

Article Excerpt: Benefits of D-Ribose

From Fatigued to Fantastic! by Jacob Teitelbaum, MD.

Jump-Starting Your Body's Energy Furnaces

CFS and fibromyalgia reflect an energy crisis in your body. Although it can have numerous causes, the energy crisis will then trigger a host of downstream effects, including hypothalamic dysfunction (“blowing a fuse”) which causes multiple other problems including, muscle pain, insomnia, hormonal deficiencies, infections, poor liver detoxification, decreased heart function, and more. Although going after these many triggers and problems is very important, it is also critical to also go to the heart of the problem and treat your body’s “energy furnaces”. Because of this, we will begin our discussion of treatments with those that directly increase energy production.

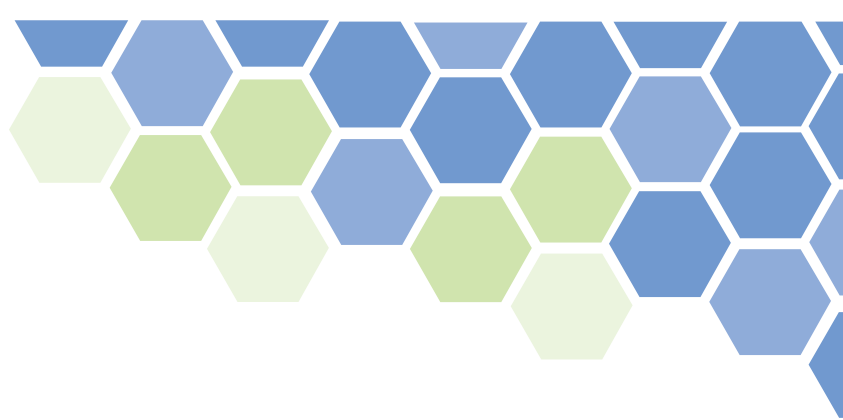
Each cell in your body contains structures called mitochondria. The mitochondria are the tiny furnaces in each cell that produce energy by burning calories. Many problems, including Epstein Barr viral infections, can suppress your energy furnaces.³ In this chapter, I will discuss treatments that can help your mitochondrial furnaces work properly, and explain how you can use this information to feel better.

The role of energy production

We simply can't overcome fatigue if the cells and tissues in our bodies don't have enough energy. Medical research shows there are many conditions that drain energy from the body, leaving us fatigued and with frequent complications such as muscle pain, heart problems, and even depression.

Of course, athletes who participate in high-intensity, endurance type exercise often face the fatigue and muscle pain associated with energy depletion. Typically, a few days of rest will allow an athlete's muscles to recharge with energy. For the rest of us, however, the physiological factors that drain hearts and muscles of energy are not as easily overcome. It is amazing how a special simple sugar, called D-ribose, can help the body restore energy, giving hearts and muscles the power they need to fully recharge, so they can recover from fatigue and chronic muscle pain.

As we age, our bodies go through many changes that affect our ability to efficiently metabolize energy. For some, these changes occur more rapidly and are more pronounced, while for others the impact is seemingly absent. People with fibromyalgia and CFS have almost 20 percent less energy in their muscles than normal, and this lack of energy causes poor exercise tolerance and lack of endurance-making it hard to perform even the most basic of life's daily activities.^{4,5}



The metabolic changes that occur in our bodies over time or with the onset of disease are varied. Many are found to have thickening of the walls of capillaries that feed blood to muscles. These thickened capillary walls make it harder for oxygen to move from the blood to the muscle tissue, reducing the oxygen tension of the muscle and slowing the rate of energy synthesis.^{6,7}

