A User's Guide to Vitamin C in the Context of COVID-19

Amory Lovins Follow
Mar 29 · 14 min read ★

by Amory B. Lovins and Eric Rasmussen MD

Getty

This document supplements the authors' article Don't Just Avoid the Virus — Defeat It by Strengthening Your Immunity, which should be read first.

Don't Just Avoid the Virus — Defeat It by Strengthening Your Immunity

Simple, science-based steps to boost your immunity can help prevent or moderate infection — including challenging the...

medium.com

. . .

Lovins's 16 March 2020 semitechnical talk "Slowing Contagion" documented the reported value of taking oral vitamin C to help prevent COVID-19 infection or a similar respiratory RNA viruses. If you do get such an infection, medical evidence shows that adequate oral *l*-ascorbate can make your illness shorter and milder, with less chance of progressing to severe or critical pneumonia. Intravenous vitamin C in doses typically of tens of grams or more has been found safe and effective in treating such pneumonias in US and Chinese Intensive Care Units, along with oral vitamin C in preventing or moderating them (see references on slide 12 of the PDF). Two new papers there show ~2 grams per day (g/d) of vitamin C can shorten ICU stays 8.6%, and 1–6 g/d shortens average ventilator duration, for patients needing over ten hours of it, by 25%. That's a lot of cheap "virtual ventilators" to help fill the vast gap between how many real ventilators we have and how many we may soon need.

But not all vitamin C is created equal, so this note summarizes some considerations for buyers and users of this common supplement. Like all dietary supplements, it is not regulated by the US government and has not been evaluated by the FDA as a way to prevent, treat, or cure any disease. Lovins is not a physician and cannot give medical advice; Rasmussen is and can. This information is no substitute for the advice of your own physician or other healthcare professional, and can usefully update what they may know from older sources. The suggestions in Lovins's 16 March talk, based on his study of the medical and scientific literature and on discussions with physicians, were firmly endorsed in Rasmussen's 18 March talk and Q&A. We have therefore coauthored this

note. We have no financial interest in, or other conflict of interest related to, any person, product, or firm mentioned here; we're simply trying to bring you the best science-based understanding we've been able to find. Please send any comments to us at ablovins@rmi.org.

What kind of vitamin C should you take?

There are basically three kinds of vitamin C, whose chemical name is "ascorbate" or "ascorbic acid" or some salt form like "sodium ascorbate" or "calcium ascorbate." There appear to be no published data showing how much of the vitamin C on the market is of which kind. Only the third kind is labelled specifically enough so you can know which kind it is.

The first kind of ascorbate, made synthetically, is a 50/50 mixture of two varieties that have the same molecular composition but different "twists" that are mirror images of each other. These two subtly different shapes behave differently in the body. Your body needs and can use "levulo-" or "levo-" or "*l*-" ascorbate (all the same molecule). In contrast, it does not need and cannot use "dextro-" or *d*-ascorbate (only 5% as effective in guinea-pigs). Indeed, *d*-ascorbate is worse than useless because it irritates the gut (promoting hyper-motility that can cause other problems), so you can tolerate less of the beneficial *l*-ascorbate. This synthetic *d*- and *l*-ascorbate mixture may be what you get when you buy "vitamin C," even if it's labeled "pure" or the like. It would be half as effective as pure *l*-ascorbate if not for the *d*-ascorbate's irritant properties. Unfortunately, you can't tell whether "vitamin C" is of this kind without an independent and sophisticated chemical analysis, which to our knowledge no manufacturer offers.

The second kind of ascorbate is fermented by a special microorganism from glucose into *l*-ascorbate, but without excluding air, therefore oxygen, from the reactor vessel or from later processing and packaging steps. Many of vitamin C's benefits come from its being a strong "antioxidant" that combats oxidative stress in your body and mops up damaging "free radicals" that damage your cells. A strong antioxidant tries hard to combine with oxygen. But when manufactured in air, rather than being protected by an inert gas like nitrogen, vitamin C reaches your lips already partly oxidized (damaged), making it that much less helpful. Thus even if the label says "*l*-ascorbate," you can't tell whether it's partly or even largely oxidized ascorbate: one analyzed sample was one-fourth half-oxidized (to a molecule called DHA), one-half fully oxidized (to DKG, an irritant), and

only one-fourth *l*-ascorbate. Analyses are unavailable for other products made by this second method, so nobody knows how oxidized other brands are. Yet this second manufacturing process, making *l*-ascorbate that's damaged to some unknown degree, is commonly used because it's many times cheaper than keeping air away. Without actual chemical analysis, you can't tell. Ascorbate is also degraded by light or excessive heat.

