# GETTING RADICAL

## ANTIOXIDANTS AND FREE RADICALS: MUCH ADO ABOUT NOTHING?

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You've been hearing about it for years. Free radicals are molecular villains responsible for everything from aging to heart disease to cancer, and that's not even the tip of the iceberg. Go to the supermarket or health food store and you'll find bottles upon bottles of antioxidant supplements. Then you go home, turn on the television, and there's the newscaster reporting on the dangers of free radicals and how antioxidants are the solution, but then the next day's news will report on a prestigious university's study about how antioxidant supplements actually cause cancer. You're inundated with reports, findings, solutions, confusion. What to do? The first step is to take an unbiased look at the research data and build upon that. Let's get to work!

## DEFINING THE RADICAL

By textbook definition, free radicals are molecules that have one or more unpaired electrons in their outer orbit; in this state they're highly reactive—and destructive—to everything in their path.[4] That definition is fine for the biochemist, but what does it mean in practical terms?

Your body survives by breaking down the food you eat. Carbohydrates convert to glucose, protein to amino acids, and fat to fatty acids. In these elemental states they're combustible fuels readily

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burned, or oxidized, by an assembly line of cellular reactions. The released energy produces adenosine triphosphate (ATP), your body's chemical currency and a major source of energy for your muscles.

Now, just like wood in a campfire, food must have adequate oxygen in order to burn completely. In your cells, the mitochondria are metabolic fire pits that must have oxygen to stoke the furnace. However, sometimes too much oxygen gets sent down the conveyor belt, forcing some of it to fall off the assembly line. When this happens, the "mishandled" oxygen becomes highly volatile, highly reactive, creating what are called free radicals. They bounce around inside the cell, wreaking havoc on many cellular structures, particularly the cell wall, including the muscle cell wall.

The above discussion addresses oxygen-induced free radical production as it applies to aerobic activities. Being a strength and power athlete who exercises at high, anaerobic intensities, you might think you're in the clear. But radicals are produced under anaerobic conditions, too. According to Priscilla Clarkson, PhD, professor of exercise science at the University of Massachusetts in Amherst, "There are other ways to generate free radicals than just through oxidative metabolism [aerobic exercise]. They can also be generated by lactic acid." And as most of you know, lactic acid production is fairly common among power athletes due to the type and duration of your activity.

Sounds nasty, but the truth is that free radicals are a normal part of your body chemistry. In fact, they even have beneficial functions that keep you healthy.[6] For example, white blood cells give off free radicals, which attack viruses, bacteria, fungi, and other foreign invaders, thus weakening them enough to be destroyed by your immune system.[4, 7] You're probably breathing a sigh of relief. But before you get too comfortable, remember that too much of a good thing isn't a good thing. Free radicals must be kept in check by their big brothers—the antioxidants.

## INTERNING RADICALS

Antioxidants encompass a wide range of muscle enzymes and nutrients that "quench" free radicals. They work by chemically stabilizing the free radicals, effectively stopping their destructive course. Enzyme antioxidants can be synthesized in the body, but nutritional antioxidants like vitamins A, C, and E must be supplied by the diet. An important key is that most of you probably get adequate quantities in your diet. Deficiencies are rare in developed nations, and research shows that

FREE RADICALS SHOULD NOT BE A BIG CONCERN TO ANAEROBIC POWERHOUSE MICHELLE AMSDEN.

even athletes with suboptimal intakes of dietary antioxidants still get enough to adequately protect against free radical damage.[11]

