WHFoods: Kale

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Kale

What's New and Beneficial About Kale

Kale can provide you with some special cholesterol-lowering benefits if you will cook it by steaming. The fiber-related components in kale do a better job of binding together with bile acids in your digestive tract when they've been steamed. When this binding process takes place, it's easier for bile acids to be excreted, and the result is a lowering of your cholesterol levels. Raw kale still has cholesterol-lowering ability - just not as much.

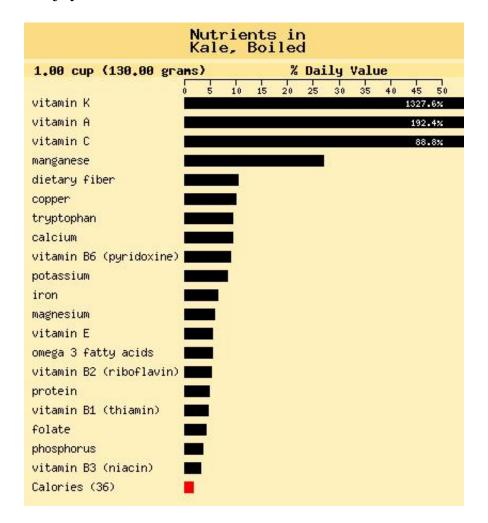
- Kale's risk-lowering benefits for cancer have recently been extended to at least five different types of cancer. These types include cancer of the bladder, breast, colon, ovary, and prostate. Isothiocyanates (ITCs) made from glucosinolates in kale play a primary role in achieving these risk-lowering benefits.
- Kale is now recognized as providing comprehensive support for the body's detoxification system. New research has shown that the ITCs made from kale's glucosinolates can help regulate detox at a genetic level.
- Researchers can now identify over 45 different flavonoids in kale. With kaempferol and quercetin heading the list, kale's flavonoids combine both antioxidant and anti-inflammatory benefits in way that gives kale a leading dietary role with respect to avoidance of chronic inflammation and oxidative stress.

WHFoods Recommendations

You'll want to include kale as one of the cruciferous vegetables you eat on a regular basis if you want to receive the fantastic health benefits provided by the cruciferous vegetable family. At a minimum, include cruciferous vegetables as part of your diet 2-3 times per week, and make the serving size at least 1-1/2 cups. Even better from a health standpoint, enjoy kale and other vegetables from the cruciferous vegetable group 4-5 times per week, and increase your serving size to 2 cups.

Kale is one of the healthiest vegetables around and one way to be sure to enjoy the maximum nutrition and flavor from kale is to cook it properly. We recommend Healthy Steaming kale for 5 minutes. To ensure quick and even cooking cut the leaves into 1/2" slices and the stems into 1/4" lengths. Let them sit for at least 5 minutes to enhance

their health-promoting qualities before steaming. See our Healthiest Way of Cooking Kale in the How to Enjoy section below.



This chart graphically details the %DV that a serving of Kale provides for each of the nutrients of which it is a good, very good, or excellent source according to our Food Rating System. Additional information about the amount of these nutrients provided by Kale can be found in the Food Rating System Chart. A link that takes you to the In-Depth Nutritional Profile for Kale, featuring information over 80 nutrients, can be found under the Food Rating System Chart.

- Health Benefits
- Description
- History
- How to Select and Store
- How to Enjoy
- Individual Concerns
- Nutritional Profile
- References

Health Benefits

While not as well researched as some of its fellow cruciferous vegetables like broccoli or cabbage, kale is a food that you can count on for some unsurpassed health benefits, if for no other reason than its exceptional nutrient richness. In our own website food rating system, kale scored 4 "excellents," 6 "very goods," and 10 "goods"-for a total of 20 standout categories of nutrient richness! That achievement is difficult for most foods to match.

