial infection
- wound healing
- mosquito repellant
- eye disorder (uveitis, inflammation of the middle layer of the eye)
- multiple sclerosis
- colitis (inflammation of the colon)

The human body does not utilize turmeric easily because the liver filters most of it out, so the addition of a small amount of black pepper, which contains Peperine reduces the solubility of curcumin and the liver is unable to filter it out.[53] Even a little black pepper will increase the bioavailability up to 2000%.[53] Use the whole root (fresh or dried powder) rather than curcumin extract because the root contains natural oils that increase bioavailability by 7 to 8 fold.[53] Bromelain, a protein extract derived from the stems and juice of pineapples, also increases the absorption of curcumin and can be taken to increase the effectiveness of turmeric, but it shouldn't be taken for more than 8-10 consecutive days.[50] In fact bromelain alone appears to be an effective anti-inflammatory agent.[54,55] Bromelain should not be taken by people allergic to pineapples.[54]

Turmeric is commercially available in capsule, fluid extract and tincture forms. It can be consumed as a spice and incorporated into the diet. Turmeric Tea or Golden Milk is a delicious way to enjoy the benefits of turmeric.[56] Many recipes are available online and they often include ginger, which is also a good anti-inflammatory agent.

Dosages. Recommended daily doses for adults are:[50,57]

- Cut root: 1.5 to 3 grams per day
- Dried powder: 1 to 3 grams per day
- Standardized curcumin powder: 400 to 600 mg. 3 times daily

Precautions. Stomach upset may result when the recommended doses are exceeded.[50] Pregnant women and people with gallstones or obstruction of the bile passages should not use turmeric as a medicinal herb, however eating foods with turmeric is safe for pregnant women.[50, 58] Talk to your healthcare provider before taking turmeric if you are taking blood-thinning medications, NSAIDs, or reserpine.[50]

d) Ginger

Ginger has been used as a medicine and in cooking in Asian, Indian, and Arabic cultures for thousands of years to aid digestion, treat stomach upset, diarrhea, nausea, arthritis, colic, and heart conditions.[59] At least 31 gingerol-related compounds have been identified from the crude extracts of ginger and there are at least 14 bioactive compounds.[60] Ginger is an effective and powerful antioxidant and anti-inflammatory agent.[60,61]

It has been found that patients taking daily doses of ginger experienced a significant reduction in pain and swelling from rheumatoid and osteoarthritis.[61,62] Rubbing ginger oil into the painful joint or placing a fresh root in a warm poultice on the painful areas may also provide relief.[59] An extract derived from typical ginger (Zingiber officinale) and galangal (Alpina galangal) a similar root from the same family and used in Asian cuisines, inhibits the induction of several genes involved in the inflammatory response.[63] This is the first evidence that ginger modulates biochemical pathways activated in chronic inflammation.[63]

Dosage. Ginger intake should not exceed 4 gm/day including all dietary and supplemental sources (e.g., fresh ginger juice, extract, or tea, ginger ale, ginger snaps, and gingerbread, as well as Asian or Indian foods).[59] Ginger should not be used by children under 2 years of age.[59] For children older than this, consult your health practitioner for the appropriate dosage.[59]

e) Green and White Tea

Green and white teas contain several compounds with powerful antioxidant properties. White tea is made from either the unopened leaf buds of the tea plant, or the leaf bud and two immature leaves before chlorophyll has formed.[64] Green tea is made from mature tea leaves and they are withered by pan-frying or steaming. Oolong tea is partially fermented, black tea is fermented. Pu erh tea can be either fermented and aged (ripe) or not fermented (raw). Raw Pu erh is a type of green tea.[64,65]

Green tea has more polyphenols than white tea.[64] White tea has higher catechin content than green tea.[64] Both are much more powerful antioxidants than black tea.[66] There is wide variability in this, however because cultivation, processing, handling, and packaging of the tea among commercially available teas is a very major factor in antioxidant properties. Some manufacturers are not particularly careful about storing the tea and maintaining its freshness, so the effectiveness of the tea is reduced significantly.[64] Research suggests that green or white tea may be useful in preventing or treating atherosclerosis, high cholesterol, cancers of many types, inflammatory bowel disease, diabetes, liver disease, and weight loss.[66] Green tea helps to reduce inflammation.[57,.66] 3-4 cups of tea or 300-400 mg of green tea extract is the typical dosage.[57] The caffeine content may cause stomach irritation in some people and the polyphenol content of decaffeinated varieties is unknown.[57]

