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Abutilon theophrasti (Velvet leaf) a medicinal weed*:* A Novel Ethnomedical Approach in Exploring Anti-Solar, Anti-Microbial, Anti-oxidant Efficacy

Research Article

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Abstract

The aim of this study was to assess the antisolar, antioxidant, and antimicrobial properties of aqueous and methanolic extracts of Abutilon theophrasti. For the evaluation of antisolar activity, a Shimadzu UV-1900 double beam UV spectrophotometer was used, along with standard SPF values. The antioxidant activity was analyzed through various methods, including DPPH, nitric oxide scavenging, ferrous ion chelating, ABTS, FRAP, NBT, and LPO assays. The determination of minimum inhibitory zone (MIC) and antimicrobial activity was conducted using the disc diffusion method. The results indicated that the plant extract exhibited significant antisolar activity, with SPF values exceeding 10, specifically 11.5 for the aqueous extract and 15.60 for the methanolic extract, providing substantial protection against UV radiation. Additionally, the methanolic extract displayed a zone of inhibition ranging from 10 to 20 mm, while the aqueous extract showed a zone of inhibition ranging from 11 to 21 mm against various bacterial and fungal strains, including Staphylococcus aureus, Escherichia coli, and Candida albicans. The MIC values ranged from 8.76 to 46.59 mg/mL for the tested bacterial species and fungal species. Furthermore, the antioxidant potential of the extracts was assessed using various methods, and their IC50 values were found to be higher than those of standard antioxidants. These findings suggest that *Abutilon theophrasti* (Velvet leaf), a medicinal weed, possesses substantial potential as an antisolar, antimicrobial, and antioxidant agent.

Keywords: *Abutilon theophrasti,* Antisolar, *Escherichia coli,* Sun Protection Factor, Anti-oxidant, Anti-Microbial activity.

Introduction

Abutilon theophrasti is an ethnomedicinal plant which belongs to the genus Abutilon and family Malvaceae which includes about more than 160 species among them, one species, *Abutilon theophrasti*, grows in the region of Uzbekistan and is mainly distributed in central Asia and the European parts of the CIS and in the Caucuses, Iran, India, China, Japan, north Africa, etc. (1) The chemical composition of A. theophrasti includes 2-3% tanning agents. Leaves contain 24.3 mg% γ-carotene, 180–200 mg% vitamin C, and ~0.28% of the air-dried mass of rubber-like substances (2).

Natural products are being used for the development of novel drugs to treat various microbial infections. Various secondary plant metabolites such as essential oils, flavonoids, and alkaloids have shown significant antimicrobial and antioxidant properties (3). However, the antisolar, antibacterial and antioxidant properties of the different extracts of *Abutilon theophrasti* plant have not been investigated thoroughly. Therefore, the present research was carried out to investigate the antisolar, antibacterial and antioxidant activities of sequentially extracted by water and organic solvent extracts of *Abutilon theophrasti* plant. Phyto constituents have been rarely reported as Roseoside, Kaempferol, P-hydroxy benzoic acid, P-coumaric acid, Syringic acid, Vanillic acid, Luteolin, Catechin, Ferulic acid, Rutin, Caffeic acid, Quercetin and other compounds have been isolated from *Abutilon theophrasti* by thin-layer chromatography (TLC), preparative paper chromatography, cellulose columns, Sephadex LH-20 and spectroscopic methods. In the roots, stems, leaves, seeds and exocarps of *Abutilon theophrasti* Medic Roseoside, Kaempferol, P-hydroxy benzoic acid, P-coumaric acid, Syringic acid, Vanillic acid, Luteolin, Catechin, Ferulic acid, Rutin, Quercetin and Caffeic acid were generally found to be primary phenol components in an earlier report (4-5).

Abutilon theophrasti has been utilised in ethnomedicine to address various ailments. The aerial parts of *Abutilon theophrasti* are employed in folk medicine as an expectorant and emollient. Additionally, the drug demonstrates anti-inflammatory and carminative properties, mainly used to treat conditions such as rheumatic pains, arthrosis, bruises, sprains, dysentery, otitis media, tinnitus, and deafness (6-7).

