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## REPORT

### How Cruciferous Vegetables Prevent Cancer

By Dale Kiefer



Alarming statistics now suggest that more than half of all cancers in US adults may be caused by poor diet.<sup>1</sup> What these frightening numbers mean is that much of the death and misery caused by cancer can be prevented.

Fortunately, scientific evidence has now established that cruciferous vegetables contain vital cancer-fighting components that offer powerful protection against carcinogens. The compounds found in certain vegetables support the body's natural detoxification process, helping to rid it of cancer-causing agents in our food, water, and environment.

Broccoli, cauliflower, and other cruciferous vegetables uniquely contain health-promoting phytonutrients that have been shown to help prevent the onset and halt the progression of colon, breast, prostate, thyroid, cervical, and other cancers.<sup>1-16</sup> These natural compounds also promote

healthy estrogen metabolism in the body—a critical component in any disease-prevention strategy—while counteracting the daily onslaught of cancer-causing chemicals.

In this article, we examine the remarkable disease-preventive compounds found in cruciferous vegetables, how they exert their multifaceted cancer-fighting effects, and how you can take advantage of these nutrients to protect against a multitude of cancer-inducing agents.

#### DOES CANCER REPRESENT A CRUCIFEROUS VEGETABLE DEFICIENCY?

Scientists now believe that one important reason why so many people contract deadly cancers is that they do not eat enough healthful fruits and vegetables.<sup>1</sup> Only a small percentage of Americans consumes the five daily servings of fruits and vegetables that the government recommends for good health. Even more distressing, the typical American diet is shockingly deficient in some of the most potent cancer-fighting foods available: cruciferous vegetables such as broccoli, cauliflower, Brussels sprouts, and kale.

Cruciferous vegetables are rich in vitamins, minerals, and antioxidants, which undoubtedly contribute to their healthful effects. However, scientists have identified other bioactive compounds in these vegetables that are specifically responsible for their cancer-preventive effects. These compounds, which are called glucosinolates, are transformed to indole-3-carbinol (I3C) and diindolylmethane (DIM) in the body.<sup>17</sup>

A dietary deficiency of phytonutrients found in cruciferous vegetables may contribute to the onset of cancer in numerous ways. Every day, we are exposed to cancer-inducing compounds in our environment. Cruciferous vegetables dramatically enhance the body's ability to neutralize these carcinogens, thus providing essential cancer-preventive support.<sup>18-20</sup>

Another major cause of cancer comes from within the body itself. When estrogens are metabolized via certain biochemical pathways, they become more likely to trigger cancer.<sup>21,22</sup> Aging adults suffer from a high prevalence of cancers associated with an imbalance in estrogen metabolism.<sup>21-24</sup> Cruciferous vegetables contain compounds that promote a healthier pathway for breaking down estrogen in the body, thus protecting against cancer.<sup>25-31</sup> Cruciferous vegetable compounds act through many other mechanisms in the body to protect against the growth and spread of existing cancers.



#### Watercress: Potent Cancer Protection from a Little-Known Vegetable

Watercress, a lesser-known cousin of broccoli, offers a host of health benefits. Watercress is an exceptionally rich source of potent cancer-fighting isothiocyanates, including the much-studied compound known as phenethyl isothiocyanate, or PEITC.<sup>68</sup>

Impressive research indicates that a watercress-broccoli extract effectively suppresses production of an enzyme that facilitates the spread of breast cancer to other tissues.<sup>69</sup> Scientists have also demonstrated that isothiocyanates in watercress suppress production of pro-inflammatory compounds such as prostaglandins, which are associated with numerous pathological conditions, including cancer. This suppression of inflammatory compounds may be yet another anti-cancer effect conferred by cruciferous vegetables.<sup>70</sup>

Because epidemiological evidence associates increased intake of cruciferous vegetables with a reduced risk of prostate cancer, scientists sought to identify the specific compounds responsible for this cancer-preventive effect. They found that a form of PEITC that is abundant in watercress inhibited the proliferation of prostate cancer cells and their ability to form tumors.<sup>71</sup>

Cancer researchers are also interested in watercress as a weapon against lethal lung cancers. Watercress is the richest source of a glucosinolate known as nasturtiin, which is transformed into PEITC in the digestive tract.<sup>72</sup> In laboratory rodents, watercress-derived PEITC helped prevent lung cancer that is ordinarily triggered by a tobacco-derived carcinogen.<sup>73-76</sup>

