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Ecofriendly Synthesis of Silver Nanoparticles using *Mentha asiatica* (Mint) Extract and Assessment of their Antioxidant Activity

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Abstract
Ecofriendly approach towards development of nanoparticles (AgNPs) has more advantages because they are safely handling and easily available. The present work of green synthesis of silver nanoparticles (AgNPs) using *Mentha asiatica* (Mint) extract and checked their antioxidant activity. Silver nanoparticles were synthesized by the bioreduction of silver nitrate (AgNO3) by using different concentrations ofMint extract, and UV–visible spectral analysis and showed silver surface plasmon resonance band in the range of 200-800 nm to confirm the formation of silver nanoparticles. The presence of various Phytoconstituents like carotenoids and polyphenols, which include phenolic acids, flavonoids, and stilbenes, was investigated by using standard biochemical methods. After that the antioxidant activity was per formed by the DPPH method, and the ethanolic leaf extract of *Menthaasi atica*was found to show significant antioxidant activity. The synthesized silver nanoparticles were characterized by scanning electron microscopy (SEM).

Keywords
Green synthesis, Silver nanoparticles, Antioxidant activity.

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INTRODUCTION
During the recent research, Materials show unique chemical and physical properties like electrical, Optical, Catalytic, and Magnetic when at Nano scale. Nano structures in different range from sub nanometers to several hundred nanometers. Silver nanoparticles ((AgNPs) are synthesized by numerous methods.[1] The chemical methods enlarged for the synthesis of nanoparticles are too costly and also involve the use of toxic, hazardous chemicals that are for various biological risks, so nanoparticles are synthesized by using plants and vegetables and their extracts. Extract of plants and vegetables having advantages over other synthesis.[2]

A majority of antioxidants naturally present in food has the phenolic structure, especially flavonoids.
Antioxidants can play a protective role in a number of diseases such as cardiovascular and neurodegenerative diseases in which oxidative stress and free radicals are the major contributors.[7] So far many studies have been conducted to evaluate the correlation between the phenolic structure and the antioxidant activity.[8]
Phytoconstituents like flavonoids and phenolics have been reported as potent free radical scavengers and they frequently occur in medicinal and aromatic plants. A majority of antioxidants naturally present in food has the phenolic structure, especially

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In this study, we report the synthesis of silver nanoparticles by green synthesis process using Mint leaf extract as reducing agent. The final products were studied-optical, structural, surface morphology and elemental analysis. The antioxidant activity was examined and reported.[4]

MATERIAL AND METHODS

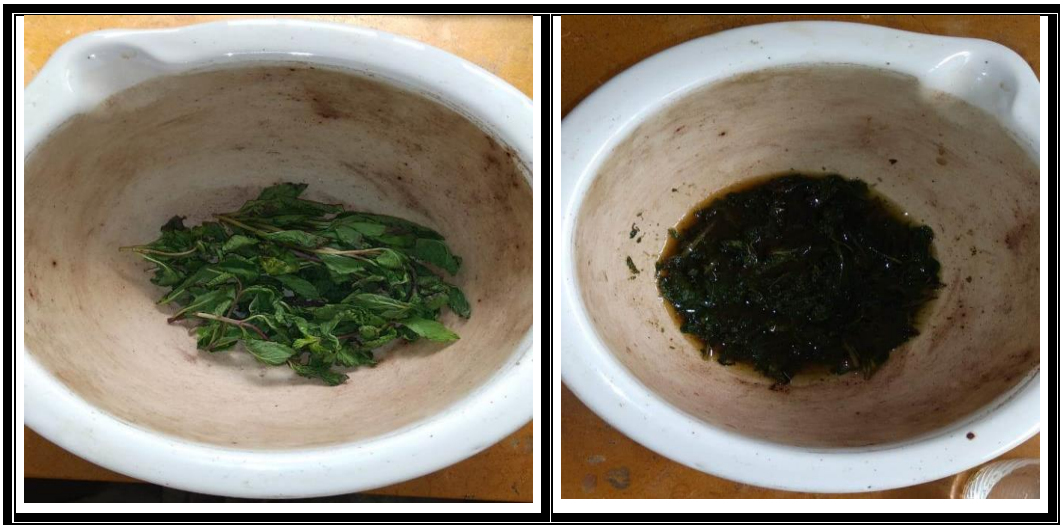
Mint leaves were freshly collected from the region of Gujarat, India. To remove contaminants which were present on the surface of the fresh leaves, so initially several times wash with tap water. Then thoroughly washed with sterile distilled water. After the wash, 10g of leaves was cut into small pieces and then soaked into 100 ml sterile distilled water using motor and pastel. These leaves were continuously stirred at 60°C for 5-10 min. the extract was filtered through Whatman No.1 filter paper. Reduction reaction of Ag^{+} ions to Ag^{0} occurs completely within time period. After 15 min, the color of the solution changed from yellowish green to dark brown that indicate the formation of silver nanoparticles.