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Materials and Methods

Collection of extract

Collection of Aqueous and Methanolic extract from Vital herbs Block-z,26/27 Commercial Enclave, Mohan Garden, Uttam Nagar, Delhi, 110059.

Extraction procedure

The leaves were cleaned, chopped into small pieces, dried in the shade, and then ground into coarse powder. The coarse powder was extracted using a maceration technique with water and organic solvent (Methanol). The extract was dried under reduced pressure using a rotary vacuum evaporator and stored in an airtight container until it is needed again (8).

Standardisation of extract using UV-spectroscopy

Precisely measured 1 mg of both extracts, dissolved each in 5 ml of methanol, and then adjusted the volume to 10 ml using a 10 ml volumetric flask. The solution was then subjected to sonication for 10 minutes. As a result, a solution with a concentration of 100 µg/ml (100 parts per million) was obtained. This solution was used as the standard stock solution. To obtain the standard calibration curve, serial dilutions were prepared from the above standard stock solution. Dilutions of 2, 4, 6, 8, 10, and 12 ppm were made (9).

Preliminary phytochemical analysis

The plant *Abutilon theophrasti* extracts were subjected to preliminary phytochemical screening to determine the presence of secondary metabolites such as Flavonoids, Alkaloids, Saponins, Triterpenoids, Steroids, Tannins, Glycosides, and Phenolics. This screening was conducted using standard methods (10).

Screening of *in-vitro* anti-solar activity

In this context, using topical formulations (with Sun Protection Factors-SPFs) on the skin may be a preferred choice to act as a sunscreen (see Table 1). These formulations can scatter, reflect, or absorb the harmful radiation that falls on the skin. Sunscreens are categorised as chemical and physical sunscreens (11). Previous studies have already demonstrated the anti-solar potential of numerous herbal products. Plants contain various photolabile compounds that may degrade when continuously exposed to sunlight. Plants that contain ascorbic acid, tocopherol, flavonoids, and polyphenols exhibit antioxidant properties and have been observed to protect photosensitive components. This leads to the inhibition of photodegradation of photosensitive compounds, which can suffer from various harmful effects. These effects range from acute damage, such as erythema, pain, and oedema to chronic damage such as premature ageing, skin wrinkling, and cancer (12).

1900 double beam UV spectrophotometer, equipped with a 1 cm quartz cell. A sample weighing 10mg was placed in a 10 ml volumetric flask and filled with ethanol and water (95%) separately. The mixture was shaken thoroughly and left for 5 minutes. Afterward, a 1 mL solution was taken from each flask and diluted with 10 mL of water and ethanol (95%) respectively. From this diluted stock solution, 0.2 ml was taken and mixed with 10 ml of water and ethanol (95%) each to obtain a final solution with a concentration of 2 µg/mL. UV absorption spectra of both aqueous and methanolic (95%) extracts were recorded in the range of 290-320 nm. Three readings were taken, and the average was calculated. Normalized product function [Table 2. **(EE (λ). I (λ) (Constant)**] (13) and mean of absorbance was used to calculate SPF values.

$$SPF = CF \times \sum_{320}^{290} EE(\lambda).I(\lambda),abs(\lambda)$$

Where,
SPF- Sun Protection Factor
CF – Correction factor = 10
EE – Erythemal effect spectrum
I – Solar intensity spectrum
Abs – Absorbance of prepared extracts (Aqueous and ethanolic)

Table 1. Suitable SPF for Different sensitive skins

Suitable SPF	Skin Type	UV Sensitivity	Effect of UV radiation
10≤	I	Very sensitive	Burns easily, never tans
10≤	II	Very sensitive	Burns easily, minimum tanning
8 to 10	III	Sensitive	Moderately burns, uniform and gradual tanning to light brown
6 to 8	IV	Moderately sensitive	Minimum burning, tans to moderate brown
4	V	Less sensitive	Rarely burns, tans to dark brown
Not specified	VI	Not sensitive	Never burns, black pigmentation

