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GC-MS And FT-IR Of Methanolic Extracts Of *Curcuma Amada* Roxb. Found In Chandel District, Manipur

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Abstract
Mango ginger (Curcuma amada Roxb.) was collected from Chandel District, Manipur and phytochemicals were analysed by using GCMS and FTIR. FTIR spectroscopy of the methanol extracts indicates the presence of secondary amines (N-H), alkane (C-H), amine salt (N-H), Fluoro compound (C-F), amine (C-N), and Halo compound (C-Br). In GC-MS twelve compounds were identified: 4-dimethyl (pentafluorophenyl) silyloxypentadecane (100%), 4H-1-benzopyran-4-one, 5-hydroxy-7-methoxy-2-phenyl- (28.806%), Endo-borneol (3.38%), Linalool (3.03%), D-Limonene (2.74%), 1,2,3,4-dodecanetetrol, [2r-(2r,3s*,4s*)]- (1.27%), and the minor compounds are Cis-2-methyl-4-n-pentylthiane, s, s-dioxide (0.42%), z,z-6,28-heptatriactontadien-2-one (0.43%), 3-methyl-2-(2-oxopropyl)furan (0.43%), 1h-3a,7-methanoazulene, octahydro-1,4,9,9-tetramethyl (0.74%), 3-methyl-2-(2-oxopropyl)furan (0.52%), 3-methyl-2-(2-oxopropyl)furan (0.74%). The main chemical constituents were 4-dimethyl (pentafluorophenyl) silyloxypentadecane (Retention time: 38.097, peak area: 28.806, Molecular formula: $C_{23}H_{37}OF_5Si$) and 4H-1-benzopyran-4-one, 5-hydroxy-7-methoxy-2-phenyl- (Retention time: 37.742, peak area: 24.136, Molecular formula: $C_{16}H_{12}O_4$).*

Key words: *Curcuma amada, Phytoconstituents, GC-MS, FT-IR*

1. INTRODUCTION

Curcuma amada belongs to the family Zingiberaceae and genus Curcuma. *C. amada* Roxb., commonly known as mango ginger, is a perennial, rhizomatous, aromatic herb widely distributed in tropical regions of Asia, Africa and Australia (Policegoudra, et al., 2011). *Curcuma amada* Roxb., commonly Known as amba ada or mango ginger (Sutar et al., 2020). It is an aromatic and medicinal plant grows extensively in the countries of Indian subcontinent and has morphological characteristics similar to ginger (*Zingiber officinale*), but its taste recalls raw mango (Akter et al., 2019). Mango ginger (Curcuma amada) is a rhizomatous plant of the Zingiberaceae family and has gained considerable attention because of its unique flavor and potential health benefits (Barman et al., 2024). The plant is found grown in wild and cultivated in all parts of India. It is called Mango ginger in English, Ama-haldi in Hindi, Yai hanuman in Manipuri and Chuwhae in Moyon. The rhizome is succulent, divided into nodes and inter-nodes with scaly leaves. Leaves are long, lanceolate, petiolate, sheathed and inflorescence is white to pale yellow and in spike. From ancient times, *C. amada* has been used in traditional systems of medicine for a number of uses, including coolant, appetizer, antipyretic, diuretic, expectorant, and laxative (Lenka et al., 2023).

Among its many pharmaceutical properties, the rhizome essential oil (ROs) of *C. amada* has antimicrobial (Al-Qudah et al., 2017), anti-inflammatory, analgesic, anticancer, antihyperglycemic, and antioxidant activity (Tampa et al., 2016). Furthermore, camphor present in the RO reduces inflammation, which helps clear blocked bronchi, larynx, pharynx, and other airway parts of phlegm and mucus (AdeOluwa et al., 2020). It has been used as spice and as herbal medicine by different communities and in food industry. It is grown in different countries throughout the year. The plant is used as a medicine, cosmetics, dye and as nutraceutical (Mishra, 2018). The rhizome of C. amada has reported to be antibacterial, antioxidant, anticancer, antihyperglycemic, anti-inflammatory, and antiallergic properties (Malek, 2011). Essential oils are explored for food preservation, aroma therapy and pharmaceutical formulations (Dosoky and setzer, 2018). Besides its medicinal properties, rhizomes of this plant are used to flavor various foods such as chutney, dahi vada, pickles, curd water rice, and more in

Odisha (India) (Sutar et al., 2020). The essential oil of C. *amada* extracted from rhizome has efficient antioxidant and antimicrobial characteristics (Sutar et al., 2020 and Behera et al., 2022).