Studies have shown that PEITC inhibits the proliferation of cancer cells in the laboratory with surprising rapidity. This is very important, as PEITC and other dietary isothiocyanates in cruciferous vegetables tend to clear the body quickly through urinary excretion. Working with a type of human leukemia cell, scientists have discovered that PEITC and other isothiocyanates act on multiple cell targets to help fight cancer proliferation.<sup>77</sup> Indeed, after just three hours of exposure to PEITC and other isothiocyanates, cancer cells experienced the full spectrum of these anti-cancer effects.

Scientists in France recently discovered that like I3C, compounds contained in watercress induce phase I and phase II liver enzymes. Thus, these natural agents not only have anti-cancer benefits, but also provide detoxification support. This effect may explain their ability to inhibit the cancer-provoking effects of a wide variety of compounds.<sup>78</sup>

## NEUTRALIZING DIETARY AND ENVIRONMENTAL TOXINS

Cruciferous vegetables help to shield us from cancer by protecting against toxic compounds encountered each day in our food, air, water, and environment.

Estrogen-like compounds in the environment are called xenoestrogens. We ingest and absorb xenoestrogens from plastics used in beverage bottles and food containers, industrial chemicals, and pesticides.<sup>32,33</sup> In the body, these xenoestrogens are toxic compounds that can potentially trigger the onset or progression of cancer. By mimicking estrogens, xenoestrogens influence hormonally regulated processes and induce changes in growth factors, which can set the stage for cancer.<sup>33</sup>

One example of particularly toxic xenoestrogens are the environmental contaminants known as PCBs, or polychlorinated biphenyls. Dangerously high levels of PCBs have been found in adults and children living in areas where these chemicals have contaminated the soil, water, and air.<sup>34,35</sup> Alarming, despite the decades-old ban on their production and use in the US, PCBs have made their way into the food chain, particularly in certain types of seafood such as Atlantic salmon.<sup>36,37</sup> Numerous studies demonstrate that PCBs have a multitude of adverse effects on human health.<sup>34,35,38-41</sup>



For example, one study found that urban-dwelling men who eat fish not only have the highest levels of PCBs and related toxins, but also have the greatest incidence of male infertility indicators such as low ejaculate volume, low sperm count, and poor sperm motility.<sup>38,39</sup> Some scientists believe PCBs are responsible for increases in the incidence of allergies, autoimmune diseases, and hormone-dependent cancers such as certain types of breast and prostate cancers.<sup>34,35</sup> Other researchers report that exposure to these toxins in the air may adversely affect the brain, altering mood and concentration.<sup>40</sup> Exposure to PCBs has been linked to increased rates of endometriosis in women, a chronic condition associated with pelvic pain and infertility.<sup>41</sup>

Although it is almost impossible to completely avoid these contaminants, research shows that it may be possible to boost one's protection against them by consuming optimal amounts of healthful phytochemicals from cruciferous vegetables.<sup>18-20</sup> These phytochemicals, which include I3C and other compounds, enhance the effectiveness of the body's primary detoxification system: the liver's phase I and phase II enzyme systems.<sup>3,42,43</sup> These enzymes help transform harmful toxins and carcinogens into harmless compounds that can be safely eliminated by the body.<sup>44-46</sup>

## Rosemary, Vitamin D Provide Synergistic Support in Cancer Prevention

Carnosic acid and carnosol, compounds derived from the culinary herb rosemary, are antioxidants that help fight cancer, much like the cruciferous vegetable compounds I3C and DIM.<sup>79</sup> Carnosic acid and carnosol reduce the carcinogenic potential of

estrogens by modulating their metabolism in the liver. For example, feeding female mice a diet containing 2% rosemary for three weeks increased beneficial estrogen metabolites by approximately 150%, while inhibiting detrimental estrogen metabolites by approximately 50%.<sup>80</sup>

Further research into these compounds has demonstrated that they work synergistically with vitamin D. Scientists are now avidly investigating vitamin D as one of the most promising nutrients in the fight against cancer. Vitamin D functions like a hormone to affect the immune system and protect against cancer.<sup>81-84</sup> Rather than killing cancer cells outright, vitamin D appears to halt cancer by forcing “runaway” cells to differentiate—that is, to become more like normal cells.<sup>85,86</sup>

New research shows that carnosic acid and carnosol from rosemary synergize with vitamin D, helping it to kill cancer cells more effectively.<sup>85-87</sup> The combination of vitamin D and rosemary compounds represents a novel addition to traditional approaches to cancer treatment.

