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Antioxidant Activity of Minimally Processed Broccoli (*Brassica oleraceae*)

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Abstract

The broccoli (*Brassica oleraceaevaritalica*) belongs to the cabbage family. Broccoli and broccoli extracts have higher antioxidant power. Regular consumption of broccoli has been associated with the lower risk of colorectal, stomach, prostrate, lungs as well as breast cancer. The aim of the present study is to assess the influence of various treatments of broccoli on antioxidant activity. Broccoli was subjected to minimal processing treatments with curd, vinegar, salt, and sugar and then powdered. Antioxidant analysis was carried out using ABTS and DPPH stable radicals adopting the standard procedures. The phenolic and flavonoid content was found higher in BT4 sample when compared to other treated samples. ABTS and DPPH assay also infers that BT4 has highest potency among the various treatments of broccoli. Thus the study proves that the treatment of broccoli with sugar (BT4) retained more phenolic compounds and possessed highest antioxidant activity.

Keywords: *Brassica oleraceaevaritalica*, DPPH, Flavonoid Glucosinolates, HTST

1. Introduction

The broccoli (*Brassica oleraceaevaritalica)* belongs to the cabbage family. The antioxidant potential of broccoli helps to prevent various degenerative diseases [1–3]. Broccoli can be taken in raw as well as cooked form. Steaming broccoli for 3-4 minutes is the preferred method of cooking as it results in the greatest retention of flavor and nutrients. Short time microwaving with little or no water also helps to retain nutrient and flavor. Over cooked broccoli develops a strong sulfur odour, turns dark green and suffers nutrient loss, especially vitamin C. Broccoli can be safely kept in the refrigerator for 3-5 days. The highest nutritional value and best flavor will result when storage time is kept short [4].

The total antioxidant activity will remain even after cooking in microwave oven [5]. The glucosinolates content of broccoli (Brassica vegetables) was maintained after steaming, microwaving and stir frying cooking process but boiling causes leaching of glucosinolates [6].

2. Methodology

2.1 Selection of Broccoli

The antioxidant rich vegetable, broccoli (*Brassica olereceaevaritalica*) selected for the present study was bought from local market.

2.2 Processing of Broccoli

As broccoli is a seasonal vegetable, it was treated in various traditional preservative agents as a mode of minimal processing so as to make it available for the off seasons. Broccoli was treated with salt, sugar, vinegar and curd, further labeled as BC, BT1, BT2, BT3, and BT4 respectively. The samples were dried in hot air oven at 96^0 C [7].

2.3 Antioxidant Compound Assay of Broccoli Powder

2.3.1 Sample Extraction Procedures

Take 10g of samples and homogenize with methanol, acetone and water for 1 min and centrifuge at 6000*g*

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for 15 min. The clear supernatant was transferred in to a plastic bottle and stored at 7°C until analysis. All the extracts were made in triplicates.

2.3.2 Measurement of Antioxidant Potential

Total phenolic content and total flavonoid content in the extracts were estimated by folin –ciocalteu method and Zhishen et al. [8] respectively. The antioxidant activity of samples were assessed by DPPH and ABTS Method [9].

3. Results and Discussion

3.1 Phenolic Content in Treated Broccoli

Consumption of fruits, vegetables and whole grains helps in reducing the risk of of cardiovascular diseases, neuro degenerated diseases and certain cancer due to their high phenolic content [10].

Table 1 and Figure 1 shows that phenolic content was found highest in BC, however among the treated samples BT4 sample has 2.18±0.02mg of phenolic content followed by BT2 (1.5±0.01) BT1 (1.4±0) and BT3(1.21±0). BT4 sample treated with sugar retained more phenolic compounds than the other agents used for preserving broccoli. The broccoli (flower, leaves and sprouts) has a high link of antioxidant potential and phenolic compound [11].

Lima et al. [12] stated that thermal processing of foods results in loss of phenolic content. So minimally processed foods may retain maximum antioxidant activity.

