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Phytochemical Profiling and Evaluation of Antimicrobial Potential of Datura Stramonium and Lantana Camara Extracts against Selected Microbial Strains

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ABSTRACT: Emergence of new plant-based antimicrobial agents is an imminent demand to tackle the increasing problem of antimicrobial resistance. Phytochemical and antimicrobial activity were performed on the leaf extracts of *Datura stramonium* and *Lantana camara*, while identification of the bioactive molecules was done by gas chromatography-mass spectrometry (GC-MS). The phytochemical screening of extracts showed the presence of major secondary plant metabolites such as alkaloids, flavonoids, phenolics, & terpenoids in both the plant extracts. The disc diffusion technique was used to assess the antimicrobial activity against bacterial pathogens (*Staphylococcus aureus, Salmonella enterica, Escherichia coli* and *Enterococcus faecalis*) and a fungal pathogen (*Aspergillus niger*). The result showed that Lantana camara was moderately effective against all the tested bacteria and Datura Stramonium was moderately effective against bacteria but showed antifungal activity against *Aspergillus niger*. GC-MS results showed presence of various bioactive compounds in extracts of both plants. In particular, *Lantana camara* exhibited the presence of a significant peak of the 13-docosenamide (Z) compound while in *Datura stramonium*, the phytol compound and n-hexadecanoic acid and alkaloids were detected which are all known for their antimicrobial activity. This indicates that both plants have phytochemicals and might possess antibacterial activity, which makes them potential source of natural products. Important aspects for evaluating their therapeutic potential are isolation, mechanism of action and in vivo studies.

1. INTRODUCTION

Antimicrobial resistance (AMR) is rapidly escalating as major public health challenge worldwide, with amplified resistance to antibiotics, resulting in more infections becoming resistant to treatment, leading to a rise in the global burden of diseases (Alum et al., 2026; Bibi et al., 2025). This has resulted in the emergence of multidrug-resistant superbugs that have also triggered an emergency research effort for the discovery of the next generation of antimicrobial compounds from new and more environmentally benign sources (Alum et al., 2026). These are all new plants that are used for medicinal purposes. They have long been employed as traditional medicines, and research efforts have begun to understand the role they play in the natural defence mechanisms of plants against microbial infection, through their content of multiple secondary metabolites like alkaloids, tannins, terpenoids, steroids & glycosides (Balouiri et al., 2016; Kanarek et al., 2025). The ancillary metabolites exert their action through several pathways, including cell membrane damage, inhibition of enzymes, inhibition and induction of synthesis of nucleic acids (Dagne et al., 2025; Kaur et al., 2025). Attractive aspect of plant extracts is that they could yield more than one active compound that can work synergistically, thereby killing the entire microbial load, and they could also slow down

the emergence of resistance (Chandola et al., 2021). This is reflected in *Lantana camara*, which has been substantiated for its pharmacological properties, such as antioxidant, antimicrobial, and anti-inflammatory characteristics. It has been observed that various phytochemicals, like, flavonoids, terpenoids, phenolics & alkaloids (Al-owaisi et al., 2014; Firdaus et al., 2025). It has been demonstrated to have antibacterial activity against pathogenic bacteria such as *Pseudomonas aeruginosa*, *Staphylococcus aureus*, & *Serratia marcescens* (Chandola et al., 2021; Oladoye, 2021). Both the volatile and non-volatile fractions of the drug *Lantana camara* are reported to be antimicrobial, as well as the significant oil of *Lantana camara* (Deena and Thoppil, 2000).

Datura stramonium belongs to the *Solanaceae* family of plants and is known for its tropane alkaloids (primarily atropine and scopolamine) with significant pharmaceutical uses. Although the presence of some antifungal activity has been reported, a substantial body of information exists on the various compounds present in the plant, indicating that it has potential antimicrobial activity against a variety of microorganisms, but this overall activity has not yet been examined (Kakade et al., 2025; Singh et al., 2025).

The antimicrobial effect is desirable and depends on the proper preparation of plant extracts (extraction method, solvent type, active compound concentration, etc.). Water extraction has been used more often, for example, due to its ease, safety and similarity to traditional use (Al-owaisi et al., 2014; Mahmoud and Selim, 2025). Note that the biological influence may be attributable to the existence of phytochemical analysis (and the type of compounds present). In advanced Laboratory Chromatography methods, like, GC-MS, a chemical fingerprint can identify volatile and semi-volatile compounds and provide insight into the relationship between chemical constituents and bioactivity (Berdgaleeva et al., 2025; Firdaus et al., 2025).

Although there is a considerable body of research on individual medicinal plants, comparative studies of plants under standardised conditions are still rare (Asfa et al., 2025; Kanarek et al., 2025).

The hypotheses weas that the antimicrobial activity, as evaluated through disc diffusion method, of the crude extracts of *Lantana camara* and *Datura stramonium*, which contain secondary metabolites (phenolics, tannins, flavonoids, alkaloids, saponins and terpenoids), will be measurable against determined bacterial strain (*Escherichia coli, Staphylococcus aureus Salmonella enterica* and *Enterococcus faecalis*) & fungal strain *(Aspergillus niger*), and that the antimicrobial activity will differ among each of the plant species, each of the crude extracts, and each of the types of microorganisms as test organism (DIN et al., 2023; Kanarek et al., 2025). In particular, little research is conducted to compare antibacterial and antifungal characteristics of *Lantana camara* and *Datura stramonium* with their phytochemical properties. Therefore, in this study, we wanted to address this knowledge gap by comparing the phytochemical profile and antimicrobial activity of the aqueous leaf extracts of these plants, obtained using standardised techniques (Nagy et al., 2021; Ramírez et al., 2025). The extracts will be tested against the selected bacterial pathogens (*Escherichia coli, Staphylococcus aureus,* and *Enterococcus faecalis*) and fungal pathogen (*Aspergillus niger*), and GC-MS will be used to further understand their comparative antimicrobial activity.

2. MATERIALS AND METHODS

Objective of this research was to analyse phytochemical makeup and antimicrobial characteristics of aqueous leaf extracts of *Lantana camara* and *Datura stramonium*. A trial process for plant collection, extraction, phytochemical screening, antimicrobial assay, and GC-MS was carried out systematically and reproducibly. Table 1 summarises the overall experimental design, and Figure 1 illustrates it.

