Asian J Biol Life Sci., 2026; 15(1):202-216.
https://ajbls.com

Research Article

Phytochemical Profiling and Biological Activities of Two Underutilized Wild Leafy Vegetables, *Cryptocoryne retrospiralis* (Roxb.) Kunth and *Glinus oppositifolius* (L.) Aug. DC: A GC-MS Analysis

Jayendra Giridhar Nakade[1,*], Praveenkumar Narayanrao Nasare[2]

[1]IHLR & SS Nilkanthrao Shinde Science and Arts College, Bhadrawati, Chandrapur, Maharashtra, INDIA.
[2]Department of Botany, Nilkanthrao Shinde Science and Arts College, Bhadrawati, Chandrapur, Maharashtra, INDIA.

Correspondence:
Mr. Jayendra Giridhar Nakade
Research Scholar, IHLR & SS Nilkanthrao Shinde Science and Arts College, Bhadrawati, Chandrapur, Maharashtra, INDIA.
Email: jayendranakade26@gmail.com
ORCID: 0000-0002-1407-0996

Received: 12-01-2026;
Revised: 09-02-2026;
Accepted: 27-03-2026.

ABSTRACT

Background: *Cryptocoryne retrospiralis* (Roxb.) and *Glinus oppositifolius* (L.) Aug. DC. are wild leafy vegetables traditionally utilized in folk medicine for their therapeutic potential. The present study aimed to evaluate their antimicrobial and antioxidant activities, along with profiling their phytochemical constituents. **Materials and Methods:** Plant samples were collected from their natural habitat in the Gadchiroli district, Maharashtra. Leaf extracts were prepared using solvents of varying polarity, including water, ethyl acetate, methanol, chloroform, and acetone. Antimicrobial activity was assessed using the disc diffusion method against selected microbial strains. Antioxidant potential was determined through the colorimetric DPPH (2,2-diphenyl-1-picrylhydrazyl) assay. Methanolic extracts were further subjected to Gas Chromatography-Mass Spectrometry (GC-MS) analysis, and compounds were identified using the NIST spectral database. **Results:** The antimicrobial analysis revealed that the chloroform extract of *C. retrospiralis* exhibited the highest activity, with zones of inhibition measuring 16 mm against *Staphylococcus aureus* and 12 mm against *Pseudomonas fluorescens*. Similarly, the methanolic extract of *G. oppositifolius* demonstrated inhibition zones of 14 mm and 12 mm against *S. aureus* and *P. fluorescens*, respectively. Both plant species showed notable antioxidant activity in methanolic extracts as determined by the DPPH assay. GC-MS analysis identified a total of 78 and 86 phytochemical compounds in *C. retrospiralis* and *G. oppositifolius*, respectively. Key compounds detected included pyridine derivatives (e.g., Pyridine, 1-acetyl-1,2,3,4-tetrahydro-) and Melezitose, among others with reported biological significance. **Conclusion:** The findings suggest that *C. retrospiralis* and *G. oppositifolius* are rich sources of bioactive phytoconstituents with promising antimicrobial and antioxidant properties, highlighting their potential applications in pharmaceutical and nutraceutical development.

Keywords: Antioxidant, *Cryptocoryne retrospiralis*, *Glinus oppositifolius*, Phytoconstituents, Wild leafy vegetable.

INTRODUCTION

Wild Leafy Vegetables (WLVs) have constituted an essential component of human diets since ancient times, serving not only as sources of nourishment but also as traditional remedies for various ailments. Plants represent one of the most accessible and sustainable sources of carbohydrates, proteins, fats, vitamins, minerals, essential oils, and dietary fibre (Bhat & Al-Daihan, 2014). In addition to their nutritional value, plants possess diverse medicinal properties and play a pivotal role in the pharmaceutical and food industries. Phytochemicals derived from plants have formed the basis of numerous commercial drugs and continue to serve as templates for the discovery of novel therapeutic agents. Bioactive compounds of plant origin contribute significantly to human health (Teoh *et al*., 2023). For generations, communities worldwide have relied on medicinal plants for primary healthcare and self-medication. Although the molecular mechanisms underlying many traditional remedies remain under scientific scrutiny, increasing evidence supports the therapeutic potential of plant-derived compounds (Baeshen *et al*., 2023). Leafy vegetables, in particular, are rich in bioactive constituents such as β-carotene, ascorbic acid, polyphenols, and dietary fibre, along with essential minerals including iron, calcium, and phosphorus. These vegetables are among the best sources of protein, vitamins, and minerals (Shukla *et al*., 2006). Forest-dwelling populations

OPEN ACCESS

DOI: 10.5530/ajbls.20260104

Manuscript TECHNOMEDIA

Publishing Partner : Manuscript Technomedia. [www.mstechnomedia.com]

frequently consume wild edible plants for sustainable nutrition and are often observed to be healthier and less prone to various diseases (Kamble & Jadhav, 2013).

In India, a wide variety of wild leafy vegetables are traditionally harvested from forests and agricultural landscapes, including *Hibiscus cannabinus*, *Olax psittacorum*, *Ipomoea carnea*, *Amaranthus* species, *Boerhaavia diffusa*, *Basella rubra*, *Chenopodium* species, *Corchorus* species, *Cleome gynandra*, *Leucas cephalotes*, and *Dentella repens*. Despite their nutritional richness and therapeutic value, many of these species remain underutilized and insufficiently studied.

Cryptocoryne retrospiralis (Roxb.) Kunth (Araceae) is commonly found along the edges of ditches, in sandy riverbank soils, and in gravelly riverbeds, often thriving in open areas on high-altitude plateaus. This species is widely distributed across India, including Assam, Maharashtra (North), Kerala, Bengal, Pondicherry, Karnataka, and the Coromandel Coast (Singh *et al*., 2000). Traditional healers utilize the rhizomes of this plant to treat ailments such as diarrhoea, fever, jaundice, burns, and boils. However, limited scientific investigations have been conducted to validate its phytochemical composition and pharmacological properties. GC-MS analysis of the methanolic leaf extract has revealed the presence of seven phytochemicals, predominantly β-sitosterol, stigmasta-22-dien-3-ol, 1,2-benzenedi-carboxylic acid, neophytadiene, phytol, acid bis(2-methylpropyl), and cycloeucalenyl compounds (Anwar and Abdussalam, 2024). *Glinus oppositifolius* (L.) DC. (Family: Molluginaceae), commonly known as "Kadubhaji" in Vidarbha (Maharashtra, India), is a diffuse or prostrate glabrous herb highly regarded for its medicinal value. The plant exhibits antioxidant, anthelmintic, hepatoprotective, analgesic, antimicrobial, anti-inflammatory, antiseptic, and antihyperglycemic effects. Traditionally, plant extracts are used to relieve stomach aches, while leaf juice is applied for dermatitis and other skin disorders (Hoque *et al*., 2011; Traore *et al*., 2000; Burkhill H.M., 1985). Dried and powdered stems combined with leaves are used in the management of jaundice and abdominal discomfort (Diallo *et al*., 1999). A decoction prepared from the powdered aerial parts is employed in the treatment of malaria (Diallo, 2000). Traditional healers also rely on the plant to manage joint pain, inflammation, diarrhoea, intestinal parasites, fever, boils, and various skin disorders (Traore *et al*., 2000). Chloroform extracts from the aerial parts have demonstrated antimalarial activity (SS *et al*., 2017; Traoré-Keita *et al*., 2000). Additionally, the shoot-bearing leaves are consumed as a vegetable despite their bitterness and are valued for their stomachic, aperient, and antiseptic properties, aiding digestion and alleviating burning sensations (Martin-Puzon *et al*., 2015).

GC-MS analysis of the whole plant of *Glinus oppositifolius* has identified compounds such as Hexadecanoic acid, isobornyl acetate, heptanoic acid, stigmasterol, 8,11-estran-3-one, dodecanoic acid, 14-eicosatrienoic acid, and other constituents (Nagannawar & Jayaraj, 2020). Phytochemical studies have further reported the presence of Squalene, vitexin, L-phenylalanine, spinasterol, adenosine, vicenin-2, oppositifolone, kaempferol 3-O-galactopyranoside, L-(−)-(N-trans-cinnamoyl)-arginine, lutein, triterpenoid saponins such as glinosides A and B, and isorhamnetin 3-O-β-D-xylopyranosyl-(1→2)-β-D-galactopyranoside (Deshpande *et al*., 1996). Reactive Oxygen Species (ROS) and free radicals are widely implicated in the induction of oxidative stress, leading to cellular damage and contributing to the pathogenesis of various chronic diseases, including neurodegenerative conditions, cardiovascular disorders, cancer, and diabetes. Antioxidants play a pivotal role in scavenging ROS, thereby mitigating oxidative damage and maintaining cellular homeostasis. In this context, natural antioxidants derived from plant sources have garnered considerable attention due to their potent bioactivity and health-promoting properties (Pattanayak, 2011). Furthermore, increased dietary intake of natural phenolic antioxidants has been associated with a reduced risk of coronary heart disease (Kumpulainen & Salonen, 1999).

Despite the recognized importance of wild leafy vegetables in promoting food sovereignty and improving local economies, particularly in less developed nations (Ravetto *et al*., 2024). Systematic scientific evaluations of many species remain limited. A review of the literature indicates that very few investigations have been conducted on *Cryptocoryne retrospiralis*. Although preliminary phytochemical analyses of both selected species have identified several bioactive constituents, comprehensive studies correlating their phytochemical profiles with antioxidant potential are scarce.

Therefore, the present study aims to evaluate the phytochemical composition and antioxidant activity of two underutilized wild leafy vegetables, *Cryptocoryne retrospiralis* and *Glinus oppositifolius*. This investigation seeks to generate scientific evidence supporting their nutritional and therapeutic significance and to promote their utilization as functional foods and natural sources of antioxidants.

