YOURS TRULY BROCCOLI

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Broccoli is a popular vegetable known from the time of Roman Empire. Like other cruciferous vegetables, broccoli is a large edible flower. It is a rich source of certain vitamins, minerals and antioxidants, having various beneficial roles on human health. Due to its strong anticancer properties, broccoli is considered as an important dietary element in cancer prevention throughout the world.

Introduction

Though this vegetable has its origin in the Eastern Mediterranean and Asia Minor, but only because of its attractive appearance and high food values, it has been accepted as a favourite item on plate by the food lovers across the world. And this has gained its currency from the ancient Roman times. This is nothing but broccoli. This green queen was popularized by the Etruscans – an ancient Italian civilization who were considered to be horticultural geniuses and lived in what is now called Tuscans¹. Later in the 17th century, broccoli was introduced to England. Just after its introduction, broccoli was referred to as ‘Italian asparagus’. But within a few years, it became a preferred source of food and nutrition in England and the rest is history. However, it did not become a popular foodstuff in the United States until Italian immigrants brought it over in the early 1920s.

Broccoli (Brassica oleracea var. italica) is a form of cabbage of the mustard family Brassicaceae. The common English name ‘broccoli’ is derived from the Italian word ‘broccolo’, meaning ‘the flowering crest of a cabbage’. Fresh broccoli is dark green in colour with firm stalks and compact bud clusters (Fig. 1). As a vegetable, it is grown for its edible flower buds and stalks. Broccoli is a cold-weather crop, even though it is available in stores year-round. We are familiar with the most common large head and thick stalk variety, known as ‘Calabrese broccoli’ (named after the place Calabria in Italy), although it is typically labeled simply as ‘broccoli’. There is another variety, with several thin stalks and heads, known as ‘sprouting broccoli’ or ‘Romanesco broccoli’. A few other varieties, such as ‘broccolini’ or ‘baby broccoli’ – actually a hybrid of broccoli and kale, and ‘broccoflower’ – a cross between broccoli and cauliflower, are also quite common in the market as many people are fond of these vegetables².

The Harvest

Broccoli is a fast growing annual plant that grows as much as 60-90 cm in height. Upright and branching with leathery leaves, broccoli bears dense green clusters of
flower buds at the ends of the central axis and branches. If left unharvested, those buds bear yellow flowers with four petals and produce siliqua fruits (a dry capsular fruit). Broccoli thrives in moderate to cool climates and is propagated by seeds. The heads, or florets, reach harvest in 2-5 months, depending upon the variety and the weather.

Like the artichoke, broccoli is essentially a large edible flower. The stalks and flower florets are eaten both raw (Fig. 2) and cooked and have a flavour reminiscent of cabbage, though broccoli is also related to kale, cauliflower, and Brussels sprouts. As far as other cruciferous vegetables are concerned, broccoli is a bit divisive, that means people either love it or avoid it for its unique taste. However, due to many ways it can be cooked, as well as all of the health benefits, broccoli has tripled in consumption over past three decades.

![Fig. 2: Broccoli is said to pack the most nutritional punch of any vegetable (Photo: Dipanjan Ghosh).](image)

Garden fresh young broccoli is the best in taste. Broccoli can become woody or fibrous if it is stored at room temperature or for a long time. If storage needed, then unwashed broccoli may be kept loose or in perforated bags in the refrigerator and should only wash broccoli right before eating it.

**Nutritional Facts**

Fresh broccoli³ contains almost 90 per cent water, 7 per cent carbohydrates, 3 per cent protein and almost no fat (details in Fig. 3). The total carbohydrates content is very low, with sugars and dietary fibres are the main constituents. The sugars are fructose, glucose, sucrose, and small amounts of lactose and maltose. Broccoli is a fat free vegetable, containing total saturated fatty acids (0.079gm), monounsaturated fatty acids (0.040gm), and polyunsaturated fatty acids (0.170gm) in traces and no cholesterol at all. Broccoli is very low in calories, providing only 35 KCal per 100gm of fresh broccoli.

![Fig. 3: Nutritional value of broccoli per 100g or 3.5 oz as recommended by USDA (Adapted from http://nbd.nal.usda.gov/nbd/foods).](image)

However, broccoli contains all the essential mineral nutrients as well as vitamins in sufficient amounts. One cup of fresh chopped broccoli contains³ about 43 milligrams (mg) of calcium (4.3 per cent of the recommended daily value, or DV), 288 mg of potassium (6.1 per cent DV), 81mg of vitamin C (90 per cent DV for men and more than 100 per cent DV for women), 92 micrograms of vitamin K (115 per cent DV), and 567 international units of vitamin A (about 11 per cent DV). Also a small amount of other vitamins, including thiamine, riboflavin, folate, vitamin E, and vitamin B6 are also present. In addition, broccoli is a rich source of some unique antioxidants (Fig. 4) which can help to prevent the toxicity of free radicals or reactive oxygen during natural processes such as metabolism and environmental stresses.

Most of the researches reveal that broccoli is more nutritious, if it is eaten raw⁴. Because raw broccoli (Fig. 5) provides significantly healthy dose of sulforaphane, a natural isothiocyanate thought to thwart cancer by helping to stimulate the body’s detoxifying enzymes, than cooked. Cooking locks sulforaphane in, making it unavailable to our body. Or, if one prefers it cooked, then steaming it until it is cooked but still crunchy. Some research suggests this method may keep sulforaphane and other thermolabile components including some vitamins available.
Because broccoli is so versatile, it can be eaten with just about anything. One can eat broccoli several times a week and prepare it differently each time. If someone is on a diet or watching calorie intake, he or she may add raw broccoli to salads. It also makes the perfect side dish. Sauté, steam, stir-fry or roast of broccoli for dinner, and eating it alongside meat or pairing it with another vegetable or rice or potatoes are very common practices in Indian cuisine.

