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# Phytochemical Screening and Quantitative Analysis of *Curcuma aromatica* Salisb (Wild Turmeric) with Reference to its Biological Significance

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**Abstract**: ***Curcuma aromatica* Salisb., commonly referred to as wild turmeric, is extensively recognized in traditional medicinal systems due to its notable pharmacological properties. The present study was undertaken to examine the qualitative as well as quantitative phytochemical features of *C. aromatica* rhizomes.**

**Various solvent extracts were prepared and systematically evaluated to detect major classes of secondary metabolites including alkaloids, phenolics, flavonoids, tannins, and glycosides. In addition, spectrophotometric techniques were applied for the determination of Total Phenolic Content (TPC) and Total Flavonoid Content (TFC).**

**The results demonstrated a comparatively high level of phenolic and flavonoid compounds, suggesting considerable antioxidant activity. The occurrence of these bioactive constituents, together with sesquiterpenes and curcuminoids, underlines the therapeutic significance of the plant.**

**Overall, the study validates the traditional use of *Curcuma aromatica* and indicates its potential utility in the development of pharmaceutical and nutraceutical formulations.**

***Keywords:*** *Curcuma aromatica; Wild Turmeric; Phytochemical Profiling; Spectrophotometric Evaluation; Total Phenolic Content (TPC); Total Flavonoid Content (TFC); Antioxidant Activity; Natural Product Chemistry; Drug Development.*

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## I. INTRODUCTION

Medicinal plants have long been an integral part of traditional healthcare systems and represent a valuable source of bioactive compounds (Gokhale et al., 2008; Shamim et al., 2011). These plants are rich in diverse classes of phytochemicals, including alkaloids, flavonoids, phenolic compounds, terpenoids, and glycosides, which are largely responsible for their therapeutic efficacy (Shamim et al., 2011). In recent years, there has been a growing scientific interest in plant-derived medicines owing to their effectiveness, cost-efficiency, and comparatively lower risk of adverse effects than synthetic drugs. As a result, natural products continue to play a crucial role in contemporary drug discovery and development, particularly in the identification of novel bioactive molecules (Lesgards et al., 2014).

The family Zingiberaceae includes several medicinally significant species, among which *Curcuma aromatica* Salisb., commonly known as wild turmeric, holds considerable importance. Although *Curcuma longa* (turmeric) has been extensively investigated and widely utilized, *Curcuma aromatica* has increasingly attracted scientific attention due to its distinctive chemical composition and notable pharmacological properties (Al-Reza et al., 2010). This perennial herb is predominantly found in tropical regions, especially across various parts of India such as West Bengal, Kerala, and Madhya Pradesh. Traditionally, it has been used

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in Ayurvedic and folk medicine for the management of skin disorders, inflammation, wounds, infections, and gastrointestinal ailments (Kumar et al., 2009). Furthermore, it is widely incorporated in cosmetic formulations for skin care and complexion improvement (Panich et al., 2010).

The rhizomes of *Curcuma aromatica* are known to be rich in secondary metabolites, including phenolics, flavonoids, curcuminoids, essential oils, and other bioactive constituents. These compounds exhibit a broad range of biological activities such as antioxidant, antimicrobial, anti-inflammatory, anticancer, and hepatoprotective effects (Wu et al., 2000; Ha et al., 2011). Among these, antioxidant activity plays a significant role in scavenging free radicals and mitigating oxidative stress-related diseases (Kim et al., 1997). Curcumin, a major bioactive constituent of *Curcuma* species, has been widely reported to exhibit significant antioxidant, anti-inflammatory, and anticancer activities (Gupta et al., 2013). Therefore, comprehensive phytochemical investigation of this plant is essential to fully understand and utilize its therapeutic potential.

Extraction of phytochemicals using solvents of varying polarity is a widely adopted approach for isolating both polar and non-polar constituents from plant materials. Different solvents facilitate selective extraction of specific groups of compounds, thereby enabling a more detailed understanding of phytochemical composition. Qualitative phytochemical screening is useful for identifying major classes of secondary metabolites, while quantitative analysis provides precise information regarding the concentration of key bioactive compounds.

Among quantitative analytical techniques, the estimation of total phenolic content (TPC) and total flavonoid content (TFC) using spectrophotometric methods is considered a reliable measure of antioxidant potential. Phenolic and flavonoid compounds are major contributors to the biological activities of medicinal plants, particularly due to their strong free radical scavenging ability and capacity to reduce oxidative damage.

In addition to their therapeutic importance, plant-derived compounds are gaining increasing attention for their applications in pharmaceutical, nutraceutical, and cosmetic industries. The rising demand for natural antioxidants and bioactive substances further highlights the need for systematic phytochemical investigations.