MATERIALS AND METHODS

A collection of plants

The fresh and healthy plant *Cryptocoryne retrospiralis* was collected from Wasa-porlawitha, with a latitude of 20.319187° and Longitude 79.97784°, from November to January, and *Glinus Oppositifolius* was collected from Deulgaon, with a latitude 20.561848° and a longitude 80.16104° during January to February. From Gadchiroli District (M.S.), India, the plants were identified with the help of available literature (Ugemuge, 1986; Yadav and Sardesai, 2002). A voucher specimen (CR, BMV730 & GO. BMV728) of both plants was prepared and deposited in the Department of Botany, Bhawabhuti Mahavidyalaya, Amgaon.

Drying & Extraction

The collected plant materials were thoroughly washed under running tap water to remove adhering soil particles and extraneous debris, followed by shade drying in a controlled air-conditioned environment for 2-3 weeks to prevent thermal degradation of bioactive compounds. The dried leaves were then pulverized individually using a mechanical grinder to obtain a fine powder, which was subsequently stored in airtight containers under appropriate conditions until further analysis. For extraction, 100 g of each powdered leaf sample was subjected to maceration in 500 mL of different solvents, namely ethanol, methanol, chloroform, ethyl acetate, acetone, and distilled water, for 72 hr at ambient temperature to ensure efficient extraction of phytoconstituents with varying polarities. Following extraction, the mixtures were filtered to separate the plant residues, and the obtained filtrates were concentrated under reduced pressure at 40°C using a rotary evaporator to yield the crude extracts.

Chemicals

The stable free radical 1,1-diphenyl-2-picryl-hydrazyl (DPPH•), Ascorbic acid, Chloroform, Ethyl acetate, Methanol, and all other chemicals used were of analytical grade.

Phytochemical Screening

Preliminary qualitative phytochemical screening of *Glinus oppositifolius* and *Cryptocoryne retrospiralis* was conducted to detect major constituents, including carbohydrates, saponins, flavonoids, tannins, alkaloids, reducing sugars, gums, and steroids. Dried and powdered leaves were extracted using a Soxhlet apparatus, and the crude extracts were analyzed following standard procedures. Specific tests were employed for alkaloids (Mayer's and Wagner's), flavonoids (ferric chloride and alkaline reagent), phenolics, coumarins, glycosides (Keller-Killiani), phytosterols, saponins (froth test), resins, tannins, terpenoids (Salkowski), and steroids (Liebermann-Burchard). Phytoconstituents were identified based on characteristic color changes, with results expressed as present (+) or absent (−) (Harborne, 1984).

Antimicrobial study

Bacterial and fungal pathogens, namely *Staphylococcus aureus* (NOCM-2257, Gram-positive bacteria), *Pseudomonas fluorescens* (NCBI 2200), *Aspergillus niger* and *Candida albicans* (MTCC 1632), were procured from NCBI, NCL, NOCM, and MTCC. The antimicrobial activity of the extracts was evaluated using the disc diffusion method. The zones of inhibition produced by the leaf extracts were measured and compared with standard antibiotics, such as ofloxacin for bacterial strains and fluconazole for fungal strains.

Antioxidant Study

The antioxidant activity of compounds can be evaluated using the colourimetric DPPH assay (Shimada *et al*., 1992), which determines the free radical scavenging ability of plant extracts. This method is based on the hydrogen-donating capacity of the test samples, which reduces the stable organic free radical DPPH. The deep violet colour of the DPPH solution shows maximum absorbance at 517 nm; upon reduction, this colour fades to a pale yellow or whitish shade, indicating scavenging activity. The decrease in absorbance is directly proportional to the degree of reduction (Arulpriya *et al*., 2010).

Preparation of Sample

The free radical scavenging activity was evaluated using the DPPH assay. Powdered leaves were extracted with methanol, ethyl acetate, and chloroform. Briefly, 10 μL of each extract or ascorbic acid (positive control, 10 mg) was mixed with 190 μL of 0.1 mM DPPH solution in methanol, incubated at 37°C for 5 min, and absorbance was measured at 517 nm using an ELISA plate reader. A decrease in absorbance indicated increased radical scavenging activity, calculated using the standard equation.

$$(\%)\ \textbf{Free radical scavenging effect} = \frac{\text{AbsorbanceofControl(Ac)} - \text{AbsorbanceofSample (As)}}{\text{AbsorbanceofControl (Ac)}} \times \mathbf{100}$$

GC-MS STUDY

Crude extracts of *Cryptocoryne retrospiralis* and *Glinus oppositifolius* were diluted in methanol and analyzed by GC-MS at SAIF, IIT Madras. A 1 μL sample was injected into an Agilent 8890 GC coupled with a 5977B MSD, using an HP-5MS ultra-inert capillary column. The oven temperature was programmed from 60°C to 350°C at 0.5°C/min. Helium was used as the carrier gas at 1 mL/min in splitless mode. Compounds were identified by comparing mass spectra with the NIST database, and their relative abundance was determined by peak area normalization. All analyses were performed in triplicate to ensure reproducibility.

RESULTS

Antimicrobial study &Antioxidant study

Antimicrobial study

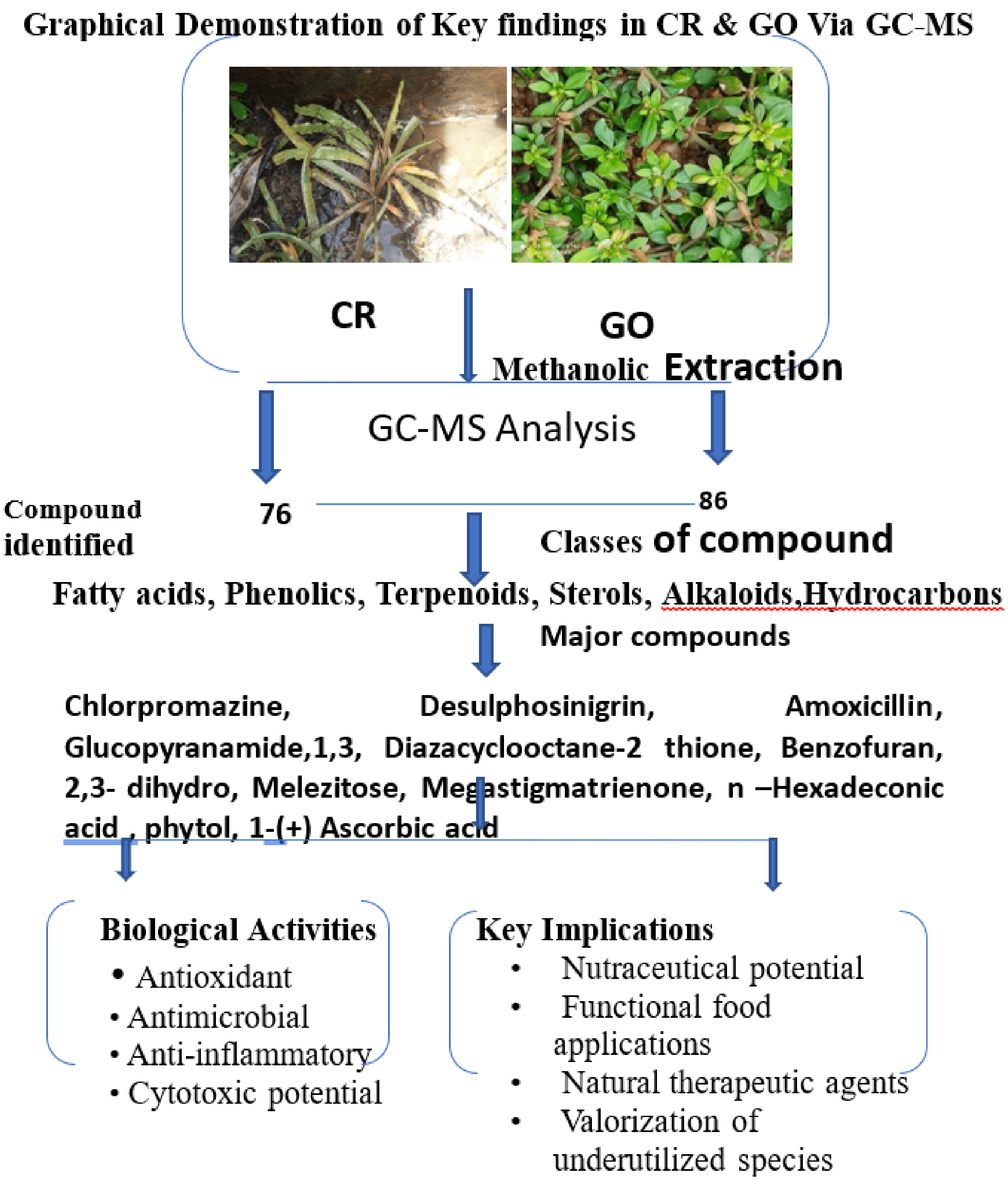
The antimicrobial activity results are shown in Table 1 and Figure 1. The maximum zone of inhibition shown by *Staphylococcus aureus* & *Pseudomonas fluorescens* in the chloroform extracts of *C. retrospralis* was 16 mm and 12 mm, respectively. Extract of *G. oppositifolius* showed 14 mm and 12 mm zones of inhibition against *S. aureus* and *P. fluorescens*. It was observed that both the leaf extracts were not effective against *Candida albicans*, and a minimum Zone of inhibition was reported in the chloroform and ethanol extracts of *C. retrospiralis* against *Aspergillus niger*. (Photographs were taken with the help of Nikon D3500 DSLR in the Department of Botany, Bhawabhuti Mahavidyalaya, Amgaon) (Figure 1 and Table 1).

Antioxidant study

The antioxidant activities exhibited by both chosen plant extracts were evaluated for their antioxidant potential using the DPPH (2, 2-diphenyl-1-picryl hydrazyl) free radical scavenging assay. The findings are presented in the table and image below. *G. oppositifolius* extract showed significant antioxidant activity in all assays, with the Methanolic extract exhibiting the highest activity. *C. retrospiralis* extract also demonstrated antioxidant activity, although to a lesser extent, comparable to *G. oppositifolius*. The antioxidant activity of both plants was comparable to that of standard antioxidants, such as ascorbic acid (Table 1).

