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Research Note

BROCCOLI-AN UNDEREXPLOITED NEUTRACEUTICAL

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ABSTRACT

Plants have been source of nutrition and they contain secondary metabolites which protect man from various diseases. Although, list of plants with possible role as neutraceutical is long, but increasing population as well as demand has put extensive pressure on existing resources. This has led to exploration of new neutraceutical resources and Broccoli may prove to be a promising plant. Broccoli, scientifically known as *Brassica oleracea*, belonging to the family Cruciferae is native of ITALY. It can be successfully utilized in our country also as a source of valuable nutrients. Broccoli has got significant amount of Vitamin C as well as dietary fiber. This plant also contains di-indolylmethane and selenium, both having established anti-cancer properties. Broccoli contains appreciable amount of glucoraphanin which is a precursor of known anti-cancer molecule sulforaphane. Presence of appreciable amount of β-carotene further makes broccoli a valuable vegetable. The nutritional content of broccoli is also worth mentioning. Low fat and high protein content of broccoli is highly suitable for cardiovascular diseases. This paper deals with nutritional and therapeutic value of broccoli and underlines need of its popularization among masses.

Key words: Neutraceuticals, Broccoli, Cancer, Cardiovascular diseases, Vitamin-C

INTRODUCTION

Broccoli scientifically known as "*Brassica oleracea var. italic"*, a Cruciferous green leaf Cole vegetable; is one such promising underexploited plant. This plant is native of Italy, but can be successfully grown in our country. It is a source of valuable nutrients Vitamin A, C & riboflavin. It is also high in Iron and Calcium and is a non-fattening food and possesses various medicinal properties as well (Mishra and Mukherjee, 2012). Broccoli was introduced to the US by Italian immigrants and by 1920s it became a popular vegetable of states. Today, Broccoli is enjoyed throughout Europe. Broccoli is a "cool weather crop" and hot summer weather is not suitable for this plant. Broccoli grows best in temperature ranging between 18 ˚C and 23˚ C. The cluster of flowers, also referred to as a "head", appears in the center of the plant, and is green. Broccoli should be harvested before the flowers on the head turn bright yellow.

Food is one of the basic needs of all organisms including man. Early man lived on roots and berries of wild plants but with civilization, man learnt to cultivate plants to satisfy his/her food needs. Man has also exploited plants for treating various diseases from time immemorial. With continuous increase in population and rapid urbanization; our plant resources have been over-exploited. As a result of this, Plant resources are getting depleted at a very fast rate. Our major concern today is how to increase production to feed the increasing population and conserving existing biodiversity (Mishra and Choudhary 2009).

Broccoli has large flower heads, usually green in color, arranged in a tree-like fashion on branches sprouting from a thick, edible stalk. The mass of flower heads is surrounded by leaves. Broccoli, most closely resembles cauliflower, which is a different cultivar of the same species.

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Calabrese Broccoli


Sprouting Broccoli


Romanesco Broccoli


Purple Broccoli


Chinese Broccoli

Sprouting broccoli has a larger number of heads with many thin stalks. It is planted in May to be harvested during the winter in areas with temperature climates. Romanesco broccoli has a distinctive fractal appearance of its heads, and is yellow-green in color. It is technically the Botrytis (Cauliflower) cultivar group. Purple cauliflower is a type of broccoli grown in Southern Italy, Spain and the United Kingdom. It has head shaped like cauliflower, but consisting of tiny flower buds. It sometimes, but not always, has a purple cast to the tips of the flower buds. Chinese broccoli (Alboglabra Group) is also a cultivar of *Brassica oleracea.*

MEDICINALVALUE OF BROCCOLI

Broccoli contains multiple nutrients with potent anti-cancer properties, such as Di-indolylmethane and small amounts of Selenium. The 3, 3-di-indolylmethane found in broccoli is a potent modulator of the innate immune response system with- Anti-viral, Anti-bacterial, and Anti-cancer activity.

Broccoli also contains the compound "glucoraphanin", which can be processed into an anti-cancer compound "sulforaphane", though the benefits of broccoli are greatly reduced if the vegetable is boiled. Broccoli is also an excellent source of "indole-3-carbinol", a chemical which boosts DNA repair in cells and appears to block the growth of cancer cells. A high intake of broccoli has been found to reduce the risk of aggressive prostate cancer. Broccoli consumption has also been shown to be beneficial in the prevention of heart disease. Broccoli consumption is also associated with malodorous flatulence; from metabolism of the sulfur-containing compounds it contains. Broccoli has a chemical component called "indole-3- carbinol" that can combat breast cancer by converting a cancer-promoting estrogen into a more protective variety (Phillip, 2011). Broccoli, especially sprouts, also have the phytochemical sulforaphane, a product of glucoraphanin- believed to aid in preventing some types of cancer, like colon and rectal cancer (Benson, 2011). Sulforaphane induces the production of certain enzymes that can deactivate free- radicals and carcinogens.

The enzymes have been shown to inhibit the growth of tumors in laboratory animals. It appears that the bitterer the broccoli is, the more glucoraphanin it has. Broccoli sprouts have been developed under the trade name "Brocco Sprouts" that have a consistent level of sulforaphane – as much as 20 times higher than the levels found in mature heads of broccoli (Jackson and Singletary, 2008). The chemical, sulforaphane, boosts the production of an enzyme known to neutralize carcinogens before they trigger tumor growth. As good as this news is, it gets even better. The real potent nutritional value of broccoli lies in substances called "isothiocyanates". They are a class of very potent anti-carcinogens. Meaning, they fight and help prevent cancer. Tests have shown that broccoli's anti-cancer compounds greatly protected mice from stomach cancer(Abdullah and Koyama, 2009).

