

Sabeet™

Dietary nitrate supplement from beetroot extract

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published by  b5 srl
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Dietary nitrates and their role in a number of biological mechanisms in the human body have raised a lot of interest in their use as a sports nutrition supplement. Green leafy vegetables and other vegetables, including Beetroot, usually have high inorganic nitrate (NO_3^-) content. In humans, after absorption through the stomach wall, ca. 25% of consumed nitrate enters the entero-salivary circulation where it is reduced to nitrite (NO_2^-) by bacterial nitrate reductases from facultative anaerobes on the dorsal surface of the tongue. On reaching the acidic environment of the stomach this nitrite is reduced to nitric oxide (NO) or re-enters the circulation as nitrite. It has been extensively studied and reported that endothelium-derived NO is a potent dilator, governs systemic blood pressure and retards atherogenesis. Subsequently, numerous cardiovascular pathologies – including pre-hypertension, hypertension, atherosclerosis and stroke – are associated with endothelial dysfunction and diminished NO bioactivity (1).

Beetroot extract is a standardized extract from the root of Beet (*Beta vulgaris*) and is a rich source of inorganic nitrate. Commonly known as Table beet, Garden beet and Red beet, its roots are eaten raw in salads, or cooked as a vegetable.

It is also a rich source of potent antioxidants and nutrients, including magnesium, sodium, potassium, and vitamin C and betaine, which is important for cardiovascular health. Beetroot juice has been shown to lower blood pressure and thus helps prevent cardiovascular problems. In addition it also finds use as a food colorant. Betanin obtained from the roots, is used industrially as red food colorants, e.g. to improve the color of tomato paste, sauces, desserts, jams and jellies, ice cream, sweets and breakfast cereals.

CHEMISTRY

The purple-red color of the roots is attributed to the presence of Betalain pigments.

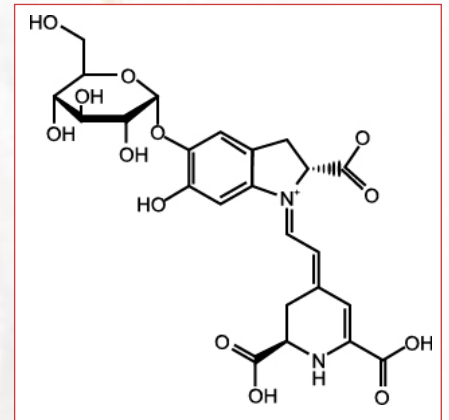


Figure 1 – Betacyanin.

Betalains are water-soluble nitrogenous pigments. They are broadly divided into two classes:

- Betacyanin – red-violet color (Figure 1);
- Betaxanthin – yellow color.

The pigments are derived from Betalamic acid.

ROLE OF BEETROOT EXTRACT IN MAINTAINING BLOOD PRESSURE

Studies indicate that the ingestion of dietary (inorganic) nitrate elevates circulating and tissue levels of nitrite through bioconversion in the entero-salivary circulation. It is also reported that nitrite derived from dietary nitrate is a potent vasodilator in humans, an effect hypothesized to underlie the blood pressure-lowering effects of dietary nitrate ingestion (2). Beetroot extract being a rich source of nitrate has been evaluated for its role in managing hypertension through number of clinical studies.

A randomized, open-label, crossover study was performed in nine healthy subjects to investigate dose dependency of the effects of

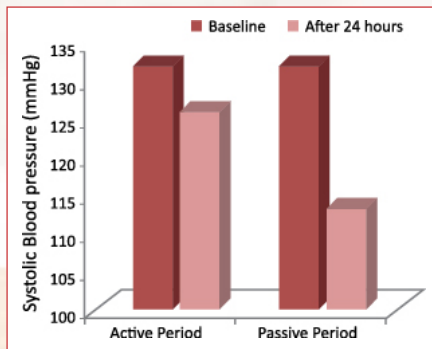


Figure 2
Adapted from Ref. 3.

beetroot juice-derived nitrate on systolic and diastolic blood pressure. After juice ingestion (5.5 mmol nitrate dose), it was observed that plasma nitrate rose rapidly and remained elevated over the 3-hour time course compared with water control. This led to Systolic Blood Pressure decrease with a peak reduction of 5.4 mmHg (2). The study clearly indicated an inverse relationship between systolic blood pressure and dietary nitrate supplementation. It could also be inferred that there was a dose dependent decrease in blood pressure and vasoprotection when inorganic nitrate in the form of dietary supplement was ingested.

In another randomized, placebo controlled clinical trial performed in Melbourne (Australia) on 30 healthy subjects, 500 g Beet root juice (providing 15 mmol/L nitrates) lowered the systolic blood pressure by 4-5 mmHg at a 6 hour interval (Figure 2) (3). Volunteers who participated in the study measured their blood pressure every hour for 24 hours. The 24 hour study period was further divided into an active 10 hours where the individuals carried their routine physical activities and the remaining hours as passive period which included their time sleeping. It can be observed even during the active period where individuals are subjecting themselves to numerous physical activities, there is significant reduction in systolic blood pressure when treated with beet root juice.

ROLE OF BEETROOT EXTRACT IN HYPOXIA DURING EXERCISE

Evidence shows that nitric oxide plays a key role in the physiological response and adaptation to hypoxia. A reduced fraction of oxygen in inspired air leads to reductions in arterial oxygen concentration and intracellular partial pressure of oxygen. The development of muscle hypoxia leads to increased metabolic imbalance and reduced functional capacity in conditions such as altitude and in several disease conditions (4). In order to restore oxygen supply, local blood flow is increased through hypoxia-induced vasodilation. It is

implicated that nitric oxide may be a major mediator of this process. Nitrite and nitrate may also promote hypoxic vasodilation in an NO-independent manner (5). Dietary nitrate supplementation, through beetroot extract represents a practical method of increasing circulating plasma nitrate and nitrite which in turn improves vasodilation and oxygen supply.