Phytochemical Study

Preliminary phytochemical analysis of leaf extracts of *Cryptocoryne retrospiralis* and *Glinus oppositifolius*, prepared using different solvents (aqueous, ethanol, methanol, and acetone), revealed the presence of alkaloids, tannins, flavonoids, and coumarins. Alkaloids and tannins were detected in all extracts except the



aqueous fraction. In contrast, gums and reducing sugars were absent in all tested extracts (Table 2).

GC-MS Analysis

Cryptocoryne retrospiralis

The methanolic extract of *C. retrospiralis* was subjected to GC-MS analysis to screen volatile bioactive compounds that may be responsible for the pharmacological activities of this plant. A total of 78 bioactive compounds has been identified from *C. retrospiralis*. Out of which a total of 61 bioactive compounds were summarized in the observation Table 3. The identified bioactive compounds from different classes, such as Imines, aziridine, bicyclic ketone, alkyl, Ester, heterocyclic compound, organosilicon, amino acid, aldehyde, terpenoids, carbohydrate, flavonoids, fatty acid, indole derivatives carboxylic ester, and organochlorine, were reported to possess pharmacological properties such as anti-inflammatory, anticancer, cytotoxic activity, hepatoprotective activity, and neuroprotective activity. The detected bioactive molecule could have exhibited a synergetic effect to reduce oxidative stress by boosting the antioxidant and immunosuppressive capabilities. Pyridine, 1-acetyl-1,2,3,4-tetrahydro9- with highest Probability 95.76% 4HPyran4one, 2.3dihydro3, 5dihydroxy6methyl (84.52%), 2Pentadecanone, 6,10,14trimethyl (83.87%), 2Methyl1ethylpyrrolidine (63.12) Tetradecanoic acid (62.63%), hexadecenoic acid, methyl ester (58.34%), n-hexadecenoic acid (52.29), octadecanoic acid (52.12%), methyl 6-oxoheptanoate (43.68%), 1-Butanamine,2-methyl-N-(2-methylbutylidene) (41.06), Melezitose (40.38%), 3-methyl-4-phenyl-1H-pyrrole (33.87%), 1Propanamine, 2methylN(2methylpropylidene) (33.07%), l(+)Ascorbicacid2, 6 di hexdecanoate, other bioactive compounds having probability ranges between (1-30%) Name of different phytochemical with their Real time, Area%, Compound name, molecular formula, molecular weight, and Biological Role mention in Table 3 and Chromatograms in Figure 2.

Glinus oppositifolius

The results of the GC-MS analysis of the methanolic extract of *G. oppositifolius* leaves. A total of 86 bioactive compounds has been identified from *G. oppositifolius*. Out of which 76 bioactive compounds and their biological activity were summarized in observation Table 4. The identified bioactive compounds from different classes, such as carbohydrate, Aromatics amine, Polyol, Organo sulfur, carboxylic acid, Saturated hydrocarbon, Pyranone, bicyclic ketone, alkyl, Ester, heterocyclic compound, coumaran's, amino acid, aldehyde, terpenoids, fatty acid, carboxylic ester, & Cyclitols The major components were 4H-Pyran-4-one,2,3-dihydro-3,5-dihydroxy-6- methyl- (77.62), chlorpromazine, 61.12%, glycerin (52.02), glucosamine (49.3), benzofuran, 2,3dihydro (45.72), Melezitose (55.66%), 6Hydroxy4,4,7atrimethyl5,6,7,7atetrahydrobenzofuran2 (85.61%), nHexadecanoicacid (50.42%), 3OMethyldglucose (44.54%), monomethylmalonate (40.15%), DLArabinose (39.7%) Hexadecanoicacid, 1(hydroxymethyl)1,2ethanediylester (37.9%) 2ethyl3oxo4pyrrolidine2ylidenebutyronitrile (35.92%), Desulphosinigrin (33.79%), l(+)Ascorbicacid2,6dihexadecanoate (34.58%), amoxicillin, (29.82%), Glucopyranuronamide, 1(4amino2oxo1(2H) pyrimidinyl1 (28.74%), octadecanoic acid (28.31%), phenol,5-ethenyl-2- methoxy-(27.92%), octadecenoate acid (28.31%) and mannosamine (25.42%). And other bioactive phytoconstituents have probability rate ranges in between (1-25%). Name of different phytochemicals with their real-time, Area%, Compound name, molecular formula, molecular weight, and Biological Role mentioned in Table 4, and Chromatograms in Figure 3. Widely used amoxicillin antibiotic & Chlorpromazine drug used against Schizophrenia and bipolar disorder found in *Glinus oppositifolius*. These phytoconstituents show anti-inflammatory activity, anticancer, hepatoprotective, neuroprotective, cytotoxic, wound healing, skin conditioning and cosmetic properties.

Table 1: Data of Antimicrobial & Antioxidant activity of CR & GO.

Plants name	Extracts	P. fluorescens gram +ve	S. aureus Gram –ve	A. niger	C. albicans	Antioxidant potential (Mean ± SD)
CR	chloroform	12 mm	16 mm	—	—	
CR	ethanol	—	12 mm	12 mm	—	
CR	methanol	—	12 mm	—	—	12.066 ± 1.89
GO	chloroform	—	14 mm	—	—	
GO	ethanol	11 mm	13 mm	—	—	
GO	methanol	12 mm	14 mm	—	—	21.852 ± 1.45
SD ofloxacin for Bacteria and Fluconazole for fungus/+Ve control (ascorbic acid)		26 mm	28 mm	18 mm	28 mm	85.23. ±3.54

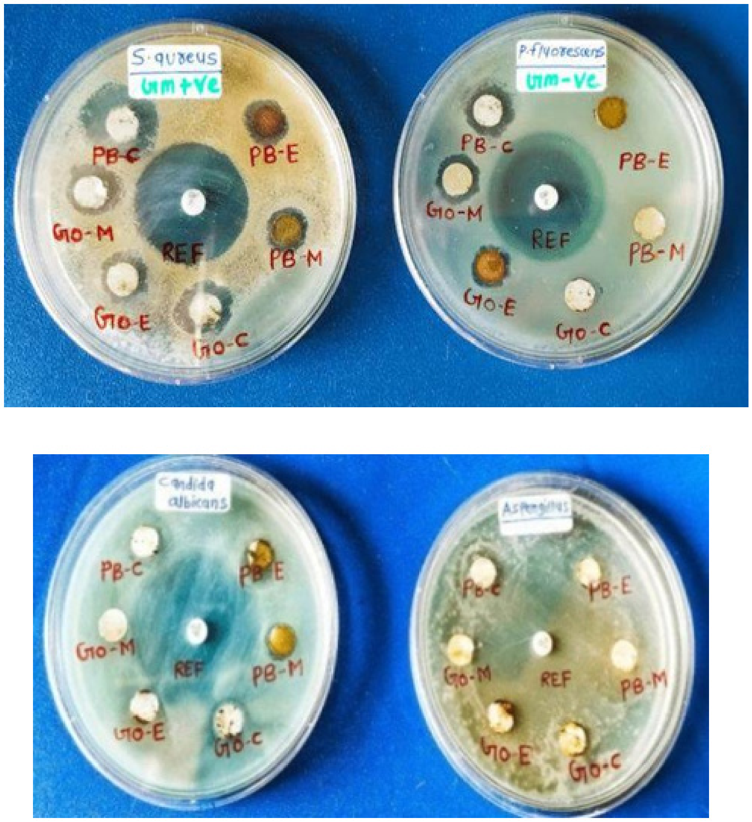


Figure 1: Showing Zone of Inhibition of Bacteria & Fungi in different Extracts of GO.

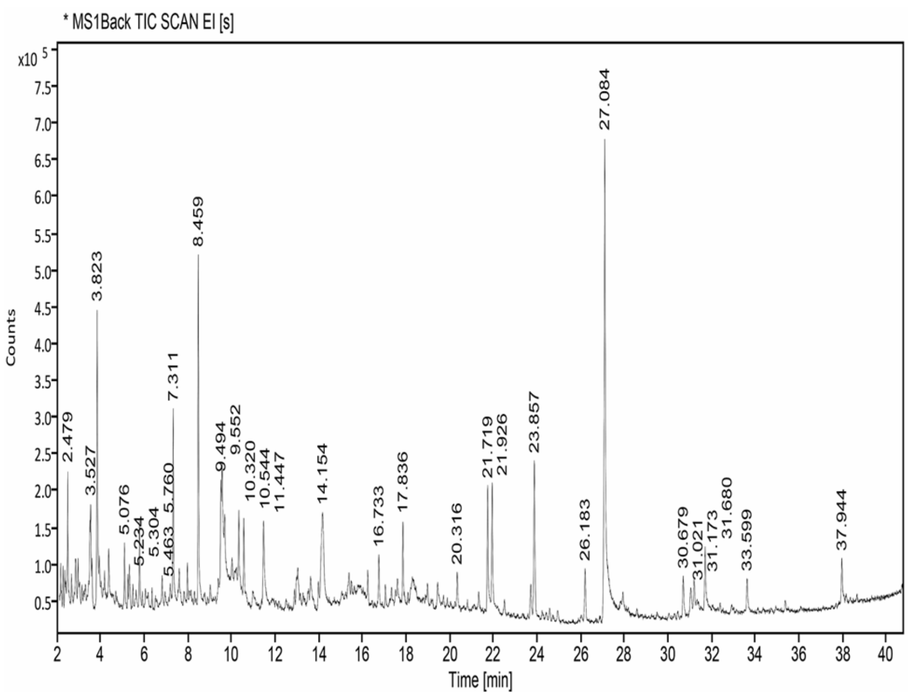


Figure 2: Chromatograms of *Cryptocoryne retrospiralis*.

