

To: JOSHUA G JONES(dwtrademarks@dickinson-wright.com)
Subject: U.S. Trademark Application Serial No. 97830483 - BEETS MODE - - 097666.23
Sent: July 08, 2024 04:28:56 PM EDT
Sent As: tmng.notices@uspto.gov

Attachments

[screenshot-www-webmd-com-vitamins-and-supplements-ss-slideshow-best-ways-to-take-different-vitamins-17204696168441](#)
[screenshot-www-personanutrion-com-blog-what-to-drink-with-supplements-for-better-absorption-17204697074371](#)
[screenshot-www-personanutrion-com-blog-what-to-drink-with-supplements-for-better-absorption-17204697361491](#)
[screenshot-www-consumerlab-com-answers-which-vitamins-and-minerals-should-be-taken-together-or-separately-how-to-take-vitamins-17204697687331](#)
[screenshot-www-ncbi-nlm-nih-gov-pmc-articles-PMC5295087-17204699169551](#)
[screenshot-runtrimag-com-beet-juice-benefits-is-it-everything-its-supposed-to-be-17204699803061](#)
[screenshot-www-verywellfit-com-how-does-beet-juice-improve-athletic-performance-4123855-17204700473161](#)

**United States Patent and Trademark Office (USPTO)
Office Action (Official Letter) About Applicant's Trademark Application**

U.S. Application Serial No. 97830483

Mark: BEETS MODE

Correspondence Address:

JOSHUA G JONES
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607 W 3RD STREET, SUITE 2500
AUSTIN TX 78701
UNITED STATES

Applicant: Juiceland IP Holdings, LLC

Reference/Docket No. 097666.23

Correspondence Email Address: dwtrademarks@dickinson-wright.com

REQUEST FOR RECONSIDERATION AFTER FINAL ACTION DENIED

Issue date: July 8, 2024

Introduction

Applicant's request for reconsideration is denied. *See* 37 C.F.R. §2.63(b)(3). The trademark examining attorney has carefully reviewed applicant's request and determined the request did not: (1) raise a new issue, (2) resolve all the outstanding issue(s), (3) provide any new or compelling evidence with regard to the outstanding issue(s), or (4) present analysis and arguments that were persuasive or shed new light on the outstanding issue(s). TMEP §§715.03(a)(ii)(B), 715.04(a).

Accordingly, the following refusal made FINAL in the Office action dated March 29, 2024 are **MAINTAINED and CONTINUED**:

- MAINTAINED & CONTINUED: Section 2(d) - Likelihood of Confusion Refusals Made FINAL

See TMEP §§715.03(a)(ii)(B), 715.04(a).

MAINTAINED & CONTINUED: Section 2(d) - Likelihood of Confusion Refusals Made FINAL

The FINAL refusal under Trademark Act Section 2(d) is MAINTAINED and CONTINUED with respect to U.S. Registration Nos. 6125905 and 6125946. *See* 15 U.S.C. §1052(d); 37 C.F.R. §2.63(b). *See the previously attached registrations.*

Applicant argued the trademark examining attorney provided twelve examples of registrations that merely included nutritional supplements in some form and beverages in some form and that most of the registrations list either liquid nutritional supplements, nutritional supplement drinks, or related supplement. The trademark examining attorney notes that the registrations merely list "dietary and nutritional supplements" without any restriction as to the form of these supplements. As such, the registrations encompass dietary and nutritional supplements in all forms.

In addition, applicant argued there was no "other type of evidence" to support the finding that supplements are related to juices. In addition to the third-party registrations previously provided as well as the previously attached internet evidence providing numerous examples of manufacturers providing both supplements and juices, the trademark examining attorney has attached additional evidence to this Office action demonstrating that juice and supplements are extremely related. The attached evidence from *WebMD*, *persona*, and *ConsumerLab.com* demonstrate that certain supplements are recommended to be taken with juices to achieve the maximum benefit of the supplements. *See attached evidence from WebMD, persona, and ConsumerLab.com.* Furthermore, the attached evidence from *NIH*, *RunTriMag*, and *verywellfit* demonstrates that some of applicant's goods, namely, beetroot juice, are used as supplements themselves. *See attached screenshots from NIH, RunTriMag, and verywellfit.* Thus, the evidence overwhelmingly shows that supplements and juices are related, as consumers are accustomed to seeing them provided by the same manufacturers, supplements and juices are often used together, and some vegetable and fruit juices are used as supplements.

Thus, the FINAL refusal under Trademark Act Section 2(d) is MAINTAINED and CONTINUED.

If applicant has already filed an appeal with the Trademark Trial and Appeal Board, the Board will be notified to resume the appeal. *See* TMEP §715.04(a).

If applicant has not filed an appeal and time remains in the response period for the final Office action, applicant has the remainder of that time to (1) [file another request for reconsideration](#) that

complies with and/or overcomes any outstanding final requirement(s) and/or refusal(s), and/or (2) [file a notice of appeal](#) to the Board. TMEP §715.03(a)(ii)(B).

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Slideshows

Supplement Smarts: Best Ways to Take Different Vitamins



Medically Reviewed by Poonam Sachdev, MD on March 27, 2024 | Written by Julie Davis



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Make Food Your Plan A

With hundreds of supplements available, it's hard to believe that not every nutrient in whole foods has been captured in a capsule. That's why eating a variety of healthy foods is the best way to meet your health needs. But if you're low on a certain vitamin or mineral, or just want to cover all bases with

a daily MVM (multivitamin/mineral), these tips will help you get the most from it.

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Timing Your Multi

You can take your MVM any time you'd like. Your body absorbs some of its vitamins better with food, so you may want to take it with a meal or a snack. You'll also avoid the upset stomach that you can get when you take it on an

you it also avoid the upset stomach that you can get when you take it on an empty stomach. Not a breakfast person? Have it with lunch or even dinner.

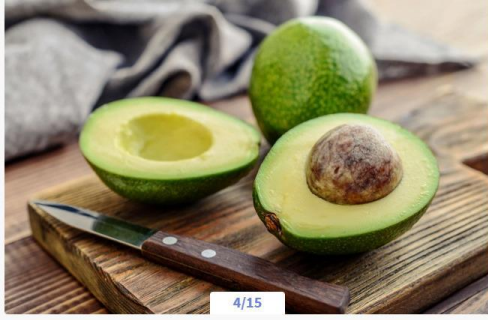
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When to Take Water-Soluble Vitamins

Water dissolves them, and your body doesn't store them, so most must be taken every day. They include C and the B's: thiamin (B1), riboflavin (B2), niacin (B3), pantothenic acid (B5), pyridoxine (B6), biotin (B7), folic acid (B9), and cobalamin (B12). Take them with or without food, with one exception: You'll absorb B12 better with a meal. If you also use [vitamin C](#), put 2 hours between them. Vitamin C can keep your body from using B12.

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When to Take Fat-Soluble Vitamins

Vitamins A, D, E, and K need to go with fat from a meal for your body to absorb and use them. But you don't need a lot of fat -- or any saturated fat. The healthy plant-based kind you find in foods like avocado or nuts will do just fine.

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If You Take Iron Supplements

You absorb **iron** best on an empty stomach. Take it with water or, better yet, a citrus **juice**: Iron and vitamin C have a tag-team effect. If it makes you queasy, save it for right after a meal. But don't mix it with calcium or high-calcium foods -- these interfere with iron. You won't take in either one fully. Men and postmenopausal women should skip supplements with this mineral unless a doctor says otherwise. The average MVM has more than you need.

RELATED: [Why Are Lutein and Zeaxanthin Good for Your Eyes?](#)



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If You Take Mineral Supplements

Large doses of minerals can compete with each other to be absorbed. Don't use calcium, zinc, or magnesium supplements at the same time. Also, these three minerals are easier on your tummy when you take them with food, so if your doctor recommends them, have them at different meals or snacks. Don't take any individual mineral at the same time as an MVM or an antioxidant vitamin formula, like one with beta-carotene and lycopene. Also see: [What is silicon dioxide](#) and how is it used in supplements?

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If You Take Vitamin A

Watch the amount of what's called preformed [vitamin A](#). If you're pregnant, doses over 10,000 IU a day can cause birth defects. High levels of both A and the usually safe beta-carotene (a substance that the body converts to vitamin A) may raise your chances of having lung cancer if you're a smoker, and maybe even if you're a former smoker.

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Prenatal Vitamins and Morning Sickness

Extra folic acid and iron are very important for a healthy baby. They can be found in most prenatal vitamins. But some [prenatal vitamins](#) can make nausea worse, mostly because of the iron. If this happens to you, pair your prenatal vitamins with a light snack before you go to bed. Talk to your doctor about the best prenatal formula for you.

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Supplements and Your Prescriptions

Even essential nutrients can interfere with many common medications. If you take a traditional blood thinner like warfarin, just the small amount of vitamin K in an MVM can cut its strength. Taking more than 1,000 mg of vitamin E per day can raise your risk for bleeding. And if you take thyroid medication, taking calcium, magnesium, or iron within 4 hours can cut its strength. Ask your doctor about how best to time it.

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The Alphabet of Amounts

RDA (recommended daily allowance) is the daily amount of a nutrient you should get, based on sex and age. DV (daily value) is the percentage of a nutrient that a supplement or food serving adds to the average daily diet for all ages. UL (upper limit) is the most of a nutrient you should get in a day. Side effects from big doses range from tiredness or diarrhea to kidney stones or organ damage.