Adults should drink 2-3 cups of green tea daily (240-320 mg polyphenols) or 100-750 mg daily as standardized green tea extract.[66] Green tea has not been studied in children and is not advised.[66]

f) Boswellia serrata

Boswellia serrata resin, also known as frankincense, possesses anti-inflammatory, anti-arthritic, and analgesic properties.[57,67] It is used in the treatment of degenerative and inflammatory joint disorders. A combination of Boswellia and curcumin has been shown to have superior effect and tolerance over nonsteroidal diclofenac in treating osteoarthritis.[57] Standardized extract of 300-500 mg boswellic acids taken three times daily is typical.[57] Some people may experience stomach discomfort, nausea, acid reflux, or diarrhea.[57]

2) Topical treatments

a) Dimethyl Sulfoxide (DMSO)

DMSO is a natural solvent that is a by-product of the wood industry. It is an effective anti-oxidant, scavenging free radicals, it inhibits the transmission of pain messages by the nerves, and it is anti-inflammatory in people and in animals.[68,69,70,71] It is effective in treating tendinitis, osteoarthritis, rheumatoid arthritis, and many other conditions associated with inflammation.[71,72]

Currently, for human use, DMSO is only available by prescription for the treatment of a bladder condition called interstitial cystitis, though it is used commonly in the alternative health community to reduce pain and inflammation.[68] It is available in gel, cream, and liquid form without a prescription. It has been studied and has been used by veterinarians especially for horses.[73,70] DMSO is absorbed very quickly by the body, including through the skin, by

penetrating cell membranes. Applications of DMSO to the skin often bring quick relief from pain caused by arthritis and connective tissue injury.[70]

The mechanism by which DMSO works is not well understood. One of the characteristics of DMSO is that it magnifies the strength of other chemicals and helps drive them deeper into the body.[68] Because of this, it is sometimes used with pharmaceuticals and chemotherapy to increase their effectiveness, but it's a double-edged sword.[68] It's important to realize that ordinary doses of pharmaceuticals may be too strong when using DMSO and any toxic agents on the skin will be absorbed quickly when DMSO is applied.[70] Apply DMSO with clean hands and on clean skin. In November 1965, a woman in Ireland died of an allergic reaction while taking several other drugs and DMSO. After that FDA closed down all clinical trials of DMSO in the United States and has refused all applications to conduct clinical studies.[69] It is unknown what the allergic reaction was caused by, but there is a suspicion that it was the compounding effect of DMSO with the other pharmaceuticals that may have been the problem.

Use no more than 70% DMSO pharmaceutical grade products.[69] Industrial grade is not pure enough for human use. It is available from many herbalists and online. There is a rose-scented type that helps to mask the garlic-like scent.

DMSO usually causes a garlic-like taste within a few minutes after the medicine is taken or applied. It can cause very bad breath if used for a period of time, which may be required to obtain significant results. DMSO can cause warmth or stinging temporarily when applied topically. Reported side effects include nasal congestion, shortness of breath or troubled breathing, dry skin, skin rash, hives, itching, headache, and burning eyes.[68] Do not use DMSO if you are pregnant, are breast feeding, or you have other health problems such as high blood pressure or blood vessel disease.

b) Arnica

Creams, ointments, or tinctures are typically applied to the skin to reduce pain and inflammation many problems including insect bites, bruises, muscle and tendon soreness, and wound healing.[74,75,76] Arnica also has antimicrobial properties.[75] Arnica, a type of aster, has been used by Native Americans and throughout history. Due to potential toxicity, internal use is no longer advised without medical supervision unless it is taken as a homeopathic preparation which contains minute quantities of the plant.[74,75,76] Use in the mouth is OK as long as none is ingested and it should not be applied to broken skin or open wounds.[75]


Photo courtesy Cepolina.com

Typically, it is Arnica Montana flower-heads that are used in traditional and homeopathic medicine, but the wild plants are protected and commercial growing has had mixed success.[77] Study of the closely related species, Arnica Chamissonis was conducted and were found to have similar, if not superior antioxidant and anti-inflammatory properties.[77] Quercetin is the primary active ingredient, however there is a synergistic effect from the compounds contained in the whole plant including phenolics, flavonoids, and quercetin content.[77] In addition, the growing conditions including the soil, climate, and altitude are all important factors in the concentrations of the various compounds in the plant.[77] Flower-heads yield the highest quercetin content compared to the plant or the rhizomes, and A. chamissonis has three times more than A. montana.[77] It is promising that this closely related plant is likely to be as effective or more

effective as the traditional plant and it does not pose the problems in harvesting or cultivation that A. montana has.[77]