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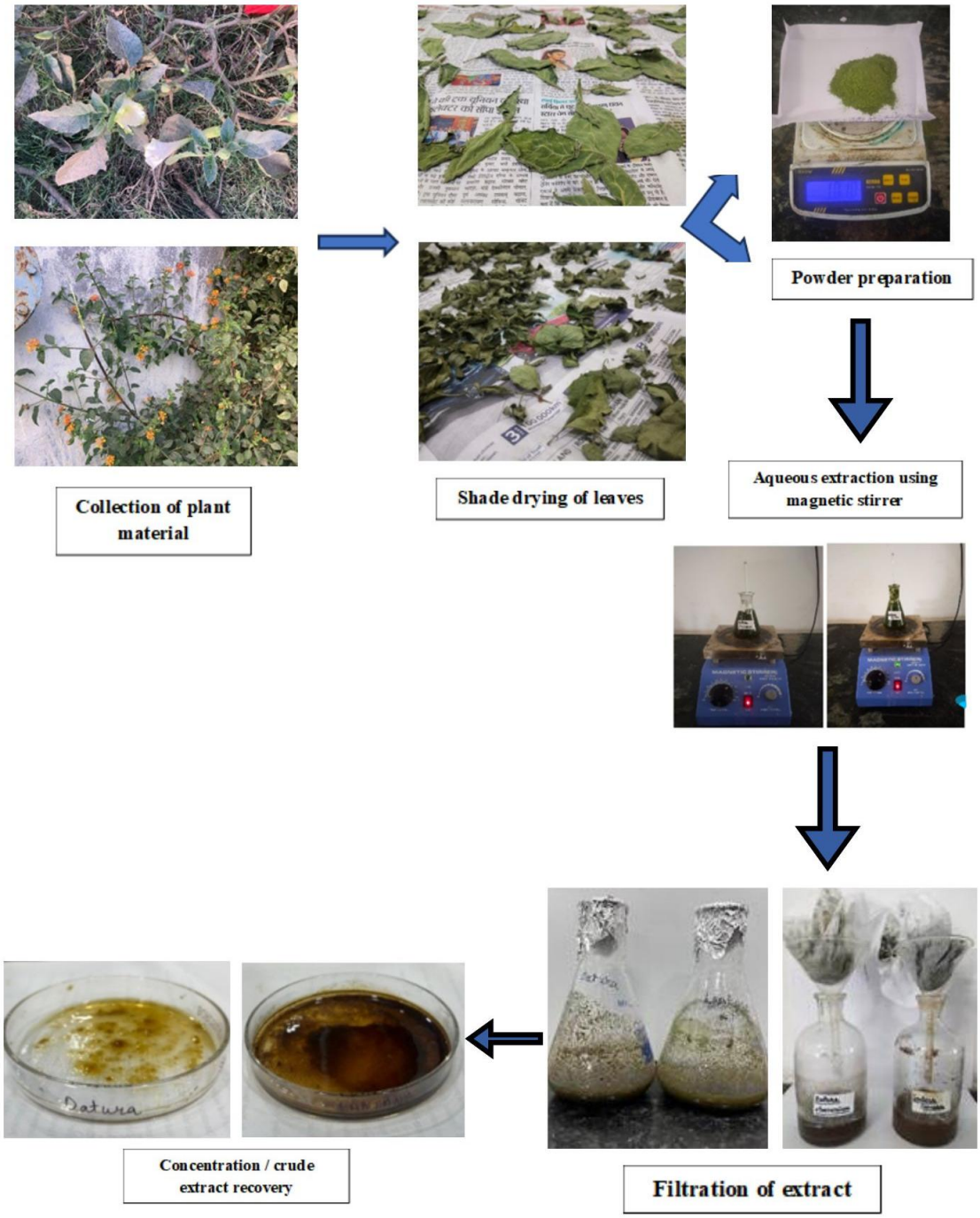


Figure 1: Sequential methodology for the extraction of plant material from *Lantana camara* and *Datura stramonium*

Table 1: Experimental Methodology Overview

S.No.	Experimental Step	Procedure Description	Output
1	**Plant Collection & Authentication**	Plants *(Lantana camara and Datura stramonium)* were collected and taxonomically identified	Authentic plant material

2	**Shade Drying**	Leaves washed and dried in shade (avoiding direct sunlight)	Dried plant material
3	**Powder Preparation**	Dried leaves pulverised into fine powder using mechanical grinder	Plant powder
4	**Extraction**	Powder suspended with distilled water (1:10 w/v) & extracted with magnetic stirrer at a suitable temperature	Crude extract
5	**Centrifugation**	Extracts centrifuged at an appropriate speed (e.g., 5000 rpm for 10-15 min)	Clear supernatant
6	**Filtration**	Filtered using Whatman No. 1 filter paper	Clear filtrate
7	**Concentration**	Filtrate concentrated by evaporation	Crude concentrated extract
8	**Phytochemical Screening**	Standard qualitative tests performed	Detection of phytoconstituents
9	**Microbial Culture**	Microorganisms cultured on nutrient agar & PDA under aseptic conditions	Active cultures
10	**Antimicrobial Assay**	Agar well diffusion method was performed	Zone of inhibition
11	**Data Analysis**	Results analysed using mean ± SD and statistical tests (ANOVA)	Validated results

2.1 Collection and Authentication of Plant Material

Leaves of *Datura stramonium* and *Lantana camara* were collected from their natural environment in the local study area. Fresh leaves were selected and carefully cleaned with distilled water to remove contaminants. Taxonomic identification of both plant species was carried out using standard taxonomic keys. Mature, disease-free leaves were used to ensure homogeneity in phytochemical composition (Firdaus et al., 2025; Singh et al., 2025).

2.2 Drying and Powder Preparation

Collected leaves were air-dried in shade at room temperature until constant weight was achieved. This strategy was employed to prevent the deterioration of heat-sensitive phytoconstituents and to avoid photo-oxidation of bioactive compounds (Balouiri et al., 2016; Mahmoud and Selim, 2025). The dried leaves were powdered utilizing mechanical grinder, & obtained powder was passed through a 60-mesh sieve to attain consistent particle size. Powdered material was then maintained in dry, airtight containers until further use (Dagne et al., 2025; Kanarek et al., 2025).

