

# Effects of Beetroot Juice on Athletic Performance

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## Background

Red beetroot, or *Beta vulgaris rubra*, is a leafy root vegetable that has been used as a food source since 1000 B.C. in the Mediterranean.<sup>1</sup> The Romans used the beetroot leaves for food, while the roots were used for medical purposes. It wasn't until the 19th century that the root of the vegetable became a commercially-utilized food product in Europe. Today, various species of beetroot exist, ranging in color from nearly white to the deep red we commonly associate with "beets".

Beetroots can be converted to nitric oxide (NO) within the body. NO causes several effects in the body, including vasodilation, reduced blood pressure, and modulation of cellular respiration and muscle contraction.<sup>1</sup> Recently, both athletes and researchers have become interested in beetroot consumption to improve physical performance.

## Nitric Oxide Production

- Dietary nitrate ( $\text{NO}_3^-$ ), is reduced to nitrite ( $\text{NO}_2^-$ ) by reductase in the mouth.
- Nitrite then enters the bloodstream where it may be reduced further to NO during conditions of low  $\text{O}_2$  levels with the help of stomach acid.<sup>2</sup>

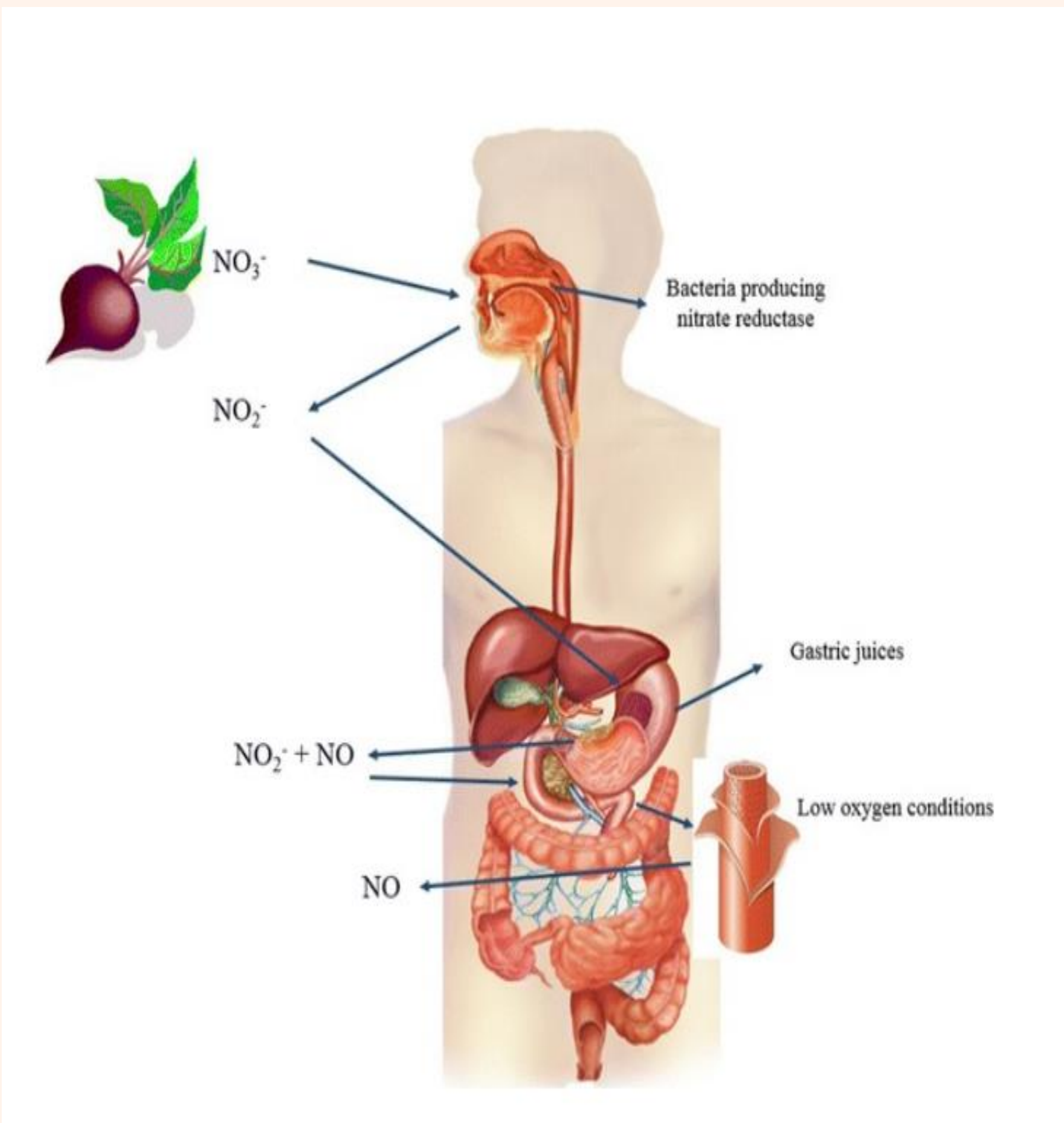


Figure 1. Diagram of  $\text{NO}_3^-$  reduction to nitric oxide.