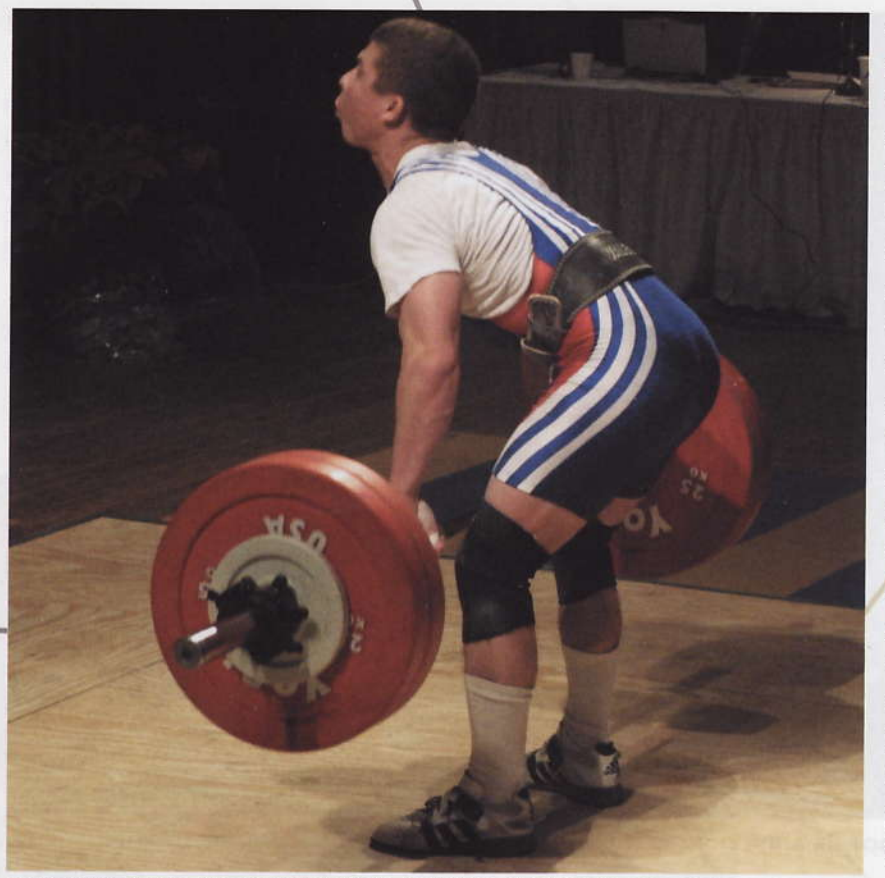
In the sports science arena, considerable research has been conducted to evaluate the effects of antioxidant supplements, over and above the normal dietary intake, on sports performance and muscle damage.

## THE EXERCISING RADICAL AND ANTIOXIDANTS

OK, so free radicals are a normal part of human metabolism. Let's take it one step farther. We know that both aerobic and anaerobic exercise stoke your metabolic furnace and crank up energy production, which, in turn, yields a normal increase in free radical production. Maybe now you're wondering if exercise has an "evil side." Not so fast. You see, basically everything in our bodies happens for a reason, and most of these "happenings" are anything but damaging, despite what some vitamin manufacturers would have you believe. That said, studies have shown that although exercise can increase free radical production, increases in antioxidant enzymes occur concomitantly in trained athletes.[2, 3] This means the trained athlete is more efficient than the nonathlete at trapping free radicals and minimizing whatever damage might otherwise occur. But if you're essentially an untrained weekend warrior, you'll likely have lower levels of antioxidant enzymes and you're therefore subject to more damage from radicals due to lower radical-quenching capacities.[1, 9]

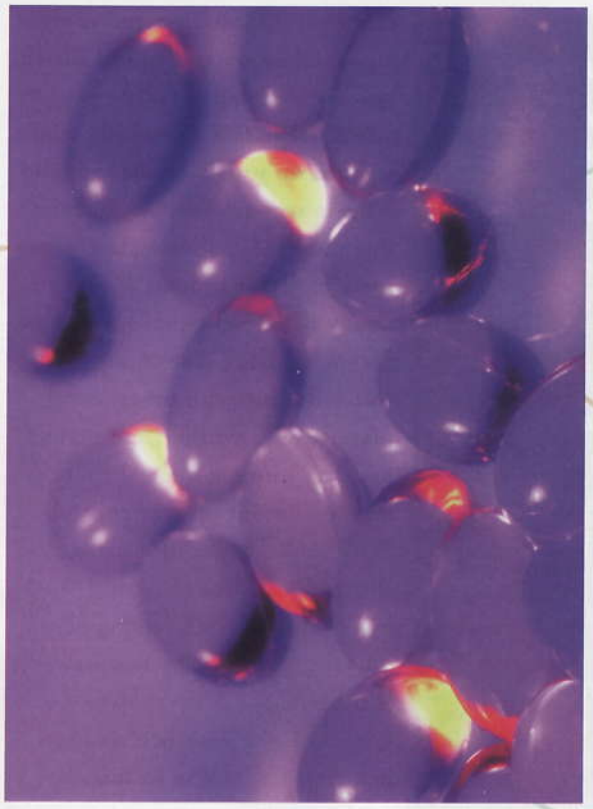
So what's the bottom line? Will extra antioxidants stave off free radicals and reduce muscle cell damage? There's plenty of research out there on aerobic endurance athletes, but how much of it applies to you as a power athlete? Not much. As of this writing, few studies have investigated antioxidants and resistance training.