DISCUSSION

Glinus oppositifolius and *Cryptocoryne retrospiralis* are two traditional green vegetables widely consumed across Maharashtra. Both plants are seasonal and available only during the winter months. Traditional healers use the leaves and rhizomes of *C. retrospiralis* to treat diarrhoea. Research has demonstrated that plant polysaccharides function as effective immunomodulating agents (Inngjerdingen *et al.*, 2005). The phytochemical screening identified the presence of polyphenolic compounds, including tannins and flavonoids, which are known to exhibit various biological effects. This analysis indicates that both plants harbour a range of phytochemicals with potential biological activities, such as antioxidant, anti-inflammatory, and antimicrobial properties. Both plants exhibit significant antioxidant capabilities, with *Glinus oppositifolius* displaying a greater potential for antioxidant activity compared to *Cryptocoryne retrospiralis*. For the quantitative analysis of volatile and semi-volatile compounds, GC-MS is regarded as one of the most reliable methods, as it integrates the separation technique of gas chromatography with the identification approach of mass spectrometry (Grover & Patni, 2013). Figures 2 and 3 depict the chromatographs, while Tables 3 and 4 show the compounds, their percentage Peak, peak area, Molecular formula, and Molecular weight. biological properties include antifungal, antibacterial, antioxidant, anticancer, insecticidal, anti-inflammatory, anti-diabetic, neuroprotective, hepatoprotective, wound healing, and more. Many Bioactive compounds identified by GC-MS are used in the fragrance, food, pharmaceutical, beverage, perfume, and detergent industries as medications, flavours, propellants, antiseptics, disinfectants, and insecticides (Semwal & Painuli, 2019; Swamy & Sinniah, 2015). Phytoanticipins are also considered to be an important part of the plant's defence mechanism (Salehi *et al*., 2019). A total of 78 and 86 bioactive compounds were found in the Methanolic leaf extract of *C. retrospiralis* & *G. oppositifolius*, respectively. Indicates that both wild leafy vegetables are rich in secondary metabolites & have antimicrobial and antioxidant properties. Leaf extract is a good antipyretic, analgesic, antimicrobial, anti-inflammatory, and antioxidant compound (Raman *et al*., 2012). Several studies show that hexadecenoic acid is a well-known substance that has strong anti-inflammatory, antioxidant, hypocholesterolemia, pesticidal, nematocidal, hemolytic, 5-Alpha reductase inhibitory, and powerful antibacterial and mosquito larvicidal

Table 2: Qualitative Phytochemical Screening of CR & GO.

Phytoconstituents	*Cryptocoryne retrospiralis*				*Glinus oppositifolius*			
	A	E	M	W	A	E	M	W
Alkaloids	+	+	+	-	+	+	+	+
Flavonoids	+	+	-	-	-	+	+	+
Tannins	+	+	+	+	-	+	+	+
Coumarin	+	+	+	-	-	+	-	-
Saponins	+	+	-	-	-	+	-	+
Glycosides	+	+	+	-	-	-	-	-
Gums	-	-	-	-	-	-	-	-
Reducing sugar	-	-	-	-	-	-	-	-
Abbreviations: A-Acetone, E-Ethanol, M-Methanol, W-Aqueous, +present, -absent.								

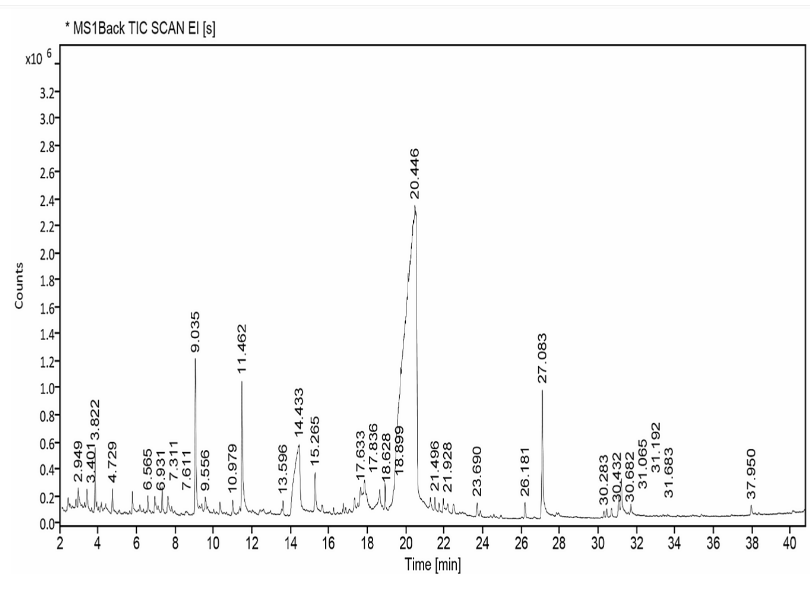


Figure 3: Chromatograms of *Glinus oppositifolius*.

Table 3: Peak report and Bioactive compounds of *Cryptocoryne retrospiralis*.

Sl. No.	Real time	Compound name	MF	MW (g/mol)	Class	Biological role
1	2.479	1-Propanamine, 2- methyl-N-(2-methylpropylidene)-	$C_8H_{17}N$	127.23	Imines	NA
		1-butylpyrrolidine	$C_8H_{17}N$	127.23	Imines	NA
2	3.527	1-([tetrahydro-2-furyl] carbonyl) piperidine	$C_{10}H_{17}NO_2$	183.25	Imines	NA
		aziridine, 2-isopropyl-1,3-dimethyl-, trans-	$C_7H_{15}N$	113.20	Aziridine	Antitumor and antibacterial (Kowalczyk *et al*., 2017).
		3-pentylpiperidine	$C_{10}H_{21}N$	155.28	Piperidines	Antihistamine, anticancer, antimicrobial (Rasheed *et al*., 2024).
3	3.823	glycerin	$C_3H_8O_3$	92.09	Polyol	Backbone of lipids.
		(2-mercaptoethyl) guanidine	$C_3H_9N_3S$	119.19	Mercaptoalkyl.	Antioxidant and anti-inflammatory (Wright *et al*., 2017).
4	5.076	1-Butanamine, 2-methyl-N-(2-methylbutylidene)-	$C_{10}H_{21}N$	155.2804	Imines	Antimicrobial properties (Gopalakrishnan *et al*., 2014).
		cyclohexanone, 4R- acetamido-2,3-cis-epoxy-	$C_8H_{11}NO_3$	171.2	Epoxide	Anti-inflammatory and antioxidant (Shen & Hammock, 2012).
		N-Ethyl-hexahydro-1*H*-azepine	$C_8H_{17}N$	127.23	Azepanes	Antidepressants, Anticonvulsants, antibacterial and antiviral drugs (Maurya *et al*., 2024).
5	5.304	6-Methylenebicyclo (3.2.0) hept-3-en-2-one	C_8H_8O	120.15	Bicyclic organic compounds	Antifungal properties (Lalthanpuii & Lalchhandama, 2020).
		2,4,6-Cycloheptatrien-1- one, 4-methyl-	C_8H_8O	136.15	Tropone derivatives	Antioxidant and anti-inflammatory properties.
6	5.463	2-Methyl-1- ethyl pyrrolidine	$C_7H_{16}N_2$	128.22	Pyrrolidine	Antitumor activity (Nicolai *et al*., 2021).
		piperidine, 1,2-dimethyl-	$C_7H_{15}N$	113.20	Piperidines	Anticancer, antiviral, anti-inflammatory (Mitra *et al*., 2022).
7	5.76	1H-Azonine, octahydro-1- nitroso-	$C_8H_{16}N_2O$	156.23	Azonines	Tumorigenic and mutagenic (Lewandowski & Gwozdzinski, 2017).
		cyclohexanamine, N-3- butenyl-N-methyl-	$C_{11}H_{21}N$	167.3	Alkyl	NA
		acetic acid, 6-morpholin-4-yl-9-oxobicyclo [3.3.1] non-3-yl e	$C_{15}H_{23}NO_4$	281.163	Ester	Antidiabetic and antioxidant.
8	7.311	4H-Pyran-4-one, 2.3-dihydro-3,5-dihydroxy-6-methyl-	$C_6H_8O_4$	144.12	Flavonoid	Antioxidant.
		1,3-Diazacyclooctane-2- thione	$C_6H_{12}N_2S$	144.24	Heterocyclic compound	Rheumatic pain, cough, and fever (Nakade *et al*., 2025).
		2,4-Dihydroxy-2,5-dimethyl-3(2H)-furan-3- one	$C_6H_8O_4$	144.1253.	Furanones	Antimicrobial agent, and exhibiting antioxidant properties.