RELATED: [Why Are Lutein and Zeaxanthin Good for Your Eyes?](#)

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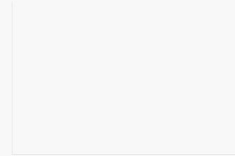
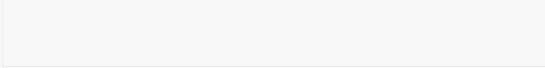


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Know What's Inside

There's no one standard MVM formula. Some have more nutrients than recommended. Others may come up short on some RDAs. For instance, the amount of calcium you need to meet the RDA is too much to fit into a tablet that you could easily swallow. Scan the full ingredients list so you know exactly what's in the supplement you're considering. This will also help you know if you need to time when you take it.

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Personalize Your Formula

Another way to get more of the nutrients you need is to shop for formulas geared to your age and sex. For example, many vitamins for seniors have more calcium and vitamins D and B12 than younger people need. As you get older, your body doesn't do as good a job of absorbing B12. Women in

particular often need extra calcium and vitamin D after menopause to protect bones. Men's formulas leave out the iron.

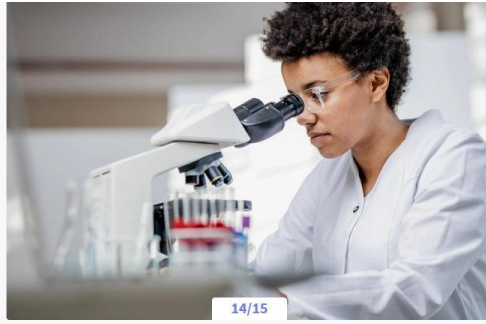
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Are Gummies Any Good?

Opinions about [gummy vitamins](#) are mixed. One study found that people who take vitamin D in gummy form get more from it than from a tablet. On the other hand, gummies can have a lot of sugar and calories. And because they taste like candy, it's easy to go overboard and eat too many. They may even cause cavities. Also, not all brands contain all essential vitamins and minerals. Some may not even contain the amounts listed on the label.

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Look for Quality Checks

Since the FDA doesn't regulate supplements, look for brands that have been "verified" by one of the three companies that test supplements in the U.S.: Pharmacopeia, Consumer Lab, or NSF International. These testing organizations verify that what's on the label is in the bottle in the right amounts.

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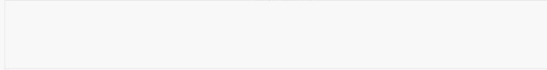
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Keep a Supplement Diary

If you keep a log, it can help you time out different supplements and keep track of how much you take every day. The National Institute of Health's Office of Dietary Supplements has a form called "My Dietary Supplement and Medicine Record" that you can print out and fill in. Bring it with you, along with your medication list, when you go to doctor visits.

RELATED: [Want to Protect Your Eyes? Check Your Multivitamin](#)

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What to drink with your supplements for better absorption, according to a pharmacist

By Emily, RD



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TAKE YOUR VITAMINS



Wake up, drink coffee, take my vitamins. Does your morning look like this? Mine too. And I felt great about it—until I realized that coffee might be sabotaging my vitamin routine. It turns out that precious cup of Joe is one of a few drinks that can interfere with nutrient absorption, preventing supplements from working at full strength.

Does that mean we all have to quit coffee for the sake of our vitamins? (“Please say no... please say no...”). Well... maybe not. If you take timing and other factors into account, you can enjoy the benefits of both.

So before making any big life choices, I sat down with Brandi Cole, PharmD, a Persona pharmacist and leading expert on dietary supplement interactions. She explained how some of my fave morning drinks can affect nutrient absorption—and what I can do to fix it.

But first, what is nutrient absorption?

Supplements don’t start doing their good work the moment they pass your lips. Instead, they have to go through a series of steps. They pass down your throat, through your stomach and arrive in your small intestine, where specialized cells absorb them into your bloodstream. Your blood delivers nutrients throughout your body to their final destination: your cells. Once inside your cells, some nutrients (the bioavailable ones) can get right to work, while others, like certain forms of folate and B12, first have to be converted into their active, usable forms.

What gets in the way of nutrient absorption?

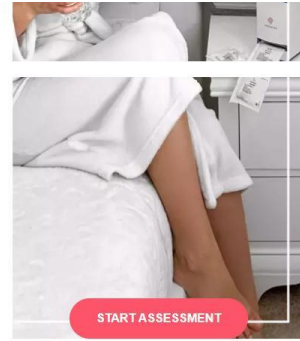
There are a few things that can interfere with this process:

- **Age:** the older we get, the harder it is to absorb certain nutrients, especially vitamin B12.
- **Gut health:** Digestive issues can hinder your ability to fully absorb nutrients from foods and supplements.
- **Genetics:** Some people are born less able to convert nutrients like folate and vitamin B12 to their active forms.
- **Food Allergies:** When people with allergies or certain autoimmune diseases—like celiac disease—eat foods they can’t tolerate, the proteins in those foods can affect the lining of the gut, which can in turn affect absorption.
- **Anti-nutrients:** Natural compounds in certain foods and drinks can interfere with your body’s ability to absorb and use the nutrients from supplements like calcium, iron and zinc. These compounds, sometimes referred to as “anti-nutrients” are mostly found in plant-based foods like grains, beans, nuts, seeds, vegetables and—importantly—certain drinks

Crimes to watch out for: anti-nutrients

So what drinks contain anti-nutrients that make your supplements less effective? There are three big offenders:

1. **Coffee:** The antioxidant compounds found in coffee beans, mainly phytates and tannins, reduce your absorption of minerals, like iron and zinc. This is especially important to keep in mind if you suffer from iron deficiency anemia.
2. **Green Tea:** The oxalates in green tea reduce calcium absorption. It can also decrease folate metabolism, an essential B vitamin that is important for healthy cells.
3. **Alcohol:** Alcohol irritates the lining of your digestive system, which impairs vitamin B12 absorption. It also changes how your body transports, stores, and metabolizes nutrients, preventing them from being fully utilized.



So if you don't want to quit coffee, then what?

When it comes to supplements, timing is everything, says Cole. "Take your supplements with food and water at least an hour before or after coffee, tea or alcohol." Even better, consider taking them with a drink that will *enhance* their effectiveness.

"Take your supplements with food and water at least an hour before or after coffee, tea or alcohol," recommends Cole.

Drinks that can give your supplements a helping hand

Just as some drinks can sabotage your vitamins, there are others that can give them a leg up. Here are a few drinks that you may want to consider adding to your supplement routine.

1. **Orange Juice (and its friends):** The vitamin C in your morning glass of OJ makes iron easier to absorb. It may even help counteract some other types of compounds that reduce iron absorption, like phytates. Not a fan of OJ? Try tomato **juice**, pineapple, strawberries, or bell peppers for an alternate source of the vitamin.
2. **Milk:** Calcium, phosphorous, and vitamin D work together to support healthy bones. The vitamin D in fortified milk increases calcium and phosphorous absorption in your intestines. It does this by helping your body make a protein, called calbindin, which works to shuttle calcium across your cells. As a bonus, the fat in milk also helps you absorb more fat-soluble nutrients like vitamins A, D, E, and K. Not a milk drinker? Most plant-based milks are fortified with vitamin D and calcium too, just check the label.

Bottom line: I *def* to keep my coffee and I'll get more out of my supplements too, which is exactly why I drink coffee, I thank to my favorite pharmacist.

Still worried about supplement interactions?

When it comes to supplements, there's a lot to consider. Persona's free nutrition assessment builds a plan for you step by step, looking at your diet, lifestyle, health goals—even your medications—and designs a daily vitamin pack that fits your needs. And it checks every pill against a huge database of supplements and medications, to make sure they won't interact. "It's a great place to start," says Cole. "I truly believe having personalized vitamins that work well together and don't interact with each other is key."

About Brandi

Brandi is a registered pharmacist with a bachelor's degree in biochemistry, cellular, and molecular biology, and a doctorate in pharmacy. With a background in community pharmacy, she is passionate about patient education when it comes to both medication and natural remedies.

About Emily

Emily is a registered dietitian with a master's degree in health communications. She is a self-proclaimed nutrition nerd and has a knack for translating nutrition science into everyday tips and resources. Emily is just one of Persona's team of qualified nutritionists. Do you have questions about nutrition? Reach out. Our experts would love to help.

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What to drink with your supplements for better absorption, according to a pharmacist

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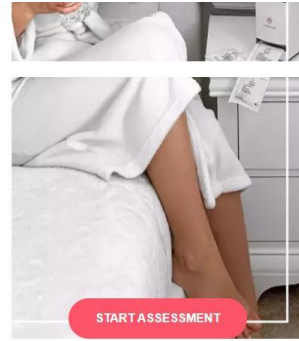
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Just as some drinks can sabotage your vitamins, there are others that can give them a leg up. Here are a few drinks that you may want to consider adding to your supplement routine.

1. **Orange Juice (and its friends):** The vitamin C in your morning glass of OJ makes iron easier to absorb. It may even help counteract some other types of compounds that reduce iron absorption, like phytates. Not a fan of OJ? Try tomato **juice**, pineapple, strawberries, or bell peppers for an alternate source of the vitamin.
2. **Milk:** Calcium, phosphorous, and vitamin D work together to support healthy bones. The vitamin D in fortified milk increases calcium and phosphorous absorption in your intestines. It does this by helping your body make a protein, called calbindin, which works to shuttle calcium across your cells. As a bonus, the fat in milk also helps you absorb more fat-soluble nutrients like vitamins A, D, E, and K. Not a milk drinker? Most plant-based milks are fortified with vitamin D and calcium too, just check the label.

