

Broccoli Compound May Solve Antibiotic Resistance Problem

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✓ Fact Checked

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STORY AT-A-GLANCE

- › Cruciferous vegetables have long been cherished for their health benefits. 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. Sulforaphane supports normal cell function and division while causing apoptosis (programmed cell death) in several types of cancer
- › Another important phytochemical found in cruciferous veggies is indole-3 carbinol (I3C), which is converted into diindolylmethane (DIM). DIM boosts immune function and, like sulforaphane, has anticancer properties
- › Recent research has found DIM effectively inhibits antibiotic-resistant biofilms and significantly boosts the effectiveness of antibiotics. *Pseudomonas aeruginosa* and *Acinetobacter baumannii* are both resistant to multiple drugs. DIM was able to inhibit biofilm formation in these bacteria by 65% to 70%
- › When DIM was combined with the antibiotic tobramycin, biofilm growth of *P. aeruginosa* was diminished by 98%. Applied topically to infected wounds, DIM with or without the antibiotic gentamycin allowed for significantly faster healing, while treatment with gentamycin alone had no effect

Cruciferous vegetables have long been cherished for their health benefits. 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 breast⁴ 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

Another important phytochemical found in cruciferous veggies is indole-3 carbinol (I3C),⁷ 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.^{8,9}

Cruciferous Compound Can Break Antibiotic Resistance

Interestingly, researchers now believe that DIM may be a potent weapon against antibiotic-resistant pathogens as well.^{10,11} Israel21c.org reports:¹²

*“A phytochemical derived from cruciferous vegetables, such as broccoli, breaks down the biofilm that lets bacteria resist antibiotics, according to a study from Ben-Gurion University in Israel ... The paper,¹³ co-authored by researchers from Near East University and Girne American University in Cyprus, was published in the journal *Pharmaceutics*.*

*The scientists found that phytochemical 3,3'-diindolylmethane (DIM) successfully broke down the biofilms protecting pathogens including *Acinetobacter baumannii* and *Pseudomonas aeruginosa* 65% and 70% of the time, respectively ...*

When the team introduced DIM into an infected wound, it sped up the healing process significantly. ‘Our findings show promise for other avenues of research

in addition to known classes of antibiotics,' said [professor Ariel] Kushmaro."

Antibiotic Resistance Is a Serious Problem

This could potentially be the breakthrough we've been searching for. Antimicrobial resistance has been on the rise for decades, thus making infections that were previously easy to treat a serious threat again. According to the World Health Organization, antimicrobial resistance is "one of the top 10 global public health threats facing humanity,"¹⁴ and the primary cause for this man-made epidemic is the widespread misuse of antibiotics.

Antibiotic overuse occurs not just in human medicine, but also in food production. In fact, agricultural uses account for about 80% of all antibiotic use in the U.S.,¹⁵ so it's a major source of human antibiotic consumption.

Animals are often fed antibiotics at low doses for disease prevention and growth promotion, and those antibiotics are transferred to you via meat and other animal products, and even via the manure used as crop fertilizer.

“ DIM was able to inhibit biofilm formation in *Acinetobacter baumannii* and *Pseudomonas aeruginosa* by 65% to 70% respectively. When DIM was combined with the antibiotic tobramycin, biofilm growth of *P. aeruginosa* was diminished by 98%. ”

Many pathogens have also developed resistance to more than one drug, so-called pan-resistance, which makes treating them even more problematic. And, while pan-resistant superbugs are increasing, the development of new antibiotics to tackle them has come to a near halt. According to the WHO:¹⁶

“In 2019 WHO identified 32 antibiotics in clinical development that address the WHO list of priority pathogens, of which only six were classified as innovative.

Furthermore, a lack of access to quality antimicrobials remains a major issue. Antibiotic shortages are affecting countries of all levels of development and especially in health care systems.

Antibiotics are becoming increasingly ineffective as drug-resistance spreads globally leading to more difficult to treat infections and death. New antibacterials are urgently needed – for example, to treat carbapenem-resistant gram-negative bacterial infections as identified in the WHO priority pathogen list.

However, if people do not change the way antibiotics are used now, these new antibiotics will suffer the same fate as the current ones and become ineffective.”

DIM for Pan-Resistant Bacteria

The four pathogenic bacteria investigated in the study¹⁷ cited above – *Pseudomonas aeruginosa*, *Acinetobacter baumannii*, *Serratia marcescens* and *Providencia stuartii* – are all gram-negative bacteria, and in the initial investigation, DIM reduced biofilm formation in all four by as much as 80%.

