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Broccoli Shows Major Healing Potential

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STORY AT-A-GLANCE

- Cruciferous veggies such as broccoli, cabbage, collards, Brussels sprouts and cauliflower contain plant compounds that are important for optimal health, including chemoprotective compounds
- One of the most well-known of these is sulforaphane. Sulforaphane supports normal cell function and division while causing programmed cell death in colon, liver, prostate, breast and tobacco-induced lung cancer
- Indole-3 carbinol (I3C) is another. In your gut, I3C is converted into diindolylmethane, which boosts immune function and plays a role in the prevention and treatment of cancer
- Recent research found mice fed an I3C-rich diet had healthier guts and were less likely to develop inflammation and colon cancer
- I3C activates a protein called aryl hydrocarbon receptor, which communicates with immune and epithelial cells in your gut lining and prevents inflammation caused by unfriendly bacteria

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Science has repeatedly proven that food is a profoundly effective medicine that can activate many healthy nuclear transcription factors in your body. Broccoli and other cruciferous vegetables, for example, have been repeatedly shown to be one of nature's

most valuable health-promoting foods, capable of preventing a number of common health issues.

Cruciferous veggies, which include broccoli, cabbage, collards, Brussels sprouts, cauliflower, kale and bok choy, just to name a few, contain several plant compounds that are important for optimal health, including powerful chemoprotective compounds.

One of the most well-known of these is sulforaphane, an organic sulfur. Studies have shown sulforaphane supports normal cell function and division while causing apoptosis (programmed cell death) in colon,[1] liver,[2] prostate,[3] breast[4] and tobacco-induced lung cancer.[5] Just three servings of broccoli per week may reduce a man's risk of prostate cancer by more than 60%.[6]

Sulforaphane may also be helpful in the treatment of breast cancer. When tested in mice and cell cultures, sulforaphane was found to actually target and kill cancer stem cells, thereby preventing the formation and spread of tumors.[7]

Another important chemoprotective phytochemical found in cruciferous veggies is indole-3 carbinol (I3C),[8] which in your gut is converted into diindolylmethane (DIM). DIM in turn boosts immune function and, like sulforaphane, plays a role in the prevention and treatment of cancer.[9,10]

How Cruciferous Vegetables Help Prevent Colon Cancer

Recent research[11,12] has again confirmed the importance of cruciferous vegetables for cancer prevention, in this case colon cancer. As reported by Newsweek,[13] "Scientists found mice who were fed a diet containing a chemical found in the brassica family of plants had healthier guts, and were less likely to develop inflammation and colon cancer."

Aside from converting to DIM, which has anticancer activity, I3C also works by activating a protein called aryl hydrocarbon receptor (AhR), which communicates with immune and epithelial cells in your gut lining, thereby helping to reduce inflammation caused by pathogenic bacteria.

AhR also helps stem cells convert into mucus-producing cells in your gut lining. These cells also help extract nutrients from the foods you eat, all of which translate into improved gut function and health.

When you have insufficient amounts of AhR, the stem cells end up producing malfunctioning cells that divide in an uncontrolled manner. This abnormal cell division is ultimately what results in abnormal growths that can turn into malignant tumors in your colon.

Consumption of cruciferous vegetables essentially helps prevent this chain of events by boosting I3C. According to coauthor Amina Metidji, Ph.D., with the Francis Crick Institute:[14]

> *"When we fed [the mice] a diet enriched with I3C, they did not develop inflammation or cancer. Interestingly, when mice whose cancer was already developing were switched to the I3C-enriched diet, they ended up with significantly fewer tumors, which were also more benign."*

Molecular immunologist and senior author Gitta Stockinger, Ph.D., added:[15,16]

> *"While there are many reports linking consumption of vegetables to improved health there was so far no molecular basis for this. Our study shows what component of vegetables affects the intestinal barrier and how it does so …*
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> *Seeing the profound effect of diet on gut inflammation and colon cancer was very striking. Many vegetables produce chemicals that keep AhR stimulated in the gut. We found that AhR-promoting chemicals in the diet can correct defects caused by insufficient AhR stimulation …*
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> *While we cannot influence our genes that may predispose us to certain diseases, we can do something about the environmental influences via our diet to ensure that our protective gut barrier is optimally supported. You probably cannot eat too many vegetables."*

Other Health Benefits of I3C

I3C also has other health benefits. Of the various indoles, I3C and its metabolites are powerful antioxidants. Research has also shown it can help balance both male and female hormones, thereby supporting reproductive health in both sexes.

Importantly, DIM has been shown to balance 4-hydroxyestrone, an estrogen that can have damaging effects and plays a role in reproductive cancers. In one study, supplementation with I3C at dosages of 200 and 400 milligrams per day for three months reversed early-stage cervical cancer in 8 of 17 women.[17] As noted by Superfoods:[18]

> *"[I3C] initiates a series of reactions in the body that culminates in the elimination of estrogen. Researchers have observed that metabolism of estrogen occurs via one of two pathways:*
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> *The 'harmful' metabolic pathway, 16 alpha-hydroxylation or the 'beneficial' metabolic pathway, 2-hydroxylation. [I3C] helps to regulate cell growth rates, and helps to change a strong and inflammatory form of estrogen into a safer, less aggressive form."*

Other studies suggest I3C works synergistically with the anticancer drug tamoxifen to improve outcomes. I3C also supports your liver's detoxification processes, and helps heal liver damage by supporting the reproduction of normal, healthy cells.