## Nitric Oxide Functions

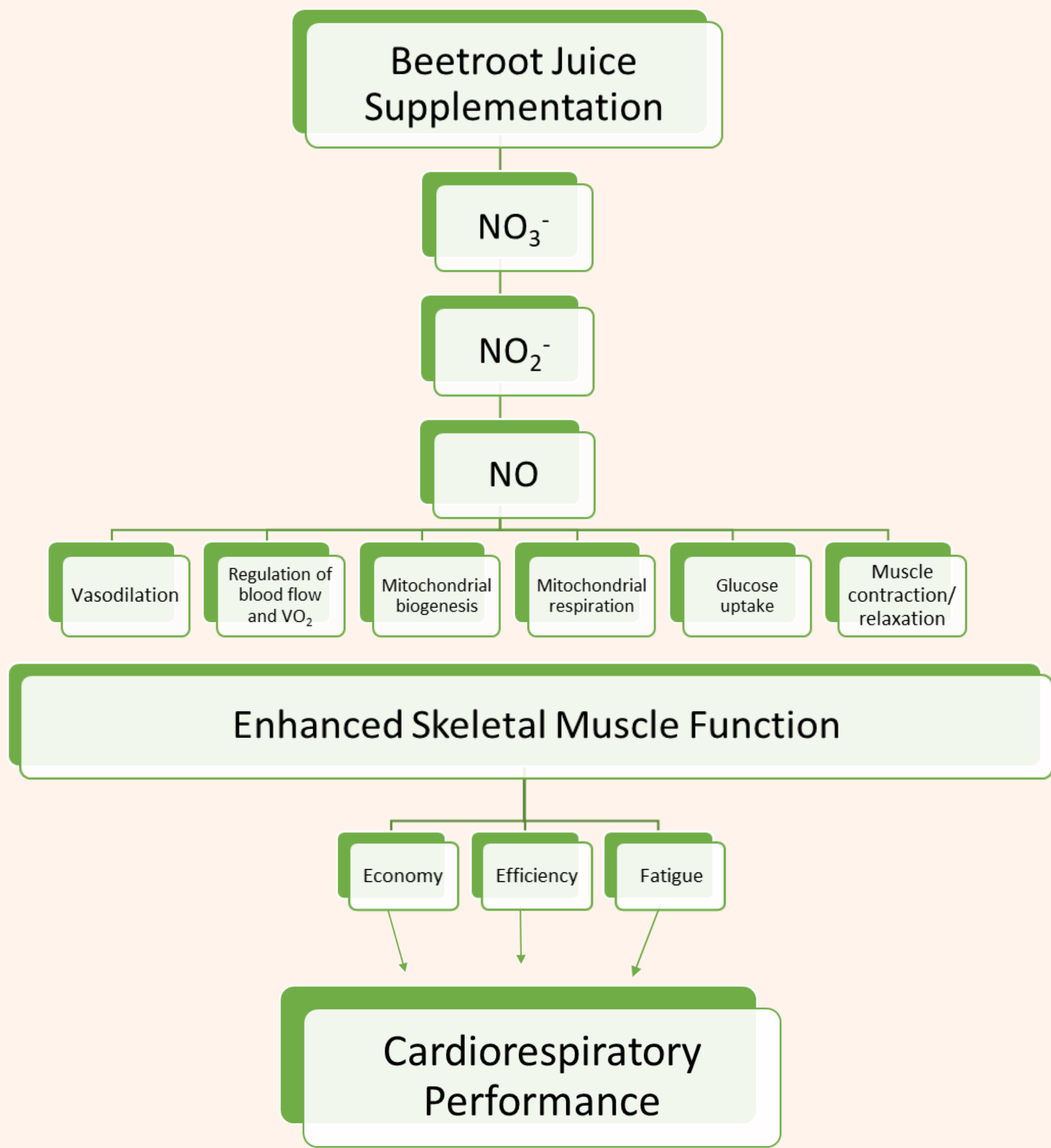


Figure 2. Pathway of NO production from beetroot juice and resulting body function effects.<sup>3</sup>

## Postponing Muscle Fatigue

NO may improve athletic performance, specifically through its action of postponing muscle fatigue. This may happen through various routes including:

- Vasodilation, which increases blood and  $\text{O}_2$  flow to active muscles.<sup>3</sup>
- Reducing the depletion of phosphocreatine (PCr), a compound stored within the body's skeletal muscle that serves as an immediate energy source.<sup>4</sup>
- Improving efficiency of mitochondrial respiration and oxidative phosphorylation (preferred system for ATP production), allowing for increased  $\text{O}_2$  availability.<sup>3</sup>
- Improving lactate threshold, which reduces lactate production surpassing lactate removal (when fatigue sets in and performance decreases).<sup>3</sup>
- Improving muscle contraction efficiency by increasing peak force response to low-frequency stimulation, thus enhancing force output.<sup>5</sup>

## Beetroot Juice Supplements

Type/Brand	Cost	Servings Per Container	Cost Per Serving
Ultra Beets	\$19.97	30	\$0.67
Power Beets	\$31.82	60	\$0.53
Beet $\text{VO}_2$ Max	\$39.97	25	\$1.61
Red Ace	\$45.00	1	\$45.00

Table 1. Cost component of popular beetroot supplements.

- An insufficient amount of research has been done to determine whether one supplement is more effective than another.