Antioxidant-Related Health Benefits

Like most of its fellow cruciferous vegetables, kale has been studied more extensively in relationship to cancer than any other health condition. This research focus makes perfect sense. Kale's nutrient richness stands out in three particular areas-(1) antioxidant nutrients, (2) anti-inflammatory nutrients, and (3) anti-cancer nutrients in the form of glucosinolates. Without sufficient intake of antioxidants, our oxygen metabolism can become compromised, and we can experience a metabolic problem called "oxidative stress." Without sufficient intake of anti-inflammatory nutrients, regulation of our inflammatory system can become compromised, and we can experience the problem of chronic inflammation. Oxidative stress and chronic inflammation - and the combination of these metabolic problems-are risk factors for development of cancer. We've seen research studies on 5 specific types of cancer-including bladder cancer, breast cancer, colon cancer, ovarian cancer, and prostate cancer-and intake of cruciferous vegetables (specifically including kale). As a group, these studies definitely show cancer preventive benefits from kale intake, and in some cases, treatment benefits as well.

Kale's cancer preventive benefits have been clearly linked to its unusual concentration of two types of antioxidants, namely, carotenoids and flavonoids. Within the carotenoids, lutein and beta-carotene are standout antioxidants in kale. Researchers have actually followed the passage of these two carotenoids in kale from the human digestive tract up into the blood stream, and they have demonstrated the ability of kale to raise blood levels of these carotenoid nutrients. That finding is important because lutein and beta-carotene are key nutrients in the protection of our body from oxidative stress and health problems related to oxidative stress. Increased risk of cataracts, atherosclerosis, and chronic obstructive pulmonary disease (COPD) are three such problems. Also among these chronic health problems is cancer since our overall risk of cells becoming

cancerous is partly related to oxidative stress.

Within the flavonoids, kaempferol is a spotlight antioxidant in kale, followed by a flavonoid called quercitin. But recent research has also made it clear that at least 45 different antioxidant flavonoids are provided in measurable amounts by kale. This broad spectrum of flavonoid antioxidants is likely to be a key to kale's cancer-preventive benefits and benefits that we expect to be documented for other health problems stemming from oxidative stress.

Anti-Inflammatory Health Benefits

We have yet to see research on kale's omega-3 content and inflammation, but we would expect this kind of research to show the omega-3s in kale to be an important part of kale's anti-inflammatory benefits. It only takes 100 calories of kale to provide us with 25-35% of the National Academy of Sciences' public health recommendation for the most basic omega-3 fatty acid (alpha-linolenic acid, or ALA). We suspect that this amount will be plenty to show direct anti-inflammatory benefits from routine kale intake.

We also have yet to see specific research on inflammation and kale's vitamin K content. But we know that kale is a spectacular source of vitamin K (one cup of kale provides far more micrograms of vitamin K than any of our 135 World's Healthiest foods) and we also know that vitamin K is a key nutrient for helping regulate our body's inflammatory process. Taken in combination, we expect these two facts about vitamin K to eventually get tied together in health research that shows kale to be an exceptional food for lowering our risk of chronic inflammation and associated health problems.

Glucosinolates and Cancer-Preventive Benefits

What we have already seen in the health research on kale is ample evidence that its glucosinolates provide cancer-preventive benefits. Kale is a top food source for at least four glucosinolates, and once kale is eaten and digested, these glucosinolates can be converted by the body into cancer preventive compounds. Kale's glucosinolates and the ITCs made from them have well-documented cancer preventive properties, and in some cases, cancer treatment properties as well. At the top of the cancer-related research for kale are colon cancer and breast cancer, but risk of bladder cancer, prostate cancer, and ovarian cancer have all been found to decrease in relationship to routine intake of kale. The chart below presents a summary of the unusual glucosinlate phytonutrients found

in kale, and the anti-cancer ITCs made from them inside the body

Glucosinolates in kale and their detox-activating isothiocyanates

Glucosinolate	Derived Isothiocyanate	Isothiocyanate Abbreviation
glucobrassicin	indole-3-carbinol*	I ₃ C
glucoraphanin	sulforaphane	SFN
gluconasturtiian	phenethyl-isothiocyanate	PEITC
glucopaeolin	benzyl-isothiocyanate	BITC
sinigrin	allyl-isothiocyanate	AITC

^{*} Indole-3-carbinol (I3C) is not an isothiocyanate. It's a benzopyrrole, and it is only formed when isothiocyanates made from glucobrassicin are further broken down into non-sulfur containing compounds.