Bottom line: I *def* to keep my coffee and I'll get more out of my supplements too, which is exactly why I drink coffee, I thank to my favorite pharmacist.

Still worried about supplement interactions?

When it comes to supplements, there's a lot to consider. Persona's free nutrition assessment builds a plan for you step by step, looking at your diet, lifestyle, health goals—even your medications—and designs a daily vitamin pack that fits your needs. And it checks every pill against a huge database of supplements and medications, to make sure they won't interact. "It's a great place to start," says Cole. "I truly believe having personalized vitamins that work well together and don't interact with each other is key."

About Brandi

Brandi is a registered pharmacist with a bachelor's degree in biochemistry, cellular, and molecular biology, and a doctorate in pharmacy. With a background in community pharmacy, she is passionate about patient education when it comes to both medication and natural remedies.

About Emily

Emily is a registered dietitian with a master's degree in health communications. She is a self-proclaimed nutrition nerd and has a knack for translating nutrition science into everyday tips and resources. Emily is just one of Persona's team of qualified nutritionists. Do you have questions about nutrition? Reach out. Our experts would love to help.

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Home / CL Answers / Which vitamins and minerals should be taken together or separately?



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Updated April 22, 2024



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A few rules of thumb on how to take vitamins and minerals:

- **If you take a large dose of a mineral, it will compete with other minerals to reduce their absorption.** The mineral most often taken in large amounts is **calcium**. The dose is usually several hundred milligrams, compared to doses of just a few milligrams or even microgram amounts (1,000 micrograms = 1 milligram) of most other minerals. So if you take several hundred milligrams of calcium from a supplement, take it at a different time of day than other mineral supplements or a multivitamin/multimineral supplement. Doses of **magnesium** can also be relatively large and should, ideally, be taken apart from other minerals. If you take high doses of **zinc** long-term (50 mg or more per day for 10 weeks or longer), be aware that it can cause copper deficiency, so you may need to **supplement with copper** as well.
- **High doses of calcium or other minerals (including magnesium, certain forms of iron, and zinc) from**

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supplements may decrease the absorption of carotenoids, such as **beta-carotene, lycopene and astaxanthin**, from foods and/or supplements. It is best to take carotenoid supplements at a different time of day than a supplement or meal containing large amounts of a mineral (e.g., hundreds of milligrams of calcium or magnesium).

- **Some vitamins can actually enhance the absorption of other nutrients.** Getting an adequate amount of **vitamin C** from your diet or supplements, for example, can enhance **iron** absorption from supplements and plant foods, but vitamin C and iron do not need to be taken together.
- **The fat-soluble vitamins (A, D, E, and K) are likely to be better-absorbed if taken with a meal that contains fats**, as this triggers the release of bile into the intestine, which aids fat absorption. In fact, one study found that taking **vitamin D** with the largest meal of the day – typically dinner – rather than breakfast increased blood levels of vitamin D by about 50%. If you take a fish oil supplement along with fat-soluble vitamins, this may help a little, but not by much – the amount of fat in a fish oil capsule is only about 1 gram, while studies have shown maximal bile release with at least 6.5 grams of fat (Marciani, Eur J Clin Nutr 2013). Other supplements that have improved absorption when taken with fats include astaxanthin, boswellia, CoQ10, curcumin/turmeric, and quercetin, many of which are also available in special formulations to further improve absorption.

Similarly, the absorption of carotenoids and fat-soluble vitamins from raw vegetables is increased when the vegetables are consumed with a fat such as the oil in salad dressing or foods such as avocado. Sign in as a member to learn the amount of dressing that seems to be beneficial for increasing absorption of vitamins from raw vegetables.

- **It may be best to take fat-soluble vitamins apart from one another**, as evidence (mainly from animal and cell studies) suggests that moderate to large doses of fat-soluble vitamins reduce absorption of other fat-soluble vitamins – by about 10 to 50% – due to competition. Absorption of vitamin K appears to be particularly reduced by other fat-soluble vitamins, while vitamin A absorption is least affected and may actually be better absorbed when taken with vitamin E (Goncalves, Food Chem 2015). Taking vitamins D, E, or K several hours before or after other fat-soluble vitamins would seem to maximize their absorption.
- **Taking certain supplements with food can reduce gastrointestinal side-effects.** For example, taking **magnesium** with food can reduce the occurrence of diarrhea, and taking **iron** with food can reduce the chance of stomach upset.
- **Be aware that vitamins and minerals can also affect the absorption and effectiveness of medications.** You'll find more specific information about this in the "Concerns and Cautions" section of each of our **Product Reviews**.
- **Multivitamin/multimineral supplements** contain many nutrients that, as described above, can potentially interfere with the absorption of each other. Keep in mind that, at moderate doses, the reductions in absorption are only partial – probably not exceeding, at most, a 50% reduction and, more often, even smaller – so you will still get most of what you would normally have absorbed if the nutrient was taken alone. Unless you are known to be deficient in a particular nutrient, this reduction may not be clinically important. However, if you are

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deficient in a nutrient, it may be best to take that nutrient separately, as described above. If you need to get more iron, magnesium, or zinc, for example, it may be best to choose a multivitamin that does not contain more than 200 mg of calcium. (The results table in our [Multivitamin Review](#) allows for easy comparisons of nutrient amounts among products.)

Because how and when you take supplements can affect absorption, the [table below](#) condenses the information listed and outlines how to maximize absorption of certain vitamins, minerals, and carotenoids.

How to Best Take Vitamins, Minerals, and Carotenoids

	Take with food?	Notes to maximize absorption*
Vitamins:		
A, D, E, & K	Yes, with largest meal of the day containing oils or fats	Don't take vitamin K with large doses of vitamin E.
B-12	Can be taken with or without food.	Doses of more than 1.5 mcg should be divided and taken at least 6 hours apart. To get the most B-12 from a meal and supplement, take them at different times of day.
B-6	Preferably with food	
Folate	May be best to take on an empty stomach	Folic acid is absorbed about 1.7 times as well as natural folate, and twice as well if taken on an empty stomach.
C	Yes, with a meal if causing stomach upset	Divide large doses over course of the day
Minerals:		
Calcium and magnesium	Yes, to improve absorption and to reduce the possibility of diarrhea from magnesium	Don't take together in large amounts (hundreds of milligrams). Don't take more than 500 mg of calcium at once.
Iron	Best not to take with food – and definitely not with tea or coffee. But can take after a meal if needed to reduce stomach upset.	Don't take with large amounts of other minerals. Taking with orange juice appears better than taking with water. Getting adequate C may enhance absorption, but taking with a vitamin C supplement doesn't help.
Zinc	Can be taken with or without food.	Don't take with milk, calcium, or high-fiber foods. If taken as lozenge for colds, allow to dissolve – don't chew.
Carotenoids:		
Beta-carotene (vitamin A), lycopene, zeaxanthin, lutein	Yes, with a meal that contains oils or fats	Don't take with minerals or meals high in calcium or magnesium

*To avoid taking things together, take at least two hours apart.

Additionally, keep in mind that these issues are not of significant concern when consuming a multivitamin providing up to the recommended daily intakes (RDAs) of vitamins and minerals – as long as it does not contain more than 250 mg of either calcium or magnesium

...ing or when... of... ..

There does not appear to be any evidence that taking probiotic supplements at the same time as vitamin or mineral supplements interferes with the absorption or potential benefits of vitamins, minerals, or probiotics, but be aware that you may want to avoid taking a calcium supplement at the same time as consuming probiotic dairy foods such as yogurt or kefir, if they already provide a significant amount of calcium, as you can only absorb about 500 mg of calcium at a time.

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Cory18919

March 08, 2024

"Similarly, the absorption of carotenoids and fat-soluble vitamins from raw vegetables is increased when the vegetables are consumed with a fat such as the oil in salad dressing...absorption of fat-soluble vitamins and carotenoids from raw vegetables is likely to be increased if consumed with low-fat (~4 grams per serving) or standard (~8 grams per serving) oil dressings.."

What about the fats in creamy, non-oil salad dressings like Thousand Island?

[ConsumerLab.com](#)

March 19, 2024

Great question! We've added information to answer it in the following section of our article above: <https://www.consumerlab.com/answers/which-vitamins-and-minerals-should-be-taken-together-or-separately/how-to-take-vitamins/#creamy-dressing-dips-fattyfood>

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Carmella172

February 06, 2023

Is it true that you should take your vitamins at least 6 hours after taking synthroid and calcium is best absorbed if you take it twice a day.

[ConsumerLab.com](#)

February 07, 2023

Hi Carmella, it's true that some supplements should be taken several hours apart from Synthroid. It's best to take calcium, for example, at least four hours after taking Synthroid, or possibly longer, if taking a high dose of calcium. Only about 500 mg of calcium can be absorbed at a time, so, if taking more than 500 mg, it is best to divide the dose. See our article about supplements and levothyroxine (Synthroid)

<https://www.consumerlab.com/answers/do-any-supplements-interfere-with-thyroid-hormones/hypothyroidism-and-supplements/> as well as the ConsumerTips section of our Calcium Supplements Review for details <https://www.consumerlab.com/reviews/bone-supplements-calcium-with-vitamin-d-k-magnesium/calcium/#howtotake>.

