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Original Research Article

In vitro evaluation of antioxidant property of ethanolic extract of *Zea mays var. saccharata*

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ABSTRACT

Background: Antioxidants play a crucial role in protecting against oxidative stress, which contributes to the pathogenesis of chronic diseases. Corn (Zea mays) is widely consumed and contains bioactive phytochemicals, but its antioxidant potential is not well established.
Methods: This was an in vitro experimental study conducted in the Department of Pharmacology, ACS Medical College and Hospital, Chennai, India, during June to July 2025. Ethanolic extract of fresh corn kernels was prepared by cold maceration. Antioxidant activity was assessed using the Total Antioxidant Capacity (TAC) assay and DPPH radical scavenging assay across concentrations of 20–100 µg/ml. Results were compared with standard antioxidants (ascorbic acid and BHT).
Results: The yield of dried ethanolic extract was 2.5 g from 50 g kernels. TAC showed a dose-dependent increase in activity, while DPPH scavenging ranged from 0% to 11.6%, significantly lower than the BHT standard (63–100%).
Conclusions: The ethanolic extract of Zea mays demonstrated moderate antioxidant potential, supporting its role as a natural source of antioxidants. Further isolation of active phytochemicals and in vivo studies are recommended.

Keywords: Antioxidant, DPPH assay, Ethanolic extract, Sweet corn, Zea mays

INTRODUCTION

Oxidative stress, resulting from an imbalance between free radicals and antioxidant defence mechanisms, plays a central role in the development of chronic diseases including cardiovascular disease, cancer, diabetes and neurodegenerative disorders.[1] Antioxidants act by neutralizing reactive oxygen species (ROS) and preventing cellular damage.[2] Dietary plants are recognized as an important source of natural antioxidants. Corn (Zea mays) is a staple cereal crop globally and is rich in phytochemicals such as phenolic acids, flavonoids, carotenoids and anthocyanins, all of which may contribute to antioxidant activity.[3,4] While studies have reported antioxidant properties of pigmented and traditional maize varieties, there is limited data on the sweet corn variety (Zea mays var. saccharata) consumed widely in India.[5,6]

The present study was therefore designed to evaluate the in vitro antioxidant activity of ethanolic extract of Zea mays var. saccharata using Total Antioxidant Capacity (TAC) assay and DPPH radical scavenging assay.

METHODS

Study type

In vitro experimental study.

Study site and period

Department of Pharmacology, ACS Medical College and Hospital, Chennai, India, conducted from June to July 2025.

Selection of samples

Fresh, healthy sweet corn kernels (Zea mays var. saccharata) were obtained from local markets in Chennai. Only undamaged kernels were included.

Extraction procedure

50 g of kernels were washed, air-dried and soaked in 100 ml of ethanol (95%) for 24 hours at room temperature (cold maceration). The extract was filtered using Whatman filter paper and evaporated at 10–20 °C under reduced pressure to yield 2.5 g of dried extract.

Antioxidant assays

Total antioxidant capacity

Performed using the method described by Aliyu et al Different concentrations (20–100 µg/ml) of extract and ascorbic acid standard were incubated with reagents at 95 °C for 90 minutes, absorbance measured at 695 nm.[7]

DPPH radical scavenging assay

Carried out using the method of Tailor and Goyal.[8] Extract solutions (20–100 µg/ml) were mixed with 0.5 mM DPPH solution in ethanol, incubated for 30 minutes in the dark and absorbance measured at 517 nm. Percent inhibition was calculated against BHT as standard.

Ethical approval

As this was an in vitro study using plant material, formal ethics approval was not required. Institutional acknowledgement for laboratory use was obtained.

Statistical analysis

All assays were performed in triplicate. Results were expressed as mean±standard deviation (SD). Statistical comparisons between extract and standard were analyzed using one-way ANOVA followed by Tukey's post hoc test. Significance was set at $p<0.05$.

RESULTS

Ethanolic extraction of 50 g of corn produced 2.5 g of dried extract, yielding approximately 5%. TAC assay showed a progressive increase in antioxidant capacity with concentration, indicating a dose-dependent effect. DPPH assay results showed that BHT exhibited significantly higher inhibition compared to the corn extract, confirming that although the extract has measurable antioxidant activity, it is less potent than synthetic standards. Antioxidant capacity increased dose-dependently with concentration of extract. As shown in Figure 1, the total antioxidant capacity of the ethanolic extract of Zea mays var. saccharata increased progressively with concentration, indicating a clear dose-dependent antioxidant response. The standard ascorbic acid displayed consistently higher absorbance values compared to the extract, reflecting its stronger reducing power. However, the upward trend observed in the sample suggests the presence of bioactive constituents capable of electron donation and free-radical neutralization.