Cardiovascular Support

You can count on kale to provide valuable cardiovascular support in terms of its cholesterol-lowering ability. Researchers now understand exactly how this support process works. Our liver uses cholesterol as a basic building block to product bile acids. Bile acids are specialized molecules that aid in the digestion and absorption of fat through a process called emulsification. These molecules are typically stored in fluid form in our gall bladder, and when we eat a fat-containing meal, they get released into the intestine where they help ready the fat for interaction with enzymes and eventual absorption up into the body. When we eat kale, fiber-related nutrients in this cruciferous vegetable bind together with some of the bile acids in the intestine in such a way that they simply stay inside the intestine and pass out of our body in a bowel movement, rather than getting absorbed along with the fat they have emulsified. When this happens, our liver needs to replace the lost bile acids by drawing upon our existing supply of cholesterol, and, as a result, our cholesterol level drops down. Kale provides us with this cholesterol-lowering benefit whether it is raw or cooked. However, a recent study has shown that the cholesterol-lowering ability of raw kale improves significantly when it is steamed. In fact, when the cholesterol-lowering ability of steamed kale was compared with the cholesterol-lowering ability of the prescription drug cholestyramine (a medication that is taken for the purpose of lowering cholesterol), kale bound 42% as many bile acids (based on a standard of comparison involving total dietary fiber). Amongst all of the cruciferous vegetables, only collard greens scored higher at 46%.

Other Health-Related Benefits

Kale has a definite role to play in support of the body's detoxification processes. The isothiocyanates (ITCs) made from kale's glucosinolates have been shown to help regulate detox activities in our cells. Most toxins that pose a risk to our body must be detoxified by our cells using a two-step process. The two steps in the process are called Phase I detoxification and Phase II detoxification. The ITCs made from kale's glucosinolates have been shown to favorably modify both detox steps (Phase I and Phase II). In addition, the unusually large numbers of sulfur compounds in kale have been shown to help support aspects of Phase II detoxification that require the presence of sulfur. By supporting both aspects of our cellular detox process (Phase I and Phase II), nutrients in kale can give our body an "edge up" in dealing with toxic exposure, whether from our environment or from our food.

We have yet to see studies that look directly at kale and its support for our digestive system. However, we have seen studies for kale's fellow cruciferous vegetable - broccoli in this regard, and we definitely expect to see future research that looks directly at kale and our digestive function. We predict that one area of digestive support provided by kale will turn out to involve fiber. We feel that 7 grams of fiber per 100 calories of kale is just too much fiber to fail in the digestive benefits category. We predict that a second area of digestive benefits will involve kale's glucosinolates. The ITCs make from kale's glucosinolates should help protect our stomach lining from bacterial overgrowth of *Helicobacter pylori* and should help avoid too much clinging by this bacterium to our stomach wall.

Description

The beautiful leaves of the kale plant provide an earthy flavor and more nutritional value for fewer calories than almost any other food around. Although it can be found in markets throughout the year, it is in season from the middle of winter through the beginning of spring when it has a sweeter taste and is more widely available.

Kale is a leafy green vegetable that belongs to the Brassica family, a group of vegetables including cabbage, collards, and Brussels sprouts that have gained recent widespread attention due to their health-promoting, sulfur-containing phytonutrients. It is easy to grow and can grow in colder temperatures where a light frost will produce especially sweet kale leaves. There are several varieties of kale; these include curly kale, ornamental kale, and dinosaur (or lLcinato or Tuscan) kale, all of which differ in taste, texture, and

appearance. The scientific name for kale is Brassica oleracea.

Curly kale has ruffled leaves and a fibrous stalk and is usually deep green in color. It has a lively pungent flavor with delicious bitter peppery qualities.

Ornamental kale is a more recently cultivated species that is oftentimes referred to as salad savoy. Its leaves may either be green, white, or purple and its stalks coalesce to form a loosely knit head. Ornamental kale has a more mellow flavor and tender texture.