Reply to this post...

Gary169

February 06, 2023

It appears a PB&J sandwich + vitamin, mineral, and carotenoid supplements are a good combination

s1s1964

February 12, 2023

haha. love it!

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February 12, 2023

Yes, as peanut butter provides fats/oils that would aid in the absorption of fat-soluble vitamins.

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Salad Dressing

March 08, 2024

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Best Way to Take Vitamin D?

February 21, 2024

Vitamin D and other fat-soluble vitamins are best absorbed with some fat or oil, but *how much* fat or oil is needed to improve absorption of these vitamins? Find out in our article about the best way to take vitamins and minerals. Also see our *Top Picks* for vitamin D.

Best Way to Take B Vitamins?

July 25, 2023

We've added information about the best way to take vitamins B-6, B-12, and folate to our article about the best way to take vitamins and minerals.

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Effects of Beetroot Juice **Supplementation** on Cardiorespiratory Endurance in Athletes. A Systematic Review

[Raúl Domínguez](#)¹, [Eduardo Cuenca](#)², [José Luis Maté-Muñoz](#)¹, [Pablo García-Fernández](#)¹, [Noemí Serra-Paya](#)², [María Carmen Lozano Estevan](#)¹, [Pablo Veiga Herreros](#)¹ and [Manuel Vicente Gamacho-Castaño](#)^{2,*}

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Abstract

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Athletes use nutritional **supplementation** to enhance the effects of training and achieve improvements in their athletic performance. Beetroot juice increases levels of nitric oxide (NO), which serves multiple functions related to increased blood flow, gas exchange, mitochondrial biogenesis and efficiency, and strengthening of muscle contraction. These biomarker improvements indicate that **supplementation** with beetroot juice could have ergogenic effects on cardiorespiratory endurance that would benefit athletic performance. The aim of this literature review was to

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endurance that would benefit athletic performance. The aim of this literature review was to determine the effects of beetroot juice supplementation and the combination of beetroot juice with other supplements on cardiorespiratory endurance in athletes. A keyword search of DialNet, MedLine, PubMed, Scopus and Web of Science databases covered publications from 2010 to 2016. After excluding reviews/meta-analyses, animal studies, inaccessible full-text, and studies that did not supplement with beetroot juice and adequately assess cardiorespiratory endurance, 23 articles were selected for analysis. The available results suggest that supplementation with beetroot juice can improve cardiorespiratory endurance in athletes by increasing efficiency, which improves performance at various distances, increases time to exhaustion at submaximal intensities, and may improve the cardiorespiratory performance at anaerobic threshold intensities and maximum oxygen uptake (VO_{2max}). Although the literature shows contradictory data, the findings of other studies lead us to hypothesize that supplementing with beetroot juice could mitigate the ergolytic effects of hypoxia on cardiorespiratory endurance in athletes. It cannot be stated that the combination of beetroot juice with other supplements has a positive or negative effect on cardiorespiratory endurance, but it is possible that the effects of supplementation with beetroot juice can be undermined by interaction with other supplements such as caffeine.

Keywords: nutrition, sport, exercise, nitric oxide, physical activity

1. Introduction

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Cardiorespiratory endurance is defined as a health-related component of physical fitness that relates to the ability of the circulatory and respiratory systems to supply fuel during sustained physical activity and to eliminate fatigue products after supplying fuel [1]. Cardiorespiratory endurance is a performance factor in all sports in which adenosine triphosphate (ATP) is resynthesized, mainly by aerobic metabolism or oxidative processes that produce energy. In these sports, the expended effort typically lasts longer than five minutes, primarily depending on the metabolic level of the oxidative processes involved [2]. Factors that limit performance in this type of endurance patterns include maximum oxygen uptake (VO_{2max}), ventilatory thresholds (first and second ventilatory threshold) and energy efficiency or economy [3,4,5].

In competitive sports, 0.5%–1.5% improvements in performance are considered a critical difference [6]. In order to enhance the effects of training and improve performance, athletes often turn to nutritional supplements [7]. According to the American College of Sports Medicine (ACSM), adequate selection of nutrients and supplements, adjusting intake according to the exercise performed, is necessary for optimal performance in athletes [8]. However, not all supplements have been shown to produce a positive effect on performance. The Australian Institute of Sport [2], classified supplements to which athletes have access, with the goal of categorizing nutritional supplements based on the level of evidence for impact on an athlete's performance (Table 1). However, the effectiveness of supplements also depends on dosage and type of effort, because the potential ergogenic effect may differ by the specific type of sport [10].

Table 1

Classification of nutritional supplements, based on performance effect. Adapted from Australian Institute of Sport

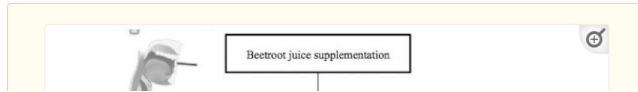
[2] and Burke [11].

Category	Sub-Categories	Supplements
High level of evidence	Will improve athletic performance with adequate dosing and specific types of effort	β-alanine
		Sodium bicarbonate
		Caffeine
		Creatinine
Moderate level of evidence	May improve performance, under specific dosing and effort conditions, although additional research is needed	Beetroot juice
		Fish oils
		Carnitine
		Curcumin
		Glucosamine
		Glutamine
		HMB
		Quercetin
		Vitamins C and E
		Tart cherry juice
Low level of evidence	No demonstrated beneficial effects	Supplements not found in other categories
Prohibited supplements	May result in positive doping tests and therefore are prohibited	Substances on the list published annually by the World Anti-Doping Agency (WADA)

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Beetroot juice is used as a supplement because of its high inorganic nitrate (NO_3^-) content, a compound found naturally in vegetables and in processed meats, where it is used as a preservative [12].

Once ingested, the NO_3^- is reduced to nitrite (NO_2^-), by anaerobic bacteria in the oral cavity by the action of nitrate reductase enzymes [13] and then to nitric oxide (NO) in the stomach [14]. This physiological mechanism depends on the entero-salivary circulation of inorganic nitrate without involving NOS activity. Once in the acidic stomach, nitrite is instantly decomposed to convert to NO and other nitrogen oxides performing determinant physiological functions (Figure 1). Nitrate and remaining nitrite is absorbed from the intestine into the circulation, which can become bioactive NO in tissues and blood [14] under physiological hypoxia.



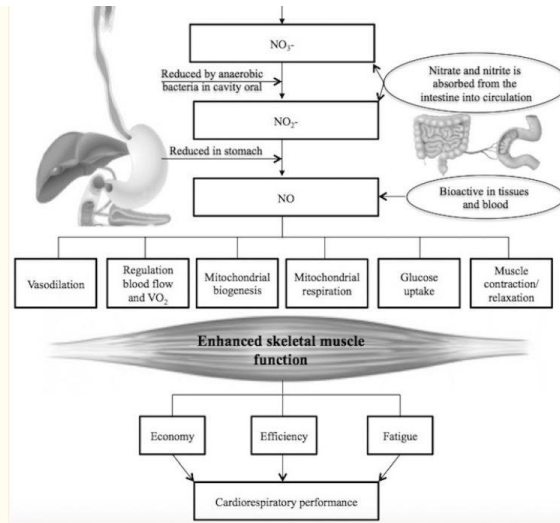


Figure 1

Pathway of nitric oxide (NO) production from beetroot juice supplementation. Nitrate (NO_3^-) is reduced to nitrite (NO_2^-) by anaerobic bacteria in the oral cavity and then to NO in the stomach. NO_3^- and remaining NO_2^- are absorbed from the intestine into the circulation, which can become bioactive NO in tissues and blood. NO induces several physiological functions improving skeletal muscle function and, consequently, increasing cardiorespiratory performance.

NO induces several physiological mechanisms that influences O_2 utilization during contraction skeletal muscle. Physiological mechanisms for NO_2^- reduction are facilitated by hypoxic conditions, therefore, NO (vasodilator) is produced in those parts of muscle that are consuming or in need of more O_2 . This mechanism would allow local blood flow to adapt to O_2 requirement providing within skeletal muscle an adequate homogeneous distribution. This physiological response could be positive in terms of muscle function, although it would not explain a reduced O_2 cost during exercise [15]. Another probable mechanism is related to NO_2^- and NO as regulators of cellular O_2 utilization [15].

In addition, a potent signaling molecule that affects cell function in many body tissues. NO is

endogenously produced by synthesizing nitric oxide from L-arginine oxidation. The molecule has important hemodynamic and metabolic functions [16,17], being a major vasodilator that can increase blood flow to muscles [18] and promote oxygen transfer in the muscle. Additional physiological benefits of NO include improved mitochondrial efficiency and glucose uptake in muscle [19] and enhanced muscle contraction and relaxation processes [20]. Other researchers have reported that NO can act as an immunomodulator [21] and stimulates gene expression and mitochondrial biogenesis [22]. Given the positive effects of beetroot juice, which are induced by means of NO, this **supplement** has been proposed as part of the therapeutic approach in people with chronic obstructive pulmonary disease [23], hypertension [24], heart failure [25] and insulin resistance [26].

