

# Broccoli May Slow Age-Related Decline and Promote Longevity by Reducing Chronic Health Risks

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## STORY AT-A-GLANCE

- › An enzyme found in broccoli may slow age-related decline in health by improving mitochondrial health and restoring your metabolism to more youthful levels
- › Broccoli has been shown to reduce your risk of many common diseases including arthritis, cancer, high blood pressure, heart disease, kidney disease, fatty liver disease and diabetes
- › Sulforaphane, a naturally occurring organic sulfur compound found in broccoli has potent anticancer activity; it may also be helpful for children with autism

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Eating plenty of fresh vegetables (ideally organic to avoid pesticides) is a foundational aspect of a healthy diet, and can help lower your risk for many chronic diseases, including Type 2 diabetes,<sup>1</sup> heart disease, stroke and certain cancers.

Besides being rich in vitamins, minerals and fiber, vegetables also contain antioxidants and disease-fighting compounds you won't find in other foods, especially not processed foods. Some phytochemicals (plant chemicals) help reduce inflammation and eliminate carcinogens, while others regulate cell reproduction, apoptosis (programmed cell death) and DNA maintenance.

Certain plant compounds also have potent antiaging effects. **Broccoli**, for example, which is probably best known for its anticancer activity, also contains an enzyme researchers believe may slow age-related decline in health by restoring your metabolism to more youthful levels.<sup>2,3,4</sup>

One basic premise of aging is that, as you age, your cells' ability to produce energy declines. With less available energy, cell repair and maintenance declines as well and, with that, degeneration sets in.

## **Broccoli Enzyme May Slow Aging**

The enzyme in question is called nicotinamide mononucleotide (NMN), which 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, which is what led the researchers to look for a precursor.

Indeed, they found that when NMN is dissolved and administered in water, it takes just three minutes for the compound to appear in the blood. Once there, the NMN is quickly converted into NAD in multiple tissues. As reported by Time magazine:<sup>5</sup>

*"When they gave normal aging mice infusions of NMN, they made more of that energy-fueling compound and some of the biological problems associated with aging went away.*

*The NMN-treated animals did not gain as much weight, they were able to convert food into energy more efficiently, their blood sugar was better – even their eyesight improved. The mice receiving NMN were also able to prevent some of the genetic changes associated with aging."*

## Eat Your Greens if You Want Health and Longevity

The results were encouraging enough that the researchers are now planning further studies in humans, using NMN supplements. As explained by senior author Dr. Shin-ichiro Imai, professor of developmental biology and medicine at Washington University:<sup>6</sup>

*"We are losing the enzyme NMN. But if we can bypass that process by adding NMN, we can make energy again. These results provide a very important foundation for the human studies."*

Besides broccoli, NMN is also found in cucumbers, cabbage and other green vegetables. While it remains to be seen whether all of these effects hold true in humans, it certainly wouldn't hurt to add more greens to your diet. Overall, studies have shown that people with higher vegetable intake have:

Lower risks of high blood pressure and stroke	Lower risks of certain types of cancer	Reduced risk of kidney stones and <b>bone loss</b>
Higher scores on cognitive tests	Higher antioxidant levels	Lower biomarkers for oxidative stress
Lower risk for Alzheimer's disease <sup>7</sup>	Lower risk for eye diseases	Fewer digestive problems

## The Role of NAD and Adipose Tissue in Whole Body Energy Metabolism

A related study<sup>8</sup> by this research team, published in August 2016, revealed more about NAD's influence on glucose metabolism and body fat specifically. As reported by Science Daily:<sup>9</sup>

*"In that study, the mice had a defect in the ability to manufacture NAD only in the body's fat tissue. The rest of their tissues and organs were normal. 'Even*

*though NAD synthesis was stopped only in the fat tissue, we saw metabolic dysfunction throughout the body, including the skeletal muscle, the heart muscle, the liver and in measures of the blood lipids,' Yoshino said.*

*'When we gave NMN to these mice, these dysfunctions were reversed. That means NAD in adipose tissue is a critical regulator of whole body metabolism.'*

*Added Imai, 'This is important because ... if you mess up NAD synthesis only in fat tissue, you see insulin resistance everywhere. Adipose tissue must be doing something remarkable to control whole body insulin sensitivity.'"*