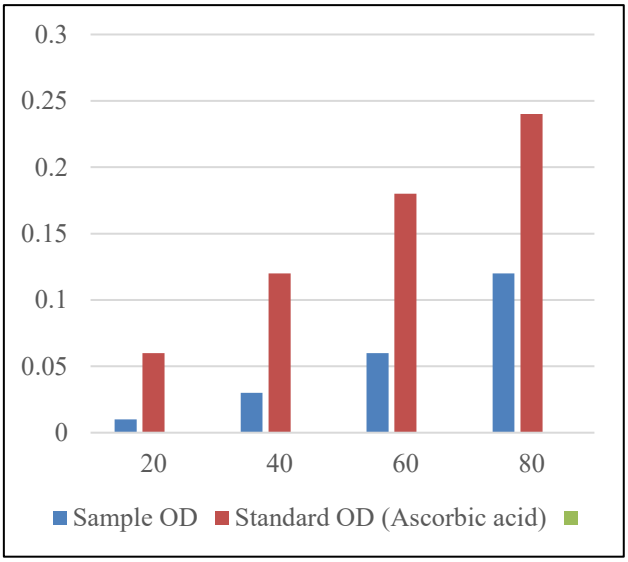

Figure 1: Total antioxidant capacity (OD at 695 nm vs concentration).

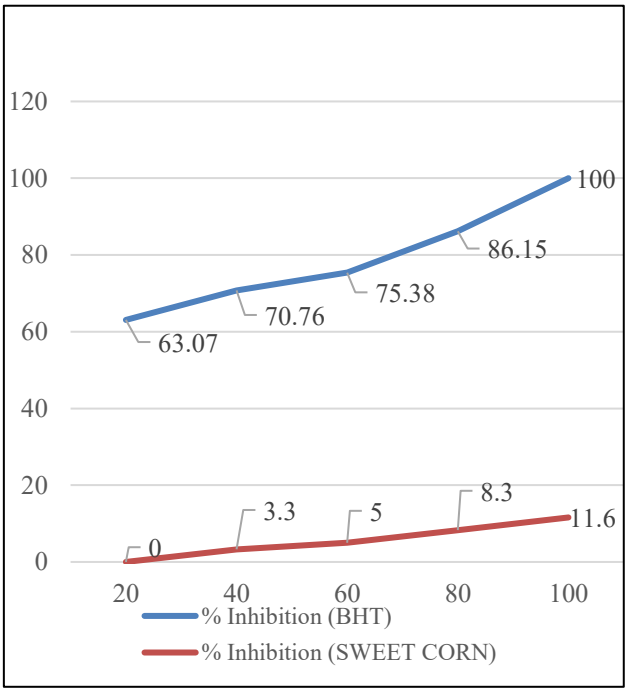

Figure 2: DPPH radical scavenging activity (% inhibition vs. concentration).

Radical scavenging activity ranged from 0–11.6% for the extract, compared to 63–100% for BHT. DPPH assay demonstrated moderate radical scavenging activity, lower than the standard BHT. As depicted in figure 2, the DPPH radical scavenging activity of the ethanolic extract of Zea

mays var. saccharata increased gradually with concentration, demonstrating a mild yet consistent antioxidant response. In contrast, the standard BHT exhibited markedly higher inhibition across all concentrations, reaching 100% at 100 µg/ml. The comparatively lower inhibition values of the sweet corn extract indicate moderate free radical scavenging capacity, likely due to a lower content of active phenolic and flavonoid constituents.

Table 1: Total antioxidant activity of sample and standard.

Concentration (µg/ml)	Sample OD (Sweet corn)	Standard OD (Ascorbic acid)	TA (µg)
20	0.01	0.06	3.5
40	0.03	0.12	10
60	0.06	0.18	20
80	0.12	0.24	40
100	0.15	0.3	50

Table 2: DPPH radical scavenging activity of sample and BHT standard.