Ointments containing not more than 20-25% arnica tincture or more than 15% arnica oil are recommended.[75] Arnica may inhibit blood clotting, so it should probably not be taken with other anti-coagulants.[74] When taken by mouth, it can be toxic when taken in large amounts.[74] Do not use arnica in any form if you are pregnant or breast-feeding, allergic to ragweed, have IBS, Crohn's disease, or other stomach/intestinal conditions, or if you have fast heart rate or high blood pressure.[74]

3. Stress.

Research has found that prolonged stress results in a chain of events in the body which causes increased inflammation.[78,79] Stress can be of physiological origin, such as illness, it can be induced by social-environmental conditions, or it can originate from thinking or worrying about a stressful incident.[78, 79,80] Regardless of your source of stress, it's important to address it or suffer inflammation. We offer a series of articles for you to learn more about the stress response and how to tame it:

- The Physiology of Stress: http://www.working-well.org/articles/pdf/Stress1.pdf
- The Psychology of Stress: http://www.working-well.org/articles/pdf/Stress2.pdf
- Dealing effectively with life's demands: http://www.working-well.org/articles/pdf/Stress3.pdf

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REFERENCES:

1. *In Search of a Germ Theory Equivalent for Chronic Disease.* By Egger, G. Preventing Chronic Disease 2012(9). Centers for Disease Control and Prevention. http://www.cdc.gov/pcd/issues/2012/11_0301.htm#table1_down
2. **Essentials of Pathology**, by Woolf, Wotherspoon, and Young. Chapter 2: Basic Pathological Processes. *Acute inflammation, healing, and repair*
3. *Disease and Inflammation*, ©2004-20011, Massachusetts General Hospital http://www.gluegrant.org/index.htm
4. *Understanding Autoinflammatory Diseases.* National Institue of Arthritis and Muscoloskeletal and Skin Diseases. March 2010. *http://www.niams.nih.gov/health_info/autoinflammatory/default.asp*
5. *PRICE Injury Protocol.* ©FirstAid4Sport. http://www.firstaid4sport.co.uk/PRICE-Injury-Protocol-AIG_price/
6. *NSAIDs and Musculoskeletal Treatment*, Stovitz, S.D., M.D., and Johnson, R.J., M.D., The Physician and Sportsmedicine, Vol 31, No. 1, Jan. 2003. ©2003 The McGraw-Hill Co. http://www.physsportsmed.com/issues/2003/0103/stovitz.htm
7. *Acute Inflammation: When and How to Treat?* By Schaeffer, A., and el Murr, T. Rev. Prat. Mar, 2003, Vol53(5), pgs 512-515. http://www.ncbi.nlm.nih.gov/pubmed/12722609
8. *Local cooling does not prevent hyperalgesia following burn injury in humans.* Werner, M.U., Lassen, B., Pedersen, J.L., Kehlet, H. Pain. Aug 2002, 98(3):297-303. PubMed, National Library of Medicine http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=pubmed&dopt=Abstract&list_uids=12127031
9. *Does Cryotherapy Improve Outcomes With Soft Tissue Injury?* Hubbard, T.J., and Denegar, C.R., Journal of Athletic Training, Sept. 2004, 39(3):278-279. PubMed, National Library of Medicine,

http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=pubmed&dopt=Abstract&list_uids=15496998