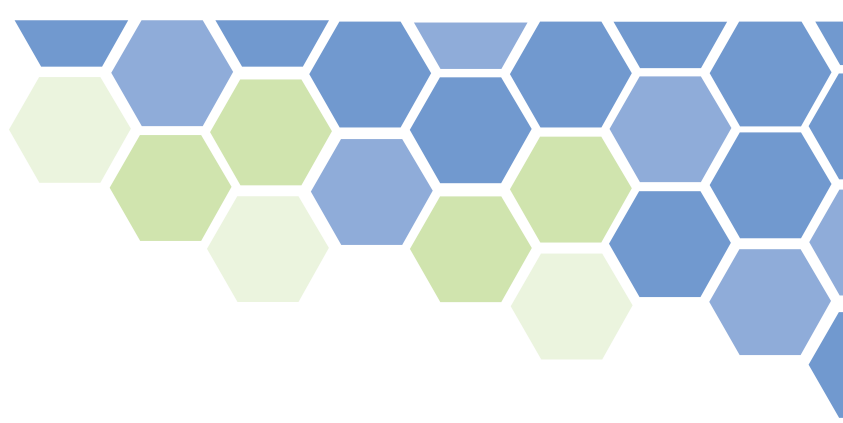
In others, the mitochondrial energy furnaces are found to be defective and cannot keep up with the energy demand of cells and tissues as they work through daily activities. 8-10 Still for others, cells and tissues are deficient in certain nutrients that are needed to process food into energy, leaving the tissues energy starved.¹¹⁻¹³ And in the most difficult conditions, the muscle itself is affected, leaking vital cellular constituents that include energy compounds and the fuels needed to restore energy levels in affected tissues.¹⁴

No matter the cause, the impact of energy depletion is to propel a downward spiral of fatigue, muscle pain, soreness and stiffness that will not stop until the energy in the affected tissue can be restored. As energy is used faster than it can be restored, muscles become more painful, stiff, and fatigued. This causes even more energy to be used as the muscle struggles to recover, causing even more fatigue, soreness and stiffness,¹⁵⁻¹⁷ and the cycle continues. If the conditions leading to energy depletion are not arrested in time, the fatigue can become overwhelming and debilitating-as occurs in CFS/FMS.

The Consequences of Mitochondrial Dysfunction

A large number of clinical findings common in CFS/FMS can be explained by mitochondrial furnace malfunction.

- **Hypothalamic suppression.** Particularly severe changes in the hypothalamus have been seen in mitochondrial dysfunction syndromes.¹⁸
- **Brain fog.** Mitochondrial dysfunction can cause decreases in levels of neurotransmitters in the brain, specifically low dopamine and acetylcholine, and possibly low serotonin.
- **Sensitivities and allergies.** Decreased ability of the liver to eliminate toxins and medications could contribute to sensitivities to both medications and environmental factors.
- **Post-exertion fatigue.** Low energy production and accumulation of excessive amounts of lactic acid in muscles would inhibit recovery after exercise.
- **Poor digestion.** Mitochondrial dysfunction would also cause related to the bowel problems that plague so many people with chronic fatigue and fibromyalgia.
- **Weak immune system.** With problems in the mitochondria, you would expect to see poor white blood cell function and therefore a decreased ability to fight infection.



- **Heart dysfunction.** Based on research by Dr. Paul Cheney, mitochondrial dysfunction may weaken the heart muscle, requiring increased anti-oxidant levels through supplementation.
- **Kidney function.** Poor kidney function resulting from mitochondrial dysfunction may cause a defect in the filtration and detoxification process.

Thus, mitochondrial dysfunction might well be the root cause of—or at least a contributing factor to—the hypothalamic, immune, neurotransmitter, nutritional, detoxification, sleep and other disorders seen in CFS/FMS.

Improving Mitochondrial Function

If mitochondrial dysfunction is an underlying or contributing cause to CFS/FMS, the next question is whether anything can be done to make those cellular energy furnaces work better. A number of natural treatments are available to do just that. Let us now look at some of the treatments that can improve mitochondrial energy production. Let's begin with D-Ribose, the key to energy production.

D-Ribose—The Natural Body Energizer

In looking at energy production, it helps to look at the “energy molecules” such as ATP, NADH, and FADH. These represent the energy currency in your body, and are like the paper that money is printed on. You can have all the fuel you want, but if it cannot be converted to these molecules, it is useless!