Table 2. Standard values of $EE_{(A)}$. $I_{(A)}$ used to calculate Sun Protection Factor (SPF)

Wavelength (nm)	$EE_{(A)}$. $I_{(A)}$ (Constant)
290	0.0150
295	0.0817
300	0.2874
305	0.3278
310	0.1864
315	0.0837
320	0.0180
Total	1

Screening for *in-vitro* Anti-Microbial activity

Microbial Culture

In this study, we utilized the following standard bacterial cultural strains belonging to various bacterial species: Staphylococcus aureus (ATCC 29213) and Escherichia coli (ATCC 25922), as well as the fungal species Candida albicans (ATCC 10231). These strains

were acquired from KAHER's Dr. Prabhakar Kore Basic Science Research Centre located in Belagavi, Karnataka, India. These microbial organisms, which encompass Gram-positive, Gram-negative, and fungal types, were chosen due to their remarkable ability to thrive in challenging conditions and adapt to diverse environmental habitats. Consequently, they pose a significant risk as the primary sources of severe infections in humans (14).

Determination of the minimum inhibitory concentration (MIC)

The MIC (Minimum Inhibitory Concentration) of bacterial species, Staphylococcus aureus (ATCC 29213), Escherichia coli (ATCC 25922), and fungal species, Candida albicans (ATCC 10231), was determined using the broth micro-dilution method. These microorganisms were cultured overnight on Mueller-Hinton agar (MHA) and adjusted to a concentration of 1×108 CFU/ml, which was then diluted 1:100 with sterile nutrient broth. The different extracts were dissolved in 1% DMSO and further diluted using a ten serial twofold dilution method. Briefly, 100µl of each extract solution was added to separate wells of a 96-well plate, along with 100µl of bacterial or fungal inoculums. For bacterial species, 100µl of 0.1% DMSO and gentamicin were used, while for fungal species, 100µl of 0.1% DMSO and Fluconazole were used. The plates were covered and then incubated at 37°C for 24 hours. The MIC values represented the lowest concentration of samples that suppressed bacterial growth in a specific environment. These values were used for the quantitative determination of the extracts' antibacterial activity. The entire experiment was repeated three times to ensure accuracy and reliability (15-16).

Disc diffusion method

The antimicrobial susceptibility testing was conducted using the disc diffusion method, following the standard procedure described by Bauer et al. (1966), to evaluate the antibacterial activities of the plant extracts. Initially, various extracts were dissolved in DMSO at concentrations of 500, 250, and 100 mg/mL. Subsequently, they were filtered through 0.45 µm sterile filter membranes. For each experiment, 500, 250, and 100 µL of bacterial inoculums containing 108 CFU/mL were evenly spread on Mueller Hinton agar plates. Then, 6 mm diameter discs impregnated with 10 µL of the different extract solutions (1 mg/disc) were placed on the surface of the agar. The experiment included one positive control, which was a standard commercial antibiotic disc, and one negative control with DMSO (100%). Additionally, two treated discs were included. The standard antibiotic discs used were Gentamicin (10 µg/disc) for antibacterial and Fluconazole (10 µg/disc) for antifungal. These discs were placed at equal distances from each other on the same plate. The plates were then incubated at 37°C for 18 to 24 hours, depending on the bacterial species tested. Following the incubation period, the plates were carefully examined for inhibition zones, and the diameters of the zones were measured using calipers and recorded. To ensure the reliability of the results, the entire test was repeated three times (17-18).

Screening for *in-vitro* antioxidant activity

The antioxidant properties of the extracts were investigated through seven different methods: DPPH free radical assay, ferrous ion chelating, nitric oxide scavenging activity, ABTS radical scavenging activity, ferric-reducing antioxidant power (FRAP), Superoxide radical scavenging activity (NBT method), and Anti-lipid peroxidation activity. All seven antioxidant assays were conducted following standard methods.