10. *Does Cryotherapy Improve Outcomes With Soft Tissue Injury?* By Hubbard, T.J. and Denegar, C.R. Journal of Athletic Trianing, Sept. 2004, Vol. 39(3), 278-279. http://www.ncbi.nlm.nih.gov/pubmed/15496998?dopt=Abstract
11. *Ice Reduces Edema.* By Deal, D.N., Tipton, J., Rowencrance, E., Curl, W.W., and Smith, T.L. Journal of Bone and Joint Surgery, Sep. 2002, Vol. 84(9), pgs 1573-1578. http://jbjs.org/content/84/9/1573.abstract
12. *Ice Reduces Edema: A Study of Microvascular Permeability in Rats*, Deal, D.N., Tipton, J., Rosencrance, E., Curl, W.W., and Smith, T.L., ©2002, Journal of Bone & Joint Surgery, 84:1573-1578. http://www.ejbjs.org/cgi/content/abstract/84/9/1573
13. *Study thaws mystery of ice's healing properties*, Cramer, B., The Reporter, ©2005, Vanderbilt University Medical Center. http://www.mc.vanderbilt.edu/reporter/?ID=1155
14. *The Role of Nonsteroidal Anit-Inflammatory Drugs in the Treatment of Acute Soft Tissue Injuries.* By Hertel, J. Journal of Athletic Training, 1997, Oct-Dec; Vol 32(4), 350-358. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1320354/
15. *Anti-inflammatory medication after muscle injury. A treatment resulting in short-term improvement but subsequent loss of muscle function.* By Mishra, D.K., Friden, J., Schmitz, M.C., and Lieber, R.L. Journal of Bone and Joint Surgery, American, 1995, Oct. Vol. 77(10), 1510-9. http://www.ncbi.nlm.nih.gov/pubmed/7593059
16. *Inflammation: Chronic and Acute.* By Nordqvist, C. Updated Sept. 16, 2015. ©2004-2016 Medical News Today, MediLexicon International, Ltd. http://www.medicalnewstoday.com/articles/248423.php?page=2
17. *Omega-3s, Inflammation and Tinnitus.* By Keate, B. ©2013 Arches Natural Products, Inc. http://www.tinnitusformula.com/library/omega-3s-inflammation-and-tinnitus/#.VuB0qebpfao
18. *Inflammation*, Condition Care Guide, ©2004 Weil Lifestyle, LLC. http://www.drweil.com/u/Article/A140/
19. *Visible small-intestinal mucosal injury in chronic NSAID users*. Graham, D.Y., Opekun, A.R., Willingham, F.F., and Quereshi, W.A. Clinical Gastroenterology and Hepatology, Jan. 2005, Vol. 3, No. 1., http://www.ncbi.nlm.nih.gov/pubmed/15645405
20. *A Curry to Remember.* Bouchez, C., HealthScoutNews Reporter., http://ayurveda-foryou.com/archive/curry.html
21. *Q & A: Sabotaging Helpful Inflammation?* By Weil, A. 4/19/2013. http://www.drweil.com/drw/u/QAA401270/Sabotaging-Helpful-Inflammation.html#_ga=1.86496539.2016819071.1433728710
22. *Omega-3 fatty acids.* University of Maryland Medical Center. By Ehrlich, S.D. Reviewed 8/5/2015. ©A.D.A.M., Inc. http://umm.edu/health/medical/altmed/supplement/omega3-fatty-acids
23. *Omega-6 fatty acids*. University of Maryland Medical Center. By Ehrlich, S.D. Reviewed on 8/5/2015. ©A.D.A.M., Inc. https://umm.edu/health/medical/altmed/supplement/omega6-fatty-acids
24. **Essentials of Pathology**, by Woolf, Wotherspoon, and Young. Chapter 2: Basic Pathological Processes. *Acute inflammation, healing, and repair*
25. **The Omega Rx Zone**, Sears, B., ©2002 by Dr. Barry Sears, Regan Books/HarperCollins Publishers.
26. *Weil Q&A Library: Need Omega-9 Fatty Acid?* By Weil, A. 12/20/2012. http://www.drweil.com/drw/u/QAA401214/Need-Omega-9-Fatty-Acid.html
27. *Omega 9 Fatty Acids.* By Langtree, I. Revised 1/5/2016. ©2004-2016 Disabled World. http://www.disabled-world.com/artman/publish/omega9.shtml
28. *Omega-3 fatty acid*. Modified March 13, 2016. Wikipedia.com https://en.wikipedia.org/wiki/Omega-3_fatty_acid#List_of_omega-3_fatty_acids
29. *Micronutrient Information Center: Essential Fatty Acids*. Oregon State University. Reviewed May, 2014 by Jump, D.B. http://lpi.oregonstate.edu/mic/other-nutrients/essential-fatty-acids
30. *Alpha-linolenic acid.* University of Maryland Medical Center. By Ehrlich, S.D. Reviewed 6/26/2014. ©A.D.A.M., Inc. http://umm.edu/health/medical/altmed/supplement/alphalinolenic-acid
31. *High ALA Sources.* ©2003-2016 VeganHealth.org. http://veganhealth.org/articles/alasources
32. *Food Sources of Alpha-lipoic Acid*. By Corleone, J. Updated Dec. 18, 2013. ©2016 Demand Media, Inc. http://www.livestrong.com/article/132100-food-sources-alpha-lipoic-acid/

