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Assessment of Antioxidant Activity and Phytochemical Composition in Brassica nigra L. And Brassica oleracea var. Botrytis Microgreens

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ABSTRACT

The growing global population presents significant food security challenges, demanding innovative agricultural solutions that are climate-resilient, space-efficient, and sustainable. Brassicaceae microgreens (BM) emerge as a promising alternative, offering rapid growth, minimal resource requirements, and the potential for year-round production. These microgreens are rich in essential nutrients and phytochemicals, drawing increasing interest for their health- promoting properties, including antioxidant, anticancer, antidiabetic and anti-inflammatory effects. This review provides an updated analysis of BM's nutritional profile, cultivation techniques, shelf-life extension methods, and their application in novel food products. It highlights the potential of BM to improve global nutrition and address the challenges posed by climate change. Researchers are also focusing on the use of natural antioxidants to combat oxidative stress, with leafy greens, particularly microgreens, emerging as key sources. This study examined the phytochemical content and antioxidant capacity of two microgreens, finding that **Brassica oleracea var. botrytis** microgreens exhibited the highest antioxidant content and activity. These results suggest that antioxidant-rich microgreens could be a valuable addition to a health-conscious diet.

KEY WORDS –Microgreens, Phytochemical, Antioxidant, Nutrients

INTRODUCTION

Over the past two decades, growing public interest in healthy eating has led consumers to focus more on premium fresh, functional, and nutraceutical foods. As a result, researchers, extension professionals, and specialty crop growers have a unique opportunity to capitalize on emerging trends and market potential for these specialized products. Among these products, **microgreens** have gained particular attention. Microgreens are young, edible plantlets of vegetables and herbs, harvested just 7 to 21 days after germination, typically when the first true leaves appear. Unlike larger vegetables that require weeks or months to mature, microgreens are harvested at a much earlier stage, offering a rapid and highly nutritious addition to the diet.

Though microgreens have been cultivated since the mid-1990s, they began appearing on chef's menus as early as the 1980s in San Francisco and Southern California. They are now considered a new, trendy vegetable category, rapidly gaining popularity for their intense sensory qualities, including flavor, texture, aroma, and vibrant colors (Kyriacou et al., 2016; Pinto et al., 2015). Often referred to as "vegetable confetti," microgreens are soft, immature greens grown from the seeds of vegetables, herbs, or cereals, including wild species. They are typically harvested at the soil level, when the cotyledons are fully expanded, and before the first pair of true leaves emerges (Sun et al., 2013).

Despite their small size (typically 2-8 cm tall), microgreens are packed with a wealth of phytonutrients, which vary depending on the plant species. These nutrients include higher concentrations of vitamins, minerals, antioxidants, and phenolic compounds compared to mature greens or seeds. As such, microgreens are considered functional foods, offering not only nutritional benefits but also serving as potent carriers of biologically active ingredients.

Key health benefits of microgreens include:

Antioxidant Properties: Microgreens are rich in antioxidants, which help protect the body from free radicals and oxidative stress.

Chronic Disease Risk Reduction: Research suggests that microgreens may help reduce the risk of chronic conditions such as heart disease, diabetes, and cancer.

Immune System Support: High in vitamin C, microgreens can boost the immune system, supporting overall health.

Digestive Health: The fiber content in microgreens contributes to improved digestion and gut health.

Skin Health: The vitamins and antioxidants found in microgreens may enhance skin health, promoting a youthful appearance and reducing signs of aging.

Given their nutrient density and wide range of health benefits, microgreens are increasingly recognized as a valuable addition to a balanced diet and a promising crop for growers interested in tapping into the health-focused food market.

METHODSANDMATERIALS

Sample Microgreen:

Microgreen	Scientific name
Black mustard	Brassica nigra L.
Cauliflower	Brassica oleracea var. botrytis

The bioactive compound extraction from the microgreen sample was performed using the maceration method. First, the sample was dried in a hot air oven. After drying, the sample was ground into a fine powder using a mixer.

Preparation of Extract:

This extract makes in methanol. In this method 20gm of dried sample powder was suspended in 200 ml of methanol solvent in the ratio of 80:20. Extraction was done by maceration method. After complete 3 days the extract was filtered in Petri plate.. After extract are collect and preserved in the fridge and use as sample.