DPPH free radical scavenging assay

The radical-scavenging activities of the samples were studied using the stable DPPH radical, as described by Blois (1958) [19] with some modifications (Sudarshan et al., 2019) [20]. Different concentrations (100 to 300 µg/mL) of samples and 2 mL of DPPH (100 µM) was added, made up to 3 mL with methanol and the reaction mixture was incubated in dark for 45 min at room temperature. The absorbance was measured using a spectrophotometer (Shimadzu UV-1800, Kyoto, Japan) at 517 nm against the blank (Without sample/ Standard) at the end of the incubation time. In comparison to BHT (butylated hydroxytoluene), a standard antioxidant, the samples' capacity to scavenge free radicals was calculated and expressed as IC50 values.

Ferrous-Ion Chelating Assay

The ferrous-ion chelating effect of samples were determined according to Danis et al., (1994), [21] with the modification (Lakshmegowda et al., 2020) [22] in brief, different concentration (0 to 300 µg) of appropriately diluted samples were mixed separately with 0.05 mL of 2 mM $FeCl_2$ and the reaction was initiated by adding 0.1 mL of 5 mM Ferro-zine and then incubated for 10 min at room temperature. The absorbance of the colour produced was measured by spectrophotometer at 562 nm against the blank (Without sample/Standard). The percentage inhibition of Ferro zine-Fe^{2+} complex formation was calculated and the results were expressed in IC_{50} values in comparison with EDTA as a standard antioxidant.

Ferric reducing antioxidant power (FRAP) assay

The antioxidant capacity of samples was estimated according to the method of Benzie and Strain (1996) [23] the same slightly modified as in Sudarshan et al., (2019) [20]. 900 µL of FRAP reagent (2.5 mL of 10 mM TPTZ solution in 40 mM HCl + 2.5 mL of 20 mM $FeCl_3 \cdot 6H_2O$ + 25 mL of 0.3 M acetate buffer, pH 3.6) prepared freshly and incubated at 37 °C, was mixed with 10 µL with or without samples and made up to 1000 µL by acetate buffer. The test samples and reagent blank were incubated at 37 °C for 30 min in a water bath. At the end of incubation period the absorbance was read at 593 nm using a spectrophotometer (Shimadzu, UV-1800, Japan). Similarly, Fe (II) solution

of concentration ranging between 0 to 100 µM ($FeSO_4$•$7H_2O$) were used for the preparation of standard calibration curve. The principle of assay is based on reduction ability of ferric-TPTZ colour less to ferrous-TPTZ blue equivalent to that of mM $FeSO_4$•$7H_2O$ per mg of extract was calculated as the FRAP value. And it was determined using the corresponding regression equation as fallows, the results were expressed in µM/ µg.

Nitric oxide scavenging activity

In this experiment, sodium nitroprusside (10 mM) in phosphate buffered saline (PBS, pH 7.4) was mixed with different concentrations of samples/standard followed by incubation at room temperature for 150 min. The same reaction mixture without the sample/ standard served as the control. After the incubation period, 0.5 mL of Griess reagent [1% sulfanilamide, 2% H_3PO_4 and 0.1% N- (1-naphthyl) ethylenediamine HCl] was added and the absorbance of the formed chromophore is measured at 546 nm (Sreejayan and Rao, 1997) [24]. The percent scavenging activity of the nitric oxide generated was measured by comparing the absorbance values of control and test preparations and the results were expressed in terms of IC_{50} values in comparison with L-ascorbic acid as a standard antioxidant.

ABTS radical scavenging activity

The ABTS (2,2-azino-bis (3-ethylbenzo thiazoline-6-sulphonic acid) cat ion radical scavenging activity was performed as described by (Re et al. 1999) [25]. The principle of the assay is based on quenching the ABTS by antioxidant compounds. The ABTS•+ radicals were generated by mixing 7 mM of ABTS and 2.45 mM potassium persulphate. First the absorbance of ABTS solution was adjusted to 0.700 ± 0.025 at 734 nm to get a blue-green colour then 20 µL of sample was mixed with 1.0 mL of ABTS solution. The decrease in absorbance was recorded by spectrophotometer after 6 min of incubation at room temperature. The decrease in colour was calculated as percentage reduction by the extract and the results were expressed in terms of IC_{50} values in comparison with Gallic acid as standard.