Therefore, the present study aims to perform a comprehensive qualitative and quantitative phytochemical analysis of *Curcuma aromatica* rhizomes. The study focuses on the identification of major phytochemical constituents along with the estimation of TPC and TFC to assess the antioxidant potential and biological relevance of the plant. The outcomes of this research may contribute to the development of plant-based therapeutic agents and provide scientific validation for the traditional uses of *Curcuma aromatica*.

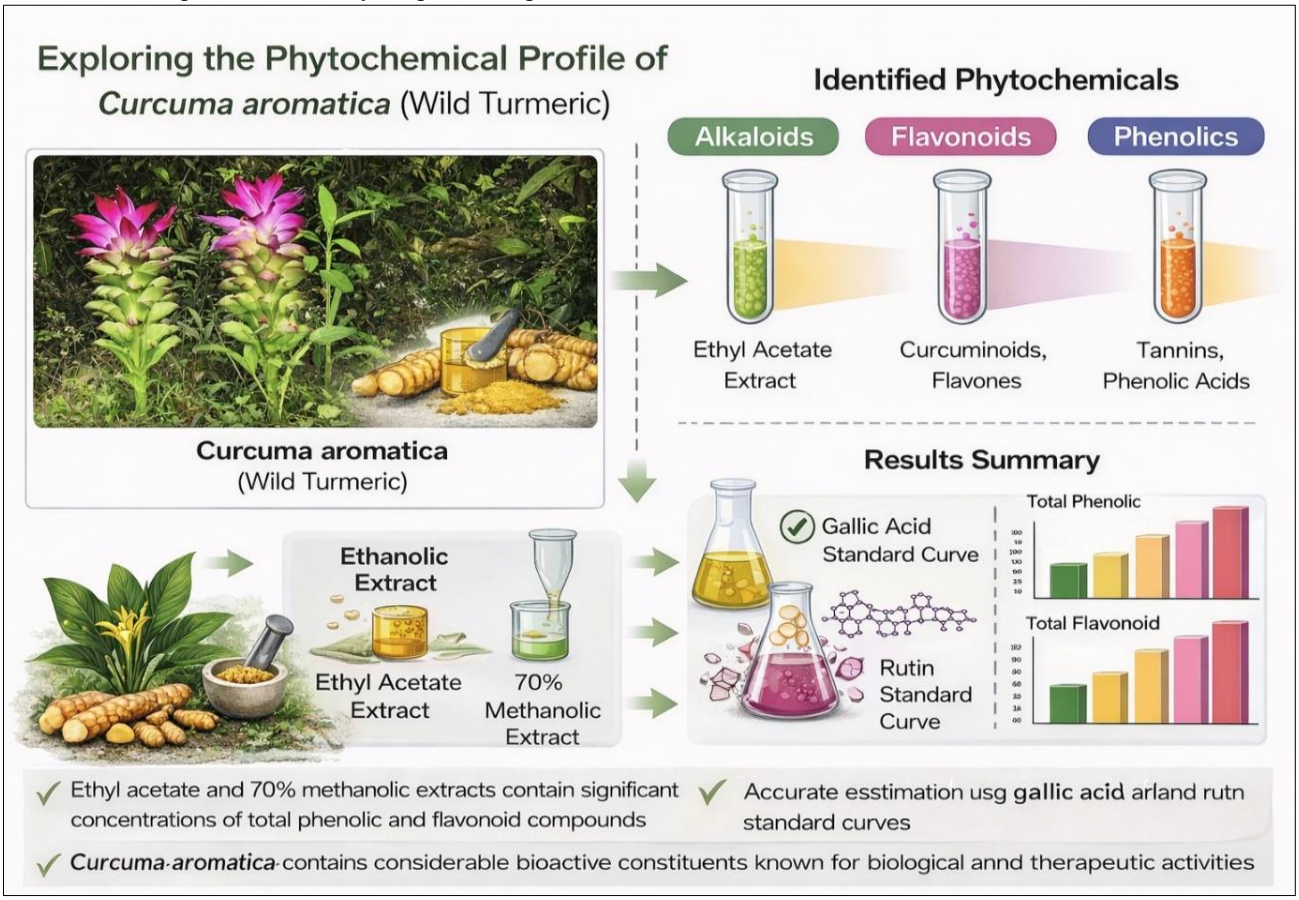

Fig 1 Schematic Overview of Phytochemical Screening and Quantitative Analysis of *Curcuma aromatica* Extracts

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## II. PLANT PROFILE

➢ *Botanical Name: Curcuma aromatica Salisb*

- *Kingdom:* Plantae
- *Order:* Zingiberales
- *Family:* Zingiberaceae
- *Genus: Curcuma*
- *Species: Curcuma aromatica*
- *Common Names:* Ban-Haridra, Jangli Haldi (wild turmeric)

