

# Some Misconceptions About Fruit and Vegetables in Human Nutrition

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**ADDITIONAL INDEX WORDS.** food myths

**SUMMARY.** The origins, demise and current status of some common misconceptions about the role of fruit and vegetables in human nutrition are discussed. Most, but not all, of the misconceptions were held by the public. The early widespread belief that tomatoes were poisonous was gradually overcome, and today the tomato is one of the most versatile and widely used foods in the diet. Recent reports suggest that consumption of tomatoes and tomato products has the potential to reduce the risk of certain cancers. Our current awareness of the potential of spinach in nutrition and health evolved from an early misconception that its only important nutritive value was as a source of iron. The connection between foods from the nightshade family and arthritis and the connection of cherries and gout relief are discussed briefly. The misconception that a wide variety of fruit and vegetables was not needed in the human diet was rejected long ago. Today fruit and vegetables are considered essential for their intrinsic nutritive value and for their potential health functionality because of the phytochemicals they contain.

What is misconception? A recent edition of the Collegiate Dictionary defines misconception as an erroneous interpretation or mistaken notion. I will expand the definition to include accepting as correct an idea or notion based on information that proves to be inadequate or incomplete. According to this definition, many of the notions or ideas that we call misconceptions either have been disproved and are no longer accepted or continue to be accepted without adequate evidence to support them. Several widely held misconceptions about fruit and vegetables in human nutrition—their origins, what led to their demise, and how they look in the light of our current understanding of the nutrition and health functionality of fruit and vegetables—will be discussed.

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## Misconception: Tomatoes are poisonous

An outdated concept familiar to most of us is the notion that tomatoes are poisonous. Jenkins (1948) and Rick (1986) reviewed the origin and domestication of the cultivated tomato, and McCue (1952) reviewed the history of its use through 1950. Probably because they are members of the nightshade family and related to such known poisonous plants as belladonna and mandrake, tomatoes were avoided by many people who believed they also were poisonous.

Introduced into the North American colonies in about 1700, acceptance of the tomato as being edible was slow, and there are not many early references to its consumption. According to an undocumented reference, tomato catsup was being made in New Orleans in 1779 (Heiser, 1969). Thomas Jefferson described tomato plantings in Virginia in the 1790s and table use of tomatoes in the early 1800s in his Monticello garden books (McCue, 1952). George Washington Carver, as late as 1900, reportedly would eat tomatoes in front of people who still believed they were poisonous in an attempt to convince them to add tomatoes to their diet (Heiser, 1969). The increase in printed references to the consumption of tomatoes and tomato products indicates that by 1900 the misconception that they were poisonous was dispelled for most people.

The rising popularity of tomatoes led to their inclusion in the nutritional data accumulated by the USDA, and, inadvertently, to a misconception of their nutritive value. Atwater and Woods (1896) reported that canned tomatoes were found to be one of the most costly sources of protein and energy and, when used by poor families, took the place of no more expensive but much more nutritious canned foods. As knowledge of the nutritional importance of vitamins and minerals increased, so did the nutritional status of the tomato. Based on a study of 10 vitamins and minerals in major fruit and vegetable crops, tomatoes ranked 16th in total nutrient concentration; but, because of the large amount of tomatoes consumed, they were in first place for overall contribution of these vitamins and minerals to the U.S. diet (Rick, 1978, 1986). More recent data are shown in Table 1.

Langworthy, in the 1911 USDA Agricul-

ture Yearbook, refuted a potential misconception when he wrote that attributing cancer to eating tomatoes was without foundation. Contrast the notion that tomatoes cause cancer with the results of a recently published study (Giovannucci, et al., 1995) whose findings suggested that the intake of lycopene or other compounds in tomatoes and tomato products may reduce the risk of prostate cancer. Other carotenes ( $\alpha$ -carotene,  $\beta$ -carotene, lutein and  $\beta$ -cryptoxanthin) were not related to risk. Men who ate tomato-based products more than 10 times a week had a prostate cancer risk one-third lower than men who ate them less than twice a week. Their findings support the current recommendations to increase consumption of vegetables and fruit to reduce cancer incidence and suggest that consumption of tomato products may help reduce the risk of prostate cancer. One of the tomato products prominent in their study was pizza. According to comedian Jay Leno's interpretation, men who eat 10 pizzas a week are less likely to develop prostate problems; they are more likely to develop size 54 pants (Liebman, 1996).