These findings reflect the importance of **supplementation** with NO_3^- or nitrate salts to increase the bioavailability of NO in order to influence muscle function improving exercise performance, mainly in aerobic metabolism [27]. Therefore, **supplementation** with beetroot juice may have an ergogenic effect in athletes [2], especially with respect to cardiorespiratory endurance. However, the assumption that the beetroot juice **supplementation** improves performance in cardiorespiratory endurance under hypoxic conditions, and the combination of beetroot juice **supplementation** with other **supplements**, as caffeine, has a positive effect on cardiorespiratory endurance is controversial.

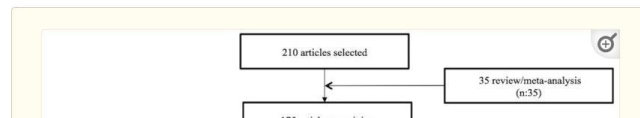
The objective of the present literature review was to analyze the effects of beetroot juice **supplementation** on cardiorespiratory endurance in several conditions (normoxia, hypoxia and beetroot juice with other **supplements**) and determine the appropriate dosage to enhance the potential ergogenic effects on performance. The focus of the article is mainly on the influence of beetroot juice of the acute and chronic responses on trained endurance athletes.

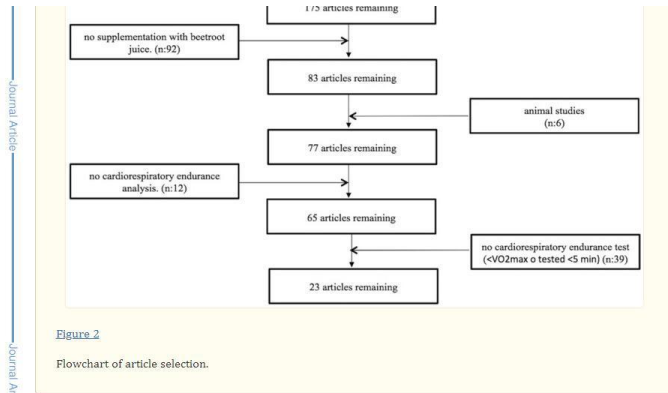
2. Methodology

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A keyword search for articles published in English or Spanish since 2010 was carried out in the DialNet, MedLine, PubMed, Scopus and Web of Science databases on 8 June 2016. The search terms included beet, beetroot, nitrate, nitrite, **supplement**, **supplementation**, nutrition, "sport nutrition" and "ergogenic aids". The 210 selected articles included at least one of those search terms, in combination with endurance, exercise, sport or athlete.

Exclusion criteria were the following: literature reviews and meta-analyses, animal studies, population other than endurance athletes, and inadequate assessment of cardiorespiratory endurance, specifically defined as $\leq \text{VO}_{2\text{max}}$ testing or no test lasting more than 5 min to determine how long the subject can maintain the lowest intensity at which $\text{VO}_{2\text{max}}$ was achieved [28]. Therefore, 23 articles were selected for the present review (Figure 2).





Journal Article

3. Results and Discussion

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The selected studies on the effects of beetroot juice supplementation on cardiorespiratory endurance are summarized in Table 2.

Journal Article

Table 2

Summary of studies that have evaluated the performance or metabolic responses after supplementation protocol with beet juice.

Reference	Participants	Experimental Conditions	Supplementation Protocol	Variables	Results
[12]	M (n: 5) and W (n: 6), trained athletes	EC1: beet juice, EC2: placebo	EC1: beet juice (8 mmol nitrate) (90 min before)	Test 5 km: Performance, HR, RPE	Performance: Last mile 1.1: faster EC1 vs. EC2 (5%), RPE: 1 mile: lower in EC1 vs. EC2 Performance in test 4 km: Time: lower in EC1 vs. EC2 (6.27 ± 0.35 vs. 6.45 ± 0.42 min)

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[27]	M. competitive cyclists (n: 9)	EC1: beet juice, EC2: placebo	EC1: 500 mL beet juice (6.2 mmol nitrate) (120 min before)	Tests 4 km and 16 km: respiratory parameters, performance	Higher in EC1 vs. EC2 (292 ± 44 vs. 279 ± 51 W), W/VO ₂ : Higher in EC1 vs. EC2 (93 ± 17 vs. 83 ± 9 W/L/min), Performance test of 16 km: Time: lower in EC1 vs. EC2 (26.9 ± 1.8 vs. 27.7 ± 2.1 min), Power: Higher in EC1 vs. EC2 (247 ± 44 vs. 233 ± 43 W),
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ATP: adenosine triphosphate; EC: experimental condition; HR: heart rate; M: men; h: hours; kg: kilograms; km: kilometers; bpm: beats per minute; m: meter; min: minutes; mL: milliliter; MAP: maximal aerobic power; RER: respiratory exchange rate; RPE: subjective perception of effort; s: sec; VT1: first ventilatory threshold; VO₂: oxygen consumption; VO_{2max}: maximal oxygen consumption; W: Watt. All results presented reflect statistically significant differences ($p < 0.05$). * Studies where only the effect of beet juice vs. placebo in both hypoxic situations as compared normoxic condition.

In [Table 2](#), 23 articles were examined regarding beetroot juice **supplementation** in normoxic conditions, hypoxic conditions and beetroot juice combined with caffeine **supplementation**: 11 of those articles were related to trained athletes, four of them to cyclists-triathletes, three to cyclists trained, two to trained kayakers, one to trained runners, one to trained swimmers, and one to healthy physically active people. Twenty-one of these articles assessed respiratory parameters including VO₂ at several intensities (approximately 60%–100% VO_{2max}, VT1)

Briefly, in trained athletes men and women in normoxia conditions appeared that beetroot juice **supplementation** enhances aerobic performance by a decrease in VO₂ at several intensities (60%–100% VO_{2max}, VT1) increasing the economy during exercise. In kayak studies, a decrease of VO₂ at the same intensity in kayakers **supplemented** with beetroot juice compared to a placebo group was found. In trained swimmers, a decrease in energy expenditure in the experimental condition of beetroot juice **supplementation** was observed.

Regarding the **supplementation** with beetroot juice in hypoxic conditions, five studies were selected. The hypothesis that beetroot improves cardiorespiratory performance in hypoxic conditions is controversial.

Two studies evaluated the effect of the combination of beetroot juice and caffeine in men and women trained cyclists-triathletes, and one study evaluated the same supplementation in trained men athletes. The studies did not determine that the effects of beetroot juice combined with caffeine increase the cardiorespiratory performance regarding caffeine supplementation.

3.1. Acute Effects of Beetroot Juice Supplementation on Performance in Cardiorespiratory Endurance

Several studies have shown a positive effect of acute beetroot juice intake on various parameters of performance improvement associated with the cardiovascular and respiratory system. Economy is a parameter that expresses the relationship between oxygen consumption (VO_2) and power generated or the distance traveled by an athlete [29], regarded as a performance factor in cardiorespiratory endurance [3,4,5]. Improved economy is due to achieving higher output power with the same VO_2 level [30]. Another improvement attributed to beetroot juice supplementation is related to the increased blood flow, favoring the supply of oxygen to the mitochondria [50], which has the side effect of stimulating oxidative metabolism. In addition, supplementation with NO_3^- could improve the processes of muscle contraction and relaxation [31].

A study in trained cyclists found that beetroot juice supplementation improves performance by 0.8% in a 50-mile test [32]. Significant increases in efficiency, measured as watts (W) per liter of VO_2 (W/VO_2) were observed in the last 10 miles; these improvements were associated with a decrease in time required to travel this distance. Another study [33] aimed to assess efficiency on a 40-min test at submaximal intensity (20 min at 50% $\text{VO}_{2\text{max}}$ followed by 20 min at 70% $\text{VO}_{2\text{max}}$). A decrease in VO_2 and improved efficiency was also observed after beetroot juice supplementation, but did not reach statistical significance. After supplementation and immediately after the submaximal 40-min test, the time-to-exhaustion at an intensity of 90% $\text{VO}_{2\text{max}}$ improved as much as 16% in the trained cyclists. These findings make us suspect that beetroot juice might have an ergogenic effect, increasing performance in prolonged cycling events that require alternations in relative intensity, from moderate to high $\text{VO}_{2\text{max}}$, which is very characteristic of the stages of cycling races.

In a time trial of 16.1 km, supplementation with beetroot juice improved the performance of trained cyclists diminishing a completion time in a 2.7% and by 2.8% in a 4-km time trial [27]. Although, the protocol test used in this study had a high ecological validity, providing an accurate simulation of the physiological responses during competition, it is unclear that beetroot supplementation can increase the performance by this magnitude in elite cyclist [27].

This increased performance was also associated with W/VO_2 improvements of 7% in a time trial of 16.1 km and 11% in 4-km time trial [27]. The observed improvements in efficiency match those found in high-performance kayakers when paddling at 60% relative $\text{VO}_{2\text{max}}$ intensity or in a 4-min test [34].

Response to a submaximal VO_2 test at constant load is very important to cardiorespiratory endurance in athletic performance. In this type of test, VO_2 increases disproportionately during the first 3 min because of an increase at the respiratory center to meet the exercise-induced increase in energy demand [51]. At an intensity below VT1 60% $\text{VO}_{2\text{max}}$ efforts, approximately stabilization of

VO_2 is observed from the 3-min point until the end of the effort [52]. Nonetheless, at intensities greater than VT_1 a progressively greater recruitment of type II motor units occurs [53], which have a lower oxidative potential than type I [54], and therefore a progressive increase in VO_2 is observed from the third minute until the end of the exercise. This has been called the slow component of VO_2 [55], which has been identified as one of the main factors limiting performance in endurance exercise of moderate and/or high intensity [4], because the increase in the slow component of VO_2 attains values of $\text{VO}_{2\text{max}}$ at submaximal intensity, causing fatigue [56].