PRELIMINARY PHYTOCHEMICAL SCREENING

The ethanolic extract of *Mentha asiatica* (Mint) leaves was investigated for the presence of phytochemicals like alkaloids, Saponins, flavonoids, anthraquinone derivatives, tannins and phenolic, by following standard biochemicalmethods.[5]

SYNTHEIS OF SILVER NANOPARTICLE

In this study, 10 ml of0.1 M Silver nitrate solution was prepared; 15 ml of the *Mentha asiatica* (Mint) leaf extract was added to 10 ml of silver nitrate solution and put the mixture on the magnetic stirrer at 60-70 °C for 20 minutes. To ensure the formation of AgNPs, within 10-15 min, the color solution changes to dark brown color due to the formation of AgNPs.[6]



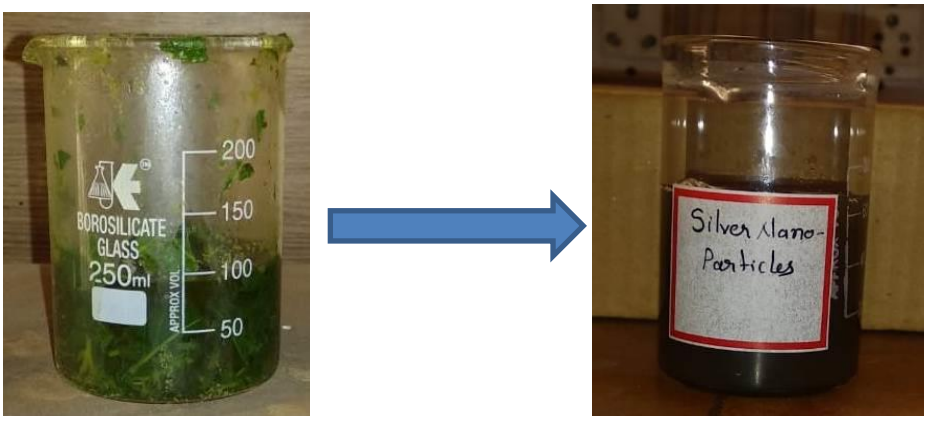


Figure 1Preparation of Silver nanoparticles of leaf extracts of *Mentha asiatica*.

UV–VIS SPECTRAL ANALYSIS

Synthesized silver nanoparticles were characterized by using UV-Vis spectroscopy. The bioreduction of silver ions was showed by their absorbance from 200 to800 nm. The maximum absorbance and wavelength to confirm the reduction of Silvernitrate.[7]

SEM ANALYSIS

For the morphological characters (shape and size), Characterization of synthesized silver nanoparticles from the *Mentha asiatica* (Mint)leaf extract using a scanning electron microscope.[8] Figure 3 indicated spherical shaped nanoparticles with range from 50 to 70 nm, observed at a magnification of x 9.99k. This Conformation of silver nanoparticles was obtained from the *Mentha asiatica* (Mint) leaf extract.