In India, the rhizomes are used by different tribal communities to treat fever, jaundice and intestinal diseases (Jain, 1995). The rhizome paste is also applied to heal cuts, wounds and itching (Padalia, et al., 2013). C. *amada* is used in culinary and the plant is also used in Ayurvedic and Unani medicine as a diuretic, antipyretic, laxative, appetite stimulant, emollient, antipyretic, expectorant and aphrodisiac agent (Padalia, et al., 2013). The Monsang tribe of Manipur used the rhizome of C. *amada* as herbal medicine to treat diabetes and associated ailments (Syiem, et al., 2011). The leaf extract is used to relieve bruises and sprains by. Applying tropically (Policegoudra, et al., 2011). The methanol extract of C. *amada* leaf has been reported to have potent cytotoxic activity against breast cancer cell lines (Jambunathan, et al., 2014) whereas the aqueous methanolic extract of leaf exhibited significant anti- inflammatory activity (Annapurna, et al., 2021). The plant was widespread throughout the tropical regions of South and Southeast Asia in both wild and cultivated environments for its cure for respiratory, skin and digestive diseases((Barman et al., 2024). A number of epidemiological studies have linked phytochemicals with a series of bioactivities associated with health benefits. The bioactivity of many phytoconstituents is believed to be higher in the form in which they are found in nature (Behera et al., 2022).

The phytochemical characterization of bioactive compounds using GC-MS and FTIR of *Curcuma amada* collected from Chandel District of Manipur has not yet been done till date. Therefore, The aim of the present study is to identify the phytochemicals in the rhizome of mango ginger (Curcuma amada Roxb.) collected from Chandel District of Manipur and to subject it by using GCMS and FTIR analysis.

2. METHODOLOGY

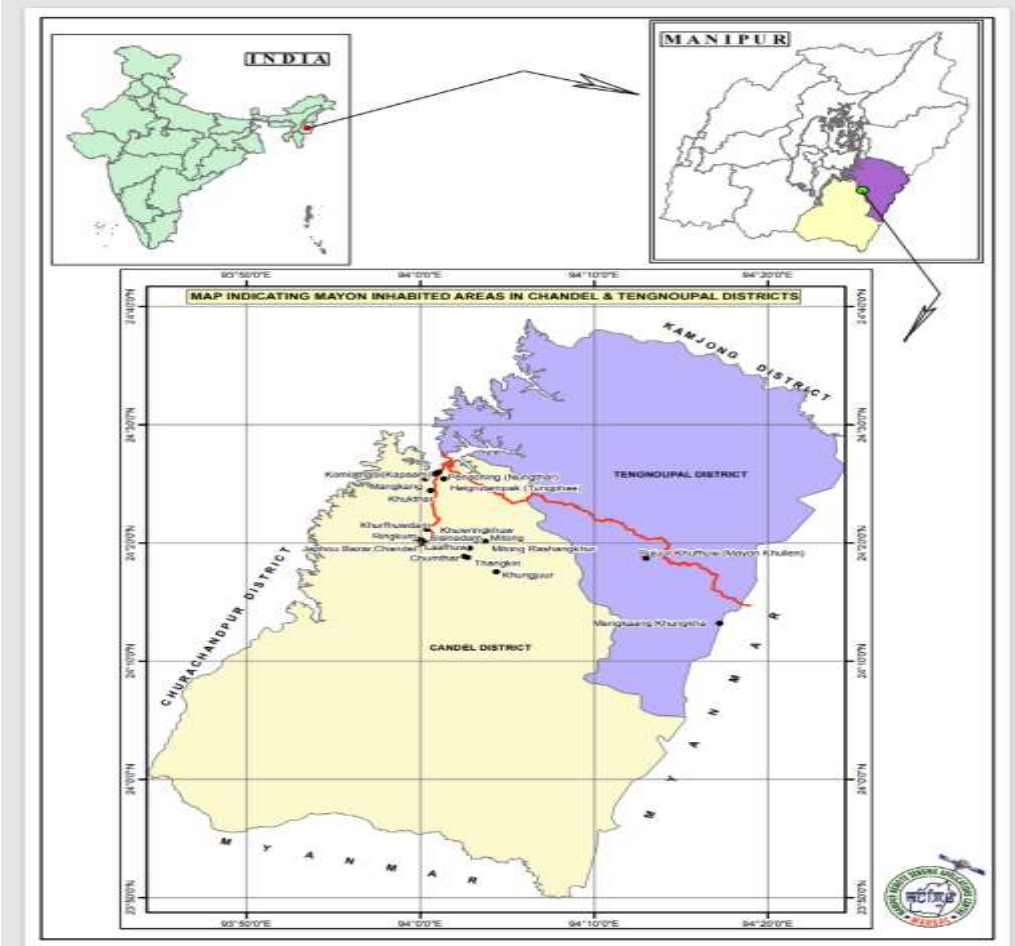

Figure 1: Source: Manipur Remote Sensing Applications Centre (MARSAC)

Figure 2: *Curcuma amada* Roxb.

2.1 Plant materials and collection

The plant was collected from the natural population growing in the kitchen garden at Kapaam, Khukthar, Tungphae and Penaching villages of the Moyon Naga Tribe in chandel district, Manipur. The plant sample was identified and voucher specimen was deposited at Assam Royal Global University, Guwahati and Manipur International University for further references.