Concentration (µg/ml)	Sample OD (Sweet corn)	% Inhibition	Std (BHT) OD	% Inhibition
20	0.6	0	0.24	63.07
40	0.58	3.3	0.19	70.76
60	0.57	5	0.16	75.38
80	0.55	8.3	0.09	86.15
100	0.53	11.6	0.0	100

DISCUSSION

The present study demonstrates that ethanolic extract of Zea mays var. saccharata possesses moderate antioxidant potential, as evidenced by TAC and DPPH assays. The dose-dependent increase in antioxidant activity indicates the presence of bioactive compounds, most likely phenolic acids and flavonoids, which have been documented in corn extracts.[3,4,9]

However, the activity observed was markedly lower than that of standard antioxidants such as ascorbic acid and BHT. This finding is consistent with previous reports showing that common yellow corn varieties possess lower antioxidant potential compared to pigmented maize strains.[6,10] Although its efficacy was lower than that of the standard antioxidant BHT, the extract demonstrated consistent activity, supporting its potential as a source of natural antioxidants. These findings align with recent evidence emphasizing that maize and its by-products possess diverse bioactive compounds whose antioxidant activity varies with extraction method, solvent polarity and processing technique. Esparza et al reported that modern extraction approaches, including solvent optimization and enzymatic pre-treatment, enhance the recovery of phenolic compounds from maize tissues, resulting in higher antioxidant yields.[11] The moderate activity in the current study could therefore be attributed to the cold maceration technique, which, while gentle, may extract fewer bound phenolics compared to advanced extraction methods such as ultrasound-assisted or pressurized solvent extraction.

Furthermore, Rodriguez et al demonstrated that pigmented maize varieties rich in anthocyanins and phenolic acids exhibit significantly higher antioxidant capacity compared with yellow or white maize.[12] The comparatively lower activity of the sweet corn extract observed here may thus reflect its lower pigment and phenolic content, consistent with these findings. Similarly, Lapčík et al investigated corn silk extracts and found that both the solvent system and physicochemical properties of the extract profoundly affect its antioxidant potential.[13] This reinforces the importance of optimizing extraction parameters to maximize antioxidant activity from different maize parts.

Recent advancements in processing have also shown promise in enhancing antioxidant potential. Tang et al demonstrated that heat and enzymatic treatments significantly increased antioxidant activity in corn bract and silk juices by improving phenolic release and solubility.[14] Incorporating such processing steps in future studies on sweet corn extracts may therefore enhance their activity. Additionally, Gogoi et al highlighted the role of both free and bound polyphenols in determining total antioxidant capacity, particularly in pigmented maize kernels.[15] This distinction is relevant since the cold ethanolic extraction used in this study may have favoured free phenolics over bound ones, thus underestimating total antioxidant potential.

Overall, the present results corroborate recent literature demonstrating that maize, though often underappreciated as an antioxidant source, harbors valuable phytochemicals with health-promoting potential. Differences in antioxidant activity across studies are largely attributable to maize variety, solvent selection and post-harvest processing methods. Further work involving chromatographic profiling and comparative extraction optimization is warranted to isolate active constituents and validate their pharmacological relevance.

Adom et al and Liu et al highlighted that bound phenolic compounds in whole grains contribute significantly to total antioxidant activity, suggesting that extraction method and solvent system may influence yield.[3] Hu et al and Xu et al further reported that germ and bran fractions of corn display higher antioxidant activity compared to kernels alone.[5] Thus, future studies isolating individual components (such as ferulic acid and anthocyanins) may provide better insights. The present findings extend prior work by providing the first laboratory evidence on antioxidant activity in Indian sweet corn, suggesting potential as a functional food.

Limitations

The study was limited by its in vitro design, small sample size and evaluation of only two antioxidant assays. In vitro studies provide valuable insights into cellular mechanisms and biochemical interactions under controlled conditions; however, they are inherently limited by their artificial nature. Such studies cannot fully replicate the complex physiological environment of a whole organism, including systemic metabolism, immune responses and intercellular interactions. Additionally, the use of single cell types, simplified culture conditions and often higher-than-physiological concentrations of test compounds may affect the relevance and translatability of the results. Therefore, while in vitro findings are useful for preliminary investigation, they should be interpreted with caution and validated through in vivo studies to confirm their applicability in real biological systems.

CONCLUSION

The present study demonstrates that ethanolic extract of Zea mays var. saccharata exhibits moderate, dose-dependent antioxidant activity as evidenced by TAC and DPPH assays, though its effect is weaker compared to established standards such as ascorbic acid and BHT. By providing new data on the antioxidant potential of the commonly consumed sweet corn variety in India, this work advances current knowledge by highlighting its role as a functional food source of natural antioxidants. These findings lay the foundation for future research aimed at isolating active phytochemicals and validating their effects through in vivo and clinical studies, thereby contributing to the development of safer, plant-based therapeutic options against oxidative stress–related disorders.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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