The third way to make vitamin C is like the second but is "anerobic" — excluding air in fermentation, processing, and packaging, so what reaches your lips is *unoxidized* ("fully reduced") *l*-ascorbate. That's the recommended kind, even though it costs much more to make.

Such products should and generally do have one further attribute that's important because ascorbic acid is, well, acid — pH ~3.5 — which is fine in your stomach but not in your cells. To absorb well into your gut and go to where it's needed, it must be "buffered" by combining the ascorbate part of the molecule not with hydrogen (making ascorbic acid — for cells that already tend to be too acidic) but with other atoms you also need, ideally in the right mixture. (Sodium isn't the most desirable choice either, because most of us already get too much sodium in our diets, raising our blood pressure.) Some vitamin C made by any of the three methods is buffered, some isn't; some more thoughtfully, some less.

Together, these issues with conventional mass-market vitamin C can make it at least two, and plausibly four or more, times *less effective* than pure *l*-ascorbate that is fully reduced and fully buffered. Inferior C is cheap on the shelf but not in your cells. Personally, Lovins takes 13–20 grams a day (1 gram = 1,000 milligrams), a few dollars' worth per day, of high-quality vitamin C — triple-crystallized under nitrogen to produce unoxidized pure *l*-ascorbate (no *d*-). Protected from air throughout, it's also buffered with potassium, magnesium, calcium, and a little zinc in a physiologically appropriate ratio. It's called PERQUE *PotentC Guard* and comes in 1-gram tabsules, or as a powder you can mix in water, juice, applesauce, cereal, etc. Lovins gets his from www.vitamins-today.com or 800–806–8671; many other vendors are online if you search on the product name. Searching on "l-ascorbate AND fully reduced AND buffered" returns such competing brands (listed alphabetically, not researched) as www.alkalineforlife.com, www.beyondhealth.com, www.pure-essentials.com, www.tnawc.com, and www.vitaminc.healthrangerstore.com.

Some brands include extra ingredients — stabilizers, binders, fillers, colorings, flow agents, etc. — that may be undesirable, so read labels carefully. One brand of bulk vitamin C was even found to contain toxic methanol. So seek reputable firms with serious quality control and culture grounded in science.

Next, having chosen a source you like,…

How much vitamin C should you take?

Practitioners of "orthomolecular medicine," which helps supply the body with the right amounts of substances it needs but can't make (such as vitamin C), have been using oral vitamin C for over 70 years to try to make various illnesses less likely and less severe. Since the 1970s, they have typically recommended, against viral infections like colds and flu, trying 3–5 grams of vitamin C per day. Everyone needs vitamin C, but those needs differ widely between individuals, over time, and with your state of health. A crude approximation to how much you need is: two grams per day less than causes diarrhea. This "titration to bowel tolerance" means simply raising the daily dose until you start to get diarrhea (or at least loose stool), then reducing the dose by two grams per day. However, the most accurate way to calibrate to your individual need for vitamin C is called C-Cleanse, carefully described here. It uses the powdered form of PERQUE *PotentC Guard*, water, a teaspoon (to measure "rounded teaspoons" of about 3 grams), and a watch or clock to time your doses. You do it first thing in the morning, on an empty stomach, and you'll need to use the toilet, perhaps over several hours. How this test evolved is summarized here. The healthier you become, the less vitamin C you'll need.

Why take *more* than 3–5 grams a day? Because that's the *minimum* claimed to lower substantially your risk of viral infection. But you'll be even better protected if you take more, up to your individually required level (or, if you don't do a C-Cleanse calibration, then to bowel tolerance). As you'll see in the C-Cleanse instructions, the ideal dose is three-fourths of the dose that makes your bowel evacuate in a "whoosh."

Further, for most of us, the physical, chemical, and mental insults that our bodies experience nowadays are considerably greater than they were in the 1970s, so the dose we need to offset that oxidative stress may well be several times what it was then. This is consistent with C-Cleanse results reported over the years to its inventor and the PERQUE

supplements' developer, Russell Jaffe MD PhD (biochemistry). (Full disclosure: he's Lovins's longstanding personal medical advisor and a friend of both of us.)

Importantly, too, when you're sick or fighting off illness, your body needs more, often *much* more, vitamin C: tens of grams per day is not uncommon. So if you get sick, don't restrict yourself to your calibrated dose; you may well need to take *multiple grams per hour* to meet your cells' greatly heightened need for this vital nutrient. For example, one expert recommends a 10-g loading (if not already close), then at least 2 g per hour. Your bowel tolerance will rise with your need. (People who think there's no point taking so much because it'll just give you expensive urine, but not usefully raise the levels in your tissues, are out-of-date and should read the nerdy note below about ascorbate saturation.)

