

Cruciferous Vegetables, Associated Compounds and Hormonally Related Cancers

Special Health Report

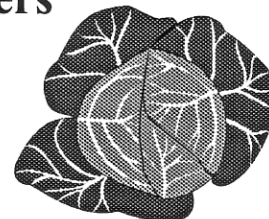
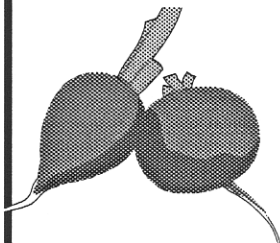


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Introduction

The paper is designed to outline some of the ongoing research on cruciferous vegetables and related compounds which influence hormonally caused cancers.



Cruciferous plants obtain their name from a distinctive cross shaped flower. Plants of

interest include broccoli, cabbage, cauliflower, Brussels sprouts, mustard, kale, radish, horseradish, and collard greens.

These plants are all known for a pungent taste. This taste is caused by breakdown products such as isothiocyanates and indolecarbinols.

There is an inverse relationship between consumption of cruciferous vegetables and hormonally related cancers. These cancers are among the most rapidly increasing in the United States. A man over 50 in the United States has a 30% chance of developing prostate cancer. One out of eight women in the United States will experience breast cancer in her lifetime.

Reference:

Jaret, Peter, "Foods That Fight Cancer," *Health*, March/April 1995.

The Environmental Problem

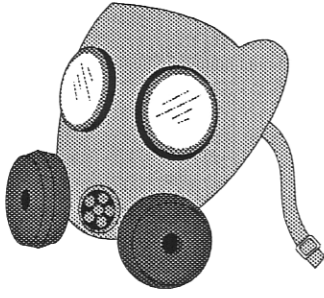
Rachel Carson published *Silent Spring* in 1962, a book which began the modern environmental movement. Sadly, two years after the publication of the book she died of breast cancer. It now appears she may have been a victim of the pollution she warned against.

Hormonally caused cancers (breast and prostate) have increased rapidly. Some researchers feel that estrogenic chemicals in the environment play a role. Research conducted over the last quarter century has revealed that a good many man-made chemicals have estrogenic effects. Among the compounds with estrogenic effects according to *Science News* are "DDT (and its even more toxic metabolite DDE), kepone, heptachlor, dieldrin, mirex, and toxophene. Some polychlorinated biphenyls (PCB's) exhibit these disruptive properties, as do certain combustion pollutants, ingredients in plastics, and breakdown products of common detergents."¹ Related chlorine compounds are used in dry cleaning, fire prevention, and refrigeration.² Even tampons contain chlorine compounds.³

DDT was the first widely distributed chemical with estrogenic effects. The product was banned for use in the United States in 1972. DDT was shown to alter estrogen chemistry in birds interfering with calcium metabolism and causing the shells of their eggs to break. In the late 1960's scientists observed the so-called "lesbian gulls" -- females sharing nests with other females. DDT was also shown to "chemically castrate" male gulls in the 1980's.⁴

Cruciferous Vegetables

Broccoli	Kohlrabi
Brussels Sprouts	Mustard Greens
Cabbage	Mustard Seed
Cauliflower	Turnip
Collards	Radish
Kale	Watercress



Research on these compounds is significant in relation to breast cancer because biopsies of women with breast cancer have been shown to have much higher levels of DDE than those found in women without breast cancer.⁵

The experience of the nation of Israel may have great relevance and significance for the rest of the industrialized world. Prior to 1978 Israel used three organochlorine pesticides around cowsheds and pesticide levels in the milk skyrocketed. A public outcry resulted in the ban of DDT, alpha-benzene hexachloride (BHC), and lindane in 1978.

By 1986 breast cancer deaths had dropped in Israel by 8 percent. This followed a continually rising incidence for the 25 years prior to 1978. Even more significant, breast cancer incidence rose in every other industrialized country in the decade following 1978.⁶

References:

1. Raloff, Janet, "The Gender Benders," *Science News*, Vol. 145, No. 2, January 8, 1994, p. 24.
2. Castleman, Michael, *Mother Jones*, May/June 1994, p. 39.
3. Greene, Gayle and Ratner, Vicki, "A Toxic Link to Breast Cancer," *The Nation*, Je 20, 1994, p. 866.
4. Raloff, Janet, "The Gender Benders," *Science News*, January 8, 1994, pp. 24-25.
5. Castleman, Michael, *Mother Jones*, May/June 1994, p. 34.
6. Castleman, Michael, *Mother Jones*, May/June 1994, p. 40.

Cruciferous Vegetables

To understand the relevance of cruciferous vegetables to the problem of toxic exposures one must understand how the body handles these compounds. DDT and other pesticides go through a two phase detoxification process. In Phase I DDT is converted to DDE. Phase I detox often makes compounds more toxic because they are more soluble and more reactive. Phase II detox expedites the results of Phase I detox out of the body.¹

Broccoli is high in a chemical called sulforaphane. This compound is a selective phase II enzyme inducer. This means it upgrades detoxification of environmental pollutants.² Compounds in cruciferous vegetables not only aid phase II detox, they also help prevent some of the toxic compounds pro-

Bad Estrogen

In discussions of breast cancer one often will run across references to "bad" estrogen. Estradiol, one of the female estrogens, can take two metabolic pathways. One of these is harmless (2-hydroxyestrone or "good" estrogen). Another of these pathways promotes uncontrolled cell division, a trait associated with cancer (16-alpha hydroxyestrone or "bad" estrogen).