- Of the studies conducted, athletes have ingested doses of concentrated beetroot juice ranging from 4-11 mmol of nitrates.<sup>6</sup>
- Unfortunately, nitrate is not an essential nutrient and thus is not included on supplement labels.

## Other Dietary Nitrate Sources

### Nitrate Content of Selected Vegetables

Vegetable	Nitrate Content
Red beetroot, celery, lettuce, spinach	Very High (> 2500 mg)
Parsley, leek, endive, fennel	High (100-250 mg)
Cabbage, dill, turnup	Medium (50-100 mg)
Broccoli, carrot, cauliflower, cucumber, pumpkin	Low (20-50 mg)

Table 2. Nitrate content per 100g of fresh produce.

- While beetroot has been the focus of research thus far, other vegetables contain fairly high amounts of nitrates. Future investigation may include expansion of nitrate sources.<sup>7,8</sup>

## Overview

- Nitrates found in beetroot juice may enhance athletic performance.
- Nitrate can convert to nitric oxide in the body during intense physical activity when  $\text{O}_2$  levels are reduced.<sup>2,3</sup>
- Costly supplements may not be a wise decision as beetroot juice is still being researched and there is limited evidence of its performance enhancing effects.<sup>6</sup>
- No harm has been reported from consuming beetroot juice as part of a healthy diet.<sup>5</sup>
- Despite the popularity of beetroot juice, many other nitrate-rich vegetables exist, such as spinach, arugula, and other green leafy vegetables.<sup>7,8</sup>



## References

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