2.2 Extraction of plant materials

Freshly collected plant parts were washed with running water and wiped with clean cotton clothes. Then the rhizome is thinly sliced and dried under room temperature for three to four weeks. The dried sample is ground into powdered with manually by using mortal and pestle. Methanol was used for the extraction of the plant sample. Twenty-five grams of powdered *C. amada* sample was weighted and extraction was carried out using Soxhlet apparatus. The extract was taken in a beaker and kept on hot water bath and heated at 30-40 ^{0}C till all the solvent got evaporated. The extract obtained was transferred into airtight containers and kept in refrigerator at 4^0 C with proper labelling for future use in phytochemical analysis.

2.3 Phytochemical screening

Phytochemical analysis of methanol extracts of *C. amada* was performed by using standard methods:

2.3.1 Test for Alkaloids (Wagner Test): 2 ml of Wagner reagent (picric acid) is added to 1 ml of extracts. The presence of reddish colour precipitation confirms the test as positive.

2.3.2 Test for Glycosides (Keller-kilani test): To the 1 mL methanol extract add 2 ml of glacial acetic acid and 1-2 drops of 2% ferric chloride. Then this whole mixture was poured in another test tube containing 2 ml of concentrated sulphuric acid (H_2SO_4). A reddish brown coloration at the junction of two layers indicates the presence of Cardiac glycosides.

2.3.3 Test for Flavonoids (NaOH Solution test): To the 1 ml of the filtrate add 2 ml of dilute sodium hydroxide and observed. Presence of golden yellow colour indicates the presence of flavonoids.

2.3.4 Test for saponins (Frothing test): 2ml of the crude extract was mixed with 5 mL of distilled water and it is shaken vigorously. The formation of stable foam indicates the presence of saponins in the extracts.

2.3.5 Test for phenols: To the crude extract, 2 ml of 2% ferric chloride solution ($FeCl_2$) was added. Observation of black coloration indicates for the presence of phenol.

2.3.6 Test for carbohydrates (Molisch's test): 2 drops of filtrates were treated with alcohol α-naphthol solution in a test tube. The formation of violet ring at the junction signifies the presence of carbohydrates
2.3.7 Test for proteins: 2-5 drops of ninhydrin solution was treated with 2 ml of filtrate and placed in a boiling water for 1-2 minutes and observed the formation of purple colour.
2.3.8 Test for terpenoids: To the 5 ml of aqueous extracts, 2 ml of chloroform is added. The mixture is evaporated on the water bath and then boiled with 3 ml of conc. H_2SO_4. Observation of Grey color confirms the presence of Terpenoids.
2.3.9 Test for steroid (Salkowaski reaction): To the 5ml aqueous extract, 2 ml of chloroform was added and successively add concentrated sulphuric acid (H_2SO_4) from the sides of test-tube. Observation of red colour in the lower chloroform layer indicates the presence of steroids.
2.3.10 Test for amino acids (Tyrosine): Few drops of Millon's reagent is added to the aqueous extracts and the mixture is heated. Observation of the solution turning into dark red confirms the presence of tyrosine (amino acid)

2.4 Phytochemical analysis using GCMS

GC-MS analysis was carried out with Perkin Elmer (USA) make GCMS instrument, Model: Clarus 680 GC & Clarus 600C MS comprising a liquid auto-sampler. The Software used in the system is Turbo Mass Ver. 6.4.2. The peaks were analysed using data analysis software NIST 2014.Capillary column Stationary Phase: The capillary column used is 'Elite- 5MS' having dimensions- length- 60 m, ID- 0.25 mm and film thickness- 0.25 µm and the stationary phase is 5% diphenyl 95% dimethyl polysiloxane. Helium gas (99.99%) was used as carrier gas (i.e mobile phase) at flow rate of 1 ml/min. An injection volume of 1 µl was employed in split less mode. Injector temperature is 280°C and ion-source temperature 180°C. The oven temperature was programmed at 60°C (for 1 min), with an increase at the rate 7°C/min to 200°C (hold for 3 min) then again increased at rate of 10.C/min to 300.C (hold for 5 min). The total run time is ~ 39min. Solvent delay was kept for 7 minutes. Mass Spectra was taken in Electron Impact positive (EI+) mode at 70 eV. A solvent delay of 8 min was there for MS scan. Mass range i.e m/z range is 50-600 amu. Identification of Peaks Interpretation of the peaks appeared in the GC Chromatogram were done by library search of the mass spectrum of corresponding peaks using the database software of National Institute Standard and Technology-2014 (NIST 2014). The percentage of each component was calculated by comparing the average area of its peak to the total area of all the peaks (Tran-Trung et al., 2023)

2.5 Fourier Transform Infrared Spectrophotometer (FTIR) Analysis

FTIR analysis was done by the instrument NICOLET iS10 at Technology Incubation Centre, Guwahati Biotech Park (TIC, GBP) near SP Office, TNAMEripti Nagar, Amingaon, Guwahati -781031, Kamrup, Assam.Extracts of plant material in methanol (MeOH) solvent used for FTIR analysis. 10mg of the dried extract powder was encapsulated in 100 mg of KBr pellet, in order to prepare translucent sample disc. The extract of each plant specimen was loaded in FTIR Spectroscope (Shimadzu, IR Affinity1, Japan), with a scan range from 400 to 4000 cm-1 with a resolution of 4cm-1. IR spectra in frequency region 400-4000 cm^{-1} were recorded at room temperature on a perkin- Elmer Fourier Transform Spectrometer equipped an air cooled DTGs (deuterated triglycine sulfate) detector. For each spectrum, 100 scans were co-added at a spectral resolution of 4cm. The frequencies for all sharp bands were accurate to 0.01 cm. All the spectral values were expressed in percentage (%) transmittance (Fahd, et al., 2017) and pellet technique was adopted to record the spectra.

