

Cruciferous Vegetables, Your Mom Was Right After All

Cruciferous vegetables are a family of plants that include broccoli, cauliflower, Brussels's sprouts, bok choy, collard greens, mustard, turnips, cabbage, kale, kohlrabi, arugula and radish.

From an early age, many of us developed an on-again/off-again type of relationship with these oddly shaped edibles. For most of us, when our parent's used all of their political savvy to try and entice (or force) us to eat our broccoli, we met them with equal defiance and cunning. We fed them to the dog under the table, or maybe we drowned them in ketchup or thoroughly mixed them with our other food to hide the odd flavors. I think its safe to say that most of the health food flavor criticisms typically begin with these particular vegetables. The mere mention of Brussels sprouts is enough to give many the "eww" expression.

I heard an excellent analogy one time about vegetables; they are like the men you should date. They may be better for you, but they are usually much less exciting than the 'bad boys'. It's only in the end when you hit the bottom in the toxic relationship that you fully realize the error of your ways and begin to do what's right.

What exactly is so unappealing about this powerfully healthy group of vegetables? Obviously the taste. To some people they taste very bitter, to others they simply taste like nothing, which may be equally unappealing. What's interesting about these vegetables is that they contain compounds that are very similar to something called *phenylthiocarbamide*, or PTC. It is a sulfur compound that has been used for genetic testing since the late 1930s. PTC either tastes very bitter or like nothing at all, which is entirely dependent upon the genetic make up of

the person tasting it. The PTC taste trait is a dominant genetic trait and its correlation was that it was actually used as the basis for paternity testing before the development of DNA testing. So if your parent's taste buds were sensitive to the bitterness of cruciferous vegetables, chances are you taste it the same way and may have to overcome that barrier the same way they did: pinch your nose and swallow it quick!

What's the big fuss about broccoli anyway? Or the other vegetables for that matter? Sure they have nutrients and stuff, but why can't we all save ourselves the suffering and take a multivitamin and call it a day? While it is true that these vegetables contain ample amounts of essential nutrients like trace minerals and vitamins, researchers are discovering new natural chemical compounds in these vegetables that have powerful protective and remedial health benefits to humans. We are going to take a closer look at two of them.

Both of the substances we are going to discuss originate through the same chemical process with only minor differences. Cruciferous vegetables contain large amounts of *glucosinolates*. These are organic compounds that contain sulfur, nitrogen, glucose and an amino acid. The purpose of glucosinolates in nature is to serve as a defense mechanism for plants. One of the methods that plant life use to protect themselves from being eaten is to make themselves mildly poisonous to creatures that want to consume them.

When a plant that contains glucosinolates is chewed by an animal, a group of enzymes in the plant called *myrosinase* activates and removes the glucose molecule from the glucosinolates, which then become different types of chemicals that are all toxic to the animal in various concentrations.

Hold on. Stop the presses. You're saying that when I chew my cauliflower at the dinner table, there's a bunch of chemical hocus pocus making poison in my mouth? The answer to that is yes... and no. Just like macadamia nuts and chocolate are poisonous to dogs, but not to us, in a similar manner are metabolized glucosinolates poisonous to various herbivore animal species, but not us. In fact, it is this mild toxic property of these substances that make them healthy for us.

The most famous of these glucosinolates metabolites is *sulforaphane*. There are numerous studies being conducted, reviewed, and hotly debated about the properties of sulphoraphane in the human body. The crux of the discussion is to what degree it protects humans from various types of cancers in different organs of the body. In the studies that have been completed on sulphoraphane, they have shown that sulforaphane contributes strongly to anti-oxidant activity in the body and also that it promotes the activity of a number of different enzymes in the body that make proteins that both repair and protect DNA from damage and also suppress tumor growth and development.

One group of enzymes that sulforaphane stimulates are the glutathione S-transferase. These enzymes are responsible for using glutathione and binding it to various toxic substances in the body so that they can be excreted. This includes carcinogens, free radicals, and even prescription medications. These enzymes play a critical role in protecting the body from cellular and DNA damage from there various toxins. Sulforaphane strongly promotes the activity of these enzymes in their protective role.