2.3 Aqueous Extraction Procedure

Aqueous extracts were prepared using a refined procedure (Table 2). In a brief, 10 g of powdered sample was combined with 100 mL of distilled water (1:10 w/v) and stirred continuously using magnetic stirrer with a hot plate at 60-70°C for 3 hours(Bibi et al., 2025; Sheoran and Arora, 2025). Post-extraction, solution was cooled to room temperature & then centrifuged at 5000 rpm for 10 minutes to separate particulate matter. The supernatant was then decanted and filtered using Whatman No. 1 filter paper. Filtrate was then dried at 50 °C to yield crude extract. All extraction procedures were performed under controlled laboratory conditions to ensure reproducibility and consistency.

Table 2: Optimized extraction parameters for aqueous preparation of *Lantana camara* and *Datura stramonium* leaf extracts used for phytochemical and antimicrobial analysis.

Parameter	Condition
Solvent	Distilled water (analytical grade)

Plant-to-solvent ratio	1:10 (w/v)
Extraction method	Aqueous extraction using magnetic stirrer with hot plate
Temperature	65°C ± 2°C
Extraction time	3 hours
Stirring condition	Continuous stirring at constant speed
Filtration	Whatman No. 1 filter paper (11 µm pore size)
Concentration method	Evaporation under reduced pressure / hot plate
Storage of extract	4°C in airtight container until further use

2.4 Qualitative Phytochemical Screening

Qualitative phytochemical study was done on aqueous extracts of both plants to detect presence of major classes of bioactive compounds, including saponins, phenols, flavonoids, alkaloids, tannins, & steroids (Dagne et al., 2025; Singh et al., 2025). Standard chemical tests were employed for this purpose, Wagner analysis for alkaloids, the Shinoda analysis for flavonoids, ferric chloride analysis for tannins and phenols, foam analysis for saponins, Salkowski analysis for steroids, and the Keller-Kiliani and Liebermann-Burchard tests for glycosides and terpenoids, respectively (Balouiri et al., 2016; Mahmoud and Selim, 2025). Each test stemmed from specific chemical reactions that produce a characteristic colour change or precipitate formation, which served as the basis for positive or negative identification. The standard operating procedure and colour indicators for each test are encapsulated in Table 3.

Table 3: Qualitative phytochemical screening methods and corresponding indicators used for the identification of major bioactive constituents in Lantana camara and Datura stramonium leaf extracts.

Phytochemical	Test Method	Positive Result
Alkaloids	Wagner's Test	Reddish-brown precipitate
Flavonoids	Shinoda Test	Pink/red color
Tannins	Ferric chloride	Blue-green/black
Saponins	Foam test	Stable froth
Phenols	Ferric chloride	Dark green
Terpenoids	Salkowski test	Reddish-brown layer
Glycosides	Keller–Kiliani	Brown ring
Steroids	Libermann–Burchard	Blue-green

2.5 Preparation of Microbial Strains and Inoculum

The research study presents 4 bacterial strains (*Escherichia coli, Staphylococcus aureus, Salmonella enterica* and *Enterococcus faecalis*) & one fungal strain (*Aspergillus niger*) for the evaluation of antimicrobial activity (Bibi et al., 2025; Firdaus et al., 2025). Bacterial strains were grown on nutrient agar, & fungal strain was grown on potato dextrose agar. For standardisation of the microbial inoculum in the experiments, bacterial culture was adjusted to 0.5 McFarland turbidity standard, equal to 1.5×10^8 CFU/m (Asfa et al., 2025; Balouiri et al., 2016).

2.6 Antimicrobial Test (Disc Diffusion Method)

Based on Kirby - Bauer test disc diffusion technique used to evaluate antimicrobial activity (Balouiri et al., 2016) plates used for agar nutrient were uniformly inoculated with standardised suspensions of microorganisms to ensure growth on the surface. Sterile 6 mm diameter filter paper discs were loaded aseptically with 50 µL of the plant extract (100 mg/mL) to allow appropriate diffusion and then all plates were inoculated with the discs (Dagne et al., 2025; Kanarek et al., 2025).

Positive & negative controls were used in test. Ciprofloxacin (50 µg/disc) was utilised as positive control for bacterial pathogens, and Fluconazole (100 µg/disc) for the fungal strain. The negative control was sterile distilled water (Asfa et al., 2025; Bibi et al., 2025).

Nutrient plates were incubated for 24 hours at 37°C for bacterial strains & 48 hours at 28°C for fungal strain. After incubation, diameter of zone (inhibition) was recorded in millimetres using a calliper(Balouiri et al., 2016; Nxumalo et al., 2020). Triplicate experiments were conducted, & observations were reported as mean ± standard deviation. The experimental requirements are shown in Table 4.

Table 4: Experimental conditions for antimicrobial activity assessment of plant extracts using agar well diffusion method against selected bacterial and fungal strains.

Parameter	**Details**
Method	Agar well diffusion
Bacterial Strains	*S. aureus, E. coli, S. enterica, E. faecalis*
Fungal strain	*Aspergillus niger*
Media	Nutrient agar (bacteria), PDA (fungi)
Incubation	37°C for 24–48 hrs
Positive control	Ciprofloxacin (bacteria), Fluconazole (fungi)
Negative control	Distilled water
Measurement	Zone of inhibition (mm)
Replicates	Triplicate

2.7 GC–MS Analysis of Plant Extracts

The bioactive substances present in aqueous extracts were identified utilising GC-MS analysis(Firdaus et al., 2025; Kakade et al., 2025). Analysis was carried out on PerkinElmer Clarus 600 GC-MS system equipped with an Rtx-5MS capillary column (30 m × 0.25 mm × 0.25 mm film thickness). Helium (99.99% purity) was utilised as carrier gas at constant flow rate of 1.0 mL/min. Injector temperature was maintained at 290°C. Oven temperature was set to 60°C for 2 minutes at the start, then raised to 280°C at 3°C/min. Sample volume of 1 µL of diluted extract (1:100) was injected in split mode at a ratio of 30:1. Mass spectra were acquired using electron ionisation (EI) at 70 eV over a scan range of 40-550 m/z. Molecular Authentication was carried out by comparing obtained mass spectra against NIST library database, and the related percentage composition of individual compound was calculated by peak intensity normalisation (Berdgaleeva et al., 2025; Ramírez et al., 2025)