3. RESULTS AND DISCUSSIONS

Table 1: Phytochemical screening of extracts of *Curcuma amada Roxb.*

Sl. No.	Chemical Test	Extracts of *Curcuma amada*
1	Alkaloids	+
2	Glycosides	+
3	Flavonoids	+

4	Saponins	+
5	Phenols	+
6	Carbohydrate	+
7	Proteins	-
8	Terpenoids	+
9	Steroids	+
10	Amino acids	+

PHYTOCHEMICAL ANALYSIS:
The present study of Phytochemical screening of powdered Methanol extracts of C. *amada* revealed the presence of Alkaloids, Glycosides, flavonoid, saponins, phenols, carbohydrates, terpenoid, steroid, amino acid are present and proteins, are absent. Previous workers have also confirmed the presence of alkaloids, flavonoids, saponins, tannins, phenolics, carbohydrates, protein, and fibre in methanolic extracts (Mahadevi et al., 2021), confirms presence of steroids, tannins, flavonoids, amino acids, carbohydrates, and glycosides and carbohydrates are absent (Thakur et al., 2015). curcumin, flavonoid, terpenoid saponins, phenolic compounds, carbohydrates, tannins and glycosides in the rhizome of the plant extracts (Hait and Deepak, 2018). describes the presence of alkaloids, flavonoids, saponnins, tannins, carbohydrates, protein and fibre in the rhizome extract of mango ginger (Annapurna et al., 2021)

The therapeutic application of C. *amada* has been comfirm from the literature due to the presence of these compounds. The presence of Flavonoid in plants have varied biological and pharmacological effect such as anti-oxidant, anti-inflammatory, anti-cancer, anti-diabetic, and immune stimulating effect (Karki et al., 2018). Saponin are reported to have cytotoxic effect (kiem et al., 2009), anti-ulcer activity (Ukwe et al., 1997), protect against hypercholesterolemia and possess anti-biotic properties (Sofowra, 1993). Alkaloids are responsible for anti-microbial (Dias et al., 2007) and anti-tumor activity (Goal et al., 2007). Alkaloids protects against chronic diseases (Sofowra, 1993)..Tannins in plants have spasmolysis activity, free radical scavenger and possess anti-oxidant activities. Phenols are good anti-oxidant (Yang et al., 2007), anti-tumor agent (Sangeta et al., 2007). Steroid are analgecic for central nervous system activities (Sofowra, 1993). The flavonoids and phenolic compounds in plant are reported to make use of many biological effects such as antioxidant, free radical scavenging abilities, anti-inflammatory, anti-carcinogenic, astringent, anti-diabetic, anti-tubercular, antipyretic effects etc 9Amin et al., 2013 and Das et al., 2010).

GCMS Analysis: The compounds identified in the *Curcuma amada* methanolic extracts through GC-MS are presented in Table 1. The major compounds are 4-dimethyl(pentafluorophenyl)silyloxypentadecane (100%), 4H-1-benzopyran-4-one, 5-hydroxy-7-methoxy-2-phenyl- (28.806%), Endo-borneol(3.38%), Linalool(3.03%), D-Limonene (2.74%), 1,2,3,4-dodecanetetrol, [2r-(2r*,3s*,4s*)]- (1.27%), and the minor compounds are Cis-2-methyl-4-n-pentylthiane, s,s-dioxide (0.42%), z,z-6,28-heptatriactontadien-2-one (0.43%), 3-methyl-2-(2-oxopropyl)furan (0.43%), 1h-3a,7-methanoazulene, octahydro-1,4,9,9-tetramethyl (0.74%), 3-methyl-2-(2-oxopropyl)furan (0.52%), 3-methyl-2-(2-oxopropyl)furan (0.74%). All the identified chemical constituents belongs to different chemical groups and possess some biological and pharmacological activities (Ruuthiran & Selvaraj, 2017).