In experienced athletes, the effect of supplementation with beetroot juice (8.2 mmol nitrate) on time-to-exhaustion was tested at intensities of 60%, 70%, 80% and 100% peak power [35]. Athletes were able to maintain an intensity of 60% (Beetroot: 696 ± 120 vs. Placebo: 593 ± 68 s), 70% (Beetroot: 452 ± 106 vs. Placebo: 390 ± 86 s) and 80% (Beetroot: 294 ± 50 vs. Placebo: 263 ± 50 s) peak power significantly longer during exercise with supplementation, and there was a trend toward increased endurance at 100% peak power. The study results might reflect a lower VO_2 response at submaximal intensities, which would reduce the increase in the slow component, delaying the time when the athletes reached $\text{VO}_{2\text{max}}$ and therefore became fatigued. This would allow a longer sustained effort.

On the other hand, trained runners participating in a 5000-m test showed no significant overall improvement with beetroot juice supplementation, although they ran 5% faster in the later part of the race, particularly the last 1.1 miles [12]. The lack of significance could be related to the timing of the supplementation. Participants took the supplement 90 min before exercise; in the other studies cited, beetroot juice was provided 150–180 min before the effort [27,32,33,34,35] and ergogenic effects of supplementation with beetroot juice were observed at 150 min after ingestion [35].

3.2. Effects of Chronic Supplementation with Beetroot Juice on Cardiorespiratory Endurance

In addition to increasing blood flow and improving muscle contraction and relaxation, beetroot juice supplementation may improve the efficiency of mitochondrial respiration [50] and oxidative phosphorylation [57]. It seems, however, that acute supplementation is insufficient to produce mitochondrial biogenesis, suggesting that these adaptations may require longer supplementation protocols. In trained athletes, acute supplementation with beetroot juice for five days reduces VO_2 as much as 3% at an intensity of 70% $\text{VO}_{2\text{max}}$. The test was performed at 50% $\text{VO}_{2\text{max}}$ for 10 min, followed by 10 min at 70% $\text{VO}_{2\text{max}}$ [31]. Another study in trained cyclists confirmed that supplementation for a period of six days reduces VO_2 in a 60-min test. The protocol consisted of 30 min at 45% $\text{VO}_{2\text{max}}$ followed by another 30 min at 65% $\text{VO}_{2\text{max}}$. In addition, riders were able to improve their 10-km time trial performance immediately following the submaximal test [30].

These studies clarify the benefits that could result from supplementation with beetroot juice in longer intake protocols of about six days, as was the case in the time-to-exhaustion test at submaximal intensities following acute supplementation [33,35]. Time-to-exhaustion improved at intensities of 70% of $\text{VO}_{2\text{max}}$ between VT_1 and $\text{VO}_{2\text{max}}$ [37]. In trained swimmers, Pinna et al. [38] also corroborated the progressive ergogenic benefits of beetroot juice during an incremental test. At anaerobic threshold intensity, workload increased and aerobic energy expenditure decreased.

In another study, in healthy subjects physically active but not highly trained in any particular sport, Vanhatalo et al. [36] evaluated the acute and chronic (15-day) effects of dietary supplementation with NO_3^- on VO_2 in a constant load test at an intensity of 90% of the gas exchange threshold (GET), similar to the anaerobic threshold, and in a progressive incremental ergometric cycle test, compared to controls. The peak power in the incremental test and the ratio of work rate to GET intensity were increased in the group that received the dietary NO_3^- supplementation. The findings indicated that dietary supplementation reduces NO_3^- oxygen consumption at submaximal exercise, and these effects can last for 15 days if supplementation is maintained.

Potential improvements observed in the anaerobic or lactate threshold intensity is especially important for athletes in various forms of endurance sports, because the level achieved in this parameter does not depend on motivation as it occurs when $\text{VO}_{2\text{max}}$ is determined [58]. This threshold is considered a factor that better discriminates between cardiorespiratory endurance capacities than does $\text{VO}_{2\text{max}}$ [2,58]. One of the physiological parameters that conditions improvement in the anaerobic threshold is increased mitochondrial population [59]. If the beetroot juice supplementation can promote mitochondrial biogenesis, we might assume that chronic supplementation with beetroot juice would decrease oxygen consumption at anaerobic threshold intensity as an adaptation to exercise.

It has also been suggested that additional beetroot juice supplementation may improve the muscle contraction functions. A study by Whitfield et al. [31] found that VO_2 reduction after a constant load test at 70% $\text{VO}_{2\text{max}}$ occurred without any changes in markers of mitochondrial efficiency such as adenine nucleotide translocase (ANT) and uncoupling protein 3 (UCP3). Similarly, other researchers have suggested that supplementation may positively affect the interaction of actin and myosin bridges [60] by modulating the release of calcium that occurs after the action potential [61]. The effects described by these authors indicate that supplementation with beetroot juice, whether acute or chronic, could improve performance in sports that are characterized either by a predominantly aerobic or anaerobic metabolism [38]. This could explain the positive effects on effort with a high prevalence of anaerobic metabolism observed in a 500-m kayak test [22] or in the contractile force developed by mice [62].

3.3. Effects of Beetroot Juice Supplementation on Performance in Cardiorespiratory Endurance under Hypoxic Conditions

Many competitions, such as the mountain stages in cycling, are held at high altitudes [39], where cardiorespiratory endurance is decreased relative to sea level [63]. Among the factors that could be responsible for this decrease, we would highlight decreased supply of oxygen to muscles, due to a partial reduction in oxygen pressure.

It is known that NO has an important role in the adaptation processes under hypoxic conditions; higher levels of NO_2^- have been observed in Tibetans [18]. In a study of acute response to hypoxia, people who live at sea level who climb to high altitudes and show decreased NO levels have symptoms of acute altitude sickness [64,65]. The vasodilatory effects of NO may favor oxygen delivery [66], and supplementation with beetroot juice could be effective in reducing the ergolytic effects of hypoxia on cardiorespiratory endurance [39].

subjective perception of pain and the regulation of thermoregulation [71]. Thus, caffeine supplementation has proven ergogenic effects on various modalities of cardiorespiratory endurance [72] and team sports [73,74]. A plateau effect occurs in performance improvement, at doses ranging from 3 to 6 mg/kg of caffeine [75]. To test whether the combined supplementation of beetroot juice (8 mmol of NO_3^-) and caffeine (5 mg/kg) had a greater effect than each supplement separately, researchers tested the corresponding study groups of cyclists tested for 30 min at 60% $\text{VO}_{2\text{max}}$ followed by a test to exhaustion at 80% $\text{VO}_{2\text{max}}$ [45]. Although the combined supplementation improved time to exhaustion $\text{VO}_{2\text{max}}$ 80% by 46% compared to placebo, the improvement was insignificant. Furthermore, the additive effect of taking both supplements did not improve performance to a greater extent than separate supplementation with each one [46,47].

In a study that simulated the characteristics of an Olympic cycling time trial, the effect of supplementation in both men and women cyclists was tested using beetroot juice (8.2 mmol of NO_3^-) and caffeine (3 mg/kg) and the combination of both [47]. The only proven effects were that caffeine supplementation in combination with beetroot juice was effective in improving mean power and time trial results.

In a later study of trained cyclists and triathletes, performance was improved only in the athletes who received a caffeine supplement (3 mg/kg) [46]. No differences were observed in VO_2 . However, lactate concentration in the blood was increased when athletes received caffeine supplementation. Performance improvement was likely due to an increased anaerobic metabolism after caffeine intake; therefore, it is possible that the effects of supplementation with beetroot juice can be undermined by interaction with other supplements such as caffeine, which interferes with the effects of each supplement taken separately.

3.5. Dosage

Peak NO_2^- concentration in blood is obtained within 2–3 h of NO_3^- supplementation [76] and the ergogenic effects of supplementation with beetroot juice can be observed at 150 min after ingestion [36]. Oral antiseptic rinses should not be taken with beetroot juice supplementation, as these can prevent the desired increase in NO_2^- levels after NO_3^- ingestion [77]. Although the majority of studies show ergogenic effects of beetroot juice at a supplementation dose of 6–8 mmol NO_3^- (Table 2), it is possible that high performance athletes might require a slightly higher dose. For example, in high performance kayakers, the ergogenic effect of supplementation with beetroot juice was 1.7% in a 500-m test after ingestion of 9.6 mmol of NO_3^- but a 4.8 mmol dose did not significantly improve results in a 1000-m test [22].