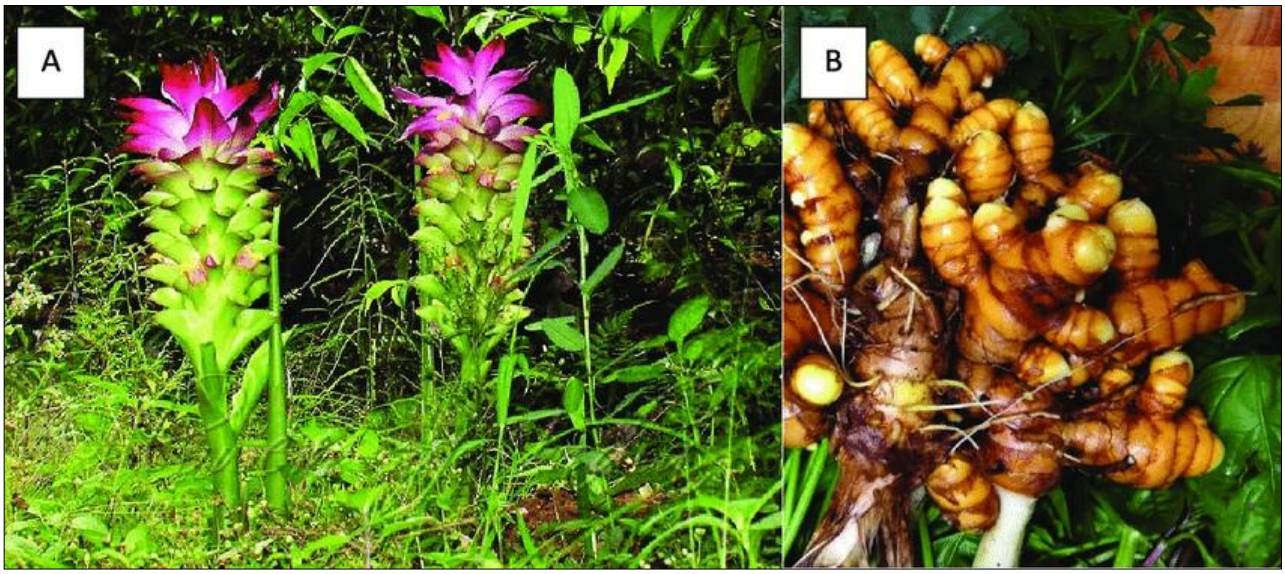


Fig 2 (A) Inflorescence of *Curcuma aromatica* in its Natural Environment
(B) Fresh rhizome samples of *Curcuma aromatica*.

## III. MATERIALS AND METHODS

➢ *Botanical Authentication and Collection*

Rhizome samples of *Curcuma aromatica* were collected from different locations in Chhindwara, Madhya Pradesh, India, during October–December. The collected plant samples were carefully cleaned to eliminate soil particles and other unwanted impurities. Herbarium specimens were prepared for accurate identification and authentication. The plant material was authenticated by Mr. Mahesh Kumar Ghyawat, Department of Botany, Danielson Degree College, Chhindwara. The authenticated specimen was then preserved for future reference.

➢ *Pre-Extraction Processing*

Fresh rhizomes were carefully washed with distilled water to eliminate surface impurities and contaminants. The cleaned samples were then allowed to dry under shade at room temperature to prevent the degradation of thermolabile compounds. Once completely dried, the rhizomes were cut into smaller pieces and pulverized into a coarse powder using a mechanical grinder. The obtained powder was passed through a sieve to ensure uniform particle size and subsequently stored in airtight containers for further experimental use.

➢ *Extraction Methodology*

The powdered rhizomes of *Curcuma aromatica* were subjected to Soxhlet extraction for the isolation of phytochemical constituents. Solvents of different polarities were employed to ensure efficient extraction of both polar and non-polar compounds.

- *Soxhlet Extraction Procedure*

The powdered plant material was loaded into a Soxhlet apparatus and extracted using suitable solvents. This technique is highly effective for extracting phytochemicals with limited solubility through repeated solvent cycling. The process enables continuous extraction and enhances the overall yield of bioactive constituents.

- *Temperature Control*

During the extraction process, temperature was carefully maintained to avoid the degradation of heat-sensitive compounds. Proper thermal control ensured the stability and preservation of.

