

Green vegetables could improve heart's efficiency, blood supply to organs and reduce risk of diabetes and obesity

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Green veg contains nitrate

In three independent studies, scientists from the Universities of Southampton and Cambridge have identified how a simple chemical called nitrate, found in leafy green vegetables, can help thin blood ensuring oxygen can be delivered to all corners of the body efficiently. Reducing the thickness of blood may also decrease instances of dangerous clots forming and reduce the risk of stroke and heart attacks.

The same researchers, part-funded by the British Heart Foundation (BHF), also found nitrate can help the diseased heart to function more efficiently, help produce more of a compound that widens and opens [blood vessels](#) and help change bad white fat cells into good brown, fat-burning cells, which could combat obesity and reduce risk of type 2 diabetes.

In the first study published this week in the *Journal of the Federation of American Societies for Experimental Biology*, scientists have identified how eating more nitrate rich vegetables like spinach can reduce the production of a hormone, called erythropoietin, made by the kidneys and liver. This hormone determines how many red [blood](#) cells we have, thus affecting not only how much oxygen can be carried around our bodies but also how thick our blood is. In abundance, erythropoietin allows more red [blood cells](#) to be produced and when levels are low fewer red blood cells are made.

Increasing the number of red blood cells is a natural response triggered by the shortage of oxygen e.g. at altitude, or in some heart diseases. However, producing too many blood cells can do more harm than good; leading to altitude sickness and death. Thickening of the blood due to hypoxia, oxygen starvation, is also a very common symptom in many cardiovascular diseases. This research shows eating more green vegetables could help alleviate some of the debilitating symptoms of damaged hearts.

In cardiovascular diseases and at high altitude the blood often becomes very thick because the body is producing more red blood cells in an attempt to get more oxygen into the blood stream. Thick blood may carry more oxygen but is less able to pass through small blood vessels and therefore prevents tissues and organs from being supplied with the oxygen they need to function.

The researchers, working with Xtreme Everest, which also involved researchers from the University of Southampton, have filmed this using a special camera, capturing blood flowing through capillaries at sea level and at 6400 meters above sea level: here.

The findings from this new work indicate people may be able to alter the thickness of their blood through simple changes in their diet. This has important implications in management of some cardiovascular diseases and in altitude related diseases. Sufferers may be able to improve their quality of life through simply introducing more nitrate rich vegetables into their diet.

This research may also help critically ill patients in intensive care units use oxygen more efficiently, speeding their recovery, and also has important ramifications for improving athletes' performance.

This research was also part-funded by Research Councils UK, The WYNG Foundation, EU framework 7 inheritance project, and the Wellcome Trust.

Dr Andrew Murray from the University of Cambridge, who co-led the study, said: "Here we show that nitrate from the diet can help regulate the delivery of oxygen to cells and tissues and its use, matching oxygen supply and demand. This ensures cells and tissues in the body have enough oxygen to function without needing to over produce red blood cells, which can make the blood too thick and compromise health."

"Lowering the blood's thickness without compromising oxygen delivery may also help prevent blood clots, reducing the risk of a stroke or heart attack."

Professor Martin Feelisch, from the University of Southampton, who also led the study said: "These findings suggest simple dietary changes

may offer treatments for people suffering from heart and blood vessel diseases that cause too many red blood cells to be produced. It is also exciting as it may have broader implications in sport science, and could aid recovery of patients in intensive care by helping us understand how [oxygen](#) can be delivered to our cells more efficiently."

The BHF-funded researcher and lead author Dr Tom Ashmore said: "The best thing about nitrate is that it is not expensive, treatment is not invasive and not much is needed to observe a significant effect. The only downfall is some people don't like vegetables."

Professor Jeremy Pearson, Associate Medical Director at the BHF, which part-funded the research, said: "It has long been thought that nitrate-rich vegetables have cardiovascular benefits. This research suggests that a previously unsuspected mechanism by which nitrate controls [red blood cell](#) production is important. These findings add to the evidence that dietary nitrate promotes cardiovascular health."

A second paper, led by Dr Murray, part-funded by the BHF and published in *The Journal of Physiology*, shows that consuming nitrate with the diet, consistent with eating a few more leafy greens or beetroot, could alleviate the symptoms of a large number of different heart and circulatory diseases by protecting vital proteins in heart cells and by increasing the production of a compound that causes blood vessels to widen, allowing the heart to pump more efficiently. This work was primarily funded by the BHF, but also part-funded by the Medical Research Council, Research Councils UK, Diabetes UK, EU Framework 7 Inheritance project, and the Wellcome Trust.

In a third study, published in *Diabetes*, the researchers from both Cambridge and Southampton identified nitrate's ability to stimulate conversion of white, or bad, fat cells into beige cells in a process called browning. Beige cells are more similar to 'good' [brown fat cells](#) and burn

fat to produce heat. These data suggest simple changes in the diet could reduce the number of bad white fat cells we have, reducing the risk of obesity and type 2 diabetes. This work was also part funded by the Biotechnology and Biological Sciences Research Council and the Medical Research Council.

Commenting on the results, Dr Murray, who worked on all three studies, said: "There have been a great many findings demonstrating a role for nitrate in reducing blood pressure and regulating the body's metabolism. These studies represent three further ways in which simple changes in the diet can modify people's risk of type 2 diabetes and obesity as well as potentially alleviating symptoms of existing cardiovascular conditions to achieve an overall healthier life."

More information: Tom Ashmore, Bernadette O. Fernandez, Colin E. Evans, Yun Huang, Cristina Branco-Price, Julian L. Griffin, Randall S. Johnson, Martin Feelisch, and Andrew J. Murray (2014) Suppression of erythropoiesis by dietary nitrate *FASEB j* fj.14-263004; published ahead of print November 24.

Tom Ashmore, Bernadette O. Fernandez, Cristina Branco-Price, James A. West, Andrew S. Cowburn, Lisa C. Heather, Julian L. Griffin, Randall S. Johnson, Martin Feelisch, and Andrew J. Murray (2014) Dietary nitrate increases arginine availability and protects mitochondrial complex I and energetics in the hypoxic rat heart *J Physiol* 592:4715-31

Lee D Roberts, Tom Ashmore, Aleksandra O Kotwica, Steven A Murfitt, Bernadette O Fernandez, Martin Feelisch, Andrew J Murray, and Julian L Griffin (2014) Inorganic Nitrate Promotes the Browning of White Adipose Tissue through the Nitrate-Nitrite-Nitric Oxide Pathway *Diabetes* published ahead of print, [DOI: 10.2337/db14-0496](https://doi.org/10.2337/db14-0496)

Provided by University of Southampton

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