Qualitative Phytochemical Analysis in Methanolic Extract of Various Microgreens

The qualitative phytochemical analysis of methanolic extracts from various microgreens revealed the presence of several bioactive compounds. Alkaloids were detected using Dragnedroff's and Wagner's tests, which showed a red

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precipitate, confirming their presence. Phenols were identified through Ferric chlorideand Lead acetatetests, with adark green colorand bulkywhite precipitate indicating phenolic compounds. The presence of saponins was confirmed by the Foam and Froth tests, which resulted in stable foam and a 1 cm froth layer, respectively. Carbohydrates were identified by the iodine test, where iodine turned from yellow-orange to blue-black, indicating starch. Phytosterols were detected using Salkowski's test, which produced a brown ring upon adding concentrated sulfuric acid. Flavonoids were confirmed by the Shinoda test, which resulted in a pink to crimson color, and the Alkaline Reagent test, where an intense yellow color faded to colorless after the addition of dilute acid. Glycosides were identified by Bontrager's test, which showed a pink color in the chloroform layer after hydrolysis. Proanthocyanidinsweredetectedbyaredorcarminecolorafterincubatingtheplantpowder

With hydrochloric acid. Finally, tannins were confirmed by a greenish to black color in the Ferric chloride test. Antioxidant activity, assessed using the phosphomolybdate assay, showed high total antioxidant capacity, calculated by measuring absorbance at 765 nm.

RESULT AND DISCUSSION

The following table summarizes the results of the qualitative phytochemical tests conducted on the methanolic extracts of Brassica nigra L. and Brassica oleracea var. botrytis microgreens:

Phytochemical Qualitative analysis of Selected Microgreens:

PHYTOCHEMICALS	TEST/COLOUR	Brassica nigra L.	Brassica oleracea var. botrytis
Alkaloids	Wagner's test/red precipitate	+++	++
	dandruff's test/red precipitate	+	-
Phenols	Ferric chloride test/dark green	+++	-
	Lead acetate test/bulky white	++	++
Saponins	Foam test	-	-
	Froth test	-	-
Carbohydrate	Iodine test/ blue	-	-
Phytosteroids	Salkowski test/ bluish green	++	+
Flavonoids	Shinoda test/ pink to crimson	-	-
	Alkaline reagent test/ Yellow colour	-	-
Glycosides	borntrager's test/pink	+	+
Proanthocyanin	Red or carmine colour	++	-
Tannin	Ferric chloride test/ Greenish to black	++	-

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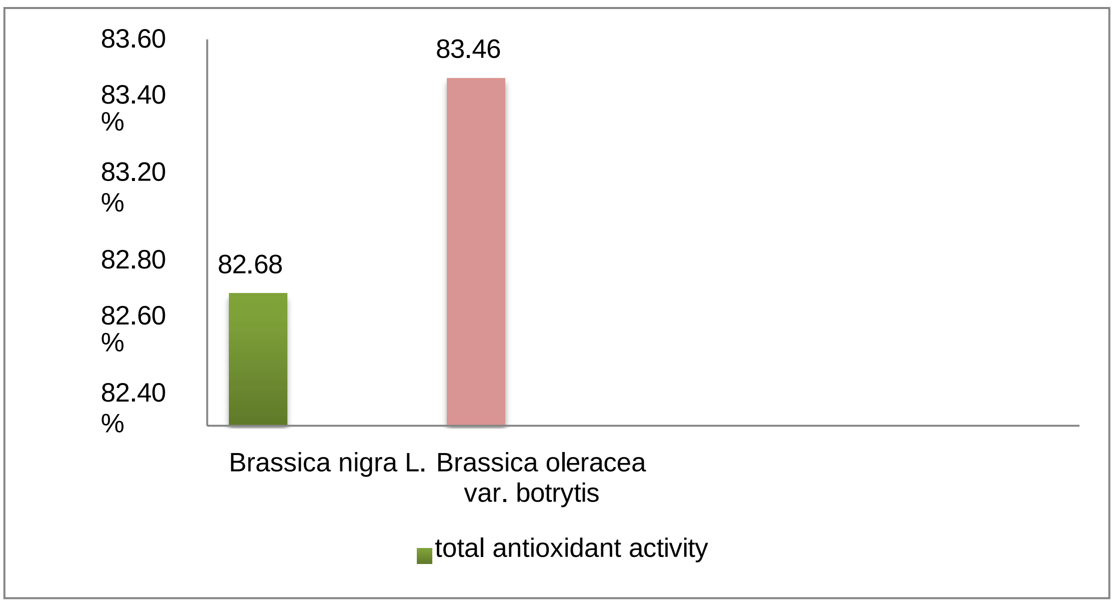
These findings highlight the distinctive phytochemical profiles of Brassica nigra L. and Brassica oleracea var. botrytis microgreens, which are rich in various bioactive compounds, particularly alkaloids, phenols, and tannins in Brassica nigra L.