Practical Considerations

It appears that acute supplementation with beetroot juice increases the power output with the same VO_2 levels [30]. This is an interesting finding for athletes as there is evidence that the economy is a key factor to improve cardiorespiratory performance increasing energy efficiency in endurance sports modalities. In addition, time to exhaustion at several intensities (60%–100% $\text{VO}_{2\text{max}}$, MAP or VT1) is another usual performance parameter that is improved with acute beetroot supplementation [33,35]. However, not all studies show a positive effect to acute beetroot

supplementation indicating that the efficacy of acute nitrate supplementation will be attributed to several factors such as the age, diet, physiological and training status, and other parameters as the intensity, duration, endurance modality and environment conditions [78]. Although most of the studies determine a supplementation dose of 6–8 mmol NO_3^- , it is unclear that this supplementation dose can be effective to improve cardiorespiratory performance in sports modalities such as kayaking or rowing. The dose should possibly be increased in sports modalities where muscular groups of upper limbs are implicated. Endurance athletes should take the dose of NO_3^- , approximately 90 min before the competition without oral antiseptic. Acute supplementation with beetroot juice is not sufficient to induce mitochondrial biogenesis, suggesting that mitochondrial adaptations could only occur after longer supplementation protocols. In chronic supplementations with beetroot juice, it appears that the benefits in cardiorespiratory performance might be produced in longer intake protocols of about six days [33, 35]. Time-to-exhaustion at several intensities (between 70% and 100% $\text{VO}_{2\text{max}}$, VT1) and the load at anaerobic threshold could be enhanced while aerobic energy expenditure could be diminished. Longer-term beetroot supplementation (15 or more days) could be effective, although it would be necessary other studies analyzing the mitochondrial biogenesis to corroborate whether mitochondrial adaptations depend on endurance training and/or beetroot supplementation. To date, this assumption is unknown.

The scientific literature shows discrepancies regarding the improvement of the cardiorespiratory performance induced by the supplementation of beetroot juice under hypoxic conditions. NO_3^- could mitigate the ergolytic effects of hypoxia on cardiorespiratory in endurance athletes [32].

We cannot assert that the combination of beetroot juice with other supplements has a positive or negative effect on cardiorespiratory endurance. It is possible that the effects of supplementation with beetroot juice can be undermined by interaction with other supplements such as caffeine. More work is needed to confirm the results of these investigations.

4. Conclusions

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- Acute supplementation with beetroot juice may have an ergogenic effect on reducing VO_2 at less than or equal to $\text{VO}_{2\text{max}}$ intensity, while improving the relationship between watts required and VO_2 level, mechanisms that make it possible to enable increase time-to-exhaustion at less than equal to $\text{VO}_{2\text{max}}$ intensity.
- In addition to improving efficiency and performance in various time trials or increasing time-to-exhaustion at submaximal intensities, chronic supplementation with beetroot juice may improve cardiorespiratory performance at the anaerobic threshold and $\text{VO}_{2\text{max}}$ intensities.
- Apparently, the effects of supplementation with beetroot juice might not have a positive interaction with caffeine supplementation, mitigating the effects of beetroot juice intake on cardiorespiratory performance, however, more work is needed to confirm the results of these investigations because the number of studies analyzing the effects of the combination of beetroot juice with other supplements, such as caffeine, is limited.
- Intake of beetroot juice should be initiated within 90 min before athletic effort, since the peak value of NO_3^- occurs within 2–3 h after ingestion. At least 6–8 mmol of NO_3^- intake is required, which can be increased in athletes with a high level of training.

Author Contributions

Go to: ▶

R.D. and M.V.G.-C. conception and design of review; R.D., E.C., J.L.M.-M., P.G.-F., M.C.L.E., P.V.H. and M.V.G.-C. carried out the bibliographic review; R.D. and M.V.G.-C. carried out the figures, tables and drafted manuscript; N.S.-P. and M.V.G.-C. performed the English translation; R.D., E.C., J.L.M.-M., P.G.-F., N.S.-P., M.C.L.E., P.V.H. and M.V.G.-C. edited and revised manuscript; R.D., E.C., J.L.M.-M., P.G.-F., N.S.-P., M.C.L.E., P.V.H. and M.V.G.-C. approved final version of manuscript.

Conflicts of Interest

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The authors declare no conflict of interest.

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NUTRITION

Beet Juice. Is It Everything It's Supposed To Be?

Jackie Hendrickson / March 26, 2023



Over the past 10 years, beet juice has become an ever-popular **supplement** among endurance athletes. In this article, we will explore the advantages of beet juice. We will also explore what the research says about its effectiveness, and how to utilize the beet juice benefits as an athlete yourself.

Why Beet Juice?



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Beets are one of the best vegetable sources of nitrates, which is where the performance benefit comes from. Other foods that have high levels of naturally occurring nitrate include celery, lettuce, and other leafy greens. When beets are juiced, an athlete is able to drink a much higher concentration of nitrates than what they would be able to consume in a salad or dish of roasted vegetables.

When absorbed, nitrates from beet juice improve muscle function by improving blood flow, oxygen flow, glucose uptake, and muscle contraction/relaxation. Specifically, the muscles in an athlete's heart are able to work more efficiently, thus providing them with an overall boost in performance.

What The Research Says

While there are mixed results as to the effectiveness of beet juice for endurance athletes, many studies do show a performance benefit for athletes who supplement with beet juice. Generally speaking, the overall consensus is that beet juice is a positive supplement for athletes to try.

With beet juice, athletes are able to tolerate high-intensity exercise for a longer period of time than they normally would be able to. So, for example, the pace an athlete could typically hold for a 3 mile race may be the pace they could now hold for 3.5-4 miles when supplementing with beet juice.

How To Use Beet Juice To Improve Your Performance

There are a few considerations that seem to impact how well beet juice will work for an athlete. The research with the most positive results had the athletes follow similar regimens, which are outlined in the bulleted points below:

- Athletes only need to supplement with beet juice for 6-7 days before their key event or time trial to get a benefit. More chronic supplementation has not been well-researched and may pose negative health risks.
- When supplementing with beet juice, drink 13-16 oz of beet juice 1 ½ hours before the event. It takes about 2-3 hours for nitrates to peak in the bloodstream.
- Just use beet juice on its own. Pairing beet juice with additional supplements, namely caffeine, has not shown any additional benefit for athletes. If you typically use caffeine to improve your performance during a race, don't expect to experience an additional boost by drinking beet juice.
- As a rule of thumb, don't try using beet juice for the first time on your key race. I would recommend seeing how your body reacted to the juice for 2-3 days before a smaller (less important) race or workout that simulated a race-day effort well.

Sources Of Beet Juice

There are a variety of ways an athlete can supplement with beet juice. Athletes can juice their own beets at home or purchase ready-to-drink bottles of juice from the grocery store. Additionally, many supplement companies offer powdered forms of beetroot juice. If using a powdered form of beet juice, choose a company that is third-party tested or NSF Sport certified in order to assure the product is free from unsafe or banned substances.

Wrapping It Up

Endurance athletes can use beet juice to improve their performance. Beet juice is a great source of nitrates which help improve muscle function & efficiency for athletes. In terms of performance, an athlete who uses beet juice is able to hold a pace at a high intensity for a longer period of time than they normally would be able to. There are various factors that influence the effectiveness of beet juice, and it is important for athletes to use it properly.

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SPORTS NUTRITION

How Does Beet Juice Improve Athletic Performance?

By [Daria Leal](#) | Updated on July 10, 2023

✓ Medically reviewed by [Jonathan Valdez, RDN, CDCES, CPT](#)



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Athletes and active adults are leaning more towards nutrient-dense foods to improve athletic performance. Diets rich in vegetables like beets are shown to have a significant impact on body functions during exercise. In fact, beetroot juice has become one of the most popular **supplements** or ergogenic aids for athletes to improve performance. What makes the beet such an athletic nutritional powerhouse?

Beet Nutrition

The beetroot (*beta vulgaris*) is enjoyed as a food source, is used medicinally, and may be used **as an ergogenic supplement**.^[1] Although there are several varieties of the heart-shaped vegetable, the most common among health-conscious people are the red beetroot.

Beets are a rich source of potent antioxidants, such as vitamin C, carotenoids, **phenolic acids**, and **flavonoids**, along with nitrate. Nitrate is a chemical naturally occurring in certain foods and is converted into nitric oxide when consumed.

Studies indicate vegetables high in nitrate promote improved health and athletic performance.^[2]

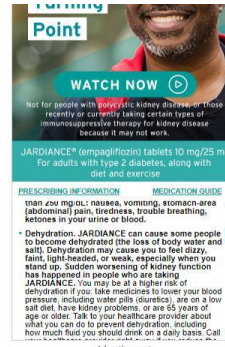
Drinking beet juice raises nitric oxide levels in your body. Research shows nitric oxide can increase blood flow, improve lung function^[3], and **strengthen muscle contraction**.^[4] This combination has stimulated athletes to **supplement** with beet juice for improved cardiorespiratory endurance and performance.

Related: [Beet Juice Nutrition Facts and Health Benefits](#)

Benefits of Beet Juice

Beet juice studies have been conducted on athletes in a variety of sports including running, swimming, cycling, and **power walking**. The common goal of all research was to examine the beneficial effects of beetroot juice on athletic performance.

A study was published on beetroot juice **supplementation** and aerobic response in fourteen male swimmers.^[5] The participants were master athletes aged in their mid to late thirties and in excellent health. Controlled swim tests were conducted with and without beetroot juice **supplementation**. The athletes were evaluated throughout the swim test



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Impact on Athletic Performance
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for the maximum volume of oxygen ($\dot{V}O_2$) and aerobic energy cost.

The swimmers significantly increased their anaerobic threshold after beet juice **supplementation** compared to testing without. This means increased oxygen capacity allowed them to swim longer before reaching exercise failure after drinking beet juice.

The athletes were also shown to have a decreased aerobic energy cost **supplementing** with beet juice. A lowered energy cost enabled the swimmers to sustain an increased exercise time.