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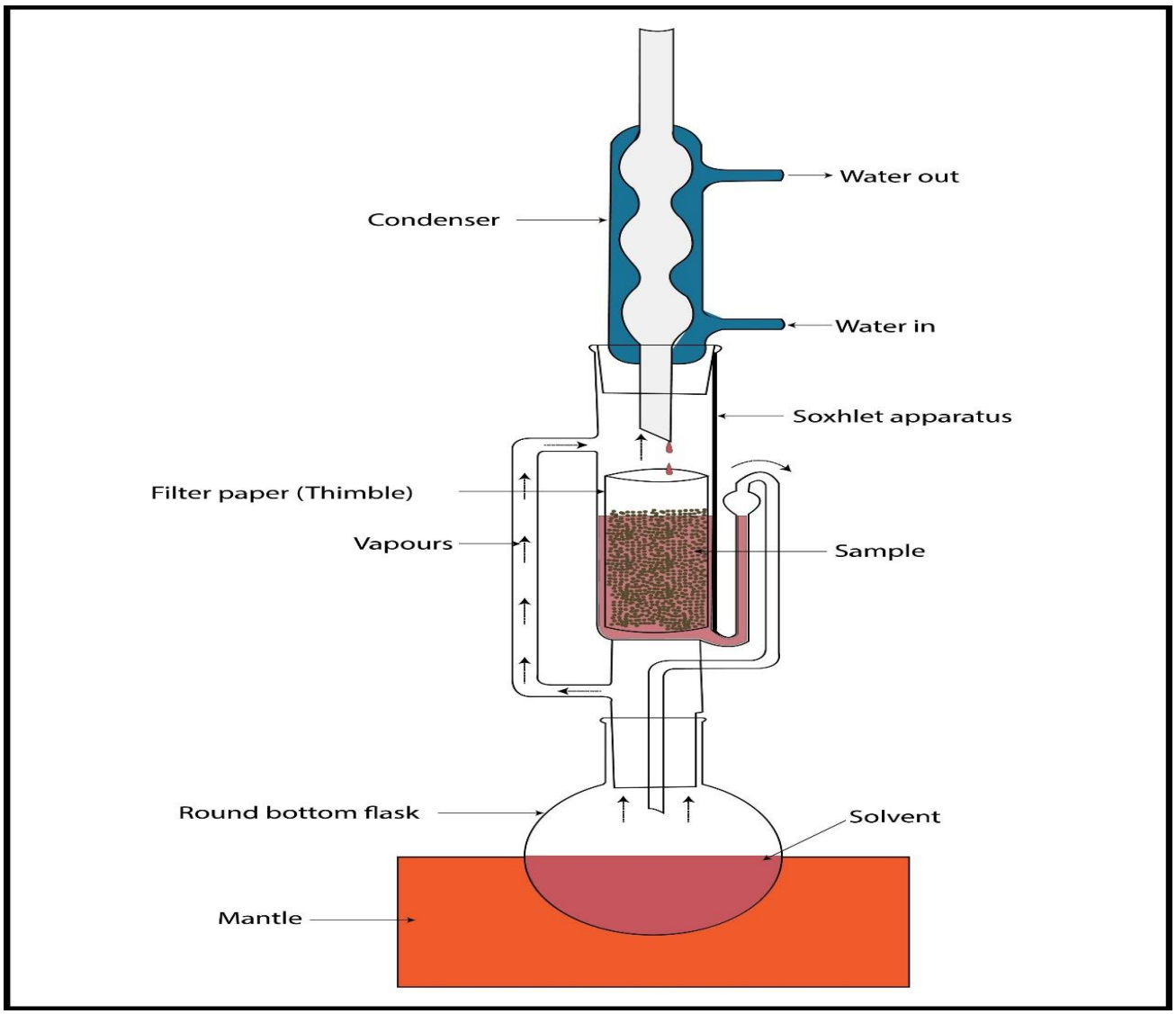


Fig 3 Schematic Illustration of the Soxhlet Extraction Assembly Used for the Systematic Extraction of Bioactive Metabolites from Powdered *Curcuma aromatica* Rhizomes

➢ *Reagents and Materials*

The following materials were employed for the systematic extraction procedure:

- Standardized powdered rhizome sample of *C. aromatica*
- Petroleum Ether
- Ethyl Acetate
- 70% Methanol

➢ *Successive Solvent Extraction Protocol*

A stepwise extraction approach was adopted to separate various chemical constituents of the rhizomes according to differences in their solubility and polarity.

- *Defatting and Petroleum Ether Extraction*

Approximately 300 g of coarsely powdered, shade-dried rhizomes of *Curcuma aromatica* were placed in a Soxhlet apparatus for extraction. The initial extraction was performed using petroleum ether (boiling range 60–80°C). The reflux process was continued until the solvent in the siphon tube became colourless, indicating complete extraction.

The extract obtained was filtered while still hot, and the solvent was removed under reduced pressure using a vacuum distillation setup. The resulting concentrated residue was further dried in a desiccator to eliminate any remaining solvent traces. Finally, the dried extract was weighed, and the percentage yield was determined based on the initial air-dried plant material.