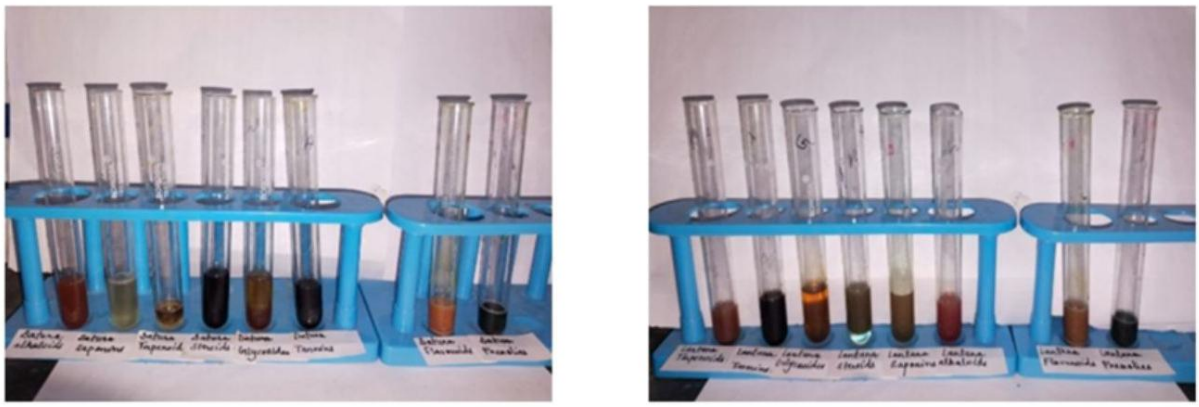
2.8 Data Recording and Statistical Analysis

Experiments were conducted in triplicate to certify consistency, accuracy, & reproducibility of outcomes in disc diffusion. Zone of Inhibition (mm) is included in Antimicrobial activity and reported as mean ± standard deviation (Asfa et al., 2025; Dagne et al., 2025). Statistical differences among treatment categories were analysed using one-way analysis of variance (ANOVA), with p-values of less than 0.05 considered statistically significant (Bibi et al., 2025; Singh et al., 2025). Every analysis was conducted under aseptic conditions using analytical-grade reagents, and all instruments were calibrated prior to use. Antimicrobial assays present Positive and negative controls that ensure the validity of the outcome (Balouiri et al., 2016; Kanarek et al., 2025)..

3. RESULTS AND DISCUSSION

3.1 Qualitative Phytochemical Screening

Phytochemical evaluation of aqueous leaf extracts of Datura stramonium and Lantana camara revealed distinct profiles of secondary metabolites in both plants. As shown in Figure 2, both extracts tested positive for saponins, alkaloids, terpenoids, glycosides, tannins, flavonoids, and phenolic substances (Firdaus et al., 2025; Oladoye, 2021). The proximity of these phytoconstituents was confirmed on the basis of characteristic visible reactions, including colour changes and precipitate formation, observed during standard laboratory screening tests(Dagne et al., 2025; Mahmoud and Selim, 2025).



(a) (b)

Figure 2: Phytochemical screening of aqueous leaf extracts of (a) *Datura stramonium* and (b) *Lantana camara,* revealing the presence of major bioactive compounds such as alkaloids, saponins, terpenoids, glycosides, tannins, flavonoids and phenolics as indicated by colour changes and precipitation in standard phytochemical tests

In *Datura stramonium*, alkaloids presence was demonstrated by formation of reddish-brown precipitate, while saponins were confirmed by frothing. Also, the appearance of blue-green or dark-coloured reactions indicated presence of phenols & tannins. In *Lantana camara*, the same reactions were seen with relatively stronger colour development in tests for phenolics and flavonoids, indicating their strong presence. The confirmed phytochemical profile signify the presence of several groups of bioactive components in these plant extracts, extractable by water (Park et al., 2023; Tavakoli-Rouzbehani et al., 2022).

Table 5: Qualitative phytochemical profile of aqueous leaf extracts of Datura stramonium and Lantana camara.

Phytochemical	*Datura stramonium*	*Lantana camara*
Alkaloids	+	+
Flavonoids	+	+
Tannins	+	+
Saponins	+	+
Phenols	+	+
Terpenoids	+	+
Glycosides	+	+
Steroids	–	+

3.2 Antimicrobial Activity (Disc Diffusion Method)

The biological activity of the aqueous leaf extracts was evaluated for antimicrobial activity utilising the disc diffusion technique, with results shown in Table 6 and Figure 3. The results expressed as zones of inhibition (mm) ± standard deviation (n = 3), illustrating consistency of the experiments.

Table 6: Antimicrobial activity of aqueous extracts against selected microbial strains expressed as zone of inhibition (mm, mean ± SD, n = 3).

Microorganism	*Lantana camara*	*Datura stramonium*	Negative control	Positive control
Staphylococcus aureus	9.04 ± 0.06	6.45 ± 0.40	–	24.14 ± 0.12
Enterococcus faecalis	–	–	–	22.80 ± 0.33
Salmonella enterica	10.51 ± 0.37	–	–	32.40 ± 0.57
Escherichia coli	7.99 ± 0.60	–	–	29.96 ± 0.90
Aspergillus niger	–	7.63 ± 0.51	–	11.00 ± 0.65