For years, I talked about the importance of B vitamins, which are a key component of these molecules. These helped to a degree, but it was clear that a key component was missing. In looking at the biochemistry of these energy molecules, they are also made of two other key components—adenine and ribose. Adenine is plentiful in the body and supplementing with adenine did not help CFS. We then turned our attention to Ribose. Ribose is made in your body in a slow, laborious process and cannot be found in food. We knew that CFS/FMS causes your body to dump other key energy molecules like acetyl-L-carnitine. We then found that the body did the same with Ribose, making it hard to get your furnaces working again even after the other problems were treated.

This was like one of those “Eureka!” moments where things came together. Not having Ribose would be like trying to build a fire without kindling—nothing would happen. We wondered if giving Ribose to people with CFS would jump-start their energy furnaces. The answer was a resounding yes!



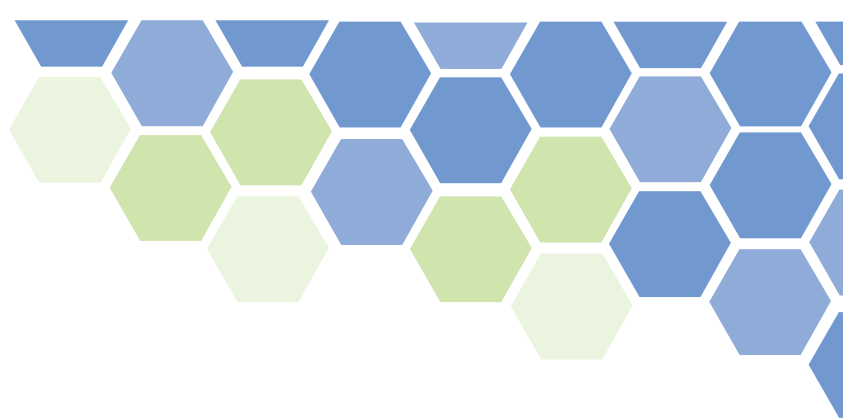
Our recently published study showed an average 44.7% increase in energy after only 3 weeks (improvement began at 12 days) and an average overall improvement in quality of life of 30%. Two thirds of the CFS/FMS patients felt they had improved.¹⁹ Usually a 10% improvement for a single nutrient is considered excellent. A 44.7% increase left us amazed, and I am now recommending Ribose for all of my CFS/FMS patients, for athletes, and any one with pain, fatigue or heart problems. Ribose recently became available (over the counter) to physicians, and is one of the few natural products actually starting with physicians and then moving out into health food stores.

It is critical to use the proper dose for the first 3 weeks, which is 5 grams (5000 mg) three times a day. It can then be dropped to twice a day. I recommend the Corvalen form of ribose as it is the least expensive and highest quality and is packaged with a 5 gm dosing scoop in it. One 280 gm container will be enough to tell you if it will work. Corvalen M (which has ribose plus magnesium and malic acid) is also available, but if you are also taking the Energy Revitalization System vitamin powder (see chapter X), you are already getting the magnesium and malic acid, and the regular Corvalen is a better deal financially. Bioenergy, which makes Corvalen, also conducts almost all of the research on Ribose, knows the most about it, and has outstanding customer service in case you have any questions. Because of its importance, it's worth looking at energy production and Ribose in greater detail. Having had the chance to explore the research and speak with a number of the researchers, below is what I've learned from them.

D-Ribose Accelerates Energy Recovery

D-Ribose (which is what I am referring to when I say ribose) is a simple, five-carbon sugar (known as a pentose by biochemists) that is found naturally in our bodies. But ribose is not like any other sugar. Sugars we are all familiar with, such as table sugar (sucrose), corn sugar (glucose), milk sugar (lactose), honey (predominantly fructose), and others are used by the body as fuel. These sugars are consumed and, with the help of the oxygen we breathe, are "burned" by the body to recycle energy. Because they are used excessively, they can also be toxic, as we've discussed earlier. Ribose, on the other hand, is special. When we consume ribose, the body recognizes that it is different from other sugars and preserves it for the vital work of actually making the energy molecule that powers our hearts, muscles, brains, and every other tissue in the body.

A key molecule, called adenosine triphosphate (or ATP for short), is known as the energy currency of the cell because the amount of ATP we have in our tissues determines whether we will be fatigued, or will have the energy we need to live vital, active lives. Ribose provides the key building block of ATP, and the presence of ribose in the cell stimulates the metabolic pathway our bodies use to actually make this vital compound. If the cell does not have enough ribose, it cannot make ATP. So, when cells and tissues become energy starved, the availability of ribose is critical to energy recovery.