Cruciferous Veggies Are an Important Part of Anticancer Diet

Sulforaphane is one of several compounds known as isothiocyanates, which have the ability to spark hundreds of genetic changes, activating some genes that fight cancer and switch off others that fuel tumors.[19]

As noted in one study,[20] "research suggests that cruciferous vegetables are not only an important source of nutrients, but perhaps a key to eliminating cancer as life threatening disease." According to Olga Azarenko, a scientist at the UC Santa Barbara laboratories,

whose research shows how the healing power of these vegetables works at the cellular level:[21]

> *"Breast cancer, the second leading cause of cancer deaths in women, can be protected against by eating cruciferous vegetables such as cabbage and near relatives of cabbage such as broccoli and cauliflower. These vegetables contain compounds called isothiocyanates which we believe to be responsible for the cancer-preventive and anti-carcinogenic activities in these vegetables."*

Broccoli, and even more so broccoli sprouts — which typically contain anywhere from 20 to 50 times more chemoprotective compounds than mature broccoli[22,23] — contain the highest amounts of isothiocyanates. Other vegetables containing isothiocyanates include:

Brussel sprouts	Cauliflower	Cabbage
Arugula	Watercress	Horseradish

Other Health Benefits of Cruciferous Vegetables

Cancer prevention is not the only health benefit you can reap from eating more cruciferous veggies, though. Not by a long shot!

These veggies provide dozens of super-nutrients that support optimal, bodywide health, including fiber, the anticancer compounds sulforaphane[24,25,26,27] and glucoraphanin,[28,29] anti-inflammatory and free radical quenching phenolic compounds[30,31,32] and immune-boosting DIM.[33,34]

Aside from cancer, these and other compounds found in broccoli and other cruciferous veggies have been shown to:[35]

Lower your risk of obesity

Suppress inflammation, in part by reducing (by as much as 73 percent) reactive oxygen species that cause cell damage,[36] and in part through the creation of short chain fatty acids (SCFAs). The fiber in cruciferous veggies is broken down into SCFAs by gut bacteria, and SCFAs have been shown to lessen your risk of inflammatory diseases[37]

Improve Type 2 diabetes by reducing glucose production. In one study, patients with dysregulated diabetes who received broccoli sprout extract in addition to metformin had 10 percent lower fasting blood glucose levels than the placebo group.[38] Sulforaphane also lowers your risk of other health problems associated with Type 2 diabetes, such as heart disease and stroke

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Support healthy liver function by improving gene expression in your liver. It also lowers your risk of nonalcoholic fatty liver disease

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Reduce risk of osteoarthritis,[39,40,41,42] in part by blocking enzymes linked to joint destruction[43]

Improve blood pressure in those with hypertension[44]

Improve allergies and asthma by reducing oxidative stress in your airways and countering cell damage caused by pollution and allergens[45]

Improve kidney function and prevent kidney disease by normalizing DNA methylation.[46] DNA methylation[47] is the process by which a methyl group is added to part of a DNA molecule. This is a crucial part of normal cell function as it allows cells to "remember who they are and where they have been."

DNA methylation also suppresses viral- and other disease-related gene expression. DNA methylation plays a role in a number of diseases, including hypertension, kidney function,[48] gut health[49] and cancer

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Improve verbal communication and decrease repetitive behaviors in children with

autism — This effect is thought to be related to sulforaphane's ability to trigger a heat-shock response — a biological effect that protects cells from stress during a fever. Previous research has shown that, in some autistic people, repetitive behaviors decline during fevers.

In this study, 80% of the participants had a history of this fever effect. Positive results from sulforaphane were observed within as little as four weeks. Communication improved, as did symptoms of hyperactivity and irritability. By the end of the 18-week study, about 50 percent of those receiving sulforaphane experienced improved ability to interact socially[50]

Be helpful in the treatment of colitis and leaky gut[51,52,53]

Inhibit Helicobacter pylori (H. pylori), the bacteria thought to cause gastric ulcers (H. pylori may also play a role in autism. Gastrointestinal problems are common among autistic children, and those with the worst gastrointestinal issues often have more severe autism)

Raise your testosterone level[54]

Inhibit retention of excess body fat[55]

Aid in detoxification of carcinogens[56] — Broccoli sprouts, in particular, have been shown to help detox environmental pollutants such as benzene.[57,58,59]

This is important for virtually everyone these days, but especially women of childbearing age. Autistic children are known to have higher levels of environmental toxins in their system, and this underlying toxic burden plays a significant role

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Protect muscles against exercise-induced damage[60]

Protect against neurodegenerative diseases such as Parkinson's and Alzheimer's disease[61]

Promote healthy, beautiful skin (a side effect of improved liver function and detox). The sulforaphane in broccoli also helps repair skin damage

Cruciferous Veggies Improve Arterial Suppleness

Another important health benefit of cruciferous vegetables is their heart-healthy influence. One study[62] that examined the effects of vegetable intake on carotid artery measures, which are indicative of arterial health (narrow, hard arteries restrict blood flow and can lead to heart attack and stroke), found those who consumed the most cruciferous vegetables had thinner and therefore healthier carotid arteries than those who consumed the fewest.