## **Broccoli Provides Many Health Benefits**

Broccoli is one of the most widely studied foods, and research has revealed a long list of health benefits associated with this cruciferous vegetable, including a reduced risk for:<sup>10</sup>

Osteoarthritis<sup>11,12,13,14</sup>

Cancer

High blood pressure<sup>15</sup>

Heart disease

Kidney disease<sup>16</sup>

Diabetes<sup>17</sup>

Neurodegenerative diseases<sup>18</sup>

Allergies<sup>19</sup>

Broccoli and other water- and nutrient-rich veggies also support healthy liver function, which in turn promotes optimal functioning of your natural detoxification systems. Broccoli sprouts, in particular, have been shown to help detox environmental pollutants such as benzene.<sup>20,21,22</sup>

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. Healthy liver function also helps promote healthy, beautiful skin, making broccoli a good antiaging food. What's more, the sulforaphane in broccoli also helps repair skin damage.

The sulforaphane found in broccoli also helps raise testosterone levels, inhibits the retention of body fat and helps protect your muscles against exercise-induced damage.<sup>23</sup>

## **Broccoli – A Good Source of Healthy Fiber**

Broccoli contains an array of beneficial compounds, including **fiber**, which is broken down into short-chain fatty acids (SCFAs) by your gut bacteria. SCFAs, in turn, have been shown to lessen your risk of inflammatory diseases.<sup>24</sup>

Your liver converts SCFAs into ketones that nourish your body and perform important signaling functions. Fiber also promotes health by nourishing beneficial gut bacteria, and by activating a gene called T-bet, which is essential for producing immune cells in the lining of your digestive tract.<sup>25</sup>

These immune cells, called innate lymphoid cells (ILCs), help maintain balance between immunity and inflammation in your body and produce interleukin-22 (IL-22), a hormone that helps protect your body from pathogenic bacteria. ILCs even help resolve cancerous lesions and prevent the development of bowel cancers and other inflammatory diseases.

## **The Anticancer Effects of Sulforaphane**

As mentioned, broccoli is perhaps most well-known for its anticancer activity, an effect attributed to a naturally occurring sulfur compound called sulforaphane. Broccoli sprouts are the most potent in this regard. Three-day-old broccoli sprouts can contain anywhere from 20 to 50 times the amount of chemoprotective compounds found in mature broccoli.<sup>26,27</sup>

Some researchers have suggested broccoli may be a key part of an anticancer diet.<sup>28</sup> Judging by the following study results, chances are broccoli may certainly improve your odds of dodging a dreaded cancer diagnosis.

- In one study, three or four servings (about 10 spears) of broccoli per week was found to reduce men's risk of prostate cancer by more than 60%.<sup>29</sup>
- Higher intake of cruciferous vegetables such as broccoli also lowered the risk of bladder cancer in men by as much as 50%.<sup>30</sup>
- Men with detectable amounts of isothiocyanates (sulfur compounds such as sulforaphane) in their bodies had a 36% lower chance of developing lung cancer over 10 years.<sup>31</sup>
- Eating broccoli three to five times per week has been shown to lower the risk of liver cancer, and help prevent the development of nonalcoholic fatty liver disease (NAFLD).<sup>32,33,34,35,36</sup>

There are a number of mechanisms behind this anticancer effect. Research has shown sulforaphane:

Can kill cancer stem cells, thereby slowing tumor growth.

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Helps detoxify carcinogens.<sup>37</sup>

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Causes apoptosis in colon,<sup>38</sup> prostate,<sup>39</sup> breast<sup>40</sup> and tobacco-induced lung cancer<sup>41</sup> cells.

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Reduces the number of **reactive oxygen species** (ROS), molecules that cause cell damage, by as much as 73%.<sup>42</sup>

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Plays a role in activating more than 200 different genes, activating some genes that fight cancer and switching off others that fuel tumors.<sup>43</sup>

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Normalizes DNA methylation, which plays a role in a number of diseases, including hypertension, kidney function<sup>44</sup> and cancer. DNA methylation<sup>45</sup> 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.

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## **Sulforaphane May Benefit Autistic Children**

Sulforaphane influences bacteria as well. For example, broccoli sprouts have been shown to inhibit *Helicobacter pylori* (*H. pylori*), the bacteria thought to cause gastric ulcers. Interestingly, *H. pylori* may also play a role in autism. Gastrointestinal (GI) problems are common among autistic children, and those with the worst GI problems often have more severe autism.