Of these, *Pseudomonas aeruginosa* and *Acinetobacter baumannii* are both resistant to multiple drugs, so in follow-up tests they focused on these two specifically. As previously noted, DIM was able to inhibit biofilm formation in these bacteria by 65% to 70%. When DIM was combined with the antibiotic tobramycin, biofilm growth of *P. aeruginosa* was diminished by 98%.

Nonhealing wounds are often infected with pan-resistant bacteria, and it's the biofilm that prevents the tissues from healing back together. To test whether DIM could work topically in these scenarios, the researchers infected puncture wounds on pigs with *P. aeruginosa*, and then applied a cream containing either DIM alone, the antibiotic gentamycin alone, or DIM plus gentamycin combined.

Wounds treated with DIM for 10 days healed significantly better than untreated wounds, thanks to a significant reduction in biofilm formation, and the combination of DIM plus antibiotic worked even better. Wounds treated with gentamycin alone saw no improvement.

When to Use This Phytochemical

Just like high-dose vitamin C, which is another potent weapon to treat infections, especially when used IV, I don't believe that DIM should be used every day as a prophylactic to prevent infections. It should be used only when needed to treat antibiotic resistant infections as it will likely do so without any of the side effects of potent antibacterials.

Other Health Benefits of Cruciferous Vegetables

While you may not be able to treat a pan-resistant infection with a few servings of broccoli, the fact that this food may offer a solution to the pressing problem of antibiotic-resistance is exciting, and just goes to show that nature has answers to many of our problems – including problems we've created ourselves.

That said, cruciferous veggies have many other health benefits that are worth taking note of, and which you can obtain simply by including more of them in your diet. In addition to its anticancer benefits, I3C – the precursor to DIM – is also a powerful antioxidant, and can help balance both male and female hormones, thereby supporting reproductive health in both sexes.

I3C also supports your liver's detoxification processes, and helps heal liver damage by supporting the reproduction of normal, healthy cells. Sulforaphane, meanwhile, has been shown to have antidiabetic properties and improves blood pressure.¹⁸ It also supports healthy kidney function¹⁹ and gut health²⁰ by normalizing DNA methylation.

In simple terms, DNA methylation²¹ is the process by which a methyl group (one carbon atom attached to three hydrogen atoms) 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.

Just realize that broccoli is not a “magic” bullet. In fact, some physicians, like Dr. Paul Saladino, present powerful arguments that nearly all vegetables are to be avoided (but not fruits). This is because the hormetic benefits from their phytochemicals can be obtained in other lifestyle measures.

The most important lifestyle measure would be to avoid all seed oils. If you only limited your diet changes to keep your seed oil less than 2% of your daily calories as confirmed by Cronometer, I strongly believe your health would improve exponentially more than regularly having the finest organic/biodynamic vegetables.

This is largely because excess LA (linoleic acid) is the most pernicious toxin in our food supply and is responsible for most all of our chronic diseases. Other lifestyle measures to improve your health would include exercise, regular sun exposure on bare skin, and sauna. Having said that, compounds found in broccoli and other cruciferous veggies have been shown to:

Lower your risk of obesity²²

Suppress inflammation — In part by reducing (by as much as 73%) reactive oxygen species that cause cell damage,²³ and in part through the creation of short chain fatty acids (SCFAs).²⁴ 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

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 up to 10% lower fasting blood glucose levels than the placebo group.²⁵ Sulforaphane also lowers your risk of other health problems associated with Type 2 diabetes, such as heart disease and stroke

Support healthy liver function and lower your risk of nonalcoholic fatty liver disease²⁶

Reduce risk of osteoarthritis²⁷ — In part by blocking enzymes linked to joint destruction²⁸

Improve allergies and asthma by reducing oxidative stress in your airways and countering cell damage caused by pollution and allergens²⁹

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 one study, 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 half (15 of 29) of those receiving sulforaphane experienced improved ability to interact socially³⁰

Improve chemically-induced colitis and leaky gut³¹

Inhibit Helicobacter pylori (H. pylori), the bacteria thought to cause gastric ulcers³²

Increase your free testosterone level³³

Protect muscles against exercise-induced damage³⁴

Facilitate detoxification of chemical pollutants^{35,36,37}

Protect against neurodegenerative diseases such as Parkinson's and Alzheimer's disease³⁸

Promote healthy, beautiful skin (a side effect of improved liver function and detox).