33. *Chia.* Updated Feb. 11, 2016. ©Memorial Sloan Kettering Cancer Center. https://www.mskcc.org/cancer-care/integrative-medicine/herbs/chia
34. *Food Sources of Omega-3 Fats.* Dieticians of Canada. Dec. 6, 2013. http://www.dietitians.ca/Your-Health/Nutrition-A-Z/Fat/Food-Sources-of-Omega-3-Fats.aspx
35. *How Dangerous Is Farmed Salmon?* DrWeil.com Q&A, Published 8/1/2006. ©2016 Weil Lifestyle, LLC. http://www.drweil.com/drw/u/id/QAA324437#_ga=1.57089449.2016819071.1433728710
36. *Methylmercury and omega-3 fatty acids: Co-occurrence of dietary sources with emphasis on fish and shellfish.* By Mehaffey, K.R.Clickner, R.P., and Jeffries, R.A. Environmental Research, Vol. 107(1), May 2008, pgs. 20-29. http://www.sciencedirect.com/science/article/pii/S0013935107002137
37. *A randomized controlled trail investigating the effects of PCSO-524, a patented oil extract of the New Zealand green lipped mussel (Perna canaliculus), on the behavior, mood, cognition, and neurophysiology of children and adolescents (aged 6-14 years) experiencing clinical and sub-clinical levels of hyperactivity and inattention: study protocol ACTRN126100000978066.* By Kean, J.D., Camfield, D., Sarris, J., Kras, M., Silberstein, R., Scholey, A, and Stough, C. Nutrition Journal, vol. 12:100. 2013. http://nutritionj.biomedcentral.com/articles/10.1186/1475-2891-12-100
38. *Bioactive compounds from marine mussles and their effects on human health.* By Frienke, U., Silka, J., and Tasdemir, D. Food Chemistry, Jan. 1, 2014. Pgs. 48-60. http://www.sciencedirect.com/science/article/pii/S0308814613009539
39. *Measurement of pain relief resulting from the administration of Perna canaliculus lipid complex PCSO-524 as compared to fish oil for treating patients who suffer from osteoarthritis of knee and/or hip joints.* By Szechinski, J. and Zawadszki, M. Reumatology, 2001, Vol. 49(4), pgs. 244-252. http://www.termedia.pl/Measurement-of-pain-relief-resulting-from-the-administration-of-Perna-canaliculus-lipid-complex-PCSO-524-as-compared-to-fish-oil-for-treating-patients-who-suffer-from-osteoarthritis-of-knee-and-or-hip,18,17171,1,1.html
40. *Product Review: Omega-3 Fatty Acids (EPA and DHA) from Fish/Marine Oils.* ©2005 ConsumerLab.com, LLC. https://www.consumerlab.com/results/omega3.asp?
41. *Product Review: Black Currant, Borage, Evening Primrose, and Flaxseed Oils: Sources of ALA and GLA (Omega-3 and -6 Fatty Acids).* ©2005 ConsumerLab.com, LLC. http://www.consumerlab.com/results/flaxseed.asp
42. *Cannabinoids, Endocannabinoids, and Related Analogs in Inflammation.* By Burstein, S.H. and Zurier, R.B. American Association of Pharmaceutical Scientists (AAPS) Journal, March 2009, Vol 11(1), pgs 109-119. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2664885/
43. *Cannabinoid Receptors.* By Mandal, A. Updated June 2, 2014. ©2000-2016 News-Medical.net. http://www.news-medical.net/health/Cannabinoid-Receptors.aspx
44. *CB1 receptors: emerging evidence for central and peripheral mechanisms that regulate energy balance, metabolism, and cardiovascular health.* By Cota, D. Aug. 7, 2007. Diabetes/Metabolism Research and Reviews. Vol. 23(7), pgs. 507-517. http://www.news-medical.net/health/Cannabinoid-Receptors.aspx
45. *The Cannabinoid Acids, Analogs, and Endogenous Counterparts.* By Burstein, S.H. Bioorganic & Medicinal Chemistry, May 15, 2014, Vol 22(10), pgs 2830-2843. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4351512/
46. *CBD-Drug Interaction: Role of Cytochrome P450.* By Devitt-Lee, A. Sept. 8, 2015. ©2016 Project CBD. https://www.projectcbd.org/article/cbd-drug-interactions-role-cytochrome-p450
47. *Terpenes and the "Entourage Effect".* ©2016 Project CBD. https://www.projectcbd.org/terpenes-and-entourage-effect
48. *Hemp and CBD FAQs.* By Bluebird Botanicals. ©2016 Gaia Botaicals LLC. https://www.bluebird-botanicals.com/cbd-oil-faq/
49. *Dosage size of CBD? How Much DCB To Take*? ©2016 Wellspring Cannabidiol. http://www.wellspringcbd.com/CBD-Oil-Dosage-Size
50. *Turmeric.* By Ehrlich, S.D. Reviewed June 26, 2014. http://umm.edu/health/medical/altmed/herb/turmeric
51. *Curcumin for Alzheimer's?* ©2016 Weil Lifestyle, LLC. http://www.drweil.com/drw/u/QAA401349/Curcumin-for-Alzheimers.html#_ga=1.86392091.2016819071.1433728710
52. *UCLA-VA study names India dietary staple as potential Alzheimer's weapon.* http://www.eurekalert.org/pub_releases/2004-12/potn-usn122804.php