**Broccoli Benefits**

Broccoli is a rich source of certain vitamins, minerals, and antioxidants which constitute its various beneficial roles over human health. Studies reveal that people eating broccoli on a regular basis can manage blood sugar level and control type-II diabetes than others. This is due to the presence of sulforaphane, the most abundant unique antioxidant found in all cruciferous vegetables including broccoli. In addition, high amount of dietary fibres as well as a phytochemical quercetin, present in broccoli, may help to reduce blood sugar levels in people with diabetes. Broccoli may have some anti-inflammatory effects due to the presence of sulforaphane and another antioxidant kaempferol in sufficient amount. Both these phytochemicals are effective against chronic autoimmune conditions such as arthritis, type-I diabetes, and allergies.

Dietary fibres of green vegetables like broccoli can help to prevent constipation, promote bowel movement, maintain a healthy digestive tract, and lower the risk of colorectal cancer. Moreover, broccoli is a no fat diet and hence it controls obesity and reduces the possibility of overweight.

A recent study reveals that antioxidant such as sulforaphane and kaempferol prevent atherosclerosis in older person and thus lessen the risk of heart attack or stroke. Besides, high potassium content in broccoli has some positive impact on human health. This relaxes the blood vessels and lowers the risk of high blood pressure, which can lead to atherosclerosis and other cardiovascular problems. On the other hand, high sulforaphane content of broccoli protects persons with type-II diabetes induced cardiomyopathy, a disease related to heart muscle that can cause high blood pressure and heart failure. Broccoli also improves bone health because high calcium and vitamin K work together to make strong bones and teeth.

Vitamin C or ascorbic acid provides a range of benefits. High vitamin C content in broccoli helps the body in producing collagen, which is the main support system for body cells and organs, including the skin. As an antioxidant, vitamin C can also prevent skin damage, wrinkling due to aging and even skin cancer. In supplement form, it may also help to reduce the symptoms of the common cold and shorten the time a cold lasts.

**Anticancer Properties**

While all cruciferous vegetables seem to be effective in fighting cancer, broccoli and broccoli sprouts are the most powerful. Even more promising results have been found in broccoli sprouts as those sprouts contain fifty
times more anticancer principles than in fully mature broccoli. According to a study\(^1\) in Britain, combining broccoli with spicy foods that contain myrosinase (an enzyme) can actually enhance the cancer fighting properties of broccoli. The particular compounds in broccoli that are so effective against cancer include the phytochemicals or active metabolites, such as sulforaphane, erucin and the indole-3-carbinol (see also Table 1).

Sulforaphane is a remarkably potent compound that fights cancer on various fronts specially melanoma\(^1\), lung\(^2\), breast\(^3\), ovarian\(^4\) and colorectal cancers\(^5,6\). Sulforaphane inhibits histone deacetylase (HDAC) enzymes that are known to work against the ability of genes that suppress development of tumours\(^6,7\). It has the ability to activate genes that can prevent cancer development\(^7\). Sulforaphane also normalizes DNA methylation (the process of when a methyl group is added to a DNA molecule), which is a crucial part of normal cell function and suppressing bad genes in the early stages of prostate\(^8\) and colorectal cancers\(^9\). At the cellular level, it also helps the body to limit oxidation, the process that initiates many chronic diseases.

A case control study in China found that intake of broccoli, measured by urinary secretion of isothiocyanates, was inversely related to the risk of breast cancer\(^10\). Also, prostate cancer risk was found to be reduced by cruciferous vegetable consumption in a population-based case control study carried out in western Washington State. Three or more servings per week, compared to less than one serving of broccoli per week resulted in a statistically significant 41 per cent decrease in prostate cancer risk\(^11\). Another case study in Shanghai, China found that men with detectable amounts of isothiocyanates in their urine had a 35 per cent decreased risk of lung cancer\(^12\). Previously in another study, it was found that bladder cancer was only weakly associated with low intake of fruits and vegetables, but high intake (5 or more servings a week versus 1 or less serving a week) of broccoli was associated with a statistically significant 51 per cent decrease in bladder cancer\(^13\).

Just like sulforaphane, erucin is a natural isothiocyanate. Erucin has both anticancer and chemopreventive activities which is effective against breast cancer\(^14\), pancreatic tumorous growth\(^15\) and hepatocellular carcinoma\(^16\). However, erucin is present in trace amount in broccoli. It is abundant in rocket (Eruca vesicaria) and in some other cruciferous vegetables.

On the other hand, indole-3-carbinol is a natural compound derived from the breakdown of the glucosinolate glucobrassicin. This active metabolite has shown antiproliferative effects in several colon cancer cell lines and reactivation of phosphatase and tensin homologue (PTEN) proteins in prostate cells. A lower risk of colorectal\(^17\) and prostate\(^18\) cancer was found to be associated with a high intake of broccoli. It is abundant in rocket (Eruca vesicaria) and in some other cruciferous vegetables.

The consumption of cruciferous vegetables is associated with a low breast cancer risk\(^19\) in Chinese women.

**Conclusion**

Across the world, the consumption of broccoli has tripled over the past thirty years, probably due to the many ways it can be cooked, as well as all of the health benefits it provides.
benefits it offers. No wonder, by eating this green queen of vegetables one can get a natural dose of chemoprevention from many chronic diseases. Though the strong smell and bitter taste of broccoli sometimes are quite disappointing but do not forget that this is caused by the presence of the sulfur compound sulforaphane that protects the vegetable from insects and other animals as well as protect us even from cancer.

References

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