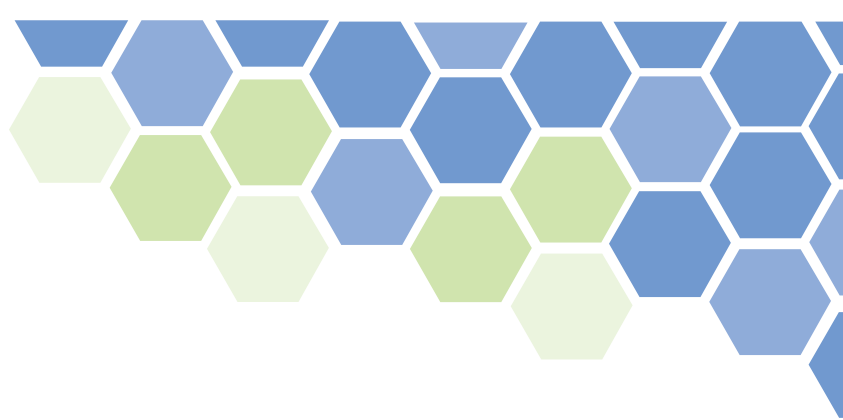
Normal, healthy heart and muscle tissue has the capacity to make all the ribose it needs. When normal tissue is stressed by overexertion, several days of rest will usually allow it to fully recover. The muscle may be sore during recovery, as we frequently see for the three or four days after a hard day of yard work or after a weekend pick up football game, but eventually energy levels will be restored, and the soreness will disappear. But when the muscle is chronically stressed by disease or conditions that affect tissue energy metabolism, the cells and tissues simply cannot make enough ribose quickly enough to recover. Hearts and muscles just don't have the metabolic machinery they need to make ribose very efficiently. The result is chronic, persistent pain, stiffness, soreness, and overwhelming fatigue that may never go away.

The Link Between Ribose, Energy, and Fatigue

Clinical and scientific research has repeatedly shown that giving ribose to energy deficient hearts and muscles stimulates energy recovery. One important study involved healthy athletes participating in high-intensity, endurance exercise over the course of one week. After exercise the energy level in the athlete's muscle was reduced by almost 30%. Giving 10-grams of ribose per day for three days following exercise restored muscle energy levels to normal, while treatment with placebo provided virtually no effect.²⁰ This study clearly showed that ribose stimulated the energy recovery pathways in the body, helping the muscle rebuild its energy supply quickly and completely. Even after three days of rest, muscle that was not treated with ribose remained energy starved and fatigued.

Two very interesting studies in animals showed how dramatic the effect of ribose could be on energy recovery in fatigued muscle. These studies were conducted by Dr. Ron Terjung, one of the top muscle physiologists in the U.S. In their research, Dr. Terjung and his co-investigators found that ribose administration in fatigued muscle increased the rate of energy recovery by 340% to 430%, depending on which type of muscle was tested.²¹ He also found that even very small amounts of ribose had the effect of helping the muscle cell preserve energy, a process known as energy salvage, and the higher the ribose dose, the more dramatic the effect on energy preservation.²² Although this groundbreaking research was done in animals it was instrumental in defining the biochemistry and physiology associated with the use of ribose in overcoming heart and muscle fatigue. But most of us with CFS and FMS are neither top athletes nor animals, so the question remains, "How will ribose affect me?"

Research in Ribose and CFS/FMS began with a case study that was published in the prestigious journal *Pharmacotherapy* in 2004.²³ This case study told the story of a veterinary surgeon diagnosed with fibromyalgia. For months, this dedicated doctor found herself becoming more and more fatigued, with pain becoming so profound she was finally unable to stand during surgery. As a result, she was forced to all but give up the practice she loved.