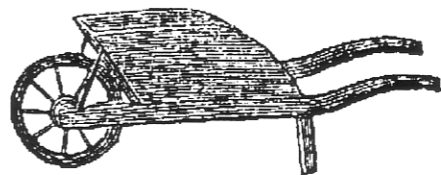
What is of great interest in this regard is that environmental estrogens increase production of "bad" estrogen and decrease production of "good" estrogen.¹

As far back as 1966 Henry Lemon demonstrated that decreased production of estriol and elevated estradiol and estrone increased the risk of breast cancer significantly enough to make the measurement predictive of the risk of the disease. While supplementation with grain oils may help prevent some of the deviations in estrogen chemistry associated with cancer in a woman, pesticides and other chlorine compounds in the environment can still push the body into manufacture of "bad" estrogen. Cruciferous vegetables can help prevent this distortion of body chemistry.²

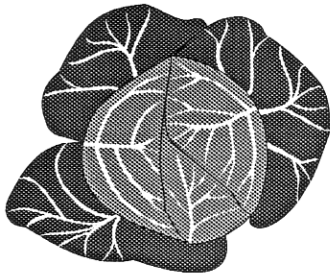
A study conducted in 1991 found that one weeks feeding with a cruciferous extract increased blood levels of "good" estrogen by 50 percent.³

References:

1. Castleman, Michael, *Mother Jones*, May/June 1994, p. 39.
2. Lemon, Henry, et al, *JAMA*, June 27, 1966, p. 112.
3. Jaret, Peter, "Foods That Fight Cancer," *Health*, March/April 1995, p. 63.



Cruciferous compounds have been likened to a wheelbarrel, wagon, or dolly increasing the capacity to cart toxic cancer causing substances out of cells.



duced in phase I detox by slowing down that process.³

The intake of cruciferous vegetables was first shown to reduce the incidence of colon cancer by Dr. Saxon Graham in the mid-1970's. He found

a direct relationship between consumption of cabbage, broccoli, and brussels sprouts and reduction of colon cancer. One serving of cabbage a week reduced risk of colon cancer by sixty-six percent.⁴

In one study, induction of breast tumors in rats was reduced from 77% to 8% by providing the animals with cruciferous compounds 2 hours prior to exposure to the carcinogen. In another study, administration of cruciferous compounds beginning one week after exposure to the carcinogen decreased both incidence and multiplication of tumors.

Cruciferous compounds have also been shown to reduce incidence of lung tumors in rats exposed to tobacco carcinogens. Tumor incidence was reduced from 80% to 43%.

Tumors of the esophagus caused by exposure to nitrosamines (found in hot dogs and other processed meats) have also been reduced in rats given cruciferous compounds. (This is believed to be a major cause of human cancers.) The extent of protection offered by cruciferous compounds was astounding. A small amount (3 μmol /gram of diet) reduced tumors from 100% to 13%. Multiplication of tumors was reduced from an average of 11.5 per animal to virtually no multiplication. Doubling the dose eliminated all observable tumors.⁵

Dr. Jon Michnovicz of the Institute for Hormone Research in New York City has demonstrated that the amount of indole-3-carbinol in 14 oz. of raw cabbage increases deactivation of harmful estrogen by about 50 percent. *Heavy cooking destroys indoles*, reducing their anti-cancer effects.⁶

Footnotes:

1. Rogers, Sherry, *Tired or Toxic*, Syracuse, New York: Prestige Publishing, 1990, p. 177.

2. *Proc. Natl. Acad. Sci.*, 89, 2399 (1992).

3. Zhang, Yuesheng and Talalay, Paul, "Anticarcinogenic Activities of Organic Isothiocyanates: Chemistry and Mechanisms", *Cancer Research* (Suppl.) 54, p. 1976s, April 1, 1994.

4. Carpen, Jean, *The Food Pharmacy*, New York: Bantam Books, 1988, p. 58.

Zhang, Yuesheng and Talalay, Paul, "Anticarcinogenic Activities of Organic Isothiocyanates: Chemistry and Mechanisms", *Cancer Research* (Suppl.) 54, p. 1978s, April 1, 1994.