There are several factors that influence the yield of essential oil and phyto-composition of mango ginger, including its genetic makeup, growing conditions, origin, chemotypes, and the nutritional value of soil (Al-Qudah et al., 2017). Other workers reported the presence of compounds including α-pinene, β-myrcene, p-cymene, (Z)-β-ocimene, Camphor, linalyl acetate, Safrole, ar-curcumene, and β-curcumene in the different C. *amada* essential oils. The present study assumes that *Curcuma amada* essential oils may be a source of eco-friendly insecticides and antibacterial agents (Narayanankutty et al., 2021). It was reported the presence of compounds such as stilbene, E-8- octadecacen-1-ol acetate, 3-Benzo[g]quinoxalin-2-yl-propionic acid and Octasiloxane, 1,1,3,3,5,5,7,7,9,9,11,11,13,13,15,15-hexadecamethyl-. in ethyl acetate extract in leaves of *Curcuma amada* Roxb (Irulandi et al., 2024). Arpita Priyadarshini et al., (2025) studied the leaf essential oil and found to be rich in

camphor (13.48%), camphene (8.55%), curdione (8.47%), β-caryophyllene (6.99%) and spathulenol (6.02%). Jatoi, et al., (2007) reported major chemical constituents of mango ginger essential oil as myrcene, ocimene, arturmerone, (Z)-β-farnasene, guaia-6,9- diene, *cis*- β-ocimene, *cis*-hydroocimene, *trans*hydroocimene, α-longipinene, α-guaiene, linalool, β- curcumene and turmerone. Al-Qudah et al., (2017) identify the presence of curcumene, α-curcumene, ß-curcumene, camphor, curzerenone, 1, 8-cineole, Curcumin, demethoxy curcumin, bis-demethoxy curcumin, caffeic acid, ferulic acid, gallic acid ,cinnamic acid , p-coumaric acid and gentisic acid in dichloromethane extract of mango ginger by GCMS.

GCMS CHARACTERIZED COMPOUNDS OF BIOLOGICAL ACTIVITY:

In phytocompounds identified in the methanol rhizome extract of *Curcuma amada* are found to have biological activity such as D-limonene are Anti-inflammatory, cardioprotective, (d'Alessio et al., 2022). Hepatoprotective, anti-cancer, anti-fibrotic, anti-genotoxic (Sun, 2007). D-limonene compounds strongly inhibit the circulation of pro-inflammatory cytokines as well as the expression of cell-anchored adhesive molecules, liable to recruit activated immune cells (d'Alessio et al., 2022). D-limonene has well-established chemo-preventive activity against many types of cancers. Sun et al., (2007) reported that evidence from a phase I clinical trial shows a partial response in a patient with breast cancer and stable disease for more than six months in three patients with colorectal cancer. (Altern Med Rev 2007;12(3):259-264). According to Liu et al., (2023) endo-borneol is the most abundant compound in the EO of *Cinnamomum burmannii* (cinnamon specie) leaves and branches (41.71% and 40.66% respectively) that contributed to antioxidant activity of the plant which means that endo-borneol is present in a good amount in cinnamon species as compared to the identified percentage of endo-borneol (3.38%) in the presented study. One of the major oxygenated mono-terpene constituent of *Artemisia* essential oil of plant extract was reported to be endo-borneol (5.72%) (El Anbri, 2022) that is less but is still more than the present study. Endo-borneol are Antioxidant (Liu et al., 2023). The compound 3-methyl-2-(2-oxopropyl)furan was revealed Antimicrobial properties in Methanolic Root-Bark Extract of *Boswellia dalzielii* (Burseraceae)(Okezu *et al.*, 2020, Sarah *et al.*, 2020, Mamza *et al.,* 2022). Linalool as Analgesic, anti-inflammatory and wound healing (Pereira et al., 2018), Sedative, anxiolytic, analgesic, anticonvulsant, anti-inflammatory, local anaesthetic (Aprotosoaie et al., 2014), Cis-2-methyl-4-n-pentylthiane, s,s-dioxide are Antihyperlipidemic agent (Anees et al., 2024), z,z-6,28-heptatriactontadien-2-one are High effectiveness as inti-fungal and anti-bacterial (Asma and Faris, 2023), strong microbial activity (Visali *et al.,* 2022). 1h-3a,7-methanoazulene, octahydro-1,4,9,9-tetramethyl are Antibacterial (Sani et al., 2019). It was reported that 4h-1-benzopyran-4-one, 5-hydroxy-7-methoxy-2-phenyl- possessed Antioxidant (Anusha and Immanuel, 2019), Anti-inflammatory, and anticancer properties (Khairullah *et al.*, 2021), Chachad and Shimpi, 2008). The GC-MS analysis of methanolic extract of *Curcuma caesia* revealed the presence of various compounds with known bioactivities comprising of anti-inflammatory, anticancer, anti-oxidant.

FTIR Analysis: FTIR analysis of Methanol extract of rhizome of *Curcuma amada* was carried out and presented in Fig. 2 and Table 4. The FTIR confirms the presence of secondary amines and amine, alkane, amine salt, Fluoro compound, Halo compound and the dominant peak is amine centered at 1021.15 cm^{-1} .

The compound indicated shows the band medium vibration at 3316.53 cm^{-1} indicates N-H stretching in secondary amines and that of strong and broad peak at 2831.85 cm^{-1} indicates N-H stretching in amine salt. The medium band at 2943.45 cm^{-1} attributes to C-H stretching in alkane and that of 1021.15 cm^{-1} indicates C-H bending in alkane. The strong peak at 1114.37 cm^{-1} attributes to C-F stretching vibration in Fluoro compound. The medium peak at 1114.37 cm^{-1} indicates C-N stretching and that of 614.44 cm^{-1} attributes to C-Br stretching vibration in Halo compound. The objective of the FTIR analysis is to identify the functional group of active phytoconstituents based on peak values in the region of infrared radiation (Coats *et al.*, 2000).