Misconceptions about the nutritive worth of tomato and their disposition with increased knowledge are outlined briefly in Fig. 1. Today, the tomato is one of the most versatile and widely used foods and a major contributor to the vitamin and mineral nutrition in the human diet. It may possess significant anticancer activity.

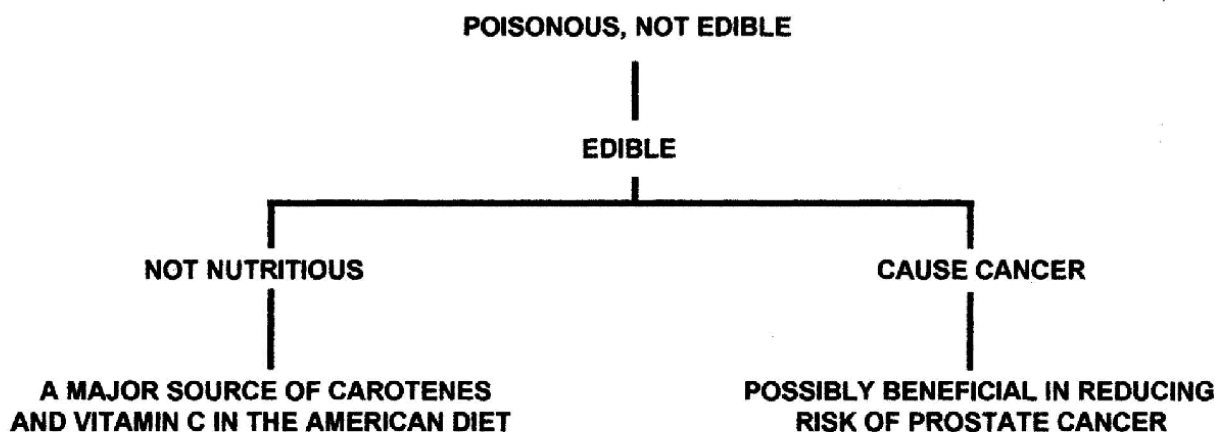
## Misconception: Iron is the major nutritive contribution of spinach

Spinach traditionally had been advocated as an exceptionally rich source of iron, almost to the point of overlooking any other nutritive attributes, a misconception apparently based on a mistake. In 1870, the iron content of spinach was reported in Europe with an incorrectly placed decimal point which

**Table 1. Major food sources of carotenes, vitamin C, and vitamin E in the American diet.<sup>2</sup>**

Rank	Carotenes	Vitamin C	Vitamin E
1	Carrots	Orange juice	Mayonnaise
2	Tomatoes	Grapefruit (and juice)	Potato Chips
3	Sweet potatoes	Tomatoes (and juice)	Apples
4	Yellow squash	Fortified fruit drink	Nuts
5	Spinach (cooked)	Oranges	Peanut butter
6	Cantaloupe	Potatoes (fried)	Oil and vinegar
7	Mixed vegetables	Potatoes (not fried)	Tomatoes
8	Romaine lettuce	Green Salad	Margarine
9	Broccoli	Other fruit juices	Sweet roll
10	Spinach (raw)	Broccoli	Tomato sauce

<sup>2</sup>From Ardestani et al. (1996).



**Fig. 1. Tomato misconceptions and their disposition.**

indicated spinach contained 10 times its actual amount of iron. This value was not corrected for several years (British Nutrition Foundation, 1979). No similar mistake was found in early U.S. reports of the iron content of spinach. Sherman (1911, 1921) reported 3.8 and 3.6 (respectively) mg of iron per 100 g of fresh material, values not much different from the 3.1 mg/100 g for raw chopped spinach listed in the USDA Handbook 8 (1984) or the 3 to 5 mg/100 g cited by Lee and Clydesdale (1981). Although Hunt stated in the 1925 Agriculture Yearbook that, as a source of iron, spinach stands in a class by itself, subsequent research on absorption (Fig. 2) and biological availability of iron showed spinach to be an adequate, but not outstanding, source of dietary iron (Layrisse, et al., 1969; Lee and Clydesdale, 1981).

