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Invitro Antioxidant Activity of Ginger

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Abstract

Ginger, or Zingiber officinale Rosc., is a medicinal spice commonly employed for antioxidant activities. The present study was designed to assess the antioxidant activity of ginger extract using different antioxidant assays. Fresh ginger was collected, cleaned, dried, and powdered, and the extract was prepared using methanol as a solvent. The extract was concentrated using a Soxhlet apparatus or maceration. The extract was tested for antioxidant activity using different assays. Phytochemical screening of ginger extract showed the presence of polyphenols, flavonoids, and terpenoids. The antioxidant activity of ginger extract was evaluated using DPPH, ABTS, FRAP, hydrogen peroxide, and phenolic content assays. The results of this study showed that ginger extract possessed antioxidant activity, as indicated by DPPH and ABTS radical scavenging activity, and the IC50 value of ginger extract was within the range of [50-100] µg/mL. The antioxidant activity of ginger extract was comparable to that of ascorbic acid or gallic acid. The antioxidant activity of ginger extract was also evident from the FRAP assay, in which ginger extract showed significant antioxidant activity. The hydrogen peroxide scavenging activity of ginger extract increased with increasing concentration. The phenolic content of ginger extract was within the range of [80-120] mg/g.. The antioxidant activities observed are consistent with the phenolic constituents of ginger, which confirms the traditional use of ginger as a health-promoting food and indicates its possible use as a natural antioxidant for the production of functional foods and nutraceuticals.

Keywords: Ginger, Zingiber officinale, in vitro antioxidant activity, DPPH, FRAP, total phenolic content

1. Introduction

Ginger (Zingiber officinale Rosc., Zingiberaceae) is one of the most commonly used medicinal and culinary spices worldwide. It is known for its characteristic pungent flavor and various biological activities. Ginger contains bioactive compounds like gingerols, shogaols, and other phenolic compounds. Oxidative stress mediated by reactive oxygen species (ROS) is known to be involved in the pathogenesis of various chronic health conditions. Cardiovascular diseases, diabetes, and cancer are examples of oxidative stress-related health disorders. Thus, natural antioxidants from plant sources have attracted considerable attention. Various research articles have shown that ginger exhibits considerable antioxidant activity in vitro. However, results vary depending on the type of extraction method used and the temperature. The aim of this study was to prepare an extract of ginger rhizomes and assess its antioxidant activity using various in vitro methods.

2. Materials and methods

2.1 Plant material and extract preparation

Fresh ginger rhizomes were purchased from the local market of Coimbatore, cleaned, sliced, and dried at temperatures ranging from 40 to 50°C.

The dried material was reduced to a fine powder, defatted with petroleum ether, and then extracted with the specified solvent, i.e., methanol, by Soxhlet apparatus or maceration at room temperature (25 ± 2°C) for 24 to 48 hours.

The filtrate was dried under reduced pressure by the rotary evaporator and stored at 4°C for further analysis.

fig 1: Ginger rhizome

fig 2: Soxhlet extraction of ginger

2.2 Preliminary phytochemical screening

The methanolic extract was subjected to standard phytochemical tests for alkaloids, flavonoids, tannins, saponins, terpenoids, and phenolic compounds using standard colorimetric methods.

SL NO	EXPERIMENT	OBSERVATION	INFERENCES
1	ALKALOIDS Dragendorff's Test Add Dragendorff's reagent to extract	Orange/red precipitate	Alkaloids present
	Mayer's Test Add Mayer's reagent	Cream/white precipitate	Alkaloids present
2	FLAVONOIDS Shinoda Test Add Mg ribbon + conc. Hcl	Pink or red color	Flavonoids present

	Alkaline Reagent Test Add NaOH, then acid	Yellow to colorless	Flavonoids present
3	TANNINS Ferric Chloride Test Add $fecl_3$ solution	Blue/ black color	Tannins present
4	SAPONINS Foam Test Shake with water vigorously	Persistent foam	Saponins present
5	TERPENOIDS Salkowski Test Add chloroform + conc. H_2SO_4	Reddish brown	Terpenoids present

2.3 In vitro antioxidant assays

DPPH Radical Scavenging Assay:

This assay was carried out by reacting different concentrations of the sample (10-100 µg/mL) with 0.1 mM solution of DPPH in methanol. The mixture was allowed to react for 30 minutes in the dark, and the absorbance was recorded at 517 nm. Ascorbic acid was used as a reference substance.

ABTS Radical Cation Decolorization Assay:

ABTS solution was prepared by reacting ABTS with potassium persulfate, and the solution was diluted until an absorbance of ~0.70 was recorded at 734 nm. The sample solution was mixed with ABTS solution, and the absorbance was recorded after 6 minutes. The percentage inhibition was computed.

Ferric Reducing Antioxidant Power (FRAP) Assay:

FRAP solution was prepared by mixing acetate buffer, TPTZ, and $FeCl_3$ solutions. Sample solutions were mixed with FRAP solution, and the mixture was kept in a water bath at 37°C for 4-10 minutes. The mixture was then allowed to cool, and the absorbance was recorded at 593 nm.

Hydrogen peroxide scavenging activity:

A H_2O_2 solution (40 mm) in phosphate buffer (pH 7.4) was added to varying concentrations of extract. After incubation, absorbance was measured at 230 nm using a blank devoid of H_2O_2. Percentage scavenging was calculated.

2.4 Total phenolic content (TPC)

TPC was determined by the Folin-Ciocalteu method. The extract solutions were mixed with Folin-Ciocalteu reagent and sodium carbonate, and after 30 to 60 min, the absorption was measured at 765 nm. The results were given as mg of gallic acid equivalents per gram of extract (mg GAE/g).

2.5 Statistical analysis

All experiments were conducted in triplicate and expressed as mean ± standard deviation. IC_{50} was calculated by linear regression.

3. Results and discussion

The methanolic extract of ginger rhizomes exhibited potent DPPH and ABTS free radical scavenging activity in a concentration-dependent manner with IC_{50} values compared to standard free radical scavenging agents like ascorbic acid and quercetin. This indicates that ginger contains hydrogen donors with potential for free radical scavenging activity. The FRAP activity was also concentration-dependent, indicating potent reducing activity of the methanolic extract of ginger. This supports the presence of phenolic compounds with potential for reducing Fe^{3+} to Fe^{2+}.In the H_2O_2 scavenging assay, ginger extract demonstrated moderate to high scavenging activity, which is important as hydrogen peroxide is a major ROS involved in oxidative damage.

Total phenolic content of the extract which correlates well with the observed antioxidant activity, as phenolic compounds are known to contribute to radical scavenging and metal-reducing capacities. The gingerol- and shogaol-rich fractions previously reported in ginger are likely responsible for this effect, supporting earlier in vitro and in vivo studies on ginger's antioxidant potential.

Overall, the current results confirm that ginger extract possesses appreciable in vitro antioxidant activity across multiple models, suggesting its potential as a natural antioxidant source for food and pharmaceutical applications.

4. Conclusion

The in vitro antioxidant screening tests revealed that the methanolic extract of Zingiber officinale rhizome possessed potent free radical scavenging and reducing power activities, which could be ascribed to its high phenolic compound content. The results of this study confirm the traditional use of ginger as a health-promoting spice and suggest its potential as a source of antioxidant-rich functional food products. Future research should focus on the characterization of the bioactive compounds and their synergetic activities with other natural antioxidants, as well as their antioxidant and therapeutic activities.