## PROMOTING HEALTHY ESTROGEN METABOLISM

As previously noted, an imbalance of estrogens in the body can set the stage for cancer, and aging adults are particularly susceptible to cancers associated with aberrant estrogen metabolism.<sup>21-24</sup> Fortunately, cruciferous vegetable compounds like I3C and DIM may provide powerful protection against cancer by promoting optimal estrogen metabolism.

Estradiol is the primary estrogen in circulation in the body, as well as one of the most active. The body metabolizes estradiol via two separate pathways. One pathway results in estradiol's conversion to a less potent form of estrogen (2-hydroxyestrone), while the other pathway increases production of a more toxic estrogen metabolite (16 alpha-hydroxyestrone). Researchers believe that women who primarily metabolize estradiol to the toxic metabolite may be at greater risk for breast cancer.<sup>25</sup>

In 2000, researchers confirmed the theory that certain estrogen metabolites can contribute to cancer. They analyzed data gathered from over 10,000 Italian women over more than five years to determine how dietary and hormonal factors influence breast cancer risk. As postulated, they found that women were much less likely to develop breast cancer when they had higher levels of the less potent estrogen metabolite (2-hydroxyestrone).<sup>25</sup>

Additional studies of different populations have since confirmed this finding. A favorable ratio of estrogen metabolites is now generally accepted as desirable for conferring protection against cancer.<sup>21,47,48</sup> The toxic estrogen metabolite (16 alpha-hydroxyestrone) can act as a breast tumor promoter.<sup>21</sup> By contrast, estrogen metabolized via the less active pathway (to 2-hydroxyestrone) does not exhibit estrogenic activity in breast tissue.<sup>21</sup> Additionally, a form of this less active estrogen metabolite is believed to prevent the formation of blood vessels necessary to feed growing cancers, thus helping to arrest tumor growth.<sup>49</sup>

This delicate balance of estrogens is crucially important for men's health as well. In a study that examined the ratio of estrogen metabolites relative to prostate cancer risk, elevated levels of the more active metabolite were linked with an increased risk of prostate cancer. These important findings suggest that a man's ratio of estrogen metabolites may offer important insight into his risk for prostate cancer.<sup>22</sup>

Fortunately, the cruciferous vegetable compounds I3C and DIM are effective in shifting the metabolism of estradiol to the more beneficial pathway, thus reducing levels of toxic 16 alpha-hydroxyestrone and increasing levels of protective 2-hydroxyestrone.<sup>26-31</sup> This beneficial modulation of estrogen metabolism has been correlated with reduced risk of breast and other cancers, including cervical, prostate, and even head and neck cancers.<sup>15,19,21,25,30,31,50-52</sup> The cruciferous vegetable compounds I3C and DIM may thus play an important role in fighting cancer by promoting healthy estrogen metabolism.

## Cat's Claw Provides Complementary Cancer Protection

In the search for effective cancer-fighting agents, scientists have turned their attention to a promising herbal remedy from the Peruvian rain forest. Dubbed “cat's claw,” this tropical vine has been used in South America for centuries in the management of cancer, arthritis, and stomach disorders.<sup>88,89</sup> Promising new laboratory, animal, and human studies show that compounds derived from cat's claw extract possess potent immune-boosting, DNA-protecting, and cancer-fighting properties.

Swedish researchers found evidence of the significant immunity-boosting properties of cat's claw extract. In rodents, administering cat's claw extract over eight weeks improved the animals' ability to respond to immune system challenges.<sup>90</sup> Similarly, when human volunteers supplemented with cat's claw extract for six weeks, they demonstrated increased levels of white blood cells.<sup>90</sup> Healthy immune system function is crucial to protecting against a wide variety of disease-provoking agents.