9	8.459	pyridine, 1-acetyl-1,2,3,4- tetrahydro-	$C_7H_{11}NO$	125.1683	Hydro pyridines	Antibacterial, anti-inflammatory, or anticancer.
		2H-Pyran-2-one, 5.6- dihydro-4,6,6-trimethyl-	$C_8H_{12}O_2$	140.1797.	Dihydropyran ones	NA
10	9.494	1,3,6-Trioxa-2- Sila cyclooctane, 2,2, -dimethyl silyl-	$C_6H_{14}O_3Si$	162.26	Silocane	NA
		1-diisopropylsilyloxybutane	$C_{10}H_{24}Osi$	204.38	Organosilicon	NA
		Decane, 1.9-bis([trimethylsilyl] oxy)-	$C_{16}H_{38}O_2Si_2$	318.64	Organosilicon	NA
11	9.552	methyl 6-oxoheptanoate	$C_8H_{14}O_3$	158.2	keto-ester	Antimicrobial And Antifungal, antioxidant and anticancer.
		4-amino-1,5-pentandioic acid	$C_7H_{13}NO_4$	175.18	Amino acid	Neurotransmitter
12	10.32	octan amide, N – (2 – mercaptoethyl)-	$C_{10}H_{21}$nos	203.34	Organic compound	Neuroprotective and liver-protective agent.
13	10.544	mopso (3-morpholino-2 -hydroxypropanesulfonic acid)	$C_7H_{15}No_5S$	225.26	Zwitterionic organic	Buffering agent
		piperidine, 3-isopropyl-	$C_8H_{17}N$	127.23	Heterocyclic	Antimicrobial And Antiviral properties, Anticancerous, Alzheimer’s disease Goel *et al*., 2018).
		N-ε-acetyl-L-lysine	$C_8H_{16}N_2O_3$	188.22	Amino acid	Epigenetics and metabolic regulation (Escalante-Semerena, 2010).
14	11.447	3,5-Heptadienal, 2- ethylidene-6-methyl-	$C_{10}H_{14}O$	150.22	Aldehyde	Antimicrobial properties.
		cyclohexene, 2-ethenyl- 1,3,3-trimethyl-	$C_{11}H_{18}$	150.26	Monoterpene	Antiangiogenic and antitumor.
15	14.154	melezitose	$C_{18}H_{32}O_{16}$	504.44	Carbohydrate	Attractant for ants and bees (Behera & Balaji, 2021).
		1-nitro-2-acetamido-1,2-dideoxy-D-mannitol	$C_8H_{16}N_2O_7$	252.22	Bioorganic compounds	Potential antibacterial activity (Al-Jassani, 2016).
16	16.733	2(4*H*)-benzofuranone, 5,6,7,7a-tetrahydro-4,4,7a-trimethyl-,	$C_{11}H_{16}O_2$	180.2435	Heterocyclic	Anticancer activity.
		6,6-Dimethyl-10-methylene-1-oxa-spiro[4.5] decane	$C_{12}H_2O_2$	180.29	Spiro cyclic ethers	Fragrance and flavour.
		Octahydrobenzo[b]pyran, 4a-acetoxy-5,5,8a- trimethyl-	$C_{15}H_{24}O_3$	252.35	Terpenoid	Anti-inflammatory activity.
17	17.836	3-methyl-4-phenyl-1*H*-pyrrole	$C_{11}H_{11}N$	157.21	Organ heterocyclic	Pheromone.
		almotriptan N-oxide	$C_{17}H_{25}N_3O_3S$	351.47	Indole compound	Reference impurity standard for quality control.
		1,2,3,4-tetrahydro-cyclopenta[b]indole	$C_{11}H_{11}N$	157.21	Indole derivatives	Antidepressant, antiviral activity.

18	20.316	E-8-Methyl-9-tetradecen- 1-ol acetate	$C_{17}H_{32}O_2$	268.43	Carboxylic ester	Insect sex pheromone.
		cyclopentanone, 2 – (2 – octenyl)-	$C_{13}H_{22}O$	194.31	Cyclic ketone	Flavoring agent.
		cis-1-Chloro-9- octadecene	$C_{18}C_{35}Cl$	286.92	Organochlorine	NA
19	21.719	Tetradecanoic acid	$C_{14}H_{28}O$	228.37	Fatty acid	Pheromones of various insects.
		Octadecanoic acid	$C_{18}H_{36}O_2$	284.48	Fatty acid	Antimicrobial (Sohn *et al.*, 2013).
		Pentadecanoic acid	$C_{15}H_3O_{52}$	242.40		Anti-inflammatory effects (Weimer, 2014).
21	23.857	2-pentadecanone, 6,10,14-trimethyl-	$C_{18}H_{36}O$	268.48	Sesquiterpenoid	Antibacterial and antifungal: anti-inflammatory and analgesic, anticancer properties (Takagi *et al.*, 1970).
22	26.183	Hexadecenoic acid, methyl ester	$C_{17}H_{34}O_2$	270.45	Fatty acid methyl ester	Anti-inflammatory anticancer/antitumor antioxidant (Karthika *et al.*, 2019).
23	27.084	n-hexadecenoic acid	$C_{16}H_{32}O_2$	256.42	Fatty acid	Antimicrobial activity, anti-inflammatory effects (Karthika *et al.*, 2019).
		l-(+)-ascorbic acid 2.6- dihexadecanoate	$C_{38}H_{68}O$	652.9	Fatty acid ester of Ascorbic acid.	Antioxidant.
24	30.679	Phytol	$C_{20}H_{40}O$	296.5	Acyclic diterpene	Chlorophyll component vitamins, cosmetics, and fragrances.
25	31.021	Cyclopropane butanoic acid, 2-(2-2-) (2-pentylcyclopropyl)	$C_{22}H_{38}O_2$	334.535	Fatty Acid	Antioxidant, anti-inflammatory, and potential neuroprotective effects.
		17-Octadecynoic acid, methyl ester	$C_{19}H_{34}O$	294.47	Fatty acid methyl ester	Anti-inflammatory and anticancer agent, Karthika *et al.*, (2019).
26	31.173	9,12,15-Octadecatrienoic acid, 2,3-dihydroxypropyl ester,	$C_{21}H_{36}O_4$	352.51	Monoglyceride ester	Antioxidant and anticancer agent.
		Gamolenic acid	$C_{18}H_3O_{82}$	278.43	Fatty Acid	Precursor to other essential bioactive molecules.
27	31.68	Octadecanoic acid	$C_{18}H_{36}O_2$	284.48	Fatty Acid	Antioxidant &Anti-inflammatory:
28	33.599	11,13-Dimethyl-12-tetradecen-1-ol acetate	$C_{18}H_{34}O$	282.46	Acetate Ester	Antimicrobial properties.
		E,E, Z-1,3,12-Nonadecatriene-5,14-diol	$C_{19}H_{34}O_2$	294.5	Fatty Alcohol	Anticarcinogenic and antiviral.
29	37.944	Hexadecanoic acid, 2-hydroxy-1- (hydroxymethyl) ethyl ester	$C_{19}H_{38}O$	330.5026	Monoglyceride	Antioxidant or anti-inflammatory effects.

Table 4: Pick Report and Bioactive Compounds of *Glinus oppositifolius*.

Sl. No.	Peak	Name of compound	MF	MW g/mol	Class of compound	Biological role
1	2.949	d-Glucosamine	$C_6H_{13}NO_5$	179.17	Monosaccharide	Anti-inflammatory Antioxidant (Vadakkan *et al*., 2019).
2	3.401	2-amino-5-(2-piperidin-1-ylethyl)-1,3,4-thiadiazole	$C_{11}H_2ON_4S_2$	228.36	Aromatic amine.	NA
		1-pyridineacetic acid, hexahydro	$C_7H_{13}NO_2$	143.19	Heterocyclic amine	NA
		1-Piperidineethanol	$C_7H_{15}NO$	129.2	Tertiary amino compound	NA
3	3.822	Glycerin	$C_3H_8O_3$	92.09	Polyol	Skin health.
		Thio cyanic acid, 2 – (2-butoxyethoxy) ethylester	$C_9H_{17}NO_2S$	203.3	Organosulfur	Insecticide.
		(2-Mercaptoethyl) guanidine	$C_3H_9N_3S$	119.19	Organic compound	Radioprotective effects (Huttner *et al*., 2020).
4	4.729	Monomethyl malonate	$C_4H_6O_4$	118.09	Carboxylic acid monoester	NA
		2-O-methyl-D-xylose	$C_6H_{12}O_5$	164.16	Ether.	Cell wall integrity.
		methyl4-O-methyl-β-D-xylopyranoside	$C_{11}H_2OO_9$	296.272	Methyl glycoside	Antifreeze agents in insects.
5	6.565	Glucopyranuronamide,1-(4-amino-2-oxo-1(2*H*)-pyrimidinyl)-1,	$C_{16}H_{25}N_7O_8$	443.412	Cytosine nucleoside	Antibiotics.
		Acetamide,N-methyl-N-(2-propynyl)-	C_6H_9NO	111.14	Amide	Neuroprotective agent.
		Cyclohexane, 1,4 1,4-dimethyl-2-octadecyl-	$C_{26}H_{52}$	364.6911	Saturated hydrocarbon	Anticancer properties (Alahmari, 2021).
6	6.931	DL-Arabinose	$C_5H_{10}O_5$	150.13	Monosaccharide	Gut health
		L-sorbose	$C_6H_{12}O_6$	180.16	Monosaccharide	Role in vitamin C synthesis.
7	7.311	4H-Pyran-4-one, 2.3-dihydro-3,5-dihydroxy-6- methyl-	$C_6H_8O_4$	144.12	Pyranose	Antioxidant.
		1,3-Diazacyclooctane-2- thione	$C_6H_{12}N_2S$	144.24	Heterocyclic thione	Antibacterial, antifungal, antiviral, and Anticancerous
		2,4-Dihydroxy-2,5-dimethyl-3(2H)-furan-3- one	C_6H_8O	144.12	Furanone	Flavour compound in foods.
8	7.611	Heptanediamide,N,N'-di-benzoyloxy-	$C_{21}H_{22}N_2O$	398.4	Organic compound	Anticancer.
		β-1,5-O-dibenzoyl-ribofuranose	$C_{19}H_{18}O_7$	358.3	Ribose-derived	Developing potential drugs (Gangangari, 2019).
		Nonanediamide,N,N'-di-benzoyloxy-	$C_{20}H_2ON_2O_6$	384.4	Organic compound	Antioxidant and antibacterial.
9	9.035	Benzofuran,2,3-dihydro-	C_8H_8O	120.1485	Coumaran's	Anti-inflammatory, anticancer, and antimicrobial properties.
10	9.556	L-glucose	$C_6H_{12}O$	180.1559	Monosaccharide	Low-calorie sweetener, and laxative.
		Methyl 3-3-hydroxytetradecanoate	$C_{15}H_{30}O$	258.3969	Fatty acid methyl ester	Quorum-sensing signal molecule in bacteria.
11	10.979	Amoxicillin	$C_{16}H_{19}N_3O_5S$	365.4	Penicillin	Antibiotic (Geddes *et al*., 2007).
		2-Amino-2-cyano-4- methyl pentane thioamide	$C_7H_{13}N_3S$,	171	Organic thioamide	Antibacterial properties.