53. *Why Pepper Bosts Turmeric Blood Levels*. By Greger, M. Feb. 5, 2015. ©2016 NutritionFacts.orghttp://nutritionfacts.org/2015/02/05/why-pepper-boosts-turmeric-blood-levels/
54. *Can Bromelain Ease Your Pain?* By Wong, C. Updated March 19, 2016. ©2016 About.com http://altmedicine.about.com/cs/herbsvitaminsa1/a/Bromelain.htm
55. *Bromelain*. ©2005-2016 WebMD, LLC. http://www.webmd.com/vitamins-supplements/ingredientmono-895-BROMELAIN.aspx?activeIngredientId=895&activeIngredientName=BROMELAIN
56. *Turmeric Tea Golden Milk Recipe*. ©2016 Wellness Mama. http://wellnessmama.com/223/turmeric-tea-recipe/
57. *Natural anti-inflammatory agents for pain relief*. Maroon, J.C., Bost, J.W., and Maroon, A. Surgical Neurology International, Dec. 13, 2010, Vol. 1(80), http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3011108/
58. *Can Herbs Combat Inflammation?* ©2004 Weil Lifestyle, LLC. http://www.drweil.com/u/QA/QA142972/
59. *Ginger*. By Ehrlich, S.D. Reviewed 6/22/2015. ©2016 University of Maryland Medical Center, Alternative/Complementary Medicine. http://umm.edu/health/medical/altmed/herb/ginger
60. *Chapter 7: The Amazing and Mighty Ginger*. By Bode, A.M. and Dong, Z. From Herbal Medicine: Giomolecular and Clinical Aspects. 2nd Edition. ©2011, Taylor and Francis Group, LLC. http://www.ncbi.nlm.nih.gov/books/NBK92775/#ch7_sec4
61. *Ginger has painkilling properties*. Kingsley, D., News in Science. ©2005 Australian Broadcasting Corporation. http://www.abc.net.au/science/news/stories/s433324.htm
62. *Anti-Oxidative and Anti-Inflammatory Effects of Ginger in Health and Physical Activity: Review of Current Evidence*. By Mashhadi, N.S., Ghiasvand, R., Askari, G., Hariri, M., Darvishi, L, and Mofid, M.R. International Journal of Preventive Medicine. April 2013, Vol. 4(Suppl 1), S36-S42. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3665023/
63. *Ginger – an herbal medicinal product with broad anti-inflammatory actions*. By Grzanna, R., Lindmakr, L., and Frondoza, C.G. Journal of Medicinal Food, Summer 2005, Vol. 8(2), pgs. 125-132. http://www.ncbi.nlm.nih.gov/pubmed/16117603
64. *White and Green Teas (Camellia sinensis var. sinensis): Variation in Phenolic, Methylxanthine, and Antioxidant Profiles*. By Unachukwu, U.J., Ahmed, S., Kavalier, A., Lyles, J.T., and Kennelly, E.J. Journal of Food Science, Vol. 75(6), Aug. 2010, pgs. C541-C548. http://onlinelibrary.wiley.com/doi/10.1111/j.1750-3841.2010.01705.x/full#f2
65. *What is Pu erh Tea?* By Yang-chu, Aug. 18, 2015. ©2015 PuerhJunky.com http://www.puerhjunky.com/what-is-pu-erh-tea/
66. *Green Tea*. By Ehrlich, S.D. Reviewed Nov. 6, 2015. ©2016 University of Maryland Medical Center, Alternative/Complementary Medicine. http://umm.edu/health/medical/altmed/herb/green-tea
67. *Boswellia serrata extract attenuates inflammatory mediators and oxidative stress in collagen induced arthritis*. By Umar, S., Umar, K., Sarwar, A.H., Khan, A., Ahmad, N., Ahmad, S., Kativar, C.K., Husain, S.A., and Khan, H.A. Phytomedicine, May 15, 2014, Vol. 21(6), pgs. 847-56. http://www.ncbi.nlm.nih.gov/pubmed/24667331
68. *DMSO and Inflammation*. By Dubois, S. Updated Sept. 23, 2015. ©2016 Demand Media, Inc. http://www.livestrong.com/article/523157-dmso-and-inflammation/
69. *DMSO: Many Uses, Much Controversy*. By Muir, M. ©2001-2014 DMSO Information Center. http://www.dmso.org/articles/information/muir.htm
70. *Information on Dimethyl Sulfoxide (DMSO) Treatments for Horses*. Winter 2000. ©2011 American Horse Rider & Horses and Horse Information. http://www.horses-and-horse-information.com/articles/0200dmso.shtml
71. *DMSO*. Reviewed March 24, 2015. University of Michigan Health System. ©2015 Aisle7. http://www.uofmhealth.org/health-library/hn-2839006
72. *Best Remedies for Tendinitis?* ©2004 Weil Lifestyle, LLC. http://www.drweil.com/u/QA/QA123924/
73. *Anti-inflammatory effects of topically applied dimethyl sulfoxide gel on endotoxin-induced synovitis in horses*. By Smith, G., Bertone, A.L., Kaeding, C., Simmons, E.J., and Apostoles, S. American Journal of Veterinary Research, Sept. 1998, Vol 59(9), pgs. 1149-1152. http://www.ncbi.nlm.nih.gov/pubmed/9736394
74. *Arnica*. ©2005-2016 WebMD, LLC. http://www.webmd.com/vitamins-supplements/ingredientmono-721-ARNICA.aspx?activeIngredientId=721&activeIngredientName=ARNICA