ANTIOXIDANT ACTIVITY OF SILVER NANOPARTICLES

DPPH ASSAY

The antioxidant activity was characterized utilizing DPPH (2, 2-diphenyl-2-picrylhydrazyl hydrate) assay.3 mL of DPPH solution (0.004%) in ethanol was added in concentrations (50- 250µg/mL) of the *Mentha asiatica*(Mint)leaf extract and SNPs separately. The mixture was shaken vigorously and allowed to stand at room temperature for 30 min. Then the absorbance was measured at 517 nm by using a UV-visible spectrophotometer.[9] Antioxidant activity was estimated by calculating the % inhibition by following formula. Ascorbic acid was served as positive reference standard.

$$\text{DPPH radical scavenging activity (\%)} = \frac{[(\text{Control absorbance}) - (\text{Sample absorbance}) \times 100}{[\text{Control absorbance}]}$$

RESULT AND DISCUSSION

Biosynthesized silver nanoparticles are most commonly valued materials and are found to have antioxidant activityand phytochemical properties which are used in textile, food, and paint industries and in other fields. The total antioxidant capacity was determined for the *Menthaasiatica* plant extract by showed in vitro antioxidant tests like the DPPH assay. Natural antioxidants are useful in protecting cells from oxidative damage. Synthetic antioxidants such as butylated hydroxyl toluene (BHT) and butylated hydroxyanisole (BHA) are hardly used in the food industry. The natural plants have antioxidant free radical scavenges which help to prevent pathologies like cancer, heart disease, arthritis, and liver disease. The natural plant extract has clinical therapeutic more potential due its antioxidant activity in reducing such free radical induced tissue injury. The natural plant extract has also use in the pharmaceutical industry. Medicinal plants can protect from free radicals originating from oxidative stress or display to UV radiation because the natural plant is found to show a variety of antioxidants.

In this study, synthesized silver nanoparticles, Phytochemical, antioxidant activity was analysed in the medicinal plant extract of *Mentha asiatica*. The results of qualitative screening of photochemical analysis of the crude methanolic mint leaf extract. A significant amount of flavanoids and tannins are found; saponins, glycosides and alkaloids were not present in the *Mentha asiatica*. (Table 1) The synthesis of silver nanoparticles was carried out by the UV–visible spectral analysis with the absorption peak ranging from 200 nm to 800 nm. The UV–Vis spectra indicate a peak approximately at 306 nm (Fig 2) which clearly shows the presence of nanoparticles in the sample. Scanning electron microscopy images (Fig 3) were obtained to analyses the shape and morphological structure of the synthesized silver nanoparticles. The antioxidant activity of the ethanol extract of *Mentha asiatica* was evaluated (Table 2) by the DPPH assay has shown a significant total

antioxidant capacity. In vitro antioxidant activity: The yield of the ethanol extract of the plant extract and AgNPs and its DPPH capacity are given in Fig. 5.
In this study disclosed that the antioxidant activity of the extract is in the increasing with the increasing concentration of the plant extract and AgNPs. The observed scavenging effect of plant extract, AgNPs and standard decreases in the following order: Ascorbic acid > AgNPs > plant extract. Synthesis of nanoparticles by a green method has more advantages over chemical and physical methods. it is eco-friendly and cost effective. It does not require the use of energy, pressure, temperature and toxic chemicals. The processes of synthesized nanoparticles have very different applications in the field of healthcare, medicine, electronics, etc.

Table 1 The photochemical test carried out in the crude methanolic mint leaf extract

Photochemical	Chemical test	Observation	Result
Glycosides	Benedicts's test (to determine reducing sugars)	No change in colour of the extract	-
Saponins	Frothing test	No frothing	-
tannins	Ferric chloride test	Extract change into dark blue	+
anthraquinone derivatives	Borntrager's test	No change in colour of the extract	-
Flavanoid	Akaline reagent test	Formation of brown colour	+
Alkaloids	Dragendorff's test	No Orange precipitates	-

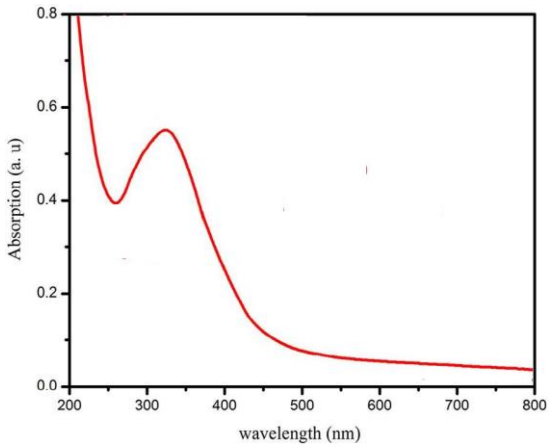


Figure 2 The UV–Vis spectrum shows an absorbance wavelength at 306 nm confirming the reduction of silver nanoparticles in the *Mentha asiatica* sample.