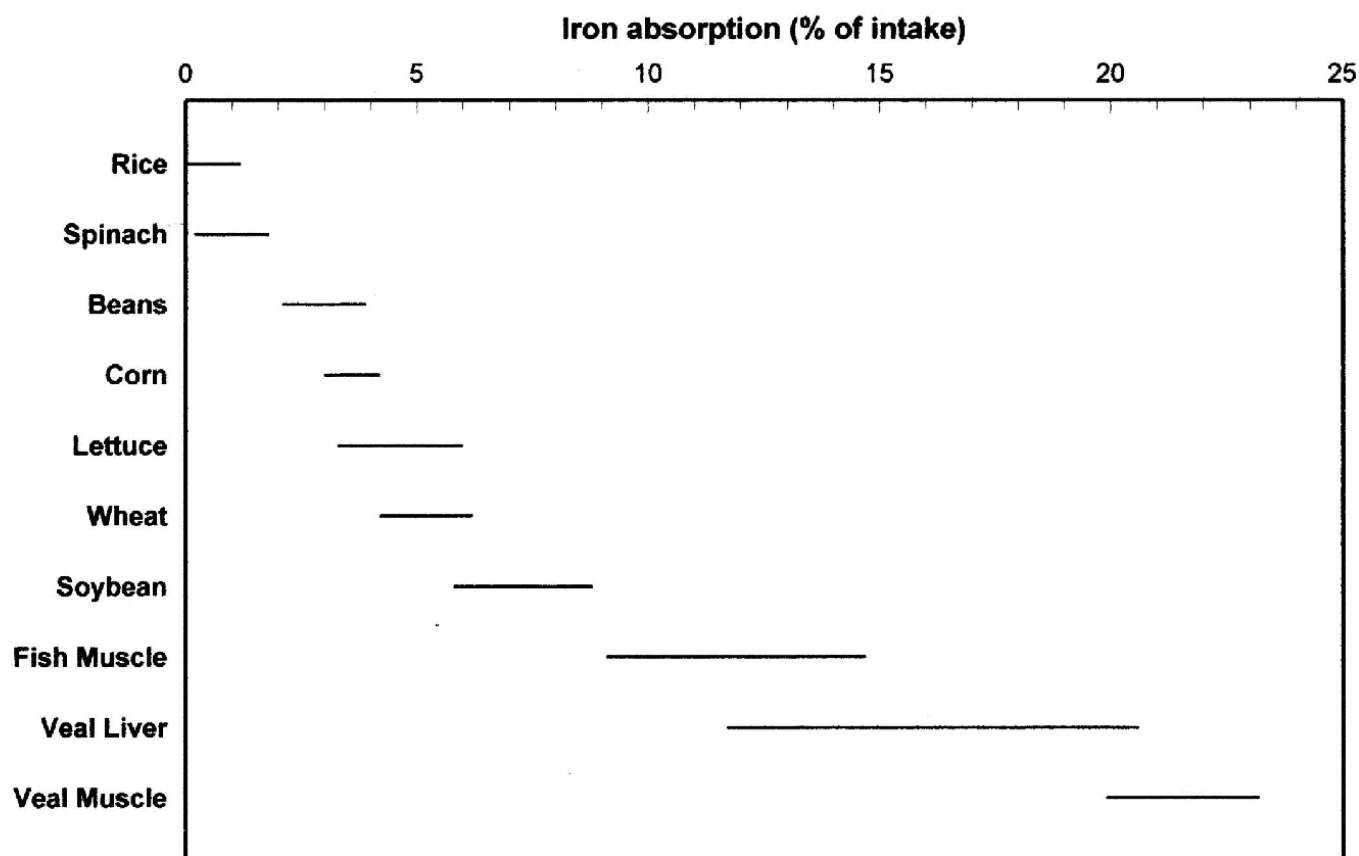
Research has shown spinach to be a good source of vitamin C, some minerals, and a major source of carotenoids in the American diet. Seddon et al. (1994) concluded that increasing the consumption of foods rich in certain carotenoids, especially dark green leafy vegetables, may decrease the risk of developing advanced age-related macular degeneration (AMD), the leading cause of irreversible blindness in older people. The carotenoids lutein and zeaxanthin from leafy greens were strongly associated with a reduced risk for AMD. A higher frequency of intake of spinach and collard greens was associated with a substantially lower risk for AMD. Reports such as that of Seddon et al. (1994) and the current interest in the potential health benefits of carotenoids in cancer risk have put to rest the notion that iron was the only important nutritive contribution of spinach to the diet.