Dinosaur kale is the common name for the kale variety known as Lacinato or Tuscan kale. It features dark blue-green leaves that have an embossed texture. It has a slightly sweeter and more delicate taste than curly kale.

History

Like broccoli, cauliflower, and collards, kale is a descendent of the wild cabbage, a plant thought to have originated in Asia Minor and to have been brought to Europe around 600 B.C. by groups of Celtic wanderers. Curly kale played an important role in early European foodways, having been a significant crop during ancient Roman times and a popular vegetable eaten by peasants in the Middle Ages. English settlers brought kale to the United States in the 17th century.

Both ornamental and dinosaur kale are much more recent varieties. Dinosaur kale was discovered in Italy in the late 19th century. Ornamental kale, originally a decorative garden plant, was first cultivated commercially as in the 1980s in California. Ornamental kale is now better known by the name salad savoy.

How to Select and Store

Look for kale with firm, deeply colored leaves and moist hardy stems. Kale should be displayed in a cool environment since warm temperatures will cause it to wilt and will negatively affect its flavor. The leaves should look fresh, be unwilted, and be free from signs of browning, yellowing, and small holes. Choose kale with smaller-sized leaves since these will be more tender and have a more mild flavor than those with larger leaves. Kale is available throughout the year, although it is more widely available, and at its peak, from the middle of winter through the beginning of spring.

To store, place kale in a plastic storage bag removing as much of the air from the bag as possible. Store in the refrigerator where it will keep for 5 days. The longer it is stored,

the more bitter its flavor becomes. Do not wash kale before storing because exposure to water encourages spoilage.

How to Enjoy

Tips for Preparing Kale

Rinse kale leaves under cold running water. Chop leaf portion into $\frac{1}{2}$ " slices and the stems into $\frac{1}{4}$ " lengths for quick and even cooking.

To get the most health benefits from kale, let sit for a minimum of 5 minutes before cooking. Sprinkling with lemon juice before letting them sit can further enhance its beneficial phytonutrient concentration.

The Healthiest Way of Cooking Kale

We recommend Healthy Steaming kale for maximum nutrition and flavor. Fill the bottom of a steamer pot with 2 inches of water. While waiting for the water to come to a rapid boil chop greens. Steam for 5 minutes and toss with our Mediterranean Dressingand top with your favorite optional ingredients. For details see 5-Minute Kale.

A Few Quick Serving Ideas

- Braise chopped kale and apples. Before serving, sprinkle with balsamic vinegar and chopped walnuts.
- Combine chopped kale, pine nuts, and feta cheese with whole grain pasta drizzled with olive oil.

WHFoods Recipes That Feature Kale

- Healthy Breakfast Frittata
- Italian Tofu Frittata
- Poached Eggs Over Sauteed Greens
- Minestrone Surprise
- Spicy Posole Soup
- Super Energy Kale Soup
- Turkey and Vegetable Chili Verde
- Sesame Braised Chicken & Cabbage
- Indian Style Lamb with Sweet Potatoes

- 5-Minute Kale
- 5-Minute Kale with Sea Vegetables

Individual Concerns

Kale and Oxalates

Kale is among a small number of foods that contain measurable amounts of oxalates, naturally occurring substances found in plants, animals, and human beings. When oxalates become too concentrated in body fluids, they can crystallize and cause health problems. For this reason, individuals with already existing and untreated kidney or gallbladder problems may want to avoid eating kale. Laboratory studies have shown that oxalates may also interfere with absorption of calcium from the body. Yet, in every peerreviewed research study we've seen, the ability of oxalates to lower calcium absorption is relatively small and definitely does not outweigh the ability of oxalate-containing foods to contribute calcium to the meal plan. If your digestive tract is healthy, and you do a good job of chewing and relaxing while you enjoy your meals, you will get significant benefits - including absorption of calcium - from calcium-rich foods plant foods that also contain oxalic acid. Ordinarily, a healthcare practitioner would not discourage a person focused on ensuring that they are meeting their calcium requirements from eating these nutrient-rich foods because of their oxalate content. For more on this subject, please see "Can you tell me what oxalates are and in which foods they can be found?"