The results indicate beetroot juice **supplementation** may enhance the athletic performance of master trained swimmers, although more research is needed to determine if beetroot juice may be beneficial for swimmers of other levels.^[5]

Related: [How to Improve Your Muscular Endurance](#)

High Altitude

Numerous studies have shown beet juice is effective in improving athletic performance, however most of this research has taken place under normal environmental conditions. There appears to be conflicting evidence on beet juice benefiting those athletes competing at higher elevations.

[Working out in high altitudes](#) places additional demands on the body, especially decreased oxygen supply to working muscles. The primary reason oxygen is decreased occurs as a response to a reduction in oxygen pressure at a higher elevation.

The change in elevation may have an effect on how nitric oxide (NO) in beet juice affects the body.

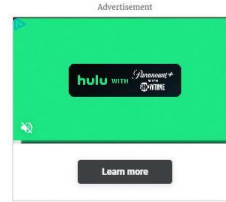
One small study investigated well-trained runners in a simulated altitude environment, where air pressure is normal but oxygen levels are lower. Results indicated increased nitrate levels in the blood after **supplementing** with beet juice but showed no enhanced running performance.^[6]

Another clinical review suggested that there is a small percentage of the population that doesn't perceive a benefit from beet juice **supplementation** training at high elevation. The reason for taking it is to enhance athletic performance but may not be the case for all athletes.^[7]

Impact on Athletic Performance
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Related: [How Does Beet Juice Improve Athletic Performance?](#)

Impact on Athletic Performance



The importance of [cardiorespiratory fitness](#) for athletes and active adults is essential. This component of physical fitness refers to the ability of the circulatory and respiratory systems to supply oxygen to working muscles during prolonged exercise.

Nitric oxide (NO) from beet juice helps this process. It is shown to increase cardiorespiratory performance and improve muscle function.^[3]

Nitric oxide (NO) works by stimulating body functions affecting oxygen utilization. It opens up your blood vessels (vasodilation) increasing blood flow and feeding more oxygen to [working muscles](#).^[3] Nitric oxide also functions as a signaling molecule communicating with your cells and body tissues. This communication ensures more blood flow to the muscle and adequate oxygen intake inside the muscle.

Beetroot juice may provide a competitive edge for some athletes and has been shown to improve performance by almost 16% according to a small study conducted in 2014.^[8]

Related: [The 9 Best Pre-Workout Drinks of 2024, Tested and Reviewed](#)

Impact on Endurance

A systematic review was conducted on several articles studying the effects of beetroot juice and improved cardiorespiratory endurance in athletes.^[3] More than twenty articles were selected to be studied.

The focus of the review was to determine the effects of beetroot juice alone and in combination with other [supplementation](#) on cardiorespiratory [endurance in athletes](#).

The articles covered a wide spectrum of sports and included both male and female athletes. Among the athletes indicated were kayakers, triathletes, cyclists, swimmers, runners, and healthy active adults. Results from these studies are summarized below:^[3]

Improves Oxygen Capacity

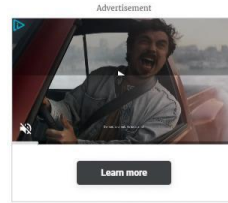
The more oxygen you can take in the more energy you will have and the faster you will recover after exercise—which translates into improved aerobic performance.^[9] The systematic review showed that beetroot juice [supplementation](#) appears to enhance aerobic performance in both trained male and female athletes. The volume of oxygen utilized at varying intensities was greatly improved after beet juice consumption.

The studies looked at several different sports. Kayakers [supplementing](#) with beet juice before competition showed improved oxygen capacity compared to a placebo group. Trained swimmers also exhibited greater



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compared to a placebo group. Athletes consumed less calories, gained exercise capacity and improved endurance after beet juice consumption while energy expenditure decreased.

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Boosts Endurance and Speed

The review found that, due to improved oxygen capacity, beet juice appears to boost athletic performance with endurance, speed, and even improves muscle contractions. Competitive cyclists who **supplemented** with beetroot juice improved their performance by 0.8 percent in a 50-mile test. Significant improvements were observed during the last 10 miles. Both oxygen efficiency and time to exhaustion were greatly improved after beet juice consumption.

All athletes were able to maintain exercise intensities from 60 to 80 percent significantly longer during exercise with beet juice **supplementation**. Trained runners ran 5% faster in the later part of a 5000-meter race **supplementing** with beetroot juice 90 minutes prior to their event. The article did note a recommendation of **supplementation** 150-180 minutes before ergogenic effects are observed

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Dosage and Timing

The review found that timing and dosage of beet juice is important. Research was conducted using amounts ranging from 70-500ml beetroot **supplement** dose for best ergogenic results for stamina and recovery.^[5] This is approximately 2 cups of juice or 384 grams.

As far as when to take the beet juice, athletes seem to benefit most from beet juice **supplementation** 150 minutes prior to their events. In addition to the day of the event, the research suggested that drinking it a few weeks prior to the event is beneficial. One study found that **supplementing** with beetroot juice at least six days prior to intense exercise or athletic events for improved stamina and recovery. Other research found that active healthy adults **supplementing** with beet juice for 15 days showed an increase in power and oxygen during sustained exercise.

If you have time, try to start **supplementing** at least two weeks before a big event, however drinking it just six days before is also beneficial.

Related: [The 10 Best Supplements for Runners](#)

Maximizing Beet Juice Benefits

To maximize the benefits of beet juice, the research found that beetroot juice **supplementation** in combination with endurance training is shown to best improve stamina and energy. It's also the reason why dehydrated

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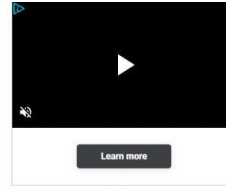
beetroot juice is commonly included in [red powder supplements](#).

If you are an athlete in an area with a higher altitude, studies found that best results were reported when beet juice was [supplemented](#) at least six days prior to their high-altitude events. As stated previously, research is mixed on the benefits of beet juice on high altitude training.

There are some products that can decrease the effectiveness of beet juice. Caffeine appears to interact with beetroot juice and mask the ergogenic benefit, while oral antiseptic rinses can lessen the effect of nitrate levels in beet juice.

It is important to note that the most common side effect reported was beeturia (red urine) and red stools.

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Other Benefits

Consuming beets or beet juice may boost your athletic performance but is also a [popular superfood](#) for overall health improvement. Consuming beetroot juice has shown to help with the following:

Reduces Hypertension

According to chronic studies on hypertension, beetroot juice is high in nitrate.^[10] When you eat beets or drink beet juice, nitrate is converted into nitric oxide. Nitric oxide is a vasodilator and functions by relaxing and dilating your blood vessels for increased blood flow.

This directly affects the pressure within your blood vessels. The research indicates a significant decrease in blood pressure three hours after drinking 500ml of beetroot juice.

These findings suggest dietary nitrate found in beets as a natural low-cost way to treat hypertension and reduce the risk of cardiovascular disease.

Anti-Cancer Properties

Beets contain powerful antioxidants or phytonutrients that may help reduce the risk of cancer. Human studies are lacking, but in vitro (test tube) evidence suggests that red beetroot extract has similar cancer-fighting compounds as some anti-cancer prescription drugs.^[11] Betanin, which is a food dye extracted from beets is shown to be biologically active. In vitro research has discovered betanin helps reduce the size of breast and prostate cancer cells.^[12] These findings have stimulated further examination to confirm the chemopreventive potential of beetroot

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...minimization to contain the strongest natural potential of beetroot extract.

Related: [The Benefits of Antioxidants](#)

Anti-Inflammatory Properties

Beets and beet juice are a rich source of betalains. Betalains are phytonutrients shown to help reduce inflammation in the body. They function by lessening the activity of certain enzymes that can trigger inflammation.^[13]

In vitro studies suggest that decreased inflammation from beetroot juice may have the potential to reduce the risk of heart disease and type-2 diabetes.^[14]

High in Nitrate

Beets are an amazing source of concentrated nitrate and other nutrients are shown to improve your health and fitness. Research indicates that approximately 80 percent of dietary nitrates come from vegetables like beetroot.^[14]

According to the *American Journal of Clinical Nutrition*, the following chart will be helpful in selecting vegetables according to their level of nitrate.^[15]

Nitrate content (mg/100g fresh weight)	Vegetable Varieties
Very low, <20	Artichoke, asparagus, broad bean, eggplant, garlic, onion, green bean, mushroom, pea, pepper, potato, summer squash, sweet potato, tomato, watermelon
Low, 20 to <50	Broccoli, carrot, cauliflower, cucumber, pumpkin, chicory
Middle, 50 to <100	Cabbage, dill, turnip, savoy cabbage
High, 100 to <250	Celeriac, Chinese cabbage, endive, fennel, kohlrabi, leek, parsley
Very high, >250	Celery, cress, chervil, lettuce, red beetroot, spinach, rocket (rucola)

Bottom Line

The nitrate found in beets and other foods can be metabolized into nitric oxide (NO) shown to enhance athletic performance and improve

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cardiovascular health. The strength of the evidence indicates nitrate-rich plant foods and especially beets to provide significant health benefits.

Beets can be consumed by cooking the vegetable, drinking the juice, or even through a dehydrated powdered [supplement](#). Like other [pre-workout foods and supplements](#), enjoying a glass of beetroot juice before your next workout may just provide the boost you need.

15 Sources



By [Darla Leal](#)

Darla Leal is a Master Fitness Trainer, freelance writer, and the creator of Stay Healthy Fitness, where she embraces a "fit-over-55" lifestyle.

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