75. *Arnica.* ©2010-2012 Medicine Hunter, Inc. http://www.medicinehunter.com/arnica
76. *Arnica.* By Erhlich, S.D. Reviewed March 24, 2015. © 2016 University of Maryland Medical Center (UMMC). http://umm.edu/health/medical/altmed/herb/arnica
77. *Comparison of in vitro Lipoxygenase, Xanthine Ocidase Inhibitory and Antioxidant Activity of Armica Montana and Arnica Chamissonis Tinctures.* By Gawlik-Dziki, U., Swieca, M., Sugier, D., and Cichocka, J. Acta Scientiarum Polonorum, Hortorum Cultus, 2011, Vol. 10(3), pgs. 15-27. http://wydawnictwo.up.lublin.pl/acta/hortorum_cultus/2011/3/02.pdf#page=7&zoom=auto,-205,842
78. *Chronic stress, glucocorticoid receptor resistance, inflammation, and disease risk.* By Cohen, S., Janicki-Deverts, D., Doyle, W.J., Miller, G.E., Frank, E., Rabin, B.S., and Turner, R.B. Proceedings of the National Academy of Sciences, April 17, 2012, Vol 109(16), pgs.5995-5998. http://www.pnas.org/content/109/16/5995.full.pdf
79. *From Stress to Inflammation and Major Depressive Disorder: A Social Signal Transduction Theory of Depression.* By Slavich, G.M. and Irwin, M.R. Psychological Bulletin, May, 2014, Vol. 140(3), pgs. 774-815. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4006295/
80. *Dwelling on stressful events can increase inflammation in the body, study finds.* Zoccola. Ohio University, Office of Research Communications, March 13, 2013. https://www.ohio.edu/research/communications/zoccola.cfm