Sulforaphane also helps protect your skin against damage from UV radiation³⁹

How to Optimize the Benefits of Broccoli

To get the most out of your broccoli, lightly steam it for three to four minutes until it's tough-tender. Do not steam longer than five minutes. This will allow you to get the most bioavailable sulforaphane out of it. 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.

If you want to augment the sulforaphane content even further, pair broccoli and other cruciferous veggies with a myrosinase-containing food⁴⁰ such as mustard seed,⁴¹ daikon radishes, wasabi, arugula or coleslaw. Of these, mustard seed is the most potent.

If you're not a fan of mature cruciferous vegetables, then consider broccoli sprouts instead. They actually pack a greater punch in terms of nutrition, so you don't have to eat as much. According to researchers at Johns Hopkins University, a mere 5 grams (0.17 ounces) of broccoli sprouts contain concentrations of the compound glucoraphanin equal to that found in 150 grams (5.2 ounces) of mature broccoli.⁴²

Sprouts can also contain up to 100 times more enzymes than raw fruits and vegetables, allowing your body to extract more vitamins, minerals, amino acids and essential fats from the foods you eat. You can easily and inexpensively grow broccoli sprouts at home, indoors, and you don't have to cook them. They are eaten raw, usually as an addition to salad or juice.

Sources and References

- ¹ [Cancer Research March 1, 2000:60\(5\):1426-33](#)
- ² [Medical News Today March 4, 2016](#)
- ³ [Science Direct Aug. 2012](#)
- ⁴ [Clinical Cancer Research May 1, 2010; 16\(9\):2580-90](#)
- ⁵ [Cancer Research September 15, 2005; 65\(18\):8548-57](#)
- ⁶ [Selfhacked.com, Sulforaphane as a Panacea](#)

- ⁷ [Superfoods.scientific.research.com Indole 3 Carbinol Benefits and Side Effects](https://www.superfoods.scientific.research.com/indole-3-carbinol-benefits-and-side-effects/)
- ⁸ [Nutrition and Cancer 2004;50\(2\):161-7](#)
- ⁹ [Journal of Biomedical Research 2014 Sep; 28\(5\): 339–348](#)
- ^{10, 13, 17} [Pharmaceutics 2022; 14\(5\): 967](#)
- ¹¹ [Medical News Today July 18, 2022](#)
- ¹² [Israel21c.org July 12, 2022](#)
- ^{14, 16} [WHO Antimicrobial Resistance](#)
- ¹⁵ [Food Safety News February 24, 2011](#)
- ¹⁸ [American Journal of Hypertension 2012 Feb;25\(2\):229-35](#)
- ¹⁹ [Am J Hypertens February 2012](#)
- ²⁰ [Dr. Amy Yasko, H. Pylori: Another piece of the puzzle Parts 1 and 2](#)
- ²¹ [Nature Education 2008; 1\(1\): 116](#)
- ²² [Deacon Chronicle January 24, 2018](#)
- ²³ [Diabetes August 4, 2008](#)
- ²⁴ [Science Daily September 29, 2015](#)
- ²⁵ [New Scientist June 14, 2017 \(Archived\)](#)
- ²⁶ [Vanduynd Center February 12, 2020](#)
- ²⁷ [Arthritis & Rheumatism 2013 Dec;65\(12\):3130-40](#)
- ²⁸ [Live Science May 30, 2013](#)
- ²⁹ [Respir Res. 2015; 16\(1\): 106. September 15, 2015](#)
- ³⁰ [PNAS 2014 Oct 28; 111\(43\): 15550–15555](#)
- ³¹ [Journal of Functional Foods October 2017; 37: 685-698](#)
- ³² [Oncology Times January 25, 2006; 28\(2\): 27-29](#)
- ³³ [Magnum Health May 5, 2022](#)
- ³⁴ [SuppVersity November 12, 2012](#)
- ³⁵ [Cancer Prevention Research 2014; 7\(8\): 813-823](#)
- ³⁶ [Johns Hopkins Press Release June 16, 2014](#)
- ³⁷ [NPR June 18, 2014](#)
- ³⁸ [Oxid Med Cell Longev. 2013; 2013: 415078](#)
- ³⁹ [PNAS October 30, 2007; 104\(44\): 17500-17505](#)
- ⁴⁰ [American Institute for Cancer Research November 7, 2013](#)
- ⁴¹ [Food Chemistry June 1, 2013; 138\(2-3\):1734-41](#)
- ⁴² [Proc Natl Acad Sci U S A. 1997 Sep 16;94\(19\):10367-72](#)