Preliminary research suggests sulforaphane may improve verbal communication and decrease repetitive behaviors in those with autism.<sup>46</sup> 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% of those receiving sulforaphane experienced improved ability to interact socially.

However, about one-third of the treatment group did not have any noticeable results, so more research needs to be done to ascertain how and why the compound works in certain cases. That said, the study still supports the notion that food is an important part of the treatment plan for autism, and can have a significant impact on behavior.

I believe part of the reason for its beneficial effect on autistic symptoms may be related to its ability to affect gene expression, inhibit detrimental gut bacteria and promote detoxification of harmful environmental pollutants. All of these factors play a role in autism, and pretty much anything that will have a beneficial effect on them is likely to be useful to some degree.

## **Other Health-Promoting Compounds Found in Broccoli**

While sulforaphane typically receives the most attention, broccoli also contains a number of other health-promoting compounds, including:

- **Glucoraphanin**, a glucosinolate precursor of sulforaphane that also influences the process of carcinogenesis and mutagenesis.<sup>47,48</sup> Compared to mature broccoli, broccoli sprouts can contain up to 20 times more glucoraphanin.
- **Phenolic compounds**, including flavonoids and phenolic acids, which have a potent ability to eliminate damaging free radicals and quell inflammation,<sup>49,50,51</sup> resulting in a lower risk for diseases such as asthma, Type 2 diabetes and heart disease.<sup>52</sup>

One of the ways phenolic compounds slow the encroachment of disease is by defending against infection, most dramatically by zapping ROS linked to atherosclerosis and neurodegenerative diseases such as Parkinson's and Alzheimer's.

- **Diindolylmethane (DIM)** — Your body produces DIM when it breaks down cruciferous vegetables. Like many other broccoli compounds, DIM has shown multiple potential benefits, including boosting your immune system and helping to prevent or treat cancer.<sup>53,54</sup>
- **Vitamins and minerals** — Broccoli has twice the vitamin C of an orange, and almost as much calcium as whole milk (with a better rate of absorption). It also contains folate and iron, and all of these nutrients are important for a healthy pregnancy.

## Lightly Steam Your Broccoli to Boost Sulforaphane Content

The "secret" to cooking broccoli is to lightly steam it. Not only will it taste better this way, but it will also optimize its nutritional value.

When you eat raw mature broccoli, you only get about 12% of the total sulforaphane content theoretically available based on the parent compound. In the video above, Elizabeth Jeffery, Ph.D., a researcher and professor in the Department of Food Science



and Human Nutrition at the University of Illinois, explains the research<sup>55</sup> showing that steaming your broccoli for three to four minutes is ideal. Do not go past five minutes.

Steaming your broccoli spears for three to four minutes will optimize the sulforaphane content by eliminating epithiospecifier protein – a heat-sensitive sulfur-grabbing protein that inactivates sulforaphane – while still retaining the enzyme myrosinase, which converts glucoraphanin to sulforaphane. Without it, you cannot get any sulforaphane.

Boiling or microwaving your broccoli past the one-minute mark is NOT recommended, as it will destroy a majority of the myrosinase. If you want to boil your broccoli, blanch it in boiling water for no more than 20 to 30 seconds, then immerse it in cold water to stop the cooking process.

Also beware that frozen broccoli has diminished ability to produce sulforaphane as the enzyme myrosinase,<sup>56</sup> which converts glucoraphanin to sulforaphane, is quickly destroyed during the blanching process.<sup>57</sup>

So ideally, use fresh broccoli. The sulforaphane content can be further optimized by adding a myrosinase-containing food to it,<sup>58</sup> such as:

- **Mustard seed**<sup>59</sup>
- **Daikon radishes**
- **Wasabi**
- **Arugula**
- Cole slaw

Adding a myrosinase-rich food is particularly important if you do not steam or flash-blanche raw broccoli. As mentioned, frozen broccoli typically has a reduced amount of myrosinase as it's already been blanched as part of the processing. Boiling or microwaving it further can easily lead to it being more or less devoid of sulforaphane. So if you're using frozen broccoli, be sure to add a food that contains myrosinase (see list above).

Another option is to eat **broccoli sprouts**. They don't need to be cooked, and are FAR more potent than whole broccoli, allowing you to eat far less in terms of quantity.

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