Phosphomolybdate Assay for Antioxidant Activity: The total antioxidant capacity of the methanolic extracts of Brassica nigra L. and Brassica oleracea var. botrytis microgreens was assessed using the Phosphomolybdate assay. The results are as follows:

Brassica nigra L.: 82.68%totalantioxidant capacity

Brassica oleracea var. botrytis: 83.46%total antioxidant capacity

These results indicate that both microgreens exhibit significant antioxidant activity, with Brassica oleracea var. botrytis showing a slightly higher total **antioxidant capacity compared to Brassica nigra L.**



Total antioxidant activity of microgreen sample

The data indicates that Brassica oleracea var.botrytis microgreens exhibit a significantly higher total antioxidant activity (83.60%) compared to Brassica nigra microgreens (82.80%).

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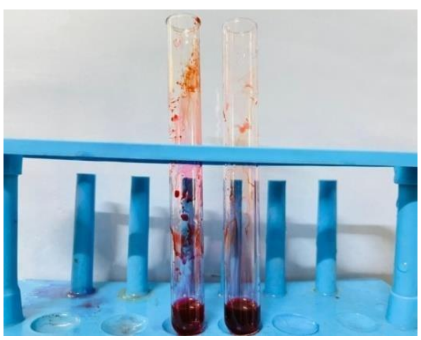
Brassica nigra L.

Brassica oleracea var.botrytis

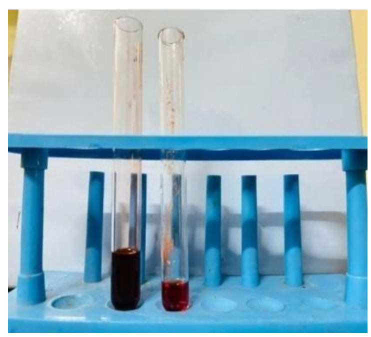
Grinding of Sample

Extract of Sample



Wagner's Test (Alkaloid)

Salkowski Test(Phyto steroids)



Proanthocyanin Test

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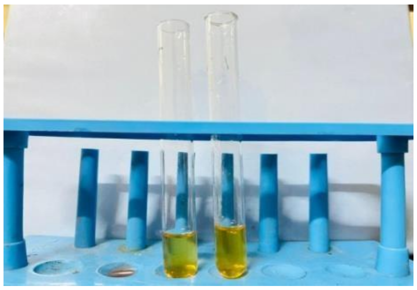
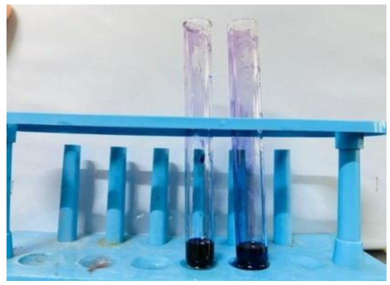
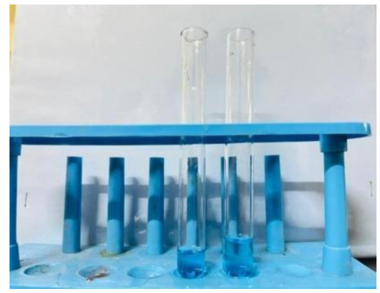


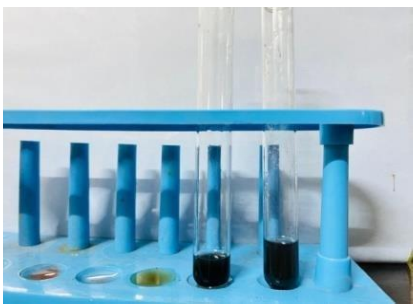
Iodine Test(Carbohydrate)



Ferric Chloride Test(Tannin)



Alkaline Reagent Test (Flavonoids)



Ferric Chloride Test (Phenol)

CONCLUSION

The primary objective of this study was to evaluate the qualitative phytochemical composition and antioxidant activity of methanolic extracts from Brassica nigra L. and Brassica oleracea var. botrytis microgreens. The microgreens were oven-dried, ground into a fine powder, and then extracted with methanol in a 20:80 ratio. The qualitative analysis revealed the presence of several bioactive compounds, including alkaloids, phenols, tannins, glycosides, flavonoids, phytosterols, and proanthocyanins.

Additionally, the study confirmed the antioxidant potential of these microgreens, highlighting their potential as valuable sources of antioxidants that could be incorporated into the diet. The bioactive compounds found in the microgreens suggest their strong radical-scavenging activities and their potential as new sources of vitamin C and phytochemicals.

Antioxidant activity was assessed using the phosphomolybdate assay, which showed that Brassica nigra L. exhibited a total antioxidant activity of 82.68%, while Brassica oleracea var. botrytis demonstrated 83.46% activity. The results confirm the presence of bioactive phytochemicals in the methanolic extracts of both microgreen species and their significant antioxidant properties.

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