Table 1. Antioxidant compounds in broccoli

Sample name	Phenolic Content (mg)	Flavonoid Content (mg)
BC	4.6±0.09	0.1127±1.699
BT1	1.4±0	0.1129±0.0017
BT2	1.5±0.01	0.1126±1.6996
BT3	1.21±0	0.1127±1.6996
BT4	2.18±0.02	0.123±0.0223

3.2 Flavonoid Content in Treated Broccoli

Flavonoid content reveals that almost all the samples contained similar concentration ranging from 0.1126±1.6996 to 0.123±0.0223mg. However BT4 has the highest concentration of flavonoid content which was treated with sugar. It is evident that the sugar binding with broccoli during heat processing retained the flavonoid content in the broccoli rather than other agents used for minimal processing. The high flavonoid contents of cooked vegetables may contribute to the medicinal value and properties.

3.3 Antioxidant Potential of Treated Broccoli

The DPPH is more frequently used in the determination of free radical scavenging activity, however it has the limitation of color inference and the sample solubility. Table 2 shows the antioxidant potential of broccoli against the stable radical at 515nm.

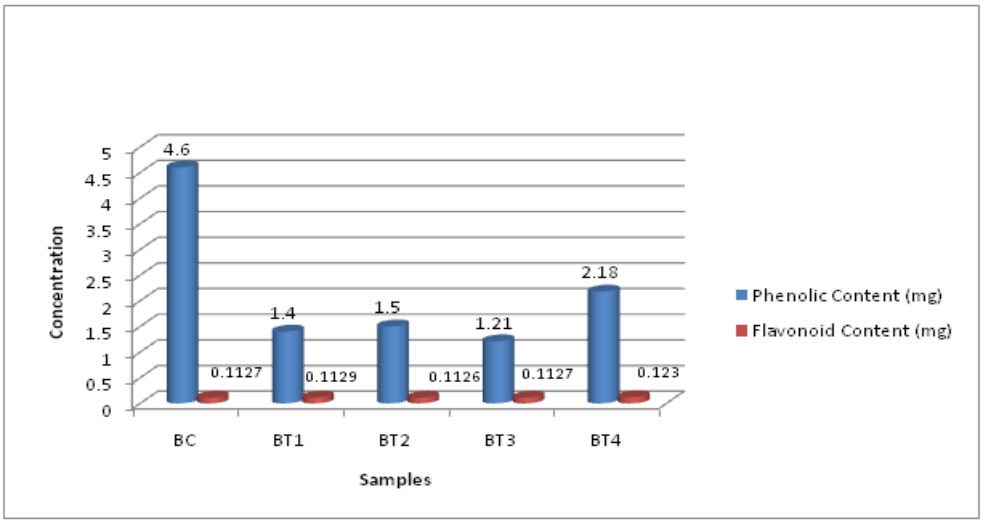

Figure 1. Total phenolic and flavonoid content of controlled and treated broccoli.

Table 2. Antioxidant potential in broccoli

Sample name	DPPH (%)	ABTS (%)
BC	40.31±20.2	8.40±6,416
BT1	82.2±30.78	5.90±4.012
BT2	65.1±34.7	6.09±4.12
BT3	72.6±56.1	19.2±16.88
BT4	85.8±54.2	20.06±13.83

As far as our results are concerned, sample BT4 produced highest antioxidant potential with 85.8 percent followed by BT1 (82.2 percent), BT3 with 72.6 percent and BT2 with 65.1 percent against the stable radical DPPH. Our results were in concordant with the results of Rosa et al., 2006 that during drying and processing many antioxidant activity is altered. Air drying improved the antioxidant activity. HTST could show the best results in higher antioxidant activity.

Table 2 shows the comparison of antiradical effect of broccoli against ABTS of control and treated broccoli. The highest inhibition potential was described in sample BT4 followed by BT3, BC, BT2 and BT1 respectively.

4. Conclusion

The present study concluded that broccoli is a nutritious leafy vegetable rich in phenolic compounds. These phenolic compounds can be best retained by minimal processing methods using various natural agents used for cooking. From the study it is proven that the treatment of broccoli with sugar (BT4) retained phenolic compounds and promoted highest antioxidant activity.

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