

Health Benefits of Broccoli and its by-products

Kamaldeep Kour, Monika Sood, Julie D Bandral, Seerat Gupta and Anjali Langeh

Department of Post Harvest Management, Sher-e-Kashmir University of Agricultural Sciences and Technology, Chatha, Jammu. 180009, J&K, India.

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Abstract

Broccoli is a nutritious green vegetable that is known for its green, tightly clustered flower heads, which are edible. It is a rich source of vitamins, minerals, and other dietary fiber, making it a healthy addition in human diet. Broccoli is a versatile vegetable, and various by-products can be produced from different parts of the vegetable.

Introduction

Broccoli (*Brassica oleracea* var. *italica*) is a cruciferous vegetable, also called green cauliflower, is a variety of wild cabbage in the *Brassica* L (Mehraj *et al.*, 2020). It is high in protein, minerals, and vitamins. It is rich source of essential minerals, and phytochemicals, making it a valuable addition to a balanced diet (Kandil and Gad, 2012). It is high in water content, fibre, protein, calcium and iron, and is a rich source of vitamin A and vitamin C, among other health promoting and anticancer properties (Acikgoz, 2011; Mahn *et al.*, 2012; Avila, *et al.*, 2013).

It also contains antioxidant activities and is beneficial to the human body. Due to its active effect, Broccoli is often consumed by people worldwide in daily life due to its health benefits. Broccoli contains large amounts of insoluble fiber and small amounts of soluble fiber (Schäfer, 2017). Based on research, 70% of the weight of the broccoli plant is wasted (Campas-Baypoli *et al.*, 2009).

Nowadays, broccoli plant parts are cultivated and can be eaten but not used as food, while broccoli plant parts are an interesting source and can be utilized as a new food product.

Health benefits of broccoli are partly associated with secondary plant compounds (secondary metabolites) known for their antioxidant activity (Jones *et al.*, 2006).



Some secondary plant compounds found in broccoli include

- **Glucosinolate** which is a sulfur- containing compounds present in different concentrations among plant organs and throughout the developmental stages of the plant and is responsible for distinctive taste and aroma. When broccoli is consumed glucosinolates are broken down into biologically active compounds, such as sulforaphane, which have been associated with potential anticancer properties. the nutraceutical properties of glucosinolates may be attributed to isothiocyanates, their hydrolysis products (Fahey *et al.*, 1997).
- **Isothiocyanates**, which have the chemical formula $R-N=C=S$, are reactive and unstable chemicals that have strong anticarcinogenic activity.
- **Flavonoid** which include kaempferol, quercetin, and apigenin which are antioxidants. Flavonoids are a large group of polyphenolic compounds found in fruits and vegetables. In the human diet, they have been demonstrated to be effective anti-inflammatory agents. (Agati *et al.*, 2012; Pan *et al.*, 2010), and it also contains a high concentration of vitamins, minerals, and bioactive substances (Liu, 2013).
- Broccoli contains **carotenoids** like beta-carotene, lutein, and zeaxanthin. Carotenoids function as antioxidants and anti-inflammatory agents. Carotenoids are extremely lipophilic substances that are found inside cell membranes and protect them from oxidative stress (Linnewiel-Hermoni *et al.*, 2016). It is also associated with promoting eye health and reducing the risk of certain diseases, including age related muscular degeneration.
- **Vitamin C** supports immune function, collagen synthesis, and acts as a scavenger of free radicals in the body.

Broccoli by products used in food industry

1. Frozen Broccoli: pre- cut and pre-packaged broccoli florets that are frozen to maintain their freshness and nutrients. Frozen broccoli is a healthy cruciferous vegetable and it's nutritional value isn't reduced during either the canning or freezing process hence, making canned or frozen broccoli just as healthy as fresh ones.
2. Broccoli Chips: Thinly sliced and baked or fried broccoli pieces serve as a healthier alternative to traditional potato chips. It contains a high concentration of vitamins, minerals, and bioactive substances. Antioxidants and fiber present in broccoli may aid blood sugar control.



3. Broccoli Soup: A creamy or chunky soup made primarily from broccoli, often combined with other vegetables and seasonings. It can work as great appetizers, as well as main course meals. It is also heart-healthy due to the presence of antioxidants, low calories, anti-inflammatory qualities, and aids digestion due to the presence of fibre. It can help manage high blood sugar levels in the body by lowering it.
4. Broccoli Rice: Finely chopped or riced broccoli florets that can be used as a low carb substitute for rice in various dishes. It is high in fiber and vitamin C, Vitamin A, and also provide beta-carotene and lutein.
5. Broccoli Pesto: It gives meals a unique touch by offering fresh, delightful flavor that complements a wide range of cuisines. Broccoli stimulates detoxification, decreases inflammation, and aids digestion.
6. Broccoli Powder: Broccoli can be dehydrated and ground into a fine powder, which can be used as a nutritional supplement or added to sauces, smoothies, and baked products.

Conclusion

In the future, broccoli products are likely to continue to be popular due to their nutritional value. Innovative ways to incorporate broccoli into various food items can see a surge in near future. Advancement in food processing and technology could lead to the development of new broccoli-based products that cater to different dietary preferences.

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