In a double-blind, crossover study, 12 healthy subjects were treated with nitrate rich and nitrate depleted beetroot extract under normal as well as hypoxic conditions. During modern intensity physical work or hypoxic condition, it was observed that individuals having nitrate rich beetroot extract showed faster oxygen uptake kinetics as compared to nitrate depleted beetroot extract. Tolerance to severe-intensity exercise was improved by dietary nitrate in hypoxia but not under normal conditions (6).

BEETROOT EXTRACT AS SPORTS NUTRIENT

With the above study it is evident that dietary nitrate supplementation in the form of beetroot extract reduces the oxygen cost of submaximal exercise and in turn improves high intensity exercise tolerance. Numerous studies have been carried out on the basis of the above activities to evaluate the role of beetroot extract in enhancement of performance of various forms of sports and athletics.

The effects of dietary nitrate on various physiological and biochemical parameters during maximal exercise was evaluated in a particular clinical study. Nine healthy, non-smoking volunteers participated in this study, which had a randomized, double-blind crossover design. Subjects received dietary supplementation with nitrate equivalent to the amount found in 100-300 g of a nitrate-rich beetroot. The maximal exercise tests consisted of an incremental exercise to exhaustion with combined arm and leg cranking on two separate ergometers. Results indicate that dietary nitrate reduced oxygen consumption while the time to exhaustion trended to an increase after nitrate supplementation. During heavy exercise the body reaches its maximum capacity to consume oxygen. Dietary nitrate reduces this maximum capacity to consume oxygen, nevertheless this did not affect the increase in exhaustion time. This study showed a correlation between the change in time to exhaustion and the change in maximum oxygen consumption which may be attributed to usage of large active muscle mass during maximal exercise (7).

In another study nine male cyclists

were assigned in a randomized, crossover design to consume 0.5 L of beetroot juice equivalent to 6.2 mmol of nitrate or 0.5 L placebo, 2.5 h before the completion of a 4- and a 16.1-km cycling time trials. Beetroot juice significantly increased mean power output during the 4-km (Figure 3) and 16.1-km cycling time trial. Further beetroot juice improved 4-km performance by 2.8% and 16.1-km performance by 2.7% respectively (8). This

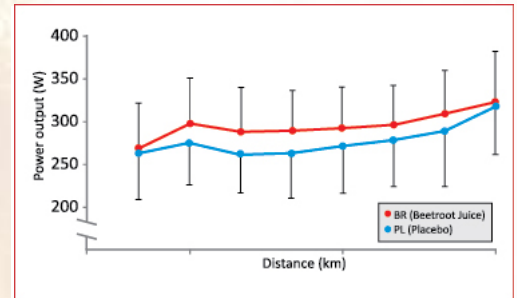


Figure 3
Adapted from Ref. 8.

study suggests that beetroot may enhance performance during simulated competition.

Studies have also been carried out to see the effect of short term supplementation of dietary nitrate in the form of beetroot extract on the performance of trained cyclists. A double-blind, repeated-measures crossover design on 12 male cyclists who ingested 140 ml/d of concentrated beetroot juice or placebo for 6 days were then subjected to 60 minutes of cycling followed by 10 km time trial. Beetroot extract improved both the time trial performance and power output compared to the placebo (9).

BEETROOT EXTRACT AS A NATURAL FOOD COLORANT

Betalains are natural water soluble nitrogen containing pigments. Betalains are synthesized from tyrosine into the red-violet betacyanins and the yellow-orange betaxanthin. Betalamic acid is the chromophore common to all betalain pigments. Crude red Beetroot concentrate is universally permitted as a food ingredient, termed "beetroot red". Betalains are stable over a wide pH range (3-7), which make them suitable for application in a broad variety of foods, in contrast with the less hydrophilic anthocyanins, which lose color under low acid conditions (10).

ADVANTAGES OF BEETROOT EXTRACT OVER OTHER NATURAL NITRATE SOURCES

The advantages of nitrate for improved health is thus evident and there is a search

	Beetroot Extract	Red Spinach
Plant	Beta vulgaris	Amaranthus dubius
Toxin	None	Hydrocyanic acid
Oxalate	NA	Present
Animal Feed use	No	Yes
Clinical	Yes	No
ODI	Yes	No
Pb accumulation	No	Yes
Weed	No	Yes
Cross contamination from similar species	No	Yes

Table 1
for natural sources for the same. However, not all natural sources have safety and efficacy profiles on par with beetroot extract that make them suitable for consumption. A typical example would be the use of *Amaranthus dubius* commonly known as red spinach. While this species of spinach is a rich source of nitrates, it also comes with several disadvantages such as the presence of oxalates and hydrocyanic acid which are detrimental to

health (Table 1). It is also not a clinically well documented source of nitrate for safe consumption. Beetroot extract thus remains a preferred and safe nutrient choice for its health benefits.

SABEET™ FROM SABINSA

All of the studies above clearly indicate the multifaceted benefits of beetroot and its various applications. Sabeet from Sabinsa is standardized to contain not less than 2% Nitrates. The extract being water soluble in nature makes it more bioavailable and thus finds use in several dosage forms including tablets, capsules, food formulations and beverages. In addition the water soluble nature of Sabeet finds use as a dispersible tablet. A natural and rich source of dietary nitrates, Sabeet is the ideal choice for sports nutrition due to its potential to increase

endurance and general health and wellness benefits.

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