Different workers have reported the functional group that Kavipriya, & Chandran (2018) screened the functional group in methonalic leaf extract of *Cassia alata* by FTIR indicates the presence of the bioactive compounds such as sulfates, sulfonamides, sulfones, sulfonyl chlorides, sulfates, sulfonamides, alkanes, aromatic, aromatic, alkenes, ester, alkenes, ketenes, isocyanates, isothiocyanates, acetylene, nitrile, phosphine, phosphine, aldehyde, alkane, amide, alcohol and alcohol. Ogwuche, C. E., & Edema, M. O. (2020) while analysing the

essential oil from the fresh leaves of Pandanus candalabrum by FTIR confirms the presence of arenes, aldehydes, alkenes, alkyl, and carboxylic. Sahithya & Krishnaveni (2022) Analysis the Stem Extract of Ethnomedicinal Plant, Bridelia montana (Roxb.) Willd by FTIR shows the presence of 5 major peaks corresponding to functional groups as alcohols, alkenes, alkyl halide, alcohols, carboxylic acids, ethers, and esters with C-O stretch and amines. Dike, *et al.,* (2023) While screening in ethanol leaf extract of Sida acuta from Imo State, Nigeria by FTIR analysis revealed functional groups such as Primary (1°) and Secondary (2°) amines, alkanes, alkenes, alkyl halides, carboxylic acids, allenes, aromatics, aliphatic amines, esters, ethers, phenols, and aldehydes. Keke, et al., (2023) screening by FTIR in the ethanol and methanol extracts of U. lobata leaves of the functional groups were indicative of alcohols, phenols, aromatic compounds, unsaturated hydrocarbons, vinyl ethers, amines, isonitriles and aliphatic compounds. Gawade B, Farooqui (2020) while screening the aqueous extract of the leaf of Abrus precatorius by FT-IR showed the presence of different functional groups of chemical constituents such as alcohols, phenols, carboxylic acids, amide, aldehydes, ketones, alkanes, alkenes, aromatics, esters, ethers, aliphatic amines, aromatic amines, peptides, nitro compounds, sulphone, phosphonate, phosphoramide, phosphonic acid, phosphine, silane, amine oxides, aromatic substituted compounds, nitroso, sulphate ester and alkyl halides compounds, which showed 27 major characteristic bands of bioactive chemical components.

CONCLUSION:

The results of the phytochemical screening of the present study indicates the presence of secondary metabolites such as Alkaloids, Glycosides, flavonoid, saponins, phenols, carbohydrates, terpenoid, steroid, amino acid and complemented by FT-IR and GC-MS spectrometry. The GC-MS analysis revealed twelve chemical constituents in methanolic rhizome extract of *Curcuma amada*. The biological activity of the compound identified through GC-MS were studied and the compound exhibits anti-inflammatory, anti- oxidant, anti-fungal, anti-bacteria, analgesic, anti-cancer. FTIR indicates 6 major peaks that attribute the presence of secondary amines (N-H), alkane (C-H), amine salt (N-H), Fluoro compound (C-F), amine (C-N), and Halo compound (C-Br). Due to the presence of these phytochemicals, *C. amada* may be considered as the source of medicine. Therefore, further investigation and proper isolation of more active compounds should be carried out.