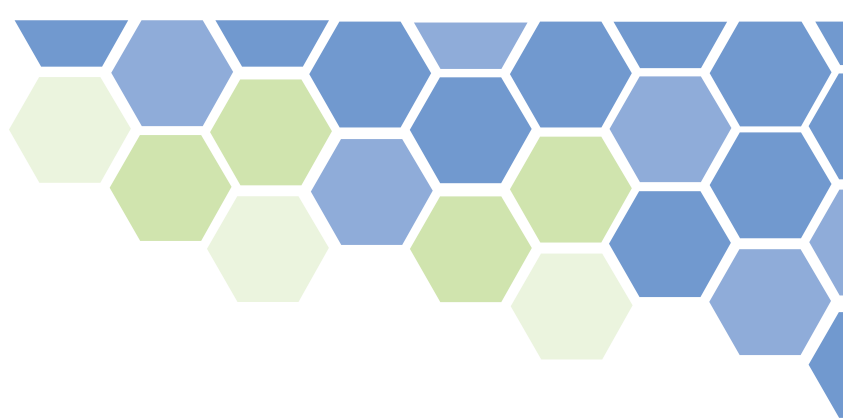


Upon hearing that a clinical study on ribose in congestive heart failure was underway in the university where she worked, she asked if she could try the ribose to see if it might help her overcome the mind-numbing fatigue she experienced from her disease. After three weeks of ribose therapy, she was back in the operating room, practicing normally with no muscle pain or stiffness, and without the fatigue that had kept her bedridden for many months.

Being a doctor, she was skeptical, not believing that a simple sugar could have such a dramatic effect on her condition. Within two weeks of stopping the ribose therapy, however, she was out of the operating room and back in bed. So, to again test the theory, she began ribose therapy a second time. The result was similar to her first experience, and she was back doing surgery in days. After yet a third round of stopping (with the return of symptoms) and starting (with the reduction of symptoms) the ribose therapy, she was convinced, and has been on ribose therapy since that time.

I found this report intriguing and decided to design the larger study in patients with fibromyalgia or chronic fatigue syndrome which I began to discuss earlier. Along with two research collaborators, I recently published a scientific paper describing the results of this research. The study we designed was intended to determine whether or not ribose would be effective in relieving the overwhelming fatigue, pain, soreness, and stiffness suffered by patients having this debilitating condition. Our study included 41 patients with a diagnosis of fibromyalgia or chronic fatigue syndrome who were given ribose at a dose of 5-grams three times per day for an average of three weeks. We found the ribose treatment led to significant improvement in energy levels, sleep patterns, mental clarity, pain intensity, and wellbeing. Of the patients participating in the study, 65.7 % experienced significant improvement while on ribose, with an average increase in energy of 44.7% and overall wellbeing of 30%- remarkable results from a single nutrient! ¹⁹ The only significant side effects were that two people felt too energized and hyper/anxious on the ribose. This is simply dealt with by lowering the dose and/or taking it with food.

To further validate these findings, we are currently conducting a much larger placebo controlled study, and hope to have the results published in the coming year. Interestingly, one of our study patients had an abnormal heart rhythm called atrial fibrillation. Ribose is outstanding in the treatment of heart disease as well, because it restores energy production in the heart muscle. Because of this, it was not surprising that this man's atrial fibrillation also went away on the ribose, and he was able to stop his heart medications as well! Because of its importance and the research showing marked heart muscle dysfunction (because of low energy) in CFS, let's look at Ribose and the heart in more detail.



Ribose and the Fatigue Associated with Heart Disease

Decades of research have shown that ribose has a profound effect on heart function in patients with congestive heart failure, coronary artery disease, and cardiomyopathy (a weakened heart muscle). Like the muscles in patients with fibromyalgia, sick hearts are energy starved.²⁴ This energy deprivation keeps the heart from relaxing between heartbeats, making it impossible for the heart to completely fill with blood²⁵ (it surprisingly takes more energy for the heart muscle to relax than contract). Because the heart does not fill completely, less blood is pumped to the body with each heartbeat. The heart then gets stiff, and it strains to contract. Ultimately, the heart becomes enlarged, a condition known as hypertrophy, and it is unable to pump normally.