- *Intermediate Polarity Extraction (Ethyl Acetate)*

After completion of petroleum ether extraction, the remaining marc was allowed to dry completely under air. The dried material (300 g) was again packed into the Soxhlet apparatus and extracted with ethyl acetate (boiling point ≈77°C).

The extraction process was continued until the solvent became colourless. The collected extract was filtered and concentrated under reduced pressure, followed by drying in a

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desiccator. The percentage yield of this fraction was calculated based on the original air-dried sample weight.

- *Polar Extraction with 70% Methanol*

The marc obtained after ethyl acetate extraction was further subjected to extraction using 70% methanol in the Soxhlet apparatus for about 24 hours. This process was repeated three times to ensure maximum extraction of polar phytoconstituents.

The obtained extract was filtered and subsequently concentrated under reduced pressure, followed by drying in a desiccator. The yield of this fraction was then calculated based on the initial air-dried sample weight.

➢ *Qualitative Phytochemical Screening*

The prepared extracts were subjected to qualitative phytochemical analysis to identify the presence of various secondary metabolites, including alkaloids, flavonoids, carbohydrates, glycosides, phenolic compounds, tannins, saponins, proteins, and steroids. The identification of these constituents was based on characteristic colour changes or the formation of specific precipitates during the respective chemical tests.

- *Detection of Alkaloids*

✓ *Mayer's Test for Alkaloids:*

A small portion of the extract was mixed with Mayer's reagent (potassium mercuric iodide solution). The appearance of a cream or pale precipitate indicated the presence of alkaloids.

✓ *Wagner's Test for Alkaloids:*

A small quantity of the extract was mixed with Wagner's reagent (iodine–potassium iodide solution). The development of a brownish-red precipitate was taken as evidence for the presence of alkaloidal compounds.

- *Carbohydrate Characterization*

✓ *Molisch's Assay:*

The extract was carefully mixed with alcoholic α-naphthol *(Molisch reagent)* followed by the careful addition of concentrated sulphuric acid along the side of the test tube. The formation of a violet ring at the junction indicated the presence of carbohydrates.

✓ *Barfoed's Assay:*

The extract was heated with Barfoed's reagent *(copper acetate in acetic acid solution)* in a boiling water bath. The appearance of a red precipitate confirmed the presence of monosaccharides.

- *Detection of Reducing Sugars*

✓ *Fehling's Assay:*

The sample solution was combined with equal volumes of Fehling's solution A *(copper sulphate solution)* and Fehling's solution B *(alkaline sodium potassium tartrate solution)* and heated in a water bath. Formation of a yellow to brick-red precipitate indicated reducing sugars.

✓ *Benedict's Assay:*

The extract was treated with Benedict's reagent *(alkaline copper citrate solution)* and heated in a water bath. The appearance of green, yellow, or red precipitate confirmed the presence of reducing sugars.

- *Screening for Flavonoids*

✓ *Alkaline Reagent Assay:*

The extract was treated with sodium hydroxide solution *(NaOH)*. A yellow colour that disappeared upon addition of dilute acid indicated flavonoids.

✓ *Shinoda Assay:*

The extract was reacted with magnesium turnings *(Mg metal)* and concentrated hydrochloric acid *(HCl)* in ethanol. The development of pink or red colour confirmed the presence of flavonoids.

✓ *Lead Acetate Assay:*

The extract was treated with lead acetate solution (Pb $(CH_3COO)_2$). The formation of a yellow precipitate indicated the presence of flavonoids.

- *Determination of Glycosides*

✓ *Borntrager's Assay:*

The extract was hydrolysed with dilute sulphuric acid *($H_2SO_4$)*, filtered, and extracted with chloroform *($CHCl_3$)*. The organic layer was separated and treated with ammonia solution *($NH_3$)*. Formation of pink to red colour indicated anthraquinone glycosides.

✓ *Legal's Assay:*

The extract was first dissolved in pyridine ($C_5H_5N$) and then allowed to react with sodium nitroprusside $Na_2[Fe(CN)_5NO]$ followed by the addition of sodium hydroxide (NaOH). The development of a pink to blood-red colour indicated the presence of cardiac glycosides.

✓ *Keller–Killiani Assay:*

The extract was treated with glacial acetic acid *($CH_3COOH$)* and ferric chloride *($FeCl_3$)* followed by concentrated sulphuric acid *($H_2SO_4$)*. Formation of a bluish-green colour at the interface confirmed cardiac glycosides.

- *Analysis of Phenolic Compounds and Tannins*

✓ *Ferric Chloride Assay:*

The extract was treated with 5% ferric chloride *($FeCl_3$)* solution. Development of blue, green, or violet colour indicated phenolic compounds.

✓ *Lead Acetate Assay:*

The extract was treated with lead acetate *($Pb(CH_3COO)_2$)* solution. Formation of a white precipitate indicated phenolics.