Cat's claw may also help protect DNA against damage that can contribute to cancer. When rats received cat's claw extract for eight weeks before being exposed to DNA-damaging radiation, they demonstrated a markedly improved ability to repair DNA damage.<sup>90</sup>

Cat's claw's ability to protect DNA has also been observed in humans. Volunteers who were exposed to a DNA-damaging chemical and supplemented with cat's claw extract showed decreased DNA damage and increased DNA repair. Cat's claw thus appears to support healthy DNA structure.<sup>91</sup>

Cat's claw likewise shows promise in protecting human cells against cancer. In 2001, Italian scientists found that cat's claw extract reduced the proliferation of human breast cancer cells in the laboratory.<sup>89</sup>

More recently, Austrian scientists showed that cat's claw extract prevents human leukemia cells from growing in the laboratory by prompting them to self-destruct (undergo apoptosis).<sup>92</sup> When the Austrian team further investigated the active constituents in cat's claw extract, they found that several of its active ingredients fight cancer by inhibiting leukemia cell proliferation or by killing leukemia cells outright.<sup>92</sup>

While scientists are still investigating how this herbal remedy fights cancer, they believe that cat's claw extract and its active ingredients may help regulate various cytokines,<sup>93</sup> proteins secreted by the immune system that are believed to play an important role in the body's natural cancer-defense system.<sup>94</sup>

## HOW TO BEST OBTAIN THE BENEFITS OF CRUCIFEROUS VEGETABLES

While the health benefits of cruciferous vegetables are undisputed, obtaining optimal amounts of these potent cancer fighters through diet alone may be difficult.<sup>53,54</sup> Studies have shown that even if you eat these vegetables every day, their beneficial glucosinolates may be lost during food storage, or degraded or leached out during food processing. Moreover, cooking cruciferous vegetables tends to inhibit the conversion of much of their glucosinolate content to beneficial cancer-fighting compounds.<sup>53,54</sup>

To help everyone benefit from the cancer-fighting power of cruciferous vegetables, scientists have identified and isolated their most bioactive compounds and made them available as low-cost concentrated dietary supplements. These cancer-fighting phytonutrients may be most beneficial when consumed with meals, by helping to neutralize dietary carcinogens.

## CONCLUSION

Amazing as it may seem, vegetables and herbs that are readily found in any supermarket produce aisle contain some of the most potent cancer-fighting compounds found in all of nature.<sup>55-67</sup>

Natural phytonutrients derived from cruciferous vegetables such as broccoli, cauliflower, and watercress, along with powerful antioxidant polyphenols such as carnosic acid and carnosol from rosemary, offer powerful, broad-spectrum support for maintaining healthy estrogen metabolism and protecting against the ubiquitous, cancer-provoking agents encountered every day in our environment.

Incorporating these extraordinarily potent, plant-based compounds in a daily supplementation program is a safe, effective, and inexpensive way to guard against many of today's most common and lethal cancers.

## Charred Meats Elevate Cancer Risk

Meat that has been cooked at high temperatures is one of the most common sources of dietary carcinogens. When cooked to a "well-done" state, meats contain dangerous compounds, including heterocyclic amines. These compounds are known to cause DNA mutations and cancer in animals.<sup>95,96</sup> Scientists have recently confirmed that eating well-done meat poses health risks to humans as well.

Epidemiological studies have linked the consumption of well-done meat with cancers of the colon, breast, and stomach in adults.<sup>96</sup> In men, greater consumption of very well-done meat has been linked with an increased risk of prostate cancer. Importantly, intake of total, red, or white meat did not increase prostate cancer risk, which led scientists to conclude that it is the heterocyclic amines produced by high-temperature cooking—rather than the meat itself—that elevates prostate cancer risk.<sup>97</sup>

While heterocyclic amines themselves are not carcinogenic, they are transformed in the body into chemically reactive compounds that can interact with DNA to trigger the initiation of cancer.<sup>96</sup> Scientists believe it may be possible to reduce the risks of these potential carcinogens by using nutritional and dietary strategies.



Protective compounds derived from vegetables, particularly cruciferous vegetables, may help to lessen the dangers of potent meat-derived carcinogens by preventing their activation or by increasing their detoxification.<sup>1</sup> Scientists have noted that cruciferous vegetables help protect against DNA damage and pre-cancerous changes that can be induced by heterocyclic amines.<sup>98</sup> Thus, ensuring regular intake of cruciferous vegetable compounds may help protect against one of the most prevalent sources of dietary carcinogens.

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