Superoxide radical scavenging activity (NBT method)

Superoxide radicals scavenging capacity of samples was determined by method as described by (Kiliç & Yeşiloğlu 2013) [26]. About 1 mL of 156 µM NBT solution, 1 mL of 468 µM NADH solution and different concentrations (0-125 µg/mL) of samples were mixed. The reaction was started by adding 100 µL of 60 µM phenazine methosulphate (PMS) solution. The reaction mixture was incubated for 10 min at room temperature, and the absorbance was read at 560 nm against blank. The decrease in colour was calculated as percent reduction of superoxide anion scavenging capacity of extract and the results were expressed in terms of IC_{50} values in comparison with BHT as standard.

Anti-lipid peroxidation activity

The lipid peroxidation was determined in terms of thiobarbituric acid reactive substances (TBARS) formed in AAPH treated liver homogenate fallowed by the method of Wright et al. (1981) [27] with slight modifications as described by Lakshmegowda et al., (2020) [22]. Liver tissues were collected from young and healthy male sheep at local market and washed with 0.95% NaCl solution. Tissue was homogenized with ice-cold 3 mM Tri's buffer containing 250 mM sucrose and 0.1 mM EDTA (pH 7.4). The reaction mixture was prepared by adding 0.5 mL of liver homogenate and 0–300 µg of samples and made up to 1 mL with phosphate buffer (0.1 M, pH 7.4). Peroxidation of liver homogenate was initiated by adding 1 mL of 200 µM AAPH followed by incubation at 37°C for 2 h. The reaction was terminated by the addition of 1.0 mL TCA (10%, w/ v) and 1.0 mL of TBA (0.67%, w/v). And incubated for 20 min in a boiling water bath, centrifuged at 2500 × g for 10 min and the amount of malondialdehyde formed in each sample was determined by measuring the absorbance at 535 nm against a reagent blank. The percentage reduction of lipid peroxidation by the extract was calculated and the results were expressed in terms of IC_{50} values in comparison with BHA (Butylated hydroxyanisole) as standard.

Results and Discussion

UV-Spectroscopy

An in-depth investigation into the UV-Spectroscopy profile of plant extracts was conducted, spanning a wide wavelength range of 190 to 900nm. The decision to explore this range was influenced by the remarkable sharpness of the peaks and the presence of a proper baseline. The study revealed that the λmax (maximum absorbance wavelength) for the aqueous extract was 243 nm, while for the methanolic extract, it was 231 nm. For both extracts, precise calibration curves were established, comprising six data points each, within a concentration range of 2-12 µg/mL. Remarkably, the responses exhibited a linear relationship across the entire concentration range under investigation. The linear regression equation for the aqueous extract was determined as y = 0.0114x + 0.004, with a highly favourable correlation coefficient of 0.9994. On the other hand, for the methanolic extract, the linear regression equation was y = 0.0069x - 0.0011, and it showed a notable correlation coefficient of 0.9989. Figure 1 and 2.

Preliminary Phytochemical Analysis

In this study, conducted a preliminary phytochemical screening of the Abutilon theophrasti plant extract. The obtained results unveiled the presence of various secondary metabolites, including flavonoids, alkaloids, saponins, triterpenoids, steroids, tannins, and glycosides Table 3.