So in summary, the orthomolecular physicians say that a *minimum* of 3–5 grams a day of a high-quality form of oral vitamin C, such as *PotentC Guard* or similar product, should give you considerable protection (though with much individual variation) against viral infections, and if you do catch one, should make it briefer, milder, and less likely to become serious. (As Lovins's 16 March 2020 talk documented, the standard metastudy of clinical trials concurs with the last three benefits but not the first, preventive, one — because its trials used doses that were too small and infrequent, and perhaps also of inferior chemical quality, so they *did not actually test* the orthomolecular claims — as that metastudy's authors explicitly agreed.)

Normal pharmacological practice would be to reduce **children's** doses in proportion to their body weight compared to a 70-kg (150-pound) average adult. We don't know what the science says about whether infants should be given vitamin C (or if so, how much), but your pediatrician may find this note useful background in advising you. Same if you are pregnant or breastfeeding. These are important examples of when you *must* consult experienced, knowledgeable, up-to-date medical professionals.

How often should you take vitamin C?

This crucial point is often overlooked. Your body uses and eliminates vitamin C very quickly. It's often half-gone in a half-hour to a few hours. Therefore, if you take it just once or twice a day, most of the time your tissues won't have much, so you'll get far less benefit. Orthomolecular physicians, following this evidence and their clinical

experience, tend to recommend dividing your vitamin C in doses every few waking hours (many suggest 3 hours or less) — and *hourly* if you're sick. If you're well, it's convenient to swallow a gram (or two or three or whatever your own calibration and state of health indicate) at breakfast, mid-morning, lunch, mid-afternoon, dinner, and bedtime. If you feel particularly at risk, you can usefully add a gram or two extra if you get up in the night. Vitamin C taken within bowel tolerance is considered very safe — *except* for a few specific groups of people. They are:

Who should *NOT* take big doses of vitamin C?

If you have diabetic ketoacidosis or glucose-6-phosphate dehydrogenase deficiency (G6PD), or perhaps if you're pregnant/breastfeeding (see above), big doses of vitamin C have been questioned, so talk to your healthcare professional first. Many doctors believe big doses are also unsafe ("contraindicated") for two additional conditions: hemochromatosis (but Dr. Jaffe says the feared Fenton reaction with excess iron, converting safe ferrous into toxic ferric ions, occurs in test tubes but not in the body, especially with buffered *l*-ascorbate); and active oxalate kidney-stones, which Dr. Jaffe says on the contrary are *dissolved* by buffered *l*-ascorbate, so with proper hydration, a very important preventative, his recommended form of vitamin C doesn't worsen but helps to treat those stones. All potential contraindications should be discussed with your doctor.

Even if your specific medical condition makes big doses of vitamin C undesirable, you should probably (subject to your doctor's advice) take as much as you safely can. Why? Because our bodies need it, they need far more of it than the tiny amount needed to prevent scurvy (the basis of official dietary recommendations), and it's hard to get enough just from the recommended daily amounts of fruits and vegetables. Of course, we should all should eat lots of fresh fruits and vegetables. But a common vitamin-C-rich food like fresh medium-sized oranges will contain only about 65–70 mg each, so the minimally protective 3–5 grams a day corresponds to roughly 40–70 oranges a day. Some foods (look online) have even more — Dr. Szent-Györgyi got a 1937 Nobel Prize for isolating vitamin C when he asked what makes paprika stay red — but it's very hard to get a health-optimal amount of vitamin C from a fine diet alone unless you eat a great-ape diet, munching on tropical fruits and dark-green leaves all day.

Are multivitamins or those little supermarket packets of "energizing" powdered vitamins a suitable source of vitamin C?

They can be better than nothing, but they typically contain only about a gram or less of vitamin C, and it's unlikely to be unoxidized, well buffered, or perhaps even *l*-ascorbate. Taking a specific vitamin C form like *PotentC Guard* will cost less, and won't risk taking too much of some other ingredients as you try to get enough vitamin C. Well-formulated and well-made multivitamins in the right amounts can also help your health. Too much, though, is not a good idea.

Might other supplements help in this pandemic?

There's evidence that some other nutrients can indeed help. Notably, PERQUE *Repair Guard* safer polyphenolics (slide 13 of Lovins's 16 March 2020 talk) are antiviral complements to vitamin C, strong immune defense and repair boosters, a potent anti-inflammatory, and a moderate analgesic. They're synergistic (four *Repair Guard*s to one *PotentC Guard* — each tabsule is 1 gram), subject to bowel tolerance for both. Other supplements can be valuable too. For example, please see Lovins's slide 14 about vitamin D (Dr. Jaffe recommends titrating not just to 30 but to 50–80 ng/mL) and the helpful (immediately at onset of sore throat) use of zinc lozenges.

What else should I do?