You can compare this to the effect of weight training on the muscles in the bicep of the upper arm. Over time, weight training against more and more weight makes the muscle larger and harder. Similarly, when the heart becomes stiff it is forced to contract against more and more pressure, making the heart muscle grow. While in the case of the bicep this may be a desirable outcome, in the heart it can be deadly. In contrast to the biceps muscle, hearts must remain supple so they can fill properly and empty fully with each contraction. If hearts cannot pump normal volumes of blood, muscles of the arms and legs and brain tissue become oxygen starved. The result is fatigue, pain on standing or walking, loss of interest in, or the ability to perform any physical activity, brain fog, and depression. In the end, the heart cannot pump enough blood to even supply itself with live-giving oxygen and a heart attack can be the result.

Using ribose to restore the energy level in the heart allows it to fully relax, fill, and empty completely to circulate blood to the outer reaches of the body.²⁶ Circulating more blood means muscles in the arms and legs, and the tissues of the brain, get the oxygen they need to function normally. This result was made evident in several important studies in patients with congestive heart failure and angina.

In one study conducted at the University of Bonn in Germany, patients with congestive heart failure were treated with either 10-grams of ribose or a sugar placebo every day for three weeks.²⁷ They were then tested for heart function, exercise tolerance (a measure of fatigue), and quality of life using a questionnaire designed for this purpose. In this study, ribose therapy had a significant effect on all measures of diastolic heart function, showing that increased energy in the heart allowed the heart to relax, fill, and pump more normally. Patients in the study were also much more tolerant to exercise when they were on ribose, and, through their responses to the questionnaire, showed they had a higher quality of life as a result.

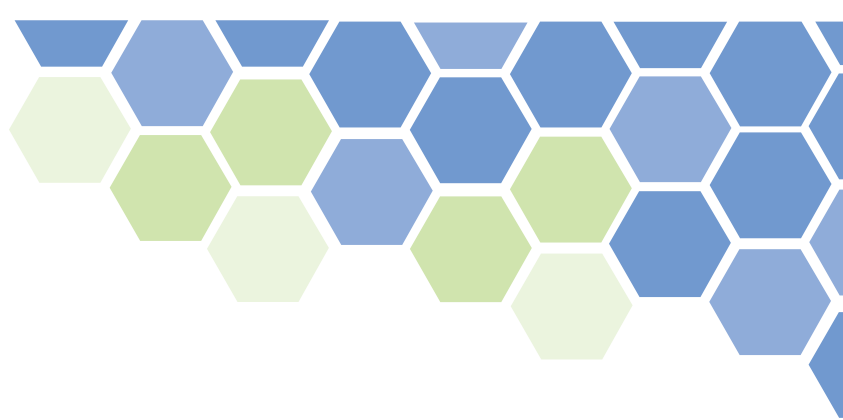


Two additional studies went on to help explain how ribose therapy in congestive heart failure may affect fatigue and exercise tolerance.^{28,29} These studies showed that ribose treatment increased ventilatory and oxygen utilization efficiency, a medical way of saying that the patients were able to breathe better and use the oxygen they inhaled more efficiently. Improving the patient's ability to use oxygen means more oxygen is available to go into the blood and out to the tissues. Having more oxygen available allows the muscle to burn fuel more efficiently, helping it keep pace with its energy demand. The result is less fatigue, a greater ability to tolerate exercise, and a higher quality of life. An added benefit to improving ventilatory efficiency is that ventilatory efficiency is a dominant predictor of mortality in congestive heart failure. Increasing ventilatory efficiency with ribose therapy is, therefore, a direct correlate to prolonging life in this patient population.