Kale and Pesticide Residues

Virtually all municipal drinking water in the United States contains pesticide residues, and with the exception of organic foods, so do the majority of foods in the U.S. food supply. Even though pesticides are present in food at very small trace levels, their negative impact on health is well documented. The liver's ability to process other toxins, the cells' ability to produce energy, and the nerves' ability to send messages can all be compromised by pesticide exposure. According to the Environmental Working Group's 2010 report "Shopper's Guide to Pesticides," kale is among the 12 foods on which pesticide residues have been most frequently found. Therefore, individuals wanting to avoid pesticide-associated health risks may want to avoid consumption of kale unless it is grown organically.

Kale as a "Goitrogenic" Food

Kale is sometimes referred to as a "goitrogenic" food. Yet, contrary to popular belief, according to the latest studies, foods themselves-kale included-are not "goitrogenic" in the sense of causing goiter whenever they are consumed, or even when they are consumed in excess. In fact, most foods that are commonly called "goitrogenic"-such as the cruciferous vegetables (including kale, broccoli, and cauliflower) and soyfoods-do not interfere with thyroid function in healthy persons even when they are consumed on a daily basis. Nor is it scientifically correct to say that foods "contain goitrogens," at least not if you are thinking about goitrogens as a category of substances like proteins, carbohydrates, or vitamins. With respect to the health of our thyroid gland, all that can be contained in a food are nutrients that provide us with a variety of health benefits but which, under certain circumstances, can also interfere with thyroid function. The term "goitrogenic food" makes it sound as if something is wrong with the food, but that is simply not the case. What causes problems for certain individuals is not the food itself but the mismatched nature of certain substances within the food to their unique health circumstances. For more, see an An Up-to-Date Look at Goitrogenic Substances in Food.

Nutritional Profile

Kale is a nutritional standout in three basic areas: (1) antioxidant and antiinflammatory nutrients, (2) much-needed macronutrients (in which the average U.S. adult is currently deficient), and (3) cancer-preventive nutrients called glucosinolates.

Antioxidant and Anti-inflammatory Nutrients

Kale's antioxidants are both traditional as well as recently discovered.

In addition to conventional antioxidants like vitamin C, beta-carotene, and manganese, kale also provides us with at least 45 different recently discovered flavonoids, including kaempferol and quercetin. Many of the flavonoids in kale are also now known to function not only as antioxidants, but also as anti-inflammatory compounds.

Fiber and Anti-Inflammatory Omega-3 Fatty Acids

Fiber and omega-3s are two macronutrients largely deficient in the U.S. diet and provided by kale in impressive amounts. It only takes 200 calories' worth of kale to provide 15 grams of fiber - substantially more than the average U.S. adult gets in an entire day after a diet of 2,000 calories. And while kale is not as concentrated in omega-3s as some of the other cruciferous vegetables - and certainly not in the same category as

walnuts or salmon - it still provides us with a significant amount of alpha-linolenic acid (ALA), the basic building block for all omega-3 fats. From less than 100 calories' worth of kale, we can get 25-35% of the National Academy of Sciences' public health recommendation for ALA.

Kale and its Cancer-Preventing Phytonutrients

Kale's special mix of cancer-preventing glucosinolates has been the hottest area of research on this cruciferous vegetable. Kale is an especially rich source of glucosinolates, and once kale is eaten and digested, these glucosinolates can be converted by the body into cancer preventive compounds. Some of this conversion process can also take place in the food itself, prior to consumption.

Also worth noting in kale's nutritional profile is its vitamin K content. Kale contains nearly twice the amount of vitamin K as most of its fellow cruciferous vegetables.

In addition to the above-cited nutrients, according to our Food Rating System, kale is an excellent source of vitamin A (in the form of carotenoids), vitamin C, and manganese; a very good source of copper, tryptophan, calcium, vitamin B6, and potassium; and a good source of iron, magnesium, vitamin E, vitamin B2, protein, vitamin B1, folate, phosphorous, and vitamin B3.

For an in-depth nutritional profile click here: Kale.