12	11.462	Phenol,5-ethenyl-2- methoxy-	$C_9H_{12}O$	136.191	Methoxyphenol	Potential anticancer properties.
		2-methoxy-4-vinylphenol	$C_9H_{10}O_2$	150.177	Methoxyphenols.	Flavour compound.
13	13.596	Chlorpromazine	$C_{17}H_{19}ClN_2S$	318.86	Phenothiazine	Schizophrenia and bipolar disorder.
		1-(3,6,6-trimethyl-1,6,7,7a-tetrahydrocyclopenta[c]pyran-1-	$C_{13}H_{18}O_2$	206.285	Pyrans	Anticancer agent.
		2H-Indeno(1,2-*b*) furan-2- one, 3,3*a*,4,5,6,7,8,8*b*-octahydro-8,	$C_{12}H_{16}O_2$	192.258	Indenofuranone	Hepatorenal protective effects.
14	14.433	Melezitose	$C_{18}H_{32}O_{16}$	504.44	Oligosaccharide	Osmo protectant for sap-feeding insects like aphids
15	15.265	D-Allose	$C_6H_{12}O_6$	180.16	Monosaccharide	Pharmaceuticals.
		3,4-Altrosan	$C_6H_{10}O_5$	162.14	Carbohydrate derivative	Pharmaceuticals.
16	17.633	Desulphosinigrin	$C_{10}H_{17}NO_6S$	279.31	Thio glycoside.	Anticancer, antimicrobial and anti-inflammatory.
		d-Mannose	$C_6H_{12}O_6$	180.16	Aldohexose	Food and Beverage industry.
17	17.836	4-(2,4,4-trimethyl-cyclohexa-1,5-dienyl)- but-3-en-2-one	$C_{13}H_{18}O$	190.28	Organic compound	NA
		1-Nitro-β-D-arabinofuranose, tetraacetate	$C_{13}H_{17}NO_{11}$	363.27	Carbohydrates	Antibacterial.
18	18.628	Cyclopentane [1,3] cyclopropane [1,2]cycloheptene- 3(3aH)-one, 1,2,3	$C_{13}H_{18}O$	190.28	Carbonyl compound	NA
		2-methyl-4-(2,6,6-trimethylcyclohex-1-enyl) but-2-en-1-ol	$C_{14}H_{24}O$	208.345.	Organic compound	Fragrance or perfume.
		Cedran-diol,8S,13-	$C_{15}H_{26}O$	238.37	Sesquiterpenoid	Antioxidant and anticancer.
19	18.899	4-(2,4,4-trimethyl-cyclohexa-1,5-dienyl)- but-3-en-2-one	$C_{13}H_{18}O$	190.28	Terpenoid ketone	Antimicrobial activity.
		Megastigmatrienone	$C_{13}H_{18}O$	~190.28	ketone	Antioxidant and anti-inflammatory (Slaghenaufi *et al*., 2016).
20	20.446	3-O-methyl-D-glucose	$C_7H_{14}O_6$	194.18	Monosaccharide	Blood-brain barrier.
		Myo-inositol,4-C-methyl-	$C_7H_{14}O$	194.18	cyclitols	Antidiabetic, anti-inflammatory, antioxidant.
21	21.496	2-Ethyl-3-oxo-4- pyrrolidine-2-ylidene- butyronitrile	$C_{10}H_{13}N_3O$	205.25	Heterocyclic compound	Antimicrobial and anticancer.
		3-ethoxy- 1,4,4a,5,6,7,8,8a-octahydroisoquinoline	$C_7H_{11}NO$.	178.23	Organic compound	Antibacterial, anticancer, and antifungal.
22	21.928	6-Hydroxy-4,4,7a-trimethyl-5,6,7,7a-tetrahydrobenzofuran-2	$C_{11}H_{16}O_3$	196.2429	Benzofurans	Insecticidal.
		2-Pentyne-1,4-diol,4- methyl-1-(2-thienyl)-	$C_{10}H_{12}O_2S$	196.27	Alkynyl diols	NA
23	23.69	ethanol, 2 – (9 – octadecenyloxy)-,(Z)-	$C_{20}H_{40}O_2$	312.538	Ether alcohol	Antileishmanial.
		17-Octadecynoicacid	$C_{18}H_{32}O_2$	280.45	Fatty acid	NA
		Phytylheptadecanoate	$C_{37}H_{72}O_2$	548.55323	Fatty acid	NA

24	26.181	Hexadecenoic acid, methyl ester	$C_{17}H_{34}O$	270.45	Fatty acid	Antimicrobial, antioxidant.
25	27.083	n-Hexadecenoic acid	$C_{16}H_{32}O$	256.42	Fatty acid	Antimicrobial activities (Ghfil *et al*., 2025).
		l-(+)-Ascorbicacid2,6-dihexadecanoate	$C_{38}H_{68}O$	652.9	(vitamin C)	antioxidant and antimicrobial.
		palmitic anhydride	$C_{32}H_{62}O_3$	494.8	Carboxylic acid	NA
26	30.283	7,10-Octadecadienoic acid, methyl ester	$C_{19}H_{34}O$	294.47	Fatty acid	Anti-inflammatory, antimicrobial, and antioxidant (Ghfil *et al*., 2025).
		9-Octadecynoic acid, methyl ester	$C_{19}H_{36}O_2$	296.4879	Fatty acid	Antioxidant and antimicrobial.
27	30.432	10-Octadecenoicacid, methyl ester	$C_{19}H_{36}O_2$	296.48	Fatty acid	Antioxidant and antimicrobial.
28	30.682	ethanol, 2 – (9 – octadecenyloxy)-, (Z)-	$C_{20}H_{40}O_2$	312.5	Fatty alcohol ether	NA
		12-methyl-E, E-2,13-octadecadien-1-ol	$C_{19}H_{36}O_2$	280.5	Alcohols	Anticonvulsant, antimicrobial.
		phytol	$C_{20}H_{40}O$	296.53	Acyclic diterpene	Anti-inflammatory, antidepressant.
29	31.065	(Z)-18-Octadec-9-enolide	$C_{18}H_{32}O_2$	280.44	Lactone	Antioxidant' (Ghfil *et al*., 2025).
		9(E),11(E)-Conjugated linoleic acid	$C_{18}H_{32}O_2$	280.4	Fatty acid	Anti-inflammatory and anticarcinogenic agent.
30	31.192	6-Octadecenoicacid	$C_{18}H_{34}O_2$	282.46	Fatty acid	Antimicrobial (Ghfil *et al*., 2025).
		cis-vaccenic acid	$C_{18}H_{34}O_2$	282.46	Fatty acid	Antioxidant and antimicrobial.
		trans-13-Octadecenoic acid	$C_{18}H_{34}O_2$	282.4614	Fatty acid	Antioxidant and antimicrobial.
31	31.683	Octadecanoic acid	$C_{18}H_{36}O_2$	284.48		Antimicrobial.
		L-Ascorbicacid,6- octadecenoate	$C_{24}H_{47}O_7$	442.59	Fatty ester of ascorbic acid	Antioxidant (Ghfil *et al*., 2025).
		2-bromotetradecanoic acid	$C_{14}H_{27}BrO$	307.267	Halo fatty acid	Antimicrobial
32	37.95	Hexadecenoic acid,1-(hydroxymethyl)-1.2-ethanediylester	$C_{35}H_{68}O_5$	568.9	Fatty acid	Antioxidant activity, anti-inflammatory.

properties (Ryszard, 2009; Igwe & Okwu, 2013). Cyclohexane, 1,4- 1,4-dimethyl-2-octadecyl- has Anticancerous properties. Unsaturated fatty acids, also referred to as omega-6 fatty acids, include octadecadienoic acid, 9-Octadecynoic acid, methyl ester,13 13-Pentadecanoic acid, and n-hexadecenoic acid. These acids are essential for lowering blood cholesterol levels for healthy cell growth and function (Okwu & Morah, 2006), and maintaining properly lubricated skin (Singh *et al*., 2023).

CONCLUSION

The current investigation on *Glinus oppositifolius* and Cryptocoryne retrospiralis leaves consists of several secondary metabolites with numerous pharmacological characteristics. The antimicrobial and antioxidant studies on these plants yielded favourable findings, showing that both plant is source of natural antioxidants for pharmaceutical and nutraceutical applications; thus, it should be popularized among people. Conservation and awareness of underutilized Indigenous vegetables should be implemented. More research is needed to realize the full potential of these plants.

ACKNOWLEDGEMENT

The authors are thankful to Dr. Ladke, Principal, Nilkantrao Shinde Science & Arts College, Bhadrawati, for providing Laboratory facilities for this work. The Authors are thankful to Shri Sureshbabu Asati, President, and Shri K. L. Mankar, Secretary, & Dr. P. K. Rahangdale, Principal, Bhawabhuti Mahavidyalaya, Amgaon, for encouraging and supporting.

ABBREVIATIONS

GC-MS: Gas Chromatography-Mass Spectrometry; **NIST:** National Institute of Standards and Technology; **DPPH:** 2,2-diphenyl-1-picrylhydrazyl; **NCBI:** National Centre for Biotechnology Information; **NCL:** National Chemical Laboratory; **NOCM:** National Collection of Microorganisms; **MTCC:** Microbial Type Culture Collection; **WLVs:** Wild Leafy Vegetables; **SD:** Standard Deviation; **MF:** Molecular Formula; **MW:** Molecular Weight; **RT:** Real Time; **Prob:** Probability; **CRC:** *Cryptocoryne retrospiralis* Chloroform extract; **CRE:** *Cryptocoryne retrospiralis* Ethyl Acetate extract; **CRM:** *Cryptocoryne retrospiralis* Methanol extract; **GOC:** *Glinus oppositifolius* Chloroform extract; **GOE:** *Glinus oppositifolius* Ethyl Acetate extract; **GOM:** *Glinus oppositifolius* Methanol extract; **NA:** Not Known.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

AUTHOR CONTRIBUTIONS

Jayendra Giridhar Nakade: Conceptualization, methodology, plant collection and authentication, experimental work, phytochemical analysis, biological activity assays, data collection, interpretation of results, and preparation of the original manuscript draft.