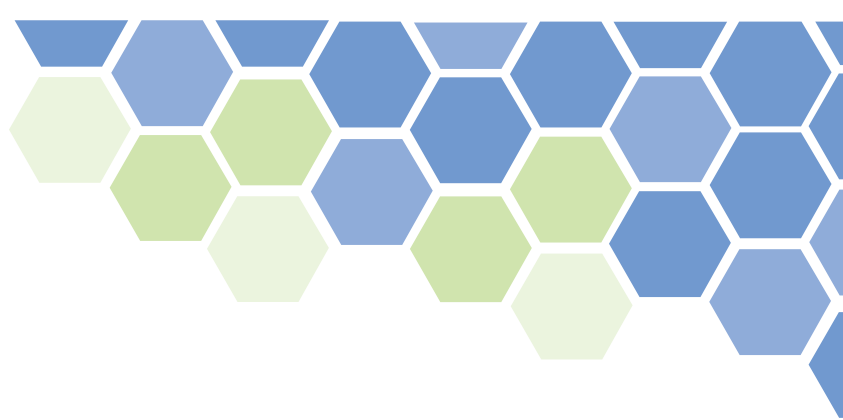
There are very few nutritional therapies that can legitimately boast of having this profound of an effect on the tissues they target. None, other than ribose, can claim such an effect in cell or tissue energy metabolism. Ribose is a unique and powerful addition to our complement of metabolic therapies in that it is completely safe, proven by strong, well designed clinical and scientific evidence, natural, and fundamental to a vital metabolic process in the body.³⁰⁻³⁴ I have added a few more study references for those who would like more information about ribose.³⁵⁻⁵⁶

Ribose regulates how much energy we have in our bodies, and for those suffering from fatigue, muscle soreness, stiffness, and a host of related medical complications, the relief found in energy restoration can be life changing. This is why I recommend that all CFS/FMS patients begin with D-Ribose 5 grams (1 scoop of Corvalen) 3 x day for 2-3 weeks then twice a day. It is critical to take the 3 scoops a day for the first few weeks to see the optimal effects. Although many of the treatments in this book take 6-12 weeks to start working, most people feel the difference by the end of a single 280 gm container. For the few who don't, retry it again once you are 12-16 weeks into the other treatments well discuss. You'll be glad you did.

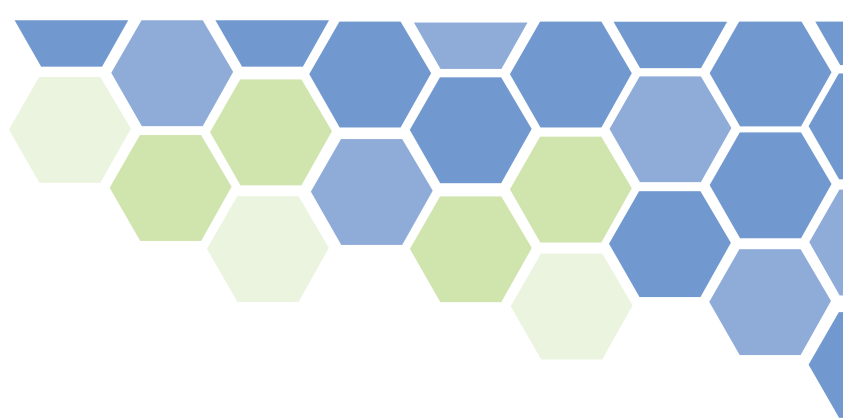
Although Ribose is the most promising energy nutrient, others are also worth looking at as well. Most of these only need to be taken for 4-9 months, though some people choose to take them longer (I take my Ribose every day even though I feel great. It makes me feel even better!). You will know by how you feel on them.



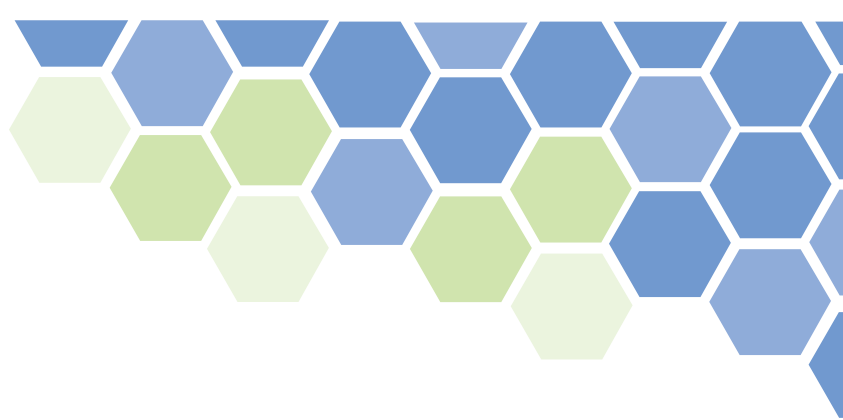
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