Sulforaphane is also anti-microbial. Over 50% of the global population has an infection in the upper intestinal tract

of a particular bacterium called *H. pylori*. This bacterium causes low-level inflammation in the lining of the stomach and has a strong correlation with the development of stomach ulcers as well as cancer. Sulforaphane is a prime active agent in the inhibition of *H. pylori* from infecting the digestive tract.

One of the experiments that caused a lot of excitement about sulforaphane was an experiment conducted by Singh et al in 2004 using cultured prostate cancer cells that were exposed to sulforaphane. They found that sulforaphane inhibits cell growth and promotes cell death in prostate cancer cells. The exact chemical mechanisms behind this are the subject of current research, but the fact that sulforaphane has this effect upon cancer cells is very inspiring.

Even better news is that sulforaphane is not the only anti-cancer compound made from glucosinolates in cruciferous vegetables. There is another that has garnered a lot of attention in recent years. *Indole 3 Carbinol* also known as I3C. According to the Linus Pauling Institute, I3C was used in several experiments similar to the 2004 experiment by Singh et al on sulforaphane where it was added to the prostate cancer cell culture. I3C had similar effects on cultures of breast, prostate, pancreatic, and cervical cancer cells. In all of the experiments I3C induced apoptosis, programmed cell death, in the cancer cells. Why this is such a significant find is because one of the unique properties of cancer cells is that they are considered 'immortal cells'. They can endlessly divide and at the time when a normal cell would expire, it simply continues. I3C reactivates the apoptosis command in the cancer cell causing them to self-destruct.

So far, the majority of the studies conducted on humans relating to the effects of I3C, sulforaphane, and cruciferous vegetable consumption have

only been able to show a strong correlation between the consumption of large amounts of cruciferous vegetables and a greatly decreased risk of developing certain cancers, namely prostate, breast, lung, pancreatic, cervical, and endometrial.

I3C and sulforaphane are considered to be the prime substances in the cruciferous vegetables that produce their benefits. In order for the I3C and sulforaphane to enter the body, the glucosinolates must be metabolized. How well this occurs depends upon the method of food preparation used. The two goals of preparing cruciferous vegetables are to make sure that the glucosinolates remain in the food and the myrosinase enzymes remain active. Boiling the vegetables leech the glucosinolates out of the food since they are water-soluble. Boiling and steaming can also deactivate the myrosinase as well. The best ways to prepare the vegetables are to either bake, fry, or ferment them.

Another option is the direct supplementation of sulforaphane and I3C. This way if there are not enough properly prepared cruciferous vegetables in your diet, you can still get the benefits of these two substances.

Some people have heard a misconception about cruciferous vegetables and possible side effects that might do harm to their thyroid or create imbalances in hormones and other effects. While it is true that some animal studies have found that consuming large amounts of these vegetables has resulted in hypothyroidism, only rarely has this occurred in humans. One example is the 88-year old woman who consumed one or two kilograms of bok choy every day for months who developed hypothyroidism and fell into a coma. While it is sad that this happened, I am sure that any person reading this right now has come to the conclusion

that they shouldn't eat several pounds of anything everyday, lest something bizarre happen and they fall into a coma. Word to the wise, eat smart.

There is, however, a more common nuisance that affects some people who eat cruciferous vegetables. These veggies also contain cellulose, which is a kind of natural sugar that sometimes gives people gas bloat from difficulty digesting the cellulose. A very simple solution to this is to take digestive enzymes in order to aid the body in breaking down the cellulose.

Even though these vegetables maybe a flavor challenge, there are some really great recipes out there to overcome this obstacle. I highly recommend a book called "The World's Healthiest Foods" by George Mateljan. It is a fantastic work and has a lot of great vegetable recipes and, as the title says, has a lot of information on other nutritious foods.

Just as an aside, the word 'cruciferous' has the same origin as 'crucifix' meaning cross. It refers to the four-leaved shape of many of these veggies. In a weird way, maybe these are 'holy veggies' and it could be God's cruel little joke to make the weirdest tasting veggies the ones that offer you the strongest protection from the cancer devil. Just a thought.



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