Praveenkumar N. Nasare: Supervision, research design guidance, validation of experimental procedures, critical review of data interpretation, manuscript editing, revision, and final approval.

SUMMARY

- Antimicrobial & Antioxidant activities of two underutilized wild leafy vegetables Viz. *C. retrospiralis* & *G. oppositifolius* were investigated.
- Both the plants show Antimicrobial & antioxidant properties.
- Both leafy vegetables consist of diverse secondary metabolites.
- In the GC-MS study, both the leafy vegetables consist of Numerous phytochemical compounds having Biological & pharmaceutical applications.
- Some novel compounds have been found, such as Chlorpromazine, Desulphosinigrine, Megastigmatrienone, from *G. oppositifolius*.

REFERENCES

Alahmari, A. (2021). Blood-brain barrier overview: Structural and functional correlation. Neural Plasticity, 2021, 6564585. https://doi.org/10.1155/2021/6564585

Al-Jassani, M. J. (2016). Secondary metabolites analysis of Saccharomyces cerevisiae and evaluation of antibacterial activity.

Anwar N. P. and Abdussalam A. K. (2024). Phytochemical screening and GC-MS analysis of *Cryptocoryne retrospiralis* (Roxb.) Kunth. Ann. Phytomed.,13(2): 903909.http://dx.doi.org/10.54085/ap.2024.13.2.92.

Arulpriya P., Lalitha P, & Hemalatha S. (2010). Cyclic voltametric assessment of the antioxidant activity of petroleum ether extract of *Samanea saman* (Jacq.) Merr. Adv. Appl. Sci. Res., 1(3) (2010) 24-35.

Baeshen, N. A., Almulaiky, Y. Q., Afifi, M., Al-Farga, A., Ali, H. A., Baeshen, N. N., Abomughaid, M. M., Abdelazim, A. M., & Baeshen, M. N. (2023). GC-MS Analysis of Bioactive Compounds Extracted from Plant *Rhazya stricta* Using Various Solvents. Plants,12(4). https://doi.org/10.3390/plants12040960

Behera, P., & Balaji, S. (2021). The forgotten sugar: A review on multifarious applications of melezitose. Carbohydrate Research, 500, 108248. https://doi.org/10.1016/j.carres.2021.108248

Bhat, R. S., & Al-Daihan, S. (2014). Phytochemical constituents and antibacterial activity of some green leafy vegetables. Asian Pacific Journal of Tropical Biomedicine, 4(3), 189-193. https://doi.org/10.1016/S2221-1691(14)60230-6

Burkhill H.M. (1985) The Useful plants of West Tropical Africa. 2nd ed. Royal Botanical Gardebs, Kew.

Deshpande S.S., Deshpande U.S.& Salunkhe D.K. (1996). Nutritional and health aspects of food antioxidants. In D. L. Madhavi, S. S. Deshpande, & D. K. Saunkhe (Eds.), Food antioxidants (pp. 361-469). New York, USA: Marcel Dekker.

Diallo D. (2000) Ethnopharmacological survey of medicinal plants in Mali and phytochemical study of four of them: *Glinus oppositifolius* (Aizoaceae), *Diospyros abyssinica*(Ebenaceae), *Entada Africana* (Mimosaceae), *Trichilia emetica* (meliaceae). These de Doctorate, Faculte de Science, University de Lausanne, Switzerland.

Diallo D., Hveem B., Mahmoud M.A., Berge G., Paulsen B.S., Maiga A. (1999). An ethnobotanical survey of herbal drugs of Gourma district, Mali. Pharm Biol. 37(1):80-91.

Escalante-Semerena J. C. (2010). Nε-Lysine Acetylation Control Conserved in All Three Life Domains: The relative simplicity of studying microbes could prove critical for understanding this posttranslational modification system. Microbe (Washington, D.C.), 5(8), 340-344. https://doi.org/10.1128/microbe.5.340.1

Gangangari, K. K. (2019). Synthesis and evaluation of novel iodine-124 labeled nucleoside analogs as PET imaging agents to predict response to gemcitabine therapy (Doctoral dissertation, City University of New York).

Geddes, A. M., Klugman, K. P., & Rolinson, G. N. (2007). Introduction: Historical perspective and development of amoxicillin/clavulanate. International Journal of Antimicrobial Agents, 30, 109-112.

Ghfil, Z. A. H. A., Aboalhur, F. J., Mshachal, M. A., & Alobaidi, A. A. A. (2025). Antioxidant and antifungal activities of n-hexadecanoic acid extracted from algae. South Asian Research Journal of PharmaceuticalSciences, 7(04),125-127

Goel, P., Alam, O., Naim, M. J., Nawaz, F., Iqbal, M., & Alam, M. I. (2018). Recent advancement of piperidine moiety in treatment of cancer: A review. European Journal of Medicinal Chemistry, 157, 480-502. https://doi.org/10.1016/j.ejmech.2018.08.017

Gopalakrishnan, R., Manikandan, P., & Bhuvaneswari, R. (2014). Antimicrobial potential and bioactive constituents from aerial parts of *Vitis setosa* Wall. J. Med. Plant Res, 8(11), 454-460.

Grover, N. & Patni, V. (2013). Phytochemical characterization using various solvent extracts and GC-MS analysis of the methanolic extract of *Woodfordia fruticosa* (L.) Kurz. Leaves. International Journal of Pharmacy & Pharmacological Science, 5(4), 291-295.

Harborne, J. B. (1984). Methods of plant analysis. In Phytochemical methods: a guide to modern techniques of plant analysis (pp. 1-36). Dordrecht: Springer Netherlands.

Hoque, N., Zafar Imam, M., Akter, S., Ahmed, J., Ehsanul Hoque Mazumder, M., Raquibul Hasan, S., & Sohel Rana, M. (2011). Antioxidant and antihyperglycemic activities of methanolic extract of *Glinus oppositifolius* leaves. Journal of Applied Pharmaceutical Science, 01(07), 50-53.

Huttner, A., Bielicki, J., Clements, M. N., Frimodt-Møller, N., Muller, A. E., Paccaud, J.-P., & Mouton, J. W. (2020). Oral amoxicillin and amoxicillin-clavulanic acid: Properties, indications and usage. Clinical Microbiology and Infection, 26(7), 871-879. https://doi.org/10.1016/j.cmi.2019.11.028

Igwe, O.U. & Okwu, D.E. (2013). GC-MS evaluation of bioactive compounds and antibacterial activity of the oil fraction from the seeds of *Brachystegia eurycoma* (HARMS). Asian Journal of Plant Science and Research, 3(2), 47-54.

Inngjerdingen, K. T., Debes, S. C., Inngjerdingen, M., Hokputsa, S., Harding, S. E., Rolstad, B., Michaelsen, T. E., Diallo, D., & Paulsen, B. S. (2005). Bioactive pectic polysaccharides from *Glinus oppositifolius* (L.) Aug. DC., a Malian medicinal plant, isolation and partial characterisation. Journal of Ethnopharmacology, 101(1-3), 204-214. https://doi.org/10.1016/j.jep.2005.04.021.

Kamble, V. S., & Jadhav, V. D. (2013). Traditional Leafy Vegetables: A Future Herbal Medicine. International Journal of Agriculture and Food Science, (2), 56-58. https://www.researchgate.net/publication/257356065

Karthika, K., Gargi, G., Jamuna, S., Paulsamy, S., Ali, M. A., Al-Hemaid, F., Elshikh, M. S., & Lee, J. (2019). The potential of antioxidant activity of methanolic extract of *Coscinium fenestratum* (Goetgh.) Colebr. (Menispermaceae). Saudi Journal of Biological Sciences, 26(5), 1037-1042. https://doi.org/10.1016/j.sjbs.2018.08.010

Kowalczyk, A., Pieczonka, A. M., Rachwalski, M., Leśniak, S., & Stączek, P. (2017). Synthesis and Evaluation of Biological Activities of Aziridine Derivatives of Urea and Thiourea. Molecules (Basel, Switzerland), 23(1),45. https://doi.org/10.3390/molecules23010045

Kumpulainen T.J &Salonen, J.T. (1999) "Natural Antioxidants and Anticarcinogens in Nutrition, Health and Disease," Royal Society of Chemistry, London, pp. 178-187. http://dx.doi.org/10.1533/9781845698409.

Lalthanpuii, P. B., Lalchhandama K. Analysis of Chemical Constituents and Antiparasitic Activities of the Extracts of *Imperata cylindrica*. Research J. Pharm. and Tech 2020; 13(2):653-658. doi: 10.5958/0974-360X.2020.00125.0

Lewandowski, M., & Gwozdzinski, K. (2017). Nitroxides as Antioxidants and Anticancer Drugs. International journal of molecular sciences, 18(11), 2490. https://doi.org/10.3390/ijms18112490

Martin-Puzon, J. J. R., Valle, D. L., & Rivera, W. L. (2015). TLC profiles and antibacterial activity of *Glinus oppositifolius* L. Aug. DC. (Molluginaceae) leaf and stem extracts against bacterial pathogens. Asian Pacific Journal of Tropical Disease, 5(7), 569-574. https://doi.org/10.1016/S2222-1808(15)60838-6.

Maurya, A., Sharma, R., Yadav, H., Mandal, D., & Shukla, A. C. (2024). *Mentha* spp.: A Miraculous Plant with Pharmaceutical Uses. Advances in Medicinal and Aromatic Plants, vol2-1.