Table 3. Preliminary phytochemical investigation of *Abutilon theophrasti*

Sr. No.	Chemical components	Aqueous Extract	Methanolic Extract
1	Flavonoids	+	+
2	Sterols	+	+
3	Triterpenes	-	-
4	Carotenoids	+	+
5	Tannins	+	+
6	Glycosides	+	+

(+)- Presence, (-)- Absence

Anti-solar activity

Both the aqueous and methanolic extracts of the Abutilon theophrasti plant have demonstrated the ability to absorb UV radiation, which is known to be a major contributor to skin cancer, particularly in the case of methanolic extracts. With SPF values exceeding 10, these extracts offer significant protection from harmful UV radiation. The proven anti-solar activity of the plant highlights its importance and potential in developing anti-solar formulations for preventive use. By utilising these extracts, we can provide a safe, superior, and cost-effective alternative to the harmful chemical sunscreens currently prevalent in the market. Detailed results are presented in Table 4 and Figure 3, respectively.

Table 4. Absorption maxima of aqueous and methanolic extracts of *Abutilon theophrasti* and calculated SPF using mean values

Sr. No.	λmax (nm)	Absorbance (Mean±SD)	
		Aqueous Extract	Methanolic Extract
1	290	0.678±0.0025	0.783±0.0035
2	295	0.875±0.0021	0.794±0.0045
3	300	0.687±0.0023	0.927±0.004
4	305	0.706±0.0031	0.918±0.003
5	310	0.788±0.0045	0.897±0.0042
6	315	0.796±0.0055	0.869±0.0035
7	320	0.652±0.0020	0.787±0.0026
	SPF	11.05	15.60

Mean±SD

Anti-Microbial activity

The anti-bacterial activities of two extracts of *Abutilon theophrasti* whole plant against the employed bacterial species: like *Staphylococcus aureus* (ATCC 29213), *Escherichia coli* (ATCC 25922), and fungal species: *Candida albicans* (ATCC 10231) were evaluated by the MIC (Minimum inhibitory concentration) at 100 µl with standards and results represented in Table 5 and Figure 4 and Zone of inhibition values both the extracts are represented in Figure 5a and Figure 5b. The results of the antibacterial properties of *Abutilon theophrasti* plant extracts, assayed by broth micro-dilution and agar-well diffusion method images of both extracts at concentration of 500,250,100 µg/ml are given in Figure 6, respectively.

Table 5. Minimum inhibitory concentration (MIC) value of *Abutilon theophrasti* whole plant extract against microbial pathogens.

Samples	MIC (mg/ml)		
	Antibacterial Pathogens		Antifungal Pathogens
	Staphylococcus aureus	*Escherichia Coli*	*Candida albicans*
Gentamicin	0.002	0.003	-
Fluconazole	-	-	0.004
Aqueous whole plant extract	45.97	46.59	11.62
Methanolic whole plant extract	17.03	8.76	17.52

In-vitro Antioxidant activity

Both extracts demonstrated exceptional free radical scavenging activity. The percentage inhibition values of both extracts and the standards increased proportionally with the concentration. Table 6 presents all the IC50 values of both extracts in various antioxidant tests, and the results were expressed as Mean±SD. The antioxidant tests included DPPH (α, α-diphenyl-β-picrylhydrazyl), NO (Nitric oxide) scavenging activity, ABTS (2,2′-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid)), NBT (Superoxide radical scavenging activity), FRAP (Ferric reducing antioxidant power assay), LPO (Anti-lipid peroxidation activity), and Ferrous-Ion Chelating Assay.

Table 6. Antioxidant properties of samples

Samples	DPPH (µg/mL)	Ferrous Iron (µg/mL)	NO (µg/mL)	ABTS (µg/mL)	NBT (µg/mL)	FRAP (µM/µg)	LPO (µg/mL)
Aqueous whole extract	34.695± 2.3	57.689± 0.39	72.135± 7.3	83.659± 5.23	160.690± 2.3	193.44 ± 8.55	1.962 ± 0.08
Methanol whole extract	32.642± 2.1	53.218±0.84	77.325±7.1	79.684±5.98	167.265±2.87	199.554±4.88	1.476±0.041
Std.	19.844± 5.2 (BHT)	48.20± 2.9 (EDTA)	66.958± 0.89 (AA)	43.269± 2.5 (GA)	101.113± 5.7 (BHT)	173.77 ± 5.09 (AA)	1.25 ± 0.30 (BHA)