Broccoli is considered a low-glycemic food which helps to normalize blood sugar. One of the keys to weight loss in controlling the body's response to insulin. It also gives a boost to enzymes which helps to detoxify the body. Detoxification leads to weight loss and helps prevent certain diseases(Stanley and Provost 2010).

It has been studied that just 3 servings a month of raw broccoli can reduce the risk of bladder cancer by as much as 40 %(Liu2009). The American Journal of Clinical Nutrition reported that "broccoli was among the top foods that may prevent colon cancer." The Harvard scientists (Kim and Berges 2009) reported that "healthy broccoli may help protect against strokes." Broccoli is good. Broccoli Sprouts are even better. At a mere 3 days old, they contain at least 20 times as much of disease- fighting Sulforaphane Glucosinolate (SGS) as their elders.

NUTRITIONAL VALUE OF BROCCOLI

Broccoli is high in Vitamin C, as well as, Dietary Fiber.A single serving provides more than 30mg of Vitamin C and a half-cup provides 52mg of Vitamin C (James and Tresses, 2010). Steaming broccoli for 3-4 minutes is recommended to maximize potential anti-cancer compounds such as sulforaphane. Boiling reduces the levels of suspected anti-carcinogenic compounds in broccoli, with losses of 20-30% after 5 minutes, 40-50% after 10 minutes and 77% after 30 minutes (USDA report, 2008) However, other preparation methods such as steaming, microwaving and stir-frying had no significant effect on the compound. Broccoli has the highest levels of carotenoids in the *Brassica* family. It is particularly rich in Lutein and also provides a modest amount of β-carotene. Calcium content in broccoli is equivalent to that in the milk (47mg/100gm.). The nutritional value of Broccoli has garnered the spotlight in recent years. Broccoli, after extensive scientific research is now viewed as one of the "top powerhouses" when it comes to nutrient density and benefits. The health benefits of broccoli are beginning to reveal that this Cruciferous vegetable may even be more potent than its advocates had ever realized.

Proximate nutritional value of Broccoli is given in Table1. Energy content in this vegetable is about 34kcal. Carbohydrate and protein content is 6.64gm/100gms and 2.82gm/100gms. Total fat in this plant is 0.37gm/100gms. Broccoli possesses 2.60gm/100gms of Dietary Fiber. Cholesterol content is nil in Broccolis. Dietary fiber is as high as 3.60gms/100gms. Proximate value of vitamin is given in Table-2.

Fresh broccoli is exceptionally rich source of Vitamin C. and provides 89.2mg or about 15% RDA per 100gm. Vitamin C is a powerful natural anti-oxidant and immune modulator, helps fight against flu causing viruses. Further, it contains very good amounts of another anti-oxidant Vitamin A. 100gm fresh head provides 623IU or 21% of recommended daily levels. Together with other pro-vitamins like β-carotene, α-carotene and zeaxanthin, Vitamin A helps maintain integrity of skin and macular degeneration of retina in the elderly population. Brocolli also contains Folates, Niacin, Pantothenic acid, Riboflavin, Thiamine, Vit.K and E in considerable quantity. Mineral content of Brocolli is given in Table-3. It is also a good source of minerals like- Calcium, Manganese, Iron, Magnesium, Selenium, Zinc and Phosphorus. In addition to that this vegetable is also good source of electrolytes (Table- 4).

CONCLUSION

Broccoli is very low in calories, provides just 34 kcal per 100g. However, it is rich in Dietary Fiber, Minerals, Vitamins and Anti-oxidants that have proven health benefits.

Various molecules of medicinal value make Broccoli further important. Bravdi *et al.,* (2005), Fahey (2001), Jagadish *et al.,* (2007), Simoset *et al.,* (2007) and a number of other workers have highlighted both medicinal as well as nutritional value of Broccoli. The plant needs adequate attention both by vegetable growers as well as nutrition lists.

TABLE 1: PROXIMATE NUTRITIONAL VALUE (/100gm) OF BROCCOLI

PRINCIPLE	NUTRIENT VALUE	%age of RDA
Energy	34 kcal	1.5
Carbohydrate	6.64g	5
Protein	2.82g	5
Total Fat	0.37g	1
Cholesterol	0mg	0
Dietary Fiber	2.60g	7

TABLE 2: PROXIMATE VITAMINS (/100gm) IN BROCCOLI

VITAMINS	NUTRIENT VALUE	%age of RDA
Folates	63mcg	16
Niacin	0.639mg	4
Pantothenic acid	0.573mg	12
Pyridoxine	0.175mg	13
Riboflavin	0.117mg	9
Thiamine	0.071mg	6
Vitamin A	623IU	21
Vitamin C	89.2mg	149
Vitamin K	0.17mg	1.5
Vitamin E	101.6mcg	85

TABLE 3: PROXIMATE MINERALS (/100 gm) IN BROCCOLI

MINERALS	NUTRIENT VALUE	%age of RDA
Calcium	47mg	5
Copper	0.049mg	5.5
Iron	0.73mg	9
Magnesium	21mg	5
Manganese	0.210mg	9
Selenium	2.5mcg	5
Zinc	0.41mg	4

TABLE 4: ELECTROLYTES AND PHYTONUTRIENTS IN BROCCOLI

ELECTROLYTES	NUTRIENT VALUE	%age of RDA
Sodium	33mg	2
Potassium	316mcg	7
PHYTO-NUTRIENTS	**NUTRIENT VALUE**	**%age of RDA**
β-carotene	361mcg	--
β-crypto-xanthan	1mcg	--
Lutein-zeaxanthan	1403mcg	--

NB- Table 1,2,3 and 4 after USDA, 2008.

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