Figure 1: GCMS Chromatogram of methanol rhizome extract of *Curcuma amada*

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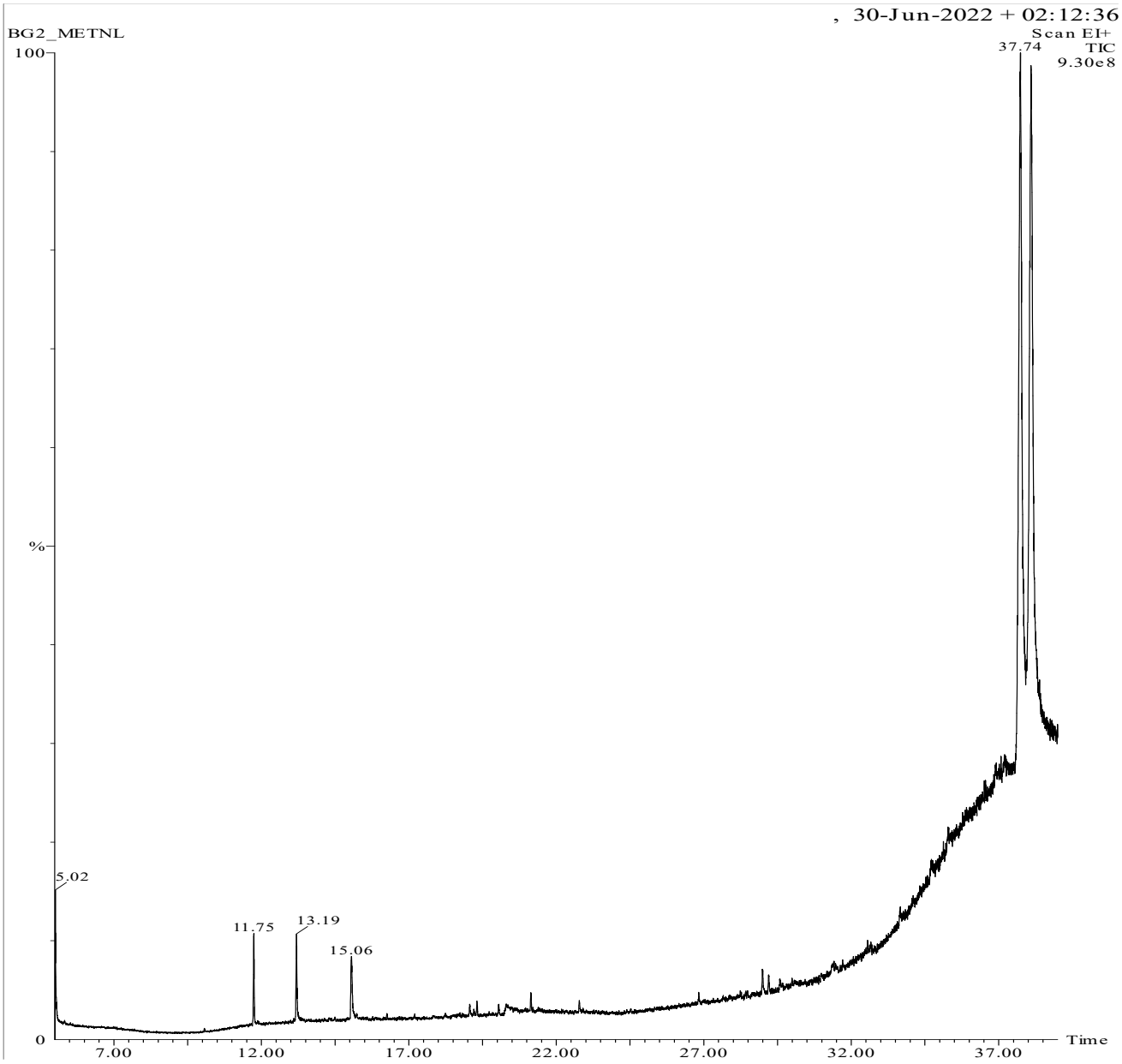
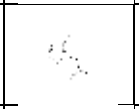
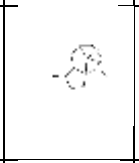


Table 2: GC-MS Characterized phytochemical compounds in methanol rhizome extract of *Curcuma amada* Roxb.

RT	Compound name	MF	MS	MW	PA %	RA %
11.746	D-Limonene	$C_{10}H_{16}$		136	0.790	2.74
13.192	Linalool	$C_{10}H_{18}O$		154	0.872	3.03
15.058	Endo-borneol	$C_{10}H_{18}O$		154	0.975	3.38

19.064	Cis-2-methyl-4-n-pentylthiane, s,s-dioxide	$C_{11}H_{22}O_2S$		218	0.120	0.42
19.309	z,z-6,28-heptatriactontadien-2-one	$C_{37}H_{70}O$		530	0.124	0.43
20.050	3-methyl-2-(2-oxopropyl)furan	$C_8H_{10}O_2$		138	0.122	0.43
21.140	1h-3a,7-methanoazulene, octahydro-1,4,9,9-tetramethyl	$C_{15}H_{26}$		206	0.213	0.74
22.786	3-methyl-2-(2-oxopropyl)furan	$C_8H_{10}O_2$		138	0.148	0.52
28.993	1,2,3,4-dodecanetetrol, [2r-(2r*,3s*,4s*)]-	$C_{12}H_{26}O_4$		234	0.365	1.27
29.203	3-methyl-2-(2-oxopropyl)furan	$C_{18}H_{10}O_2$		138	0.213	0.74
37.742	4H-1-benzopyran-4-one, 5-hydroxy-7-methoxy-2-phenyl-	$C_{16}H_{12}O_4$		268	24.136	28.806
38.097	4-dimethyl(pentafluorophenyl)silyloxypentadecane	$C_{23}H_{37}OF_5Si$		452	28.806	100

(*MF- Molecular Formula, MS-Molecular Structure, MW-Molecular Weight, PA-Peak area, RA-Relative abundance*)

Table 3: Biological activities in Methanol rhizome extract of *Curcuma amada* Roxb.