Mean±SD

Conclusion

In this study, we evaluated the aqueous and methanolic extracts of *Abutilon theophrasti*, a plant used in traditional medicine, to determine their potential antisolar, antimicrobial, and antioxidant activities. The results revealed that the extracts from the whole *Abutilon theophrasti* plant exhibit promising antisolar activity, as indicated by standard SPF values exceeding 10, providing significant protection against UV radiation. Additionally, these extracts displayed notable antimicrobial effects, with antibacterial properties observed against bacterial species such as *Staphylococcus aureus and Escherichia coli*, as well as antifungal effects on Candida albicans. The efficacy of these antimicrobial properties was confirmed through the determination of inhibition zone diameters and minimal inhibitory concentrations, which demonstrated the plant's potential as a source for novel antimicrobial agents. This successful determination was accomplished using the broth microdilution and agar-well diffusion methods. Furthermore, the antioxidant activity of the two extracts was demonstrated through various radical scavenging methods. Based on all the results, the research suggests that these extracts may have superior antioxidant activity. Therefore, when compared to synthetic antioxidants, the diverse extracts from the *Abutilon theophrasti* plant present themselves as abundant sources of natural antioxidant compounds that could be widely utilized in the food and pharmaceutical industries.

List of abbreviations

DPPH:1, 1- diphenyl-2-picryl hydrazyl, **NO:** Nitric oxide scavenging activity; **ABTS:** 2,2'-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid); **FRAP:** Ferric reducing antioxidant power; **NBT:** Nitroblue tetrazolium; **LPO:** Anti-lipid peroxidation activity, **SPF:** Sun Protection Factor, **ATCC:** American Type Culture Collection, **IC_{50}:** Inhibitory Concentration 50., **BHT:** Butylated hydroxytoluene, **EDTA:** Ethylenediamine tetra acetic acid, **AA:** Ascorbic acid, **GA:** Gallic acid**, BHA:** Butylated hydroxyanisole.

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Declarations

Ethics approval and consent to participate: Not applicable.
Consent for publication: Not applicable.
Availability of data and materials: The research work has been carried out by us, and we assure you that it can be provided to you whenever required.
Competing interests: No competing interests to declare.

Figure 1: Standard calibration curve for aqueous extract

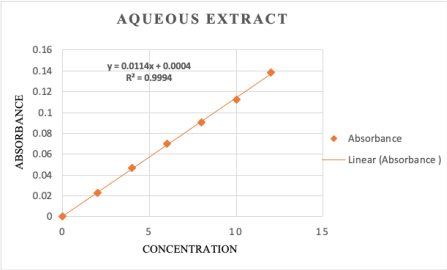


Figure 2: Standard calibration curve for methanolic extract

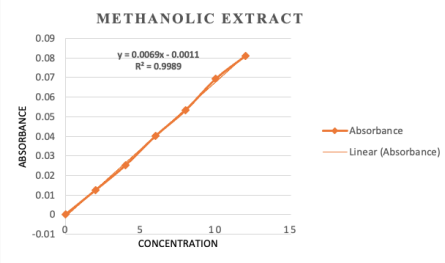


Figure 3: Antisolar activity using UV-1900 Spectrometer

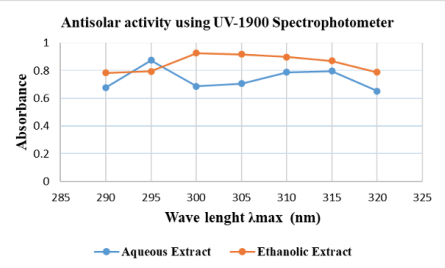


Figure 4: Minimum Inhibitory Concentration MIC (mg/ml)