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✓ *Iodine Assay:*
The extract was treated with dilute iodine solution *($I_2$/KI)*. Formation of a reddish colour suggested phenolic compounds.

- *Verification of Saponins*

✓ *Foaming Assay:*
The extract was vigorously shaken with distilled water for about 15 minutes. Formation of stable and persistent foam indicated the presence of saponins.

- *Protein and Amino Acid Estimation*

✓ *Ninhydrin Assay:*
The extract was heated with 5% ninhydrin solution *(triketohydrindene hydrate)* in a water bath. Development of blue or violet colour confirmed amino acids.

- *Steroid and Triterpenoid Profiling*

✓ *Salkowski Assay:*
The extract was dissolved in chloroform *($CHCl_3$)* and treated with concentrated sulphuric acid *($H_2SO_4$)*. A reddish-brown colour indicated steroids, whereas a yellow colour suggested triterpenoids.

✓ *Liebermann–Burchard Assay:*
The extract was treated with acetic anhydride ($(CH_3CO)_2O$) and chloroform ($CHCl_3$), followed by the addition of concentrated sulphuric acid ($H_2SO_4$). The formation of a green colour indicated the presence of steroids, whereas a red colour indicated triterpenoids.

➢ *Quantitative Phytochemical Investigation*

- *Spectrophotometric Estimation of Total Phenolic Content (TPC)*

The total phenolic content (TPC) of the extracts was evaluated using the Folin–Ciocalteu method, with gallic acid as the reference standard. The results were expressed in terms of gallic acid equivalents (mg GAE) per gram of extract.

Standard solutions of gallic acid (10–50 µg/mL) were prepared in methanol to construct the calibration curve. The plant extract solutions were prepared at concentrations of 0.1 mg/mL and 1 mg/mL. For analysis, 0.5 mL of the sample solution was mixed with 2.5 mL of diluted Folin–Ciocalteu reagent, followed by the addition of 2 mL of 7.5% sodium carbonate solution *($Na_2CO_3$)*.

The reaction mixture was incubated at ambient temperature for 30 minutes. The absorbance of the developed, blue-coloured solution was recorded at 760 nm using a spectrophotometer. All measurements were carried out in triplicate to ensure accuracy and reproducibility.

The total phenolic content was calculated using the gallic acid calibration curve based on the following regression equation:

$$Y = 0.005X + 0.065$$
$$R^2 = 0.975$$

where Y represents absorbance and X denotes the concentration of gallic acid. The high $R^2$ value indicates good linearity of the calibration curve.

- *Spectrophotometric Estimation of Total Flavonoid Content (TFC)*

The total flavonoid content (TFC) of the extracts was determined using the aluminium chloride colorimetric method, with rutin as the reference standard. The results were expressed in terms of rutin equivalents (mg RE) per gram of dry weight.

Standard solutions of rutin were prepared to generate the calibration curve. For analysis, the plant extract (or standard rutin solution) was mixed with the reagent solution and allowed to react for 6 minutes. Subsequently, 0.15 mL of aluminium chloride solution *($AlCl_3$)* (100 g/L) was added. After 5 minutes, sodium hydroxide *(NaOH)* was introduced, and the final volume was adjusted to 2.5 mL with distilled water.

The absorbance of the resulting solution was measured at 510 nm using a spectrophotometer against a reagent blank. All experiments were performed in triplicate to ensure accuracy and consistency.

The total flavonoid content was calculated using the calibration curve of rutin based on the following regression equation:

$$Y = 0.001X + 0.120$$
$$R^2 = 0.988$$

where Y represents absorbance and X indicates the concentration of rutin. The high $R^2$ value confirms good linearity of the calibration curve.

## IV. RESULTS

➢ *Qualitative Phytochemical Screening*

Phytochemical screening of *Curcuma aromatica* rhizome extracts was carried out using solvents of varying polarity to evaluate the presence of different classes of secondary metabolites. The results clearly indicated that the distribution of phytochemical constituents was influenced by the nature of the solvent used.

The petroleum ether extract exhibited a limited phytochemical profile and showed positive results only for alkaloids. In comparison, the ethyl acetate extract revealed the presence of a wider range of phytoconstituents, including alkaloids, carbohydrates, flavonoids, tannins, phenolic compounds, triterpenoids, and steroids.

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The 70% methanolic extract demonstrated the most comprehensive phytochemical profile, indicating the presence of alkaloids, carbohydrates, glycosides, tannins, phenolic compounds, triterpenoids, steroids, and saponins. This extract showed a higher efficiency in extracting polar constituents such as saponins, which were not detected in the other extracts. The detailed observations of the qualitative phytochemical screening are presented in Table 1.