### **Misconception: Processed foods are vitamin deficient**

The years 1910–50 have been called the Golden Age of Nutrition (Messina and Messina, 1994). The discovery of vitamins

during this time was one of the most important advances in nutrition this century. As food scientists and nutritionists studied the sources, chemistry, function, and human requirements for vitamins, it became apparent that many vitamins were heat labile or degraded when their fruit and vegetable sources were processed or stored. With the increased demand for processed foods that followed the shift of population from rural to urban areas during this period, food researchers began to consider nutrient losses of fruit and vegetables when stored, processed, and cooked. The effects of processing on nutrient composition have been covered in depth by Karmas and Harris (1988). Generally speaking, the vitamin content of fresh fruit and vegetables decreases linearly during their refrigerated storage life; controlled or modified atmosphere storage tends to retard nutrient loss. There are vitamin losses during blanching as a pretreatment for canning or freezing and during the thermal processes used to preserve canned fruit and vegetables. Once canned, the loss of vitamins is slight, and loss during proper frozen storage is also slight. These data were widely available in various media, and, if not considered from the viewpoint of net benefits gained from processing, created the misconception among consumers and many food professionals that processed fruit and vegetables were not a nutritionally adequate part of our diet.

This misconception has been supported in popular newspapers, magazines, and related books by statements such as: "Processing food poses the biggest threat to causing vitamin and mineral deficiencies in this country" or "For people buying *overly processed* (italics added) convenience foods, vitamin and mineral supplements are just about a must" (Wolf, 1978). Both statements foster the impression that processed foods do not provide an adequate supply of vitamins and minerals.



**Fig. 2. Iron absorption by humans from various food sources (after Tannenbaum, 1979).**

There is no question that food processing steps, particularly those involving heating, cause vitamin loss. The benefit gained for the nutrient price paid for processing is a safe, wholesome, stable, and available food supply. The question then becomes: Do the retained nutrients provide nutritionally adequate intakes? Howard and coworkers (1996) studied the stability of vitamin C and  $\beta$ -carotene in fresh, frozen, and canned carrots and of vitamin C and niacin in fresh, frozen, and canned sweet corn. Each vegetable treatment was stored and subsequently microwave cooked. Their results indicated that processed vegetables are as good a source of these nutrients as their fresh counterparts. Based on information presented at a symposium on Fitting Vegetables and Fruit Into the American Diet, Klein et al. (1996) concluded that processed fruit and vegetables are very good sources of known nutrients and that their year-round availability make them a good dietary option. In a survey compiled for the Steel Packaging Council, Klein (1995) compared table-ready fresh, frozen, and canned fruit and vegetables on the bases of their contents of several nutrients. The nutrient information was compiled from the USDA data bank and from nutritional labels. Ac-

cording to Klein (1995), nutrition label information is viewed as more reliable, and Klein and Shewfelt (1990) caution that the data base is compiled from a wide variety of sources and absolute comparisons of nutrient values are difficult. However, this data bank represents the best compilation of nutrient values available. In most cases, canned fruit and vegetables surveyed were nutritionally equal to their fresh and frozen counterparts. In Klein's opinion, consumers can feel good about selecting canned fruit and vegetables along with fresh or frozen as sources of the nutrients they expect from the fruit and vegetable food group.

### **Misconception by extrapolation**

According to a notion widely held by the public, some members of the nightshade family, especially tomatoes, caused arthritis symptoms, and, by avoiding nightshades, those symptoms would diminish or disappear (Carper, 1993). Describing his experience, Childers reported that eliminating nightshades from his diet relieved his arthritic symptoms and contended toxins in nightshades trigger arthritis symptoms in susceptible individuals, estimated to be 10% of the population (Childers and Russo, 1977). For most of the population, the notion that nightshades cause or trigger arthritis symptoms would be a



misconception. The wide acceptance of this notion could be the result of extrapolating anecdotal data from a small sample to the general population.

Childers has accumulated a lot of anecdotal evidence to support his contentions, but to my knowledge there are no reports of controlled studies that examine the involvement of nightshades in rheumatoid arthritis. The very large *per capita* consumption of potatoes and tomatoes (Table 2) considered in light of the incidence of rheumatoid arthritis lends weight to the counter-notion that nightshades do not cause arthritis in most people. For more information on the possible involvement of foods with arthritis, see Childers (1995), Darlington (1991), Panush (1990), and Panush et al. (1983).