Sl. No.	Compound name	Reported Biological activities
1	D-Limonene	Anti-inflammatory, cardioprotective, (d'Alessio et al., 2022), anti-cancer, anti-fibrotic, anti-genotoxic (Sun, 2007)
2	Linalool	Analgesic, anti-inflammatory and wound healing (Pereira et al., 2018). Sedative, analgesic, anticonvulsant, (Aprotosoaie et al., 2014)
3	Endo-borneol	Antioxidant (Liu et al., 2023)
4	Cis-2-methyl-4-n-pentylthiane, s,s-dioxide	Antihyperlipidemic agent (Anees et al., 2024)
5	z,z-6,28-heptatriactontadien-2-one	High effectiveness as inti-fungal and anti-bacterial (Asma and Faris, 2023). Strong microbial activity (Visali *et al.*, 2022)
6	3-methyl-2-(2-oxopropyl)furan	Antimicrobial properties (Okezu et al., 2020, Sarah et al., 2020, Mamza et al., 2022)
7	1h-3a,7-methanoazulene, octahydro-1,4,9,9-tetramethyl	Antibacterial (Sani et al., 2019)

8	3-methyl-2-(2-oxopropyl)furan	Antimicrobial, properties (Okezu et al., 2020, Sarah et al., 2020, Mamza et al., 2022)
9	1,2,3,4-dodecanetetrol, [2r-(2r*,3s*,4s*)]-	No activity reported
10	3-methyl-2-(2-oxopropyl)furan	Antimicrobial, properties (Okezu et al., 2020, Sarah et al., 2020, Mamza et al., 2022)
11	4H-1-benzopyran-4-one, 5-hydroxy-7-methoxy-2-phenyl-	Antioxidant (Anusha and Immanuel, 2019), Anti-inflammatory, and anticancer properties (Khairullah *et al.*, 2021), Chachad and Shimpi, 2008).
12	4-dimethyl(pentafluorophenyl)silyloxypentadecane	Not reported

Figure 2: FTIR Spectrometry of methanol rhizome extract of *Cucurma amada*

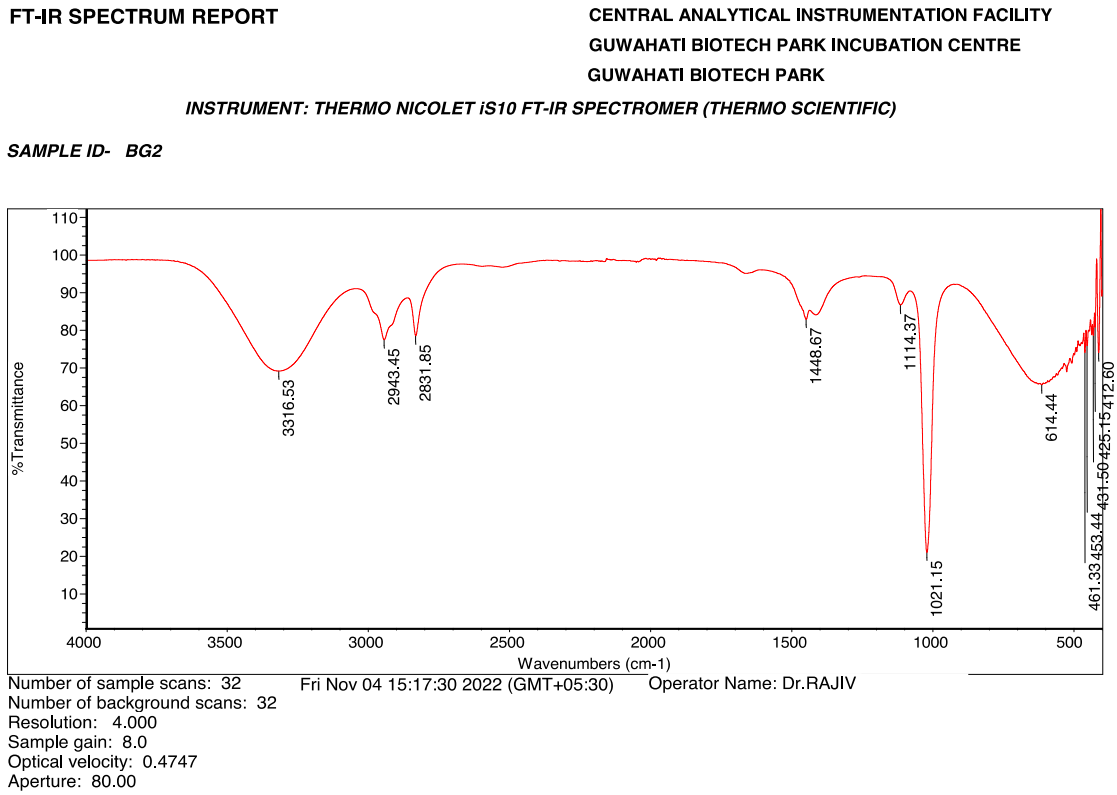


Table 4: FTIR analysis of methanol rhizome extract of *Cucurma amada*

Sl. No.	Frequency (cm-1)	Wave number (cm-1)	Bond /Mode of vibration	Functional group	Peak detail
1	3310-3350	3316.53	N-H stretching	Secondary amine	Medium
2	28401- 3000	2943.45	C-H stretching	Alkane	Medium
3	2800-3000	2831.85	N-H stretching	Amine salt	Strong, broad
4	1390 - 1450	1448.67	C-H bending	Alkane	medium
5	1000-1400	1114.37	C-F stretching	Fluoro compound	Strong
6	1020-1250	1021.15	C-N stretching	Amine	Medium
7	515-690	614.44	C-Br stretching	Halo compound	strong

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