Table 1 Qualitative Analysis of Phytochemical Constituents in *Curcuma aromatica* Extracts

| S. No. | Phytochemical Constituents | Petroleum ether extract | Ethyl acetate extract | 70% methanolicextract |
|---|---|---|---|---|
| **1.** | **Alkaloids** | | | |
| 1.1 | Mayer's Test for Alkaloids | + | + | + |
| 1.2 | Wagner's Reagent Test | + | + | + |
| 1.3 | Hager's Reagent Test | + | + | + |
| **2.** | **Carbohydrates** | | | |
| 2.1 | Molisch's Test | – | + | + |
| 2.2 | Barfoed's Test | – | + | + |
| **3.** | **Reducing Sugars** | | | |
| 3.1 | Fehling's Test | – | – | – |
| 3.2 | Benedict's Test | – | – | – |
| **4.** | **Flavonoids** | | | |
| 4.1 | Alkaline Reagent Test | – | + | + |
| 4.2 | Shinoda Test | – | + | – |
| 4.3 | Lead Acetate Test | – | + | – |
| **5.** | **Glycosides** | | | |
| 5.1 | Bornträger's Test | – | + | + |
| 5.2 | Legal's Test | – | + | + |
| 5.3 | Keller–Killiani Test | – | + | + |
| **6.** | **Phenolics & Tannins** | | | |
| 6.1 | Ferric Chloride Test | – | + | + |
| 6.2 | Lead Acetate Test | – | + | + |
| 6.3 | Dilute Iodine Solution | – | + | + |
| **7.** | **Saponins** (Foam Test) | – | – | + |
| **8.** | **Proteins & Amino Acids** | – | – | – |
| **9.** | **Triterpenoids & Steroids** | | | |
| 9.1 | Salkowski Test | – | + | + |
| 9.2 | Liebermann–Burchard Test | – | + | + |

(+) = Present; (–) = Absent

➢ *Quantitative Phytochemical Estimations*

• *Total Phenolic Content (TPC)*

The total phenolic content of *Curcuma aromatica* rhizome extracts was evaluated using the Folin–Ciocalteu method. The results were expressed in terms of gallic acid equivalents (mg GAE) per gram of extract.Quantification was performed using the gallic acid calibration curve, and the regression equation obtained was:

$$Y = 0.005X + 0.065$$
$$R^2 = 0.975$$

where Y denotes absorbance and X represents the concentration of gallic acid.

The high value of $R^2$ indicates good linearity of the calibration curve. Among the various extracts, the 70% methanolic extract exhibited the highest phenolic content, recorded as 191.16 ± 1.058 mg GAE per gram of extract, followed by the ethyl acetate extract with 174.73 ± 1.006 mg GAE per gram of extract. These findings suggest that the methanolic extract contains a greater concentration of phenolic compounds, which may be responsible for its enhanced antioxidant activity. (Al-Reza et al., 2010).

• *Total Flavonoid Content (TFC)*

The total flavonoid content of *Curcuma aromatica* rhizome extracts was determined using the aluminium chloride colorimetric method, with rutin as the reference standard. The results were expressed in terms of rutin equivalents (mg RE) per gram of extract.

The calibration curve of rutin was used for quantification, and the regression equation obtained was:

$$Y = 0.001X + 0.120$$
$$R^2 = 0.988$$

where Y represents absorbance and X indicates the concentration of rutin. The high $R^2$ value reflects good linearity of the calibration curve. Among the extracts, the 70% methanolic extract showed the highest flavonoid content, measured as 115.33 ± 1.154 mg RE per gram of extract, followed by the ethyl acetate extract with 92.33 ±

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3.055 mg RE per gram of extract. These observations indicate that the methanolic extract is richer in flavonoid constituents.

➢ *Summary of Quantitative Findings*

The comparatively higher TPC and TFC values observed in the methanolic extract suggest that polar solvents are more efficient in extracting bioactive constituents from *Curcuma aromatica*. The elevated levels of phenolic and flavonoid compounds indicate strong antioxidant potential and further support the medicinal significance of the plant.

Table 2 Spectrophotometric Absorbance Values of Gallic Acid Standards for Calibration Curve Preparation

| S. No. | Concentration | Absorbance |
|---|---|---|
| 1 | 10 | 0.1098 |
| 2 | 20 | 0.1763 |
| 3 | 30 | 0.2471 |
| 4 | 40 | 0.2979 |
| 5 | 50 | 0.3258 |