The official advice on *minimizing your exposure* to the virus by isolation, distancing, handwashing, etc. *is correct and absolutely essential*. Complementary to it, but *not* yet in the official advice, are the standard ways to *boost your immune competence*, so if you're exposed, you're less likely to get infected, and you'll be less at risk and heal faster. Immune-boosting methods, on Lovins's 16 March talk's slide 5, include sleep, de-stressing, hydration, nutrition, exercise, limited or no alcohol, avoiding toxins, and keeping your chemistry in balance. That balance can valuably include appropriate amounts of high-quality dietary supplements; most of the key ones are on slide 6. Of these, vitamin C is often officially dismissed as of little or no value (slide 7), but slides 8–11 show this view rests on misreadings of the literature (which doctors are currently far too busy to re-read!). Slide 12 shows that the startling clinical value of very high intravenous doses of vitamin C in critical pneumonias, such as those that COVID-19 causes in some patients, implies vitamin C is indeed a relevant agent in treating this disease. And most

importantly, the four numbered points on slide 11 suggest vitamin C has an important role in our defenses against COVID-19, regardless of whether oral doses can help prevent it.

Our personal opinion is that *at least and especially* healthcare, frontline, and other vital workers, and people most at risk of serious illness (chiefly the old, sick, poor, and homeless, and refugees and prisoners), should urgently begin taking at least 3–5 grams of good vitamin C per day, divided through the day, and more if possible — as much as their bowel tolerance permits or a C-Cleanse test indicates. When our country is desperately trying to catch up on avoiding exposure, as the already-widespread virus threatens soaring infection rates that could quickly overwhelm our healthcare system, **properly used vitamin C can be a vital element of our national health and security.**

If you can't afford the better but costlier third kind of vitamin C, get the best you can, preferably the second kind (labeled as *l*-ascorbate, buffered if possible); it's better than nothing. Lowest-price is not best. But we hope our governments will *give* type-3 vitamin C to all who most need it, perhaps making it available free at Social Security Offices or Post Offices and in prisons, detention centers, and shelters. If that needs far more than current producers can make, use the Defense Production Act (brewers do large-scale fermentation) but tweak to ensure anerobic production of unoxidized ascorbate. We have only one chance to flatten the currently steep curve of infection. This means getting *highly effective* vitamin C into *as many bodies as possible, as quickly as possible,* while also encouraging everyone to boost personal and community immunity by all other means.

. . .

Nerdy note on l-ascorbate saturation. *Some people say Levine et al's 1996 finding that the body saturates at ~1 g/d of oral l-ascorbate (based on a small group of young, healthy NIH staffers) invalidates orthomolecular practitioners' claim that oral doses on the order of 10 g/d can provide important antiviral protection. Yet ~400 μM/L C was achieved in plasma by administering up to 36 g of oral sodium ascorbate, mostly in phosphatidylcholine liposomes, while another subject accustomed to 10 g/d of oral C achieved 300 and sustained 100–150 μM/L with divided doses of 12–18 g liposomal ascorbate:*

Pharmacokinetics of oral vitamin C

Purpose. To test whether plasma vitamin C levels, following oral doses in supplemented volunteers, are tightly...

www.tandfonline.com

Such findings cast serious doubt on NIH's RDA assumption that plasma levels must and do saturate at ~70–80 μM/L. For comparison, IV administration, by avoiding oral-uptake restrictions, can safely reach impressive plasma concentrations of 25–30 mmol/L, i.e. 25,000–30,000 μM/L:

Vitamin C: A Concentration-Function Approach Yields Pharmacology and Therapeutic Discoveries

A concentration-function approach to vitamin C (ascorbate) has yielded new physiology and pharmacology discoveries. To...

academic.oup.com

Ascorbate saturation's science seems in flux, e.g. here and here, the pharmacokinetics remain somewhat mysterious and the partitioning is complex and not fully understood:

The Pharmacokinetics of Vitamin C

The pharmacokinetics of vitamin C (vitC) is indeed complex. Regulated primarily by a family of saturable sodium...

www.mdpi.com

But the basic science seems to be saying that sustained titer sufficient for full saturation at cellular level is essential for the l-ascorbate to set low redox potential that suppresses viruses and to quench free radicals that cause disease symptoms. We should therefore expect threshold effects, not linear dose/response starting at low doses. Whether you believe Hickey et al that ascorbate excretion half-life is 0.5 or ~2 hours, it's excreted so quickly that multigram oral doses every few hours are needed to sustain titer adequate to yield the clinical benefits of cellular-level saturation (additional information here). Excreted

ascorbate cannot donate electrons. So the strongest evidence on l-ascorbate saturation does not refute big oral doses and may support such use.

Coronavirus Covid 19 Vitamin C Health Science