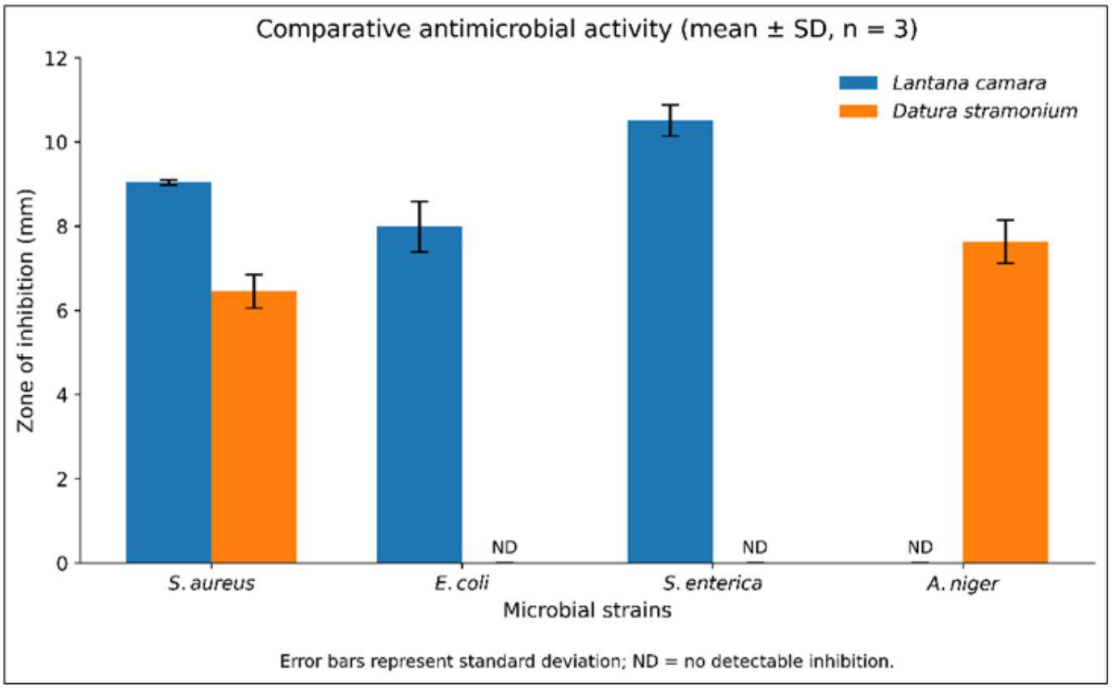


Figure 3: Mean zone of inhibition (mm) ± standard deviation (n = 3) of aqueous leaf extracts of *Lantana camara* and *Datura stramonium* against selected microorganisms. Error bars represent standard deviation.

3.3 Antibacterial Activity

Lantana camara illustrates remarkable antibacterial activity against triplicate of examined bacterial strains. Biggest zone of inhibition was recorded against *Salmonella enterica* (10.51 ± 0.37 mm), then *Staphylococcus aureus* (9.04 ± 0.06 mm) & *Escherichia coli* (7.99 ± 0.60 mm) (Chandola et al., 2021; Oladoye, 2021). Conversely, *Datura stramonium* presents comparatively limited antibacterial activity, producing a zone of inhibition only against *Staphylococcus aureus* (6.45 ± 0.40 mm), with no inhibition observed against *Escherichia coli or Salmonella enterica* (Kakade et al., 2025; Singh et al., 2025). Neither extract produced zone of inhibition against Enterococcus faecalis (Table 6) which indicates that *Lantana camara* and *Datura stramonium* have inadequacy of antimicrobial activity against the organism tested under experimental circumstances. These outcomes are demonstrated graphically in Figure 3, where mean values are displayed alongside error bars representing standard deviation. The consistently

small error bars across most measurements reflect low variability and good reproducibility of the results (Asfa et al., 2025; Dagne et al., 2025).

3.4 Antifungal Activity

Notably, Figure 4(e) presents the antifungal results, where *Datura stramonium* produced an inhibition zone against *Aspergillus niger* (7.63 ± 0.51 mm), while *Lantana camara* showed no antifungal activity under the same conditions(Kakade et al., 2025; Mtetwa et al., 2023). Lack of any restraint in negative control and the clear, well-defined zones in the positive control substantiate the assay (Balouiri et al., 2016).

3.5 Visual Assessment of Antimicrobial Activity

The plate images illustrated in Figure 4 provide visual confirmation of the disc diffusion results. In Figure 4(a), a clear zone of inhibition is visible around the *Lantana camara* disc on *Escherichia coli* plates, while the *Datura stramonium* disc produced no visible zone or only a very small one. Figure 4(b) shows no zones of inhibition for either extract against Enterococcus faecalis, consistent with the quantitative data. In Figure 4(c), *Lantana camara* produced a distinct zone of inhibition against *Salmonella enterica*, whereas *Datura stramonium* showed no activity. Notably, Figure 4(d) illustrates zones of inhibition for both plant extracts against Staphylococcus aureus, with Lantana camara producing a visibly larger zone (Firdaus et al., 2025; Oladoye, 2021).

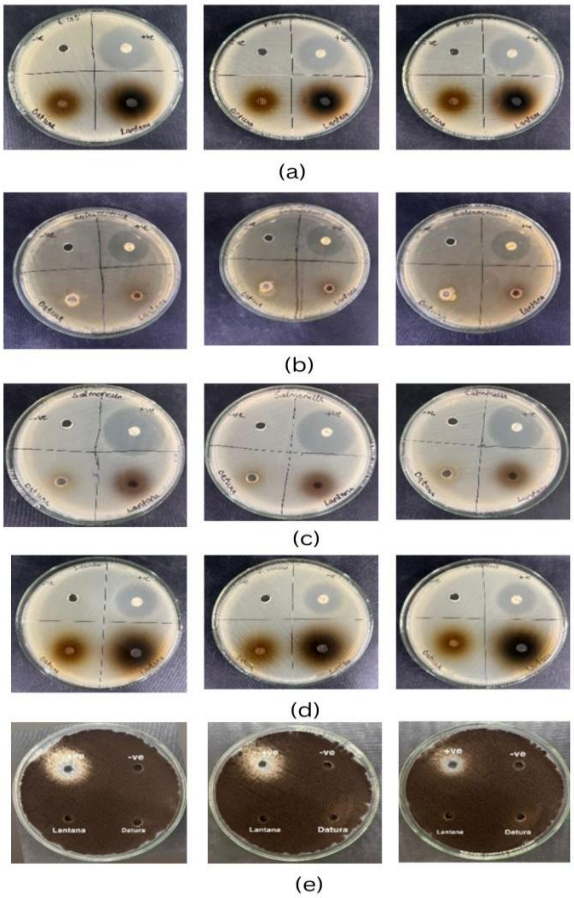


Figure 4: Antimicrobial effect of aqueous leaf extracts of *Lantana camara* and *Datura stramonium* on selected microorganisms using the agar well diffusion method. (a) *Escherichia coli* exhibiting considerable inhibitory zones, (b) *Enterococcus faecalis* showing a low level of inhibition, (c) *Salmonella enterica* showing high activity of *Lantana camara*, (d) *Staphylococcus aureus* showing moderate activity of both extracts, and (e) antifungal activity against *Aspergillus niger* showing selective inhibition by *Datura stramonium*

3.6 GC-MS Analysis of Datura stramonium

Figure 5 represents the chromatogram of GC-MS investigation of aqueous leaf extract of *Datura stramonium,* and Table 7 shows the peak report corresponding to this chromatogram. The chromatogram shows 57 peaks in the retention time range 5.50-62.92 minutes, suggesting the extract is high in a broader range of different substances (Berdgaleeva et al., 2025; Firdaus et al., 2025). Presence of peaks within this retention time range indicates the presence of both low & high molecular weight substances - earlier peaks show more volatile low molecular weight compounds, while the latter present less volatile higher molecular weight compounds(Kakade et al., 2025; Lin et al., 2023). The relative heights of peaks in chromatogram indicate varying concentrations of the constituents in the extract. There is no predominant element in the profile; instead, the extract appears to be a combination of various components that contribute to its proper chemical makeup (Dagne et al., 2025; Singh et al., 2025). Such a composite chemical profile is typical of GC–MS analysis is of medicinally important plant extracts(Berdgaleeva et al., 2025; Firdaus et al., 2025).