6. Carper, Jean, *Food--Your Miracle Medicine*, New York: Harper-Collins Publishers, 1993, p. 222.

Mechanisms of Action

The overall benefits of cruciferous vegetables do not appear to be linked to a single mode of action or to a single cruciferous compound. Various compounds inhibit binding of carcinogens to DNA, upgrade or downgrade phase I detox (the mechanisms are complex here) and in virtually all cases increase phase II detox. The increase in phase II detox activity in laboratory animals is usually 2-4 times normal. Some studies have shown over a 9 fold increase.¹

Dr. Thomas Kensler of Johns Hopkins University exposed laboratory animals to aflatoxin, a potent carcinogen, after feeding them cruciferous compounds. He found tissue glutathione levels doubled. Glutathione is a key measure of the ability of the body to detoxify aflatoxin and other compounds. Even more significant, cruciferous compounds resulted in a tenfold increase in the enzymes that cement glutathione to carcinogens. (The compounds involved are called dithiolthiones.)²

Footnotes:

1. Zhang, Yuesheng and Talalay, Paul, "Anticarcinogenic Activities of Organic Isothiocyanates: Chemistry and Mechanisms", *Cancer Research* (Suppl.) 54, p. 1980s, April 1, 1994.

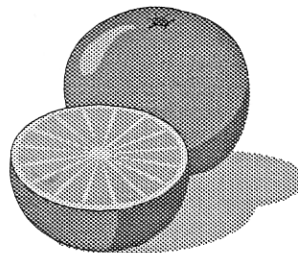
2. Carpen, Jean, *The Food Pharmacy*, New York: Bantam Books, 1988, p.61.

Other Compounds

Prevention of breast and prostate cancers is not limited to compounds in cruciferous vegetables. Citrus, soy, and licorice have some notable compounds which help prevent hormonally related cancers.

Linonene

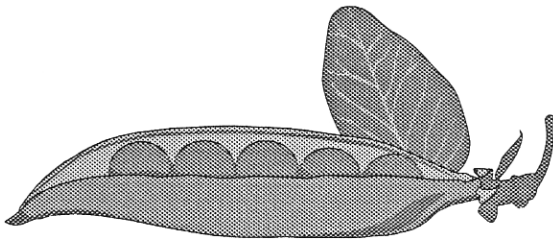
This is a compound found in the oils of citrus fruits. It has a very low toxicity but a very powerful effect in fighting breast tumors in studies with rats. In one study, tumor incidence in rats exposed to a common carcino-



gen (DMBA) was cut in half. Even more interesting, another study showed 80% regression of chemically induced breast cancers in rats. This compound inhibits cancer at all stages of development in animals. It has also demonstrated ability to dissolve gallstones in experimental studies. Researchers conclude a paper on these compounds by saying, "Thus, limonene-like monoterpenes are novel, effective chemopreventive agents for rat mammary cancer with little or no toxicity." The safety of these agents is as important as their promise in breast cancer prevention.

Reference:

Crowell, Pamela et al, "Chemoprevention of mammary carcinogenesis by hydroxylated derivatives of d-limonene," *Carcinogenesis*, Vol. 13, No1 7, pp. 1261- 1263, 1992.



Isoflavones

A diet high in soy protein appears to reduce the incidence of both breast and prostate cancers. Asians have two to three times fewer breast cancers and six times fewer prostate cancers than Americans.

It was previously thought that enzyme inhibitors in the soybean (protease inhibitors) were responsible for much of the anti-cancer activity of a diet high in soy. This does not now appear to be the case.

Isoflavones are compounds found in the protein of the soybean. They are phytoestrogens--literally "plant estrogens." Isoflavones are very weak estrogens. The exact mechanism of action of these phytoestrogens is unclear. They appear to protect cells from the carcinogenic effects of the more powerful estrogens, possibly by occupying the receptor sites of more powerful estrogens. It should be noted, however, that isoflavones can inhibit cancers even when there are no estrogen receptors to block.¹

Genistein appears to be the most powerful of the isoflavones in soy.² Genistein is an estrogen look-alike and can apparently plug up receptors for the hormone. It also apparently prevents small blood vessels from forming around cancer cells cutting off

nutrients. Thus it prevents growth and spread of cancers.³

Footnotes:

1. Carper, p. 226.
2. Barnes Stephen, et al., "Potential Role of Dietary Isoflavones in the Prevention of Cancer," *Diet and Cancer: Markers, Prevention, and Treatment*, New York: Plenum Press, 1994.
3. Jaret, Peter, "Foods That Fight Cancer," *Health*, March/April 1995, p. 63.

Chalcones

These compounds are found in certain types of licorice (the root of *Glycyrrhiza inflata*). They have demonstrated anti-inflammatory activity as well as the ability to inhibit certain types of tumors. Chalcones are flavonoids.

These compounds are of interest because they have affinity for one of two types of estrogen binding sites on many cells, both normal and malignant. When estrogen binds to these sites, it promotes cell growth. These estrogen receptor sites are blocked by a compound produced in the human body. Unfortunately, this compound (MeHPLA) is depleted when a hormonally related cancer develops. Chalcones can thus help compensate for the loss of this natural body chemical when excess estrogenic chemicals are in the environment or when cancers develop.¹

Reference:

1. Shibata, Shoji, "Anti-tumorigenic Chalcones," *Stem Cells* 1994; 12:44-52.

Neo-Life Cruciferous Plus

The leading product on the market for prevention of breast and prostate cancers is Neo-Life's Cruciferous Plus. It combines all of the compounds discussed here which have recently been shown to prevent these cancers in animals and various human studies. Ingredients are also present in laboratory certified amounts.