Another example of this type of misconception is the cherry-gout connection. Ludwig Blau (1950) reported in a Texas medical journal 12 case histories of "gouty arthritis" in which the patients' uric acid levels dropped and their symptoms alleviated after eating 0.5 lb of canned or fresh cherries a day. A popular health magazine summarized his report, and some of the magazine's readers have extrapolated these examples into a 45-year misconception that cherries relieve the symptoms of gout. The magazine did not claim that cherries would relieve gout symptoms and in a recent related publication (Feltman, 1992) reiterated that there was "no scientific evidence" to support the concept.

## Misconception: A wide variety of fruit and vegetables is not necessary

An old misconception no longer accepted is that a wide variety of foods, especially fruit and vegetables, are not needed in the human diet. In 1896, Atwater and Woods wrote that the amounts of protein and energy supplied by green vegetables were small, and although

useful for palatability and to supply bulk and mineral salts to the diet, a large variety of vegetables probably was not necessary. A day's fruit and vegetable content of a diet presented by Chittenden (1907) as an illustration of a 2800 calorie diet for a 70 kg man (e.g., one small baked potato, cup of cream of corn soup, and apple-celery-lettuce salad) is small compared to later dietary recommendations. If a larger

volume was desired without much increase in "real food value," one could add green foods such as lettuce, celery, greens of various sorts, and fruit such as apples, grapes, and oranges. As our knowledge of nutrition grew, later recommended intakes included more fruit and vegetables for their essential nutrients rather than as sources of energy. Recommended daily fruit and vegetable intakes in 1959 specified at least one citrus fruit or vegetable source of vitamin C, at least one serving of dark green or deep yellow vegetables for vitamin A, and at least two servings of other fruit or vegetables including potato. (Phipard and Page, 1959). The 1995 Dietary Guidelines for Americans recommended 2 to 4 servings of fruit and 3 to 5 servings of vegetables per day. These guidelines also mentioned fruit and vegetables as sources of carotenoids and other antioxidants because of the wide-spread interest in their potential to reduce the risk of cancer and certain other chronic diseases. For cancer prevention, Hakim et al. (1996) feel that 8 to 10 servings of fruit and vegetables per day would be better.

Messina and Messina (1994) call phytochemicals the vitamins and minerals of the 21st century and believe they will be an important part of the Second Golden Age of Nutrition, which started about 1990. They also believe that nutritionists eventually will include specific plant foods in therapeutic diets because those plants contain phytochemicals known to prevent or intervene in certain diseases. They caution that until our knowledge reaches that point, we should continue to emphasize the "overall healthy diet," which includes a large variety of fruit and vegetables. Huang et al. (1994) point out that there is no proven phytochemical "magic bullet" and the synergistic effects of compounds in fruit and vegetables should not be overlooked. The presence of fiber and the value of fruit and vegetables as low-fat, zero-cholesterol sources of vitamins, antioxidants, micronutrients, and their chemotherapeutic functions are important health-related reasons for eating a wide variety of fruit and vegetables.

## Conclusion

What we consider misconceptions today may have been the product of ignorance or of the best science available at the time. Ignorance fueled the misconception that fresh fruit and vegetables were responsible for the cholera epidemic in Chicago in 1849. The local newspapers condemned the city council for not forbidding the sale of fresh fruit and vegetables. Evaluated by today's wisdom, fresh fruit and vegetables may have been indirectly involved in the transmission of cholera but were not its cause. By identifying the etiology of cholera, science dispelled the

**Table 2. Top 10 vegetables purchased in supermarkets (by volume).<sup>2</sup>**

No.	Vegetable
1.	Potato
2.	Iceberg lettuce
3.	Tomato
4.	Onion
5.	Carrot
6.	Celery
7.	Corn
8.	Broccoli
9.	Green cabbage
10.	Cucumber

<sup>2</sup>Source: McCue (1996).

misconception. As we enter the Second Golden Age of Nutrition, some of today's truths will be proved misconceptions when evaluated by tomorrow's knowledge. Misconceptions disproved can be considered a measure of the advancement of science.

Work in just about any area of fruit and vegetable phytochemicals can be considered needed research. Identifying specific phytochemicals and their function in human nutrition and health will be supported by research in plant genetics, cultural practices, and postharvest handling.

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