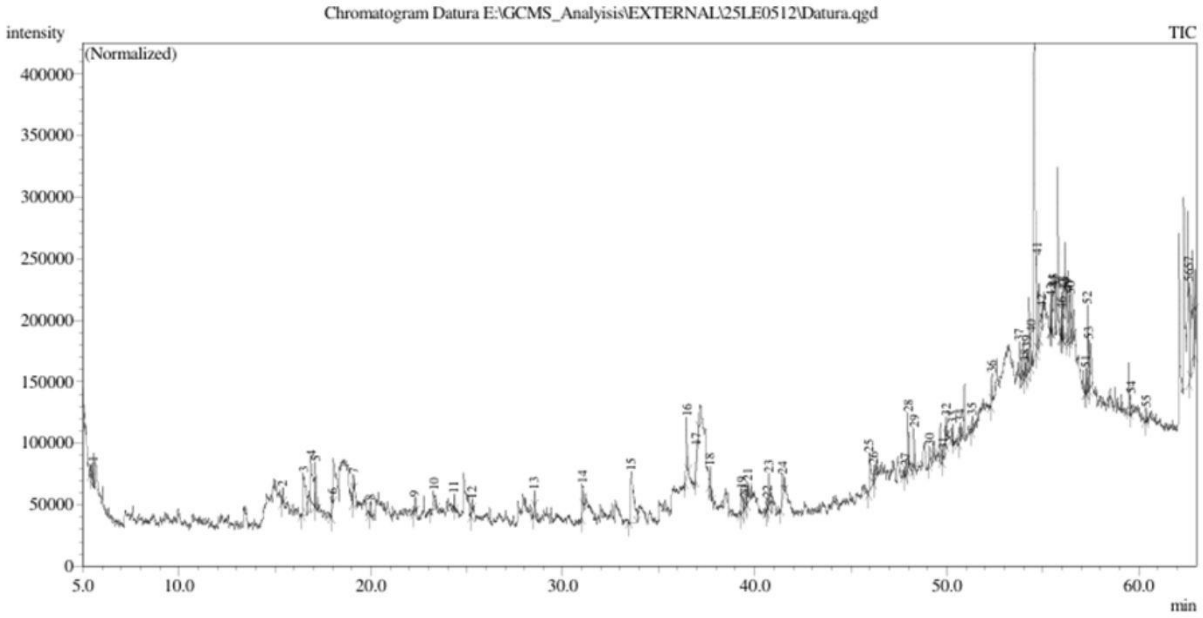


Figure 5: GC–MS total ion chromatogram of aqueous leaf extract of *Datura stramonium*, showing 57 tentatively identified peaks across the retention-time range of 5.50–62.92 min

Table 7: GC-MS peak report of aqueous leaf extract of Datura stramonium

Peak	RT (min)	Compound Name (As per GC-MS Library)	Area (%)
1	5.506	3-Diethylamino-2,2-dimethylpropionaldehyde	0.97
2	15.409	Cholest-7-en-3. beta., 5.alpha.-diol-6.alp	0.37
3	16.473	Cholest-7-en-3. beta., 5.alpha.-diol-6.alp	6.40
4	16.867	Cholest-7-en-3. beta., 5.alpha.-diol-6.alp	6.20
5	17.100	9-Octadecenoic acid, (2-phenyl-1,3-dio	2.99
6	17.967	1-(Methoxy methoxy)-3-methyl-3-hydr	0.81
7	19.097	9-Octadecenoic acid, (2-phenyl-1,3-dio	0.53
8	19.974	9-Octadecenoic acid, (2-phenyl-1,3-dio	0.62
9	22.286	9-Octadecenoic acid, (2-phenyl-1,3-dio	0.68

10	23.271	2,4-Di-tert-butylphenol	1.44
11	24.346	1,3,5-Triazine-2,4-diamine, N,N'-bis	0.38
12	25.266	l-Gala-l-ido-octose	0.24
13	28.517	Spiro[androst-5-ene-17,1'-cyclobutan]	0.45
14	31.018	Ethyl iso-allocholate	1.83
15	33.569	n-Hexadecenoic acid	8.64
16	36.434	Phytol	4.27
17	36.975	10E,12Z-Octadecadienoic acid	1.26
18	37.684	Ethyl iso-allocholate	0.67
19	39.300	Ethyl iso-allocholate	1.64
20	39.467	1b,4a-Epoxy-2H-cyclopenta [3,4] cyclo	1.36
21	39.625	2-Oxatricyclo[4.3.1.0(3,8)] decan-10-ol	1.60
22	40.625	8,11,14-Eicosatrienoic acid (Z,Z,Z)-	0.37
23	40.724	Ethyl iso-allocholate	1.23
24	41.408	Scopolamine	2.45
25	45.967	2-Myristynoyl-glycinamide	3.78
26	46.200	1-(3,3-Dimethyl-but-1-ynyl)-2,2,3,3-tet	1.29
27	47.809	Thymol, TBDMS derivative	0.17
28	47.970	Androsta-3,5-dien-3-ol, 17-acetyl-3-O-	1.80
29	48.279	2-tert-Butylphenol, trimethylsilyl ether	2.14
30	49.083	1,5,9-Tetramethyl-2-oxatricyclo[6.4.0	0.36
31	49.781	1,2-Bis(trimethylsilyl)benzene	0.23
32	49.964	3-Ethoxy-1,1,1,5,5,5-hexamethyl-3- (tri	0.65
33	50.309	3-Isopropoxy-1,1,1,5,5,5-hexamethyl-3	0.37
34	50.689	2-tert-Butylphenol, trimethylsilyl ether	0.94
35	51.318	benzoic acid, 4-[(trimethylsilyl)oxy]m	0.55
36	52.341	Cholest-8-en-3. beta. -ol, acetate	1.49
37	53.795	Ethyl homovanillate, TMS derivative	1.56
38	54.083	Ethoxy(phenyl)silane diol, acetate (2TMS)	0.55
39	54.192	Androstane derivative	1.14
40	54.375	Ethyl hemimaxillae derivative	0.82
41	54.683	2-tert-Butylphenol, trimethylsilyl ether	4.25
42	54.950	Benzoic acid derivative	1.96