In-Depth Nutritional Profile

In addition to the nutrients highlighted in our ratings chart, an in-depth nutritional profile for Kale is also available. This profile includes information on a full array of nutrients, including carbohydrates, sugar, soluble and insoluble fiber, sodium, vitamins, minerals, fatty acids, amino acids and more.

Introduction to Food Rating System Chart

In order to better help you identify foods that feature a high concentration of nutrients for the calories they contain, we created a Food Rating System. This system allows us to highlight the foods that are especially rich in particular nutrients. The following chart shows the nutrients for which this food is either an excellent, very good, or good source (below the chart you will find a table that explains these qualifications). If a nutrient is not listed in the chart, it does not necessarily mean that the food doesn't contain it. It

simply means that the nutrient is not provided in a sufficient amount or concentration to meet our rating criteria. (To view this food's in-depth nutritional profile that includes values for dozens of nutrients - not just the ones rated as excellent, very good, or good - please use the link below the chart.) To read this chart accurately, you'll need to glance up in the top left corner where you will find the name of the food and the serving size we used to calculate the food's nutrient composition. This serving size will tell you how much of the food you need to eat to obtain the amount of nutrients found in the chart. Now, returning to the chart itself, you can look next to the nutrient name in order to find the nutrient amount it offers, the percent Daily Value (DV%) that this amount represents, the nutrient density that we calculated for this food and nutrient, and the rating we established in our rating system. For most of our nutrient ratings, we adopted the government standards for food labeling that are found in the U.S. Food and Drug Administration's "Reference Values for Nutrition Labeling." Read more background information and details of our rating system.

Kale, boiled 1.00 cup 130.00 grams 36.40 calories

Nutrient	Amount	DV (%)	Nutrient Density	World's Healthiest Foods Rating	
vitamin K	1062.10 mcg	1327.6	656.5	excellent	
vitamin A	9620.00 IU	192.4	95.1	excellent	
vitamin C	53.30 mg	88.8	43.9	excellent	
manganese	0.54 mg	27.0	13.4	excellent	
dietary fiber	2.60 g	10.4	5.1	very good	
copper	0.20 mg	10.0	4.9	very good	
tryptophan	0.03 g	9.4	4.6	very good	
calcium	93.60 mg	9.4	4.6	very good	
vitamin B6 (pyridoxine)	0.18 mg	9.0	4.5	very good	
potassium	296.40 mg	8.5	4.2	very good	
iron	1.17 mg	6.5	3.2	good	
magnesium	23.40 mg	5.8	2.9	good	
vitamin E	1.11 mg	5.6	2.7	good	
omega 3 fatty acids	0.13 g	5.4	2.7	good	

0.09 mg	5.3	2.6		good
2.47 g	4.9	2.4	good	
0.07 mg	4.7	2.3	good	
17.29 mcg	4.3	2.1	good	
36.40 mg	3.6	1.8	good	
0.65 mg	3.3	1.6	good	
Rule				
DV>=75%	OR	Density>=7.6	6 AND	DV>=10%
DV>=50%	OR	Density>=3.4	4 AND	DV>=5%
DV>=25%	OR Density>=1.5		AND	DV>=2.5%
	2.47 g 0.07 mg 17.29 mcg 36.40 mg 0.65 mg Rule DV>=75% DV>=50%	2.47 g 4.9 0.07 mg 4.7 17.29 mcg 4.3 36.40 mg 3.6 0.65 mg 3.3 Rule DV>=75% OR DV>=50% OR	2.47 g 4.9 2.4 0.07 mg 4.7 2.3 17.29 mcg 4.3 2.1 36.40 mg 3.6 1.8 0.65 mg 3.3 1.6 Rule DV>=75% OR Density>=7.6 DV>=50% OR Density>=3.4	2.47 g 4.9 2.4 0.07 mg 4.7 2.3 17.29 mcg 4.3 2.1 36.40 mg 3.6 1.8 0.65 mg 3.3 1.6 Rule DV>=75% OR Density>=7.6 AND DV>=50% OR Density>=3.4 AND

In-Depth Nutritional Profile for Kale

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