On average, those who ate at least three daily servings of cruciferous veggies had nearly 0.05 millimeters (mm) thinner carotid arterial walls (the artery in your neck) than those who ate two servings or less. Each 0.1-mm decrease in thickness is associated with a decreased stroke and heart attack risk ranging from 10 to 18 percent, so the results were considered rather significant.

Overall, each 10-gram daily serving of cruciferous vegetables was associated with a 0.8% reduction in carotid artery wall thickness. This link was not found with other types of vegetables. According to study author Lauren Blekkenhorst:

> *"After adjusting for lifestyle, cardiovascular disease risk factors (including medication use) as well as other vegetable types and dietary factors, our results continued to show a protective association between cruciferous vegetables and carotid artery wall thickness*[63] *…*
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> *However, this does not discount the importance of other vegetable types, as we know increasing a variety of all vegetables is important to maintain good health. Our research suggests that recommendations to include a couple of servings of cruciferous vegetables amongst the recommended amount of vegetables may help to optimize the vascular health benefits.*[64]*"*

Eat More Cruciferous Veggies to Slow Age-Related Decline

Last but certainly not least, cruciferous vegetables have also been shown to slow age-related decline in health by restoring metabolism to more youthful levels.[65,66,67] A basic premise of aging is that your cells' ability to produce energy declines over time. With less available energy, cell repair and maintenance declines as well, and with that, degeneration sets in.

Cruciferous vegetables improve your metabolism via an enzyme called nicotinamide mononucleotide (NMN). NMN plays a role in producing nicotinamide adenine dinucleotide (NAD), a compound involved in mitochondrial health and energy metabolism. Previous research has shown that, with age, your body loses its capacity to create NAD — an effect thought to be related to, or the result of, chronic inflammation.

Studies have shown that taking NAD directly is ineffective, however. Taking its precursor, NMN or nicotinamide riboside (NR), has been shown to be far more effective. In fact, when dissolved and administered in water, it takes just three minutes for NMN to appear in your blood, and once there, the NMN is quickly converted into NAD in multiple tissues.

Other research[68] has shown that when NAD synthesis in fat tissue is defective, metabolic dysfunction occurs throughout your entire body, including your skeletal muscle, heart and liver. When NMN was administered, all of these dysfunctions were reversed. As noted by the authors,[69] "That means NAD in adipose tissue is a critical regulator of whole body metabolism."

The take-home message here is that cruciferous vegetables like broccoli are a natural, rich source in NMN, and by improving your NAD status, you'll improve your overall metabolism and mitochondrial health, which benefits your whole body.

My personal NAD precursor preference is NR. Because of its molecular structure, it's easier for NR to get into the cells where it is converted to NMN through NR kinases and then ultimately to NAD+.

How to Maximize Health Benefits of Broccoli

The isothiocyanate sulforaphane is formed when you chop or chew broccoli, as this combines its precursor glucoraphanin with the enzyme myrosinase. Once swallowed, gut bacteria help release some of broccoli's sulforaphane so your body can benefit, but it's a tricky proposition because sulforaphane is attached to a sugar molecule with a sulfur bond.

In order for the sulforaphane to be released, an enzyme in the broccoli breaks off the sugar to release it. However, the sulforaphane can be easily inactivated by a sulfur-grabbing protein.

Researchers have found one of the best ways to maximize sulforaphane your body can use is to steam it lightly for three to four minutes until it's tough-tender.[70] This is just enough heat to kill the epithiospecifier protein, which attaches to the sulfur and greatly depletes the amount of bioavailable sulforaphane. Do not steam longer than five minutes.

If you opt for boiling, blanch the broccoli in boiling water for no more than 20 to 30 seconds, then immerse it in cold water to stop the cooking process. Another option is to eat broccoli sprouts.

Fresh broccoli sprouts are FAR more potent than whole broccoli, allowing you to eat far less in terms of quantity. Tests have revealed that 3-day-old broccoli sprouts consistently contain anywhere from 10 to 100 times the amount of glucoraphanin — the precursor to sulforaphane — found in mature broccoli.[71]

The sulforaphane in broccoli and other cruciferous veggies will be further augmented if paired with a myrosinase-containing food.[72] (Again, myrosinase is the enzyme that converts glucoraphanin to sulforaphane.) Myrosinase-rich foods include mustard seed,[73] daikon radishes, wasabi, arugula or coleslaw, with mustard seed being the most potent.

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