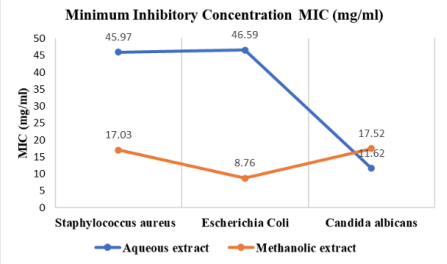


Figure 5a: Inhibitory zone diameter of methanolic extract

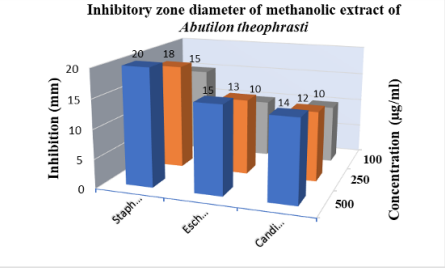


Figure 5b: Inhibitory zone diameter of Aqueous extract

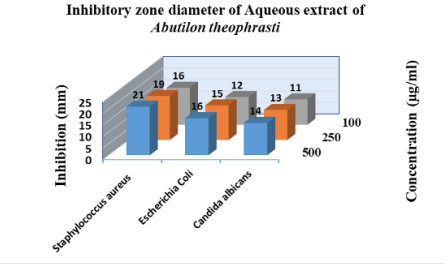
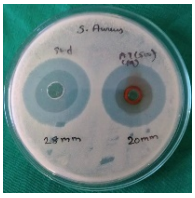
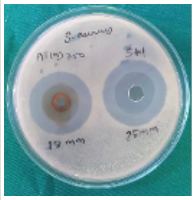
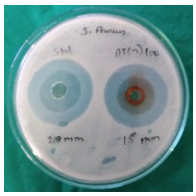
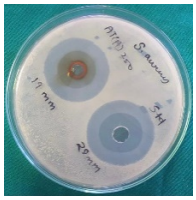
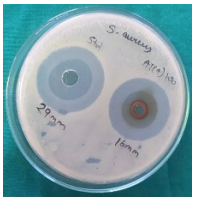
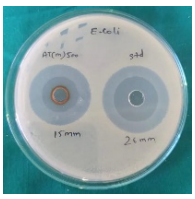
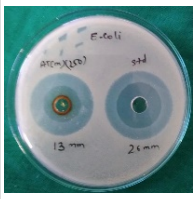
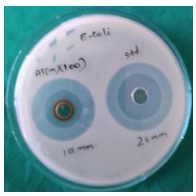
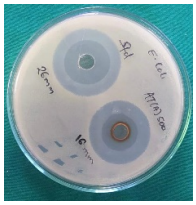
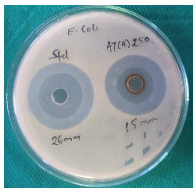
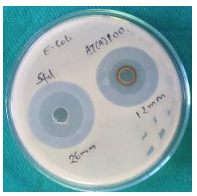
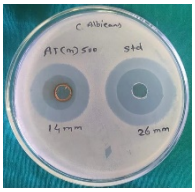
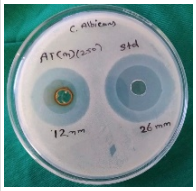
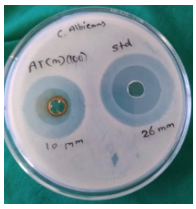
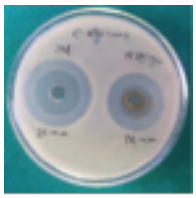
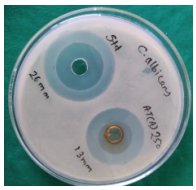
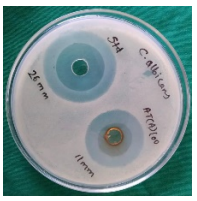


Figure 6: Disc diffusion method of Aqueous and Methanolic extracts in various concentrations.

	Maximum of Inhibitory Zone (mm) Methanolic whole plant extract			Maximum of Inhibitory Zone (mm) Aqueous whole plant extract		
Concentration (µg/ml)	**500 µg/ml**	**250 µg/ml**	**100 µg/ml**	**500 µg/ml**	**250 µg/ml**	**100 µg/ml**
Staphylococcus aureus Standard: Gentamicin						
Escherichia Coli Standard: Gentamicin						
Candida albicans Standard: Fluconazole						

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