43	55.417	Trimethylsilyl benzene	0.64
44	55.459	Silicic acid ester	1.40
45	55.589	Cyclolanostan-3-ol, acetate	4.19
46	55.972	Benzoic acid derivative	0.60
47	56.017	Trimethylsilyl benzene	1.26
48	56.052	Trimethylsilyl benzene	2.00
49	56.267	Cycloheptatrienone derivative	1.83
50	56.408	Methyl salicylic acid derivative	1.87
51	57.248	2-tert-Butylphenol derivative	0.84
52	57.326	Ethoxy(phenyl)silane diol (2TMS)	2.98
53	57.408	Silicic acid ester	1.58
54	59.567	Phenyl glyoxylic acid derivative	0.62
55	60.371	Thymol derivative	0.42
56	62.657	Trimethylsilyl benzene	6.93
57	62.922	Silicic acid ester	1.41

3.7 GC–MS Analysis of *Lantana camara*

Figure 5 shows GC - MS chromatogram of aqueous *Datura stramonium* leaf extract, while peak report is given in Table 7. The chromatogram shows 57 peaks over the retention time limit of 5.50 to 62.92 minutes, indicating the sample contains wide range of compounds. Peaks in chromatogram suggest the presence of high and lower weight compounds(Barbarossa et al., 2025; Nagy et al., 2021). The early-eluting peaks represent more volatile, low-molecular-weight compounds, while the latter peaks represent less volatile, high-molecular-weight compounds. The presence of several peaks with varying heights suggests different concentrations. The peaks indicate that no single constituent is present in the chromatogram in excess, and several compounds make up chemical constitution of extract.

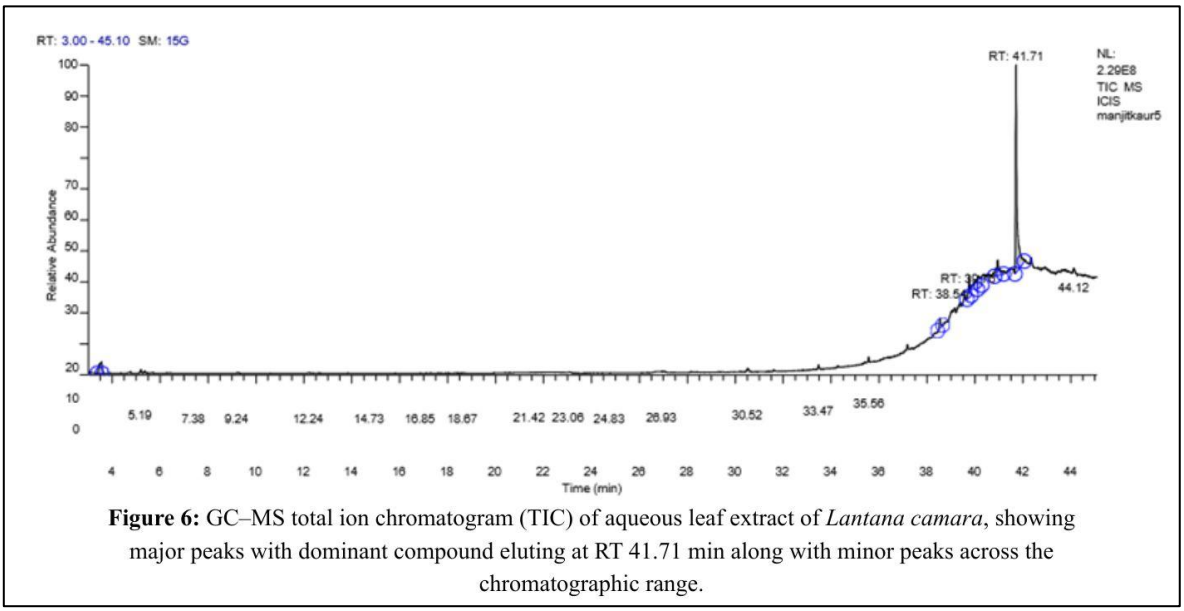


Figure 6: GC–MS total ion chromatogram (TIC) of aqueous leaf extract of *Lantana camara*, showing major peaks with dominant compound eluting at RT 41.71 min along with minor peaks across the chromatographic range.

Table 8: GC–MS of aqueous leaf extract of *Lantana camara* with major compounds having best match in NIST library

Peak	RT (min)	Compound Name (Best Library Match)	Molecular Formula	Area (%)
1	3.54	2,2-Dimethoxybutane	C6H14O2	6.81
2	38.54	1-Monolinoleoylglycerol trimethylsilyl ether	C27H54O4Si2	3.93
3	39.76	Heptasiloxane, hexadecamethyl-	C16H48O6Si7	6.65
4	40.12	1-Monolinoleoylglycerol trimethylsilyl ether	C27H54O4Si2	7.87
5	40.94	1-Monolinoleoylglycerol trimethylsilyl ether	C27H54O4Si2	9.45
6	41.71	13-Docosenamide (Z)	C22H43NO	65.30

Additional peaks were observed at RT 40.94 min (9.45%), 40.12 min (7.87%), 39.76 min (6.65%), 38.54 min (3.93%), and 3.54 min (6.81%), representing minor constituents relative to the dominant compound. These peaks suggest the presence of major and minor constituents in the extract. The chromatogram clearly shows a distribution of compounds with different retention times and abundances, representing the existence of multiple elements in the extract. The uniformity of peaks in the chromatogram suggests that the chromatograph was operating consistently and the compounds were detected with high reliability. The present study examined the phytochemical composition, antimicrobial potential, & GC-MS profiles of the aqueous leaf extracts of *Datura stramonium* & *Lantana camara*. This multidisciplinary approach (qualitative phytochemical screening, disc diffusion, and gas chromatography-mass spectrometry) provides valuable insights into the biological potential of the two plants.