Niels Ørtenblad, PhD, and colleagues at Odense



IT'S UNLIKELY THAT THE TRAINED ATHLETE NEEDS TO WORRY ABOUT FREE RADICALS DAMAGING MUSCLE CELLS.

University in Odense, Denmark, had 16 subjects (8 jump-trained, 8 untrained) perform six bouts of 30-second continuous jumping separated by two-minute rest intervals.[9] They found that trained athletes had higher protective muscle antioxidant enzymes and lower levels of creatine kinase (a muscle enzyme that leaks into the blood when muscle cells are damaged). Interestingly, there were no significant differences in malondialdehyde levels (a marker of free radical damage on muscle cell wall membranes). These results suggest that mechanisms other than free radical generation are responsible for exercise-induced muscle cell damage. Simply put, it appears possible to experience muscle cell damage by means other than free radicals—for example, mechanical stress on the muscle. This also underscores the importance of regular training and your body's ability to adapt and compensate for free radical stressors, independent of antioxidant supplementation. In a different study conducted by Jeff McBride, PhD, and colleagues at Pennsylvania State University's Noll Physiological Research Center in University Park, recreationally weight-trained men were supplemented with 1,200 IU of vitamin E followed by three circuits of eight weight training exercises with 2-, 1.5-, and 1-minute rest periods between successive circuits.[8] Creatine kinase levels went up in both groups; however, lower amounts were observed in the supplemented group compared to those on the placebo. Malondialdehyde levels significantly increased in both groups, with no differences between groups. These results also suggest that resistance exercise produces free radicals and that vitamin E supplementation may moderate muscle tissue damage.On the surface, it seems possible that vitamin E supplementation effectively quenches free radicals, which could reduce muscle damage. However, there may be more to this than meets the eye. According to Allan Goldfarb, PhD, professor of exercise and sports science at the University of North Carolina in Greensboro, "If you pre-treat athletes with vitamin E, which acts as a membrane stabilizer and antioxidant, and measure creatine kinase in the blood after eccentric exercise, its levels decrease. Thus, some have indicated that vitamin E prevents muscle damage and protein leakage. However, these are two separate processes. They've been shown to be independent and, at times, can be separated. So it's possible to stabilize the membrane to prevent creatine kinase levels from increasing, but still have muscle damage."



## THE FLY IN THE OINTMENT

You can find studies arguing for or against the efficacy of antioxidant supplements. But remember that the results are only as good as the methods employed.[5] Status of subjects (training level and age), exercise (type, intensity, duration), type of antioxidant given, and nutritional status are just some of the factors that can confuse the research outcome.[5, 10] On top of all this, you should know that it's very difficult to accurately measure free radicals or indicators of their damage. A variety of fancy biochemical tests can be done, some more accurate than others. The caveat is that most of these are indirect measures that force scientists to extrapolate and hypothesize what's actually happening at the cellular level.

All this confusion makes you wonder what in the world to do — just forget it all together? But we need not be so hasty in our judgment. We know that both aerobic and anaerobic types of exercise induce free radicals and that they must be kept in check. Regular exercise, coupled with a healthy diet, appears to offer protection against the deleterious effects of free radicals. Sometimes strenuous exercise produces more free radicals than our bodies can handle. Thus, supplementation may be warranted. However, this issue is clouded by considerable variability and limitations in experimental methods and chemical analyses, which leave us wondering how much merit these recommendations have. Clarkson probably sums it up best: "For both resistance and aerobic exercise, I think that the body can naturally take care of what's produced, given that the diet is adequate in antioxidants. Taking a multivitamin/mineral supplement with no more than the recommended dietary allowance seems a conservative yet prudent approach. Taking more than that is probably not necessary and could do more harm than good." PP

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