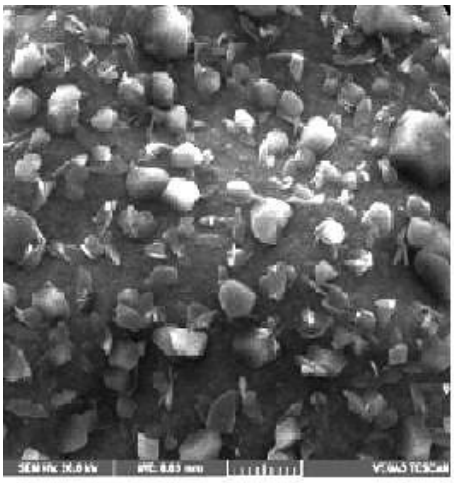


Figure 3 SEM images of silver nanoparticles from the extracts of *Mentha asiatica*

Table 2 Antioxidant activities of Plant leaf extracts, AgNPs, and ascorbic acid (standard) showing Scavenging ability in % Inhibition of extracts

Concentration in µg/ml	Scavenging ability in %Inhibition		
	Plant extract	Synthesized AgNPs	Ascorbic acid (standard)
50	13.03 ± 0.08	15.23 ± 0.04	17.23 ± 0.02
100	40.73 ± 0.03	46.25 ± 0.09	51.15 ± 0.04
150	55.92 ± 0.02	60.15 ± 0.09	67.14 ± 0.09
200	67.62 ± 0.04	71.23 ± 0.05	76.24 ± 0.03
250	72.80 ± 0.07	85.90 ± 0.08	86.00 ± 0.40

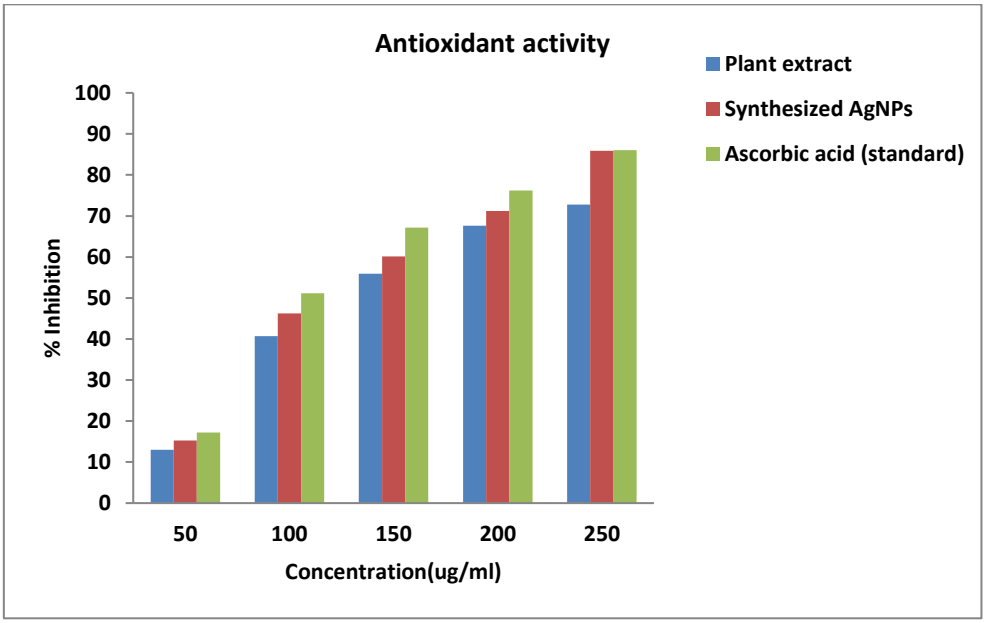


Figure 4 Antioxidant activities of the SNPs, plant extract, and ascorbic acid

CONCLUSION

Synthesis of silver nanoparticles from the *Mentha asiatica* (Mint)leaf extract was characterized by SEM and UV-spectral analysis. Phytochemical screening and evaluation of antioxidant activity of the *Mentha asiatica* (Mint)leaf extract were also performed. This plant extract shows the highest antioxidant capacity. According to the results the *Mentha asiatica* (Mint)plants extract.

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