Mitra, S., Anand, U., Jha, N. K., Shekhawat, M. S., Saha, S. C., Nongdam, P., Rengasamy, K. R. R., Proćków, J., & Dey, A. (2022). Anticancer Applications and Pharmacological Properties of Piperidine and Piperine: A Comprehensive Review on Molecular Mechanisms and Therapeutic Perspectives. Frontiersinpharmacology, 12, 772418. https://doi.org/10.3389/fphar.2021.772418

Nagannawar, A. G., & Jayaraj, M. (2020). GC-MS Analysis of Bioactive Compounds from Ethanolic Extract of Whole Plant of *Mollugo oppositifolia* L. And their Pharmacological Activities. International Journal of Pharmaceutical Sciences and Research, 11(5), 2504-2509. https://doi.org/10.13040/IJPSR.0975-8232.11(5).2504-09

Nakade, J. G., Nasare, P. N., & Mungole, A. J. (2025). Bioactive compound profiling of *Theriophonum minutum* (Willd.) Baill. using GC-MS: Implications for pharmaceutical and therapeutic application. Journal of Diversity Studies, 4(2). https://doi.org/10.51470/JOD.2025.4.2.206

Nicolai, A., Madia, V. N., Messore, A., De Vita, D., De Leo, A., Ialongo, D., Tudino, V., Tortorella, E., Scipione, L., Taurone, S., Pergolizzi, T., Artico, M., Di Santo, R., Costi, R., & Scarpa, S. (2021). Anti-Tumoral Effects of a (1H-Pyrrol-1-yl) Methyl-1H-Benzoimidazole Carbamate Ester Derivative on Head and Neck Squamous Carcinoma Cell Lines. Pharmaceuticals, 14(6), 564. https://doi.org/10.3390/ph14060564

Okwu, D.E. & Morah, F.N. I. (2006). The potentials of Garcinia kola seed as a source for nutraceuticals. Journal of Medicinal and Aromatic Plant Science, 28, 605-11.

Pattanayak, S., Shankar Ayak, S., Chandra Dinda, S., Panda, D., Kolhe, D. M., & Pattanayak, M. (2011). Antimicrobial and Anthelmiitic Potential of *Glinus Oppositifolius* (Liii) Family: Molluginaceae. In Pharmacologyonline (Vol. 1).

Raman, B. V., La, S., Saradhi, P. M., Rao, N. B., Krishna, A. N. V. & Radhakrishnan, T. (2012). Antibacterial, antioxidant activity, and GC-MS analysis of *Eupatorium odora* tum. Asian Journal of Pharmaceutical and Clinical Research, vol. 5(2), 99-106.nd their active components. Biomolecules, 9(10),551.

Rasheed, A. M., Shetty, K. K., Roy, L. D., & Kumar, J. (2024). Novel piperazine derivatives as potent antihistamine, anti-inflammatory, and anticancer agents: Their synthesis and characterization. Anti-Cancer Agents in Medicinal Chemistry, 24(14), e180424229082. https://doi.org/10.2174/0118715206295673240409071016

Ravetto Enri, S., Falla, N. M., Demasi, S., Bianchi, D. M., Squadrone, S., Lombardi, G., & Scariot, V. (2024). Exploring the potential of wild leafy vegetables widespread in the European Alps as a functional food. Journal of Agriculture and Food Research, 18. https://doi.org/10.1016/j.jafr.2024.101368.

Ryszard, A. (2009). Squalene: a natural antioxidant? European Journal of Lipid Science and Technology. 111:411-412. Doi: 10.1002/ejlt.20090010.

Salehi, B., Ata, A., Anil Kumar, N. V., Sharopov, F., Ramírez-Alarcón, K., Ruiz-Ortega, A., & Sharifi-Rad, J. (2019). Antidiabetic potential of medicinal plants and their active components. Biomolecules, 9(10), 551. https://doi.org/10.3390/biom9100551

Semwal, P. &Painuli, S. (2019). Antioxidant, antimicrobial, and GC-MS profiling of *Saussurea obvallata* (Brahma Kamal) from Uttarakhand Himalaya. Clinical Phyto science, 5 (1), 1-11.

Shen, H. C., & Hammock, B. D. (2012). Discovery of inhibitors of soluble epoxide hydrolase: a target with multiple potential therapeutic indications. Journal of medicinal chemistry, 55(5), 1789-1808. https://doi.org/10.1021/jm201468j

Shimada K., Fujikawa K., Yahara K.& Nakamura T. (1992). Antioxidative properties of xanthone on the autooxidation of soybean in cyclodextrin emulsion. J. Agr. Food Chem. 1992; 40:945-948.

Shukla S, Bhargava A, Chatterjee A, & Singh S.P. (2006). Genotypic variability in vegetable amaranth (*Amaranthus tricolour* L.) for foliage yield and its contributing traits over successive cuttings and years. Euphytica151: 103-110.

Singh, N. P., Lakshminarasimhan, P., Karthikeyan, S., & Prasanna, P. V. (2000). Flora of India Series 2 Flora of Maharashtra State Dicotyledones Volume 2 (*CombretaceaetoCeratophyllaceae*) Botanical Survey of India.

Singh, P., Dhankhar, J., Kapoor, R. K., & Sharma, A. (2023). A comparative study on GC-MS analysis and antimicrobial activity of bioactive compounds present in aerial parts (leaf and fruit) of *Ficus benghalensis* L. Journal of Applied and Natural Science, 15(2), 870.

Slaghenaufi, D., Perello, M. C., Marchand, S., & de Revel, G. (2016). Quantification of megastigmatrienone, a potential contributor to tobacco aroma in spirits. Food Chemistry, 203, 41-48.

Sohn, H.-R., Bae, J.-H., Hou, C. T., & Kim, H.-R. (2013). Antibacterial activity of a 7,10-dihydroxy-8(E)-octadecenoic acid against plant pathogenic bacteria. Enzyme and Microbial Technology, 53(3), 152-153. https://doi.org/10.1016/j.enzmictec.2013.02.009

SS, W., CC, S., FR, I., RV, G., KS, P., & JS, G. (2017). Phytochemical Screening and Antibacterial Activity of *Cryptocoryne spiralis* var. spiralis and *Cryptocoryne retrospiralis* (Roxb) Kunth. Medicinal & Aromatic Plants, 06(02). https://doi.org/10.4172/2167-0412.1000289.

Swamy, M.K. &Sinniah, U.R. (2015). A comprehensive review on the phytochemical constituents and pharmacological activities of *Pogostemon cablin* Benth.: an aromatic medicinal plant of industrial importance. Molecules, 20 (5), 8521-8547.

Takagi, Y., Sato, F., Shikita, M., Shinoda, M., Terasima, T., & Akaboshi, S. (1970). Toxicity and radioprophylactic action of 2-mercaptoethylguanidine and its derivatives in mice and in HeLa S3 cells. Radiation Research, 42(1), 79-89.

Teoh, W. Y., Yong, Y. S., Razali, F. N., Stephenie, S., Dawood Shah, M., Tan, J. K., Gnanaraj, C., & Mohd Esa, N. (2023). LC-MS/MS and GC-MS Analysis for the Identification of Bioactive Metabolites Responsible for the Antioxidant and Antibacterial Activities of *Lygodium microphyllum* (Cav.) R. Br. Separations, 10(3). https://doi.org/10.3390/separations10030215

Traore F, Faure R, Ollivier E, Gasquet M, Azas N, Debrauwer L, Keita A, Timon-David P, Balansard G. Structure and antiprotozoal activity of triterpenoid saponins from Glinus oppositifolius. Planta Med. 2000 May;66(4):368-71. doi: 10.1055/s-2000-8551. PMID: 10865459.

Traore, F., R. Faure, E. Ollivier, M. Gasquet, N. Azas, L. Debrauwer, A. Keita, P. Timon-David and G. Balansard, 2000. Structure and antiprotozoal activity of triterpenoid saponins from Glinus oppositifolius. Planta Medica, 66(4),368-371.

Traore-Keita F, Gasquet M, Di Giorgio C, Ollivier E, Delmas F, Keita A, Doumbo O, Balansard G, Timon-David P. 2000. Antimalarial activity of four plants used in traditional medicine in Mali. Phytother Res. 14(1):45-7. doi: 10.1002/(sici)1099- 1573(200002)14:1<45:aid-ptr544>3.0.co;2-c. PMID: 10641048.

Ugemuge, N.R.(1986). Flora of Nagpur District, Maharashtra state. Shree Prakashan. Nagpur.

Vadakkan, K., Vijayanand, S., Hemapriya, J., & Gunasekaran, R. (2019). Quorum sensing inimical activity of *Tribulus terrestris* against gram-negative bacterial pathogens by signalling interference. 3 Biotech, 9(4), 163. https://doi.org/10.1007/s13205-019-1695-7

Weimer, S., Priebs, J., Kuhlow, D., Groth, M., Priebe, S., Mansfeld, J., & Ristow, M. (2014). D-Glucosamine supplementation extends life span of nematodes and of ageing mice. Nature Communications, 5, 3563. https://doi.org/10.1038/ncomms4563

Wright, A. E., Killday, K. B., Chakrabarti, D., Guzmán, E. A., Harmody, D., McCarthy, P. J., Pitts, T., Pomponi, S. A., Reed, J. K., Roberts, B. F., Rodrigues Felix, C., & Rohde, K. H. (2017). Dragmacidin G, a Bioactive Bis-Indole Alkaloid from a Deep-Water Sponge of the Genus Spongosorites. Marine Drugs, 15(1), 16. https://doi.org/10.3390/md15010016

Yadav, S.R. and Sardesai, M.M. (2002). Flora of Kolhapur District. Shivaji University Publication, Kolhapur.

Cite this article: Nakade JG, Nasare PN. Phytochemical Profiling and Biological Activities of Two Underutilized Wild Leafy Vegetables, *Cryptocoryne retrospiralis* (Roxb.) Kunth and *Glinus oppositifolius* (L.) Aug. DC: A GC-MS Analysis. Asian J Biol Life Sci. 2026;15(1):202-16.