3.8 Biologically Significant Phytochemicals

Qualitative testing (Figure 2) revealed presence of diverse phytochemicals in both extracts, including alkaloids, tannins, flavonoids, phenolics, saponins, terpenoids, & glycosides. These groups of phytochemicals are known to possess antimicrobial activity and exert their effects via multiple modes of action, including damage to cell membranes, inhibition of enzymes and disruption of nucleic acid synthesis(Kanarek et al., 2025; Mahmoud and Selim, 2025). However, recent Research studies have also emphasised the potential of plant-based phytochemicals to show broad-spectrum antimicrobial activity and to overcome resistance via multi-target activities (Alum et al., 2026). The existence of multiple groups of phytochemicals in both plant extracts suggests the potential for synergy, which may lead to greater antimicrobial activity than that of individual compounds (Chandola et al., 2021).

3.9 Comparative Antimicrobial Activity

The disc diffusion test (Table 6; Figures 3 and 4) showed variation in antimicrobial activity between the two extracts. *Lantana camara* exhibited a wide range of antibacterial activity, with clear zones of prevention against *Salmonella enterica, Escherichia coli* and *Staphylococcus aureus,* while *Datura stramonium* had limited antibacterial activity, with zones against *Staphylococcus aureus* (Chandola et al., 2021; Oladoye, 2021). This difference in antimicrobial activity among plant extracts is consistent with recent studies that link variations in activity to variations in phytochemical content and concentrations (Asfa et al., 2025; Bibi et al., 2025). The lack of inhibition against *Enterococcus faecalis* for both extracts is supported by the literature, which indicates that some Gram-positive bacteria are less vulnerable to plant extracts, probably due to their specific cell wall structure and low membrane permeability(Bibi et al., 2025; Kanarek et al., 2025).

Datura stramonium exhibited selective antifungal activity against *Aspergillus niger*, whereas *Lantana camara* did not. Study observation is in agreement with recent reports of selective antifungal activity of plant extracts against different fungal strains, depending on the presence of specific active phytochemicals(Mahmoud and Selim, 2025; Singh et al., 2025).

3.10 GC-MS Analysis and Phytochemicals

Phytochemical description of two extracts was analysed by GC-MS. *Datura stramonium* chromatogram (Figure 5; Table 7) showed 57 compounds, indicating a high degree of chemical variability in this extract. Key compounds included n-hexadecanoic acid, phytol and scopolamine. N-hexadecanoic acid has been demonstrated to have antibacterial and antifungal activities, largely due

to membrane disruption (Kakade et al., 2025; Kanarek et al., 2025). Phytol has also been observed to have anti-inflammatory and antimicrobial characteristics, increasing the extract's therapeutic value (Asfa et al., 2025; Dagne et al., 2025). Presence of scopolamine further highlights the therapeutic potential of Datura stramonium, as tropane alkaloids are well known for their intrinsic activity (Kakade et al., 2025). In the GC–MS chromatogram of *Lantana camara* (Figure 6; Table 8), most abundant peak was detected at RT 41.71 min (13-docosenamide (Z) with a relative abundance of 65.30%). Indeed, recent studies have reported that docosenamide displays antibacterial activity against several bacterial species, which could in part account for the wide range of antibacterial activity observed in this work(Alum et al., 2026; Firdaus et al., 2025). The minor compounds detected in the chromatogram might play role in activity via an additive or synergistic effect (Chandola et al., 2021). It's an advantage noting that the siloxane and trimethylsilyl (TMS) derivatives shown in the chromatogram are probable artefacts often observed in GC-MS analysis, which are not present in the plant extract (Berdgaleeva et al., 2025).

3.11 Phytochemistry–Antimicrobial Activity Correlation

Antimicrobial activity can be connected to phytochemistry and GC-MS profiling of the plants. The wide-spectrum antibacterial activity of *Lantana camara* may be associated to the fatty acids, phenolic substances and amide derivatives present in this plant (Firdaus et al., 2025; Oladoye, 2021), whereas the antifungal activity of *Datura stramonium* can be linked to its alkaloids and terpenoids, in particular, scopolamine and its derivatives(Singh et al., 2025). Role of synergies among phytochemicals in overall antimicrobial potential of plant extracts has been increasingly recognised in recent research (Bibi et al., 2025; Kanarek et al., 2025), & different spectra of activity observed for the two plants confirm this. In conclusion, these results affirm that *Datura stramonium* and *Lantana camara* have a rich phytochemical profile with significant antimicrobial properties - *Datura stramonium* exhibits selective antifungal activity, and *Lantana camara* exhibits multi-directional antibacterial activity - supported by the GC-MS profile of the two plants.

4. CONCLUSION

The current analysis represented that water-based leaf extracts of *Lantana camara and Datura stramonium* contains particular antimicrobial activity together with a broader limit of phytochemical constituents, assisting the significance of medicinal plants as potential natural antimicrobial agents. Phytochemical evaluation recognising main identified bioactive substances like phenolics, flavonoids, alkaloids, tannins, saponins, and terpenoids, that recognise to prevent microbial growth by interfering cell membranes, interfering with metabolic pathways, and such as oxidative stress. Antimicrobial activity examined by disc diffusion method in which it was found that *Lantana camara* presented wider inhibitory impacts against *Salmonella enterica, Staphylococcus aureus*, and *Escherichia coli*, while *Datura stramonium* represented relatively poor activity but also show high antifungal impacts against *Aspergillus niger*. These observations are uniform with latest research indicating that the importance of phytochemical-rich medicinal plants in controlling antimicrobial resistance (AMR). GC–MS analysis further assured that the existence of biologically active substances, such as terpenoids, fatty acids, amides, and alkaloids. Primary compounds like 13-docosenamide (Z), phytol, and n-hexadecanoic acid resulting the reported antifungal and antibacterial activities. Nevertheless, the identification of siloxane and trimethylsilyl variation indicates the probability of analytical artefacts, which means the requirement for precise explanation of GC–MS data. Even though beneficial outcomes, challenges like minimal microbial strains, water-based extraction and unavailability of MIC/MBC/MFC analysis represent the requirement for future research including mechanistic investigations solvent extraction, compound isolation, toxicological evaluation, and in vivo analysis for the advancement of secure and effective plant-based antimicrobial formulations.

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AUTHOR CONTRIBUTIONS

Rashmi Vats: Methodology, Laboratory Analysis, Manuscript text

Dr. Chandrima Mandal: Review of Manuscript text

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ETHICS STATEMENT

Ethical approval was not required for this study.

DATA AVAILABILITY STATEMENT

Data supporting the findings of this study are available from the corresponding author upon reasonable request.

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