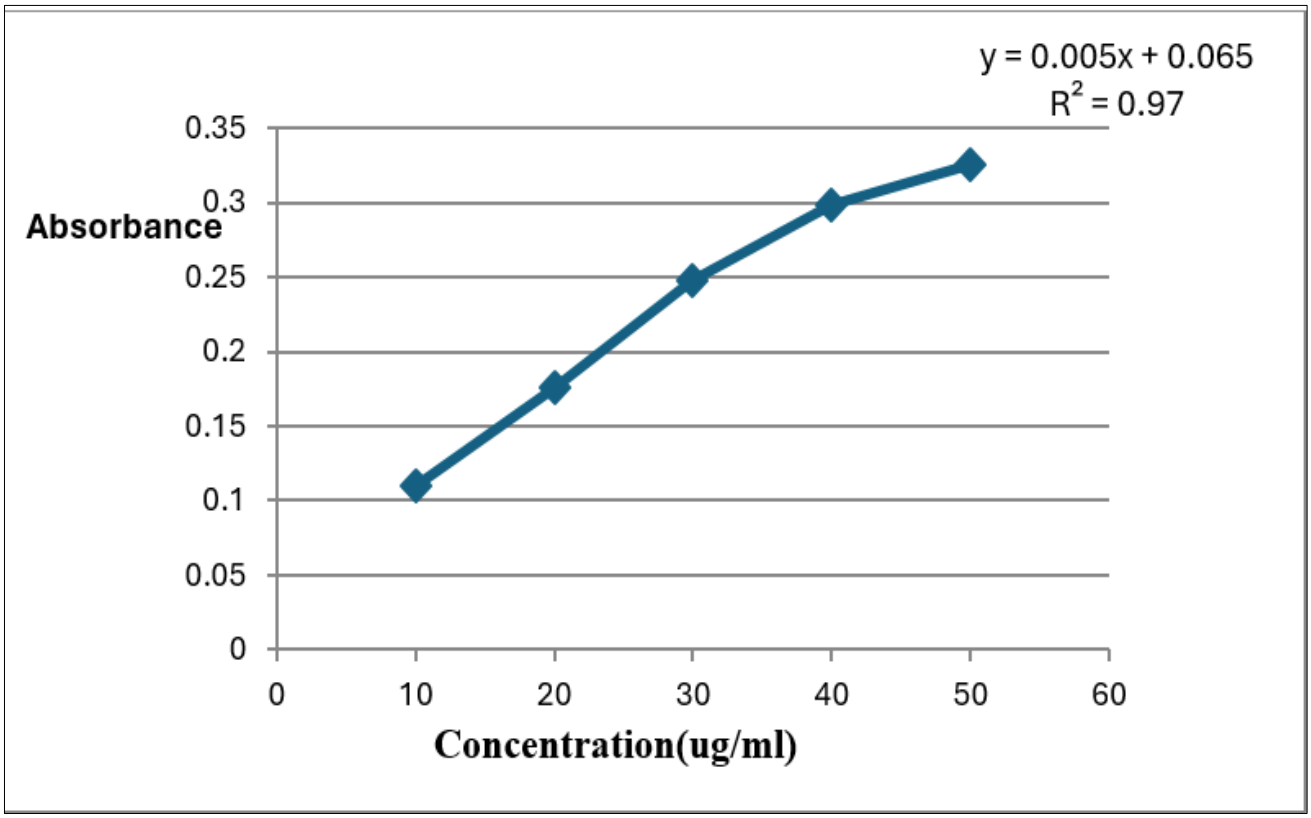


Fig 4 Calibration Curve of Gallic Acid Used for the Determination of Total Phenolic Content in *C. aromatica* Extracts

Table 3 Determination of Total Phenolic Content in Ethyl Acetate Extract of *Curcuma aromatica*

| S.No | Absorbance | Concentration | Total phenolic content (mg GAE per gram of extract) |
|---|---|---|---|
| **1** | 0.944 | 1 mg/mL | 175.8 |
| **2** | 0.934 | 1 mg/mL | 173.8 |
| **3** | 0.938 | 1 mg/mL | 174.6 |
| **MEAN±SD** | | | **174.73±1.006** |

Table 4 Determination of Total Phenolic Content in 70% Methanolic Extract of *Curcuma aromatica*

| S.No | Absorbance | Concentration | Total phenolic content (mg GAE per gram of extract) |
|---|---|---|---|
| **1** | 1.029 | 1 mg/mL | 192.8 |
| **2** | 1.021 | 1 mg/mL | 191.2 |
| **3** | 1.091 | 1 mg/mL | 190.8 |
| **MEAN±SD** | | | **191.16±1.058** |

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- *Total Flavonoid Content (TFC)*

Table 5 Spectrophotometric Absorbance Values of Rutin Standard Used for Calibration Curve

| S.No | Concentration | Absorbance |
|---|---|---|
| 1 | 10 | 0.1098 |
| 2 | 20 | 0.1763 |
| 3 | 30 | 0.2471 |
| 4 | 40 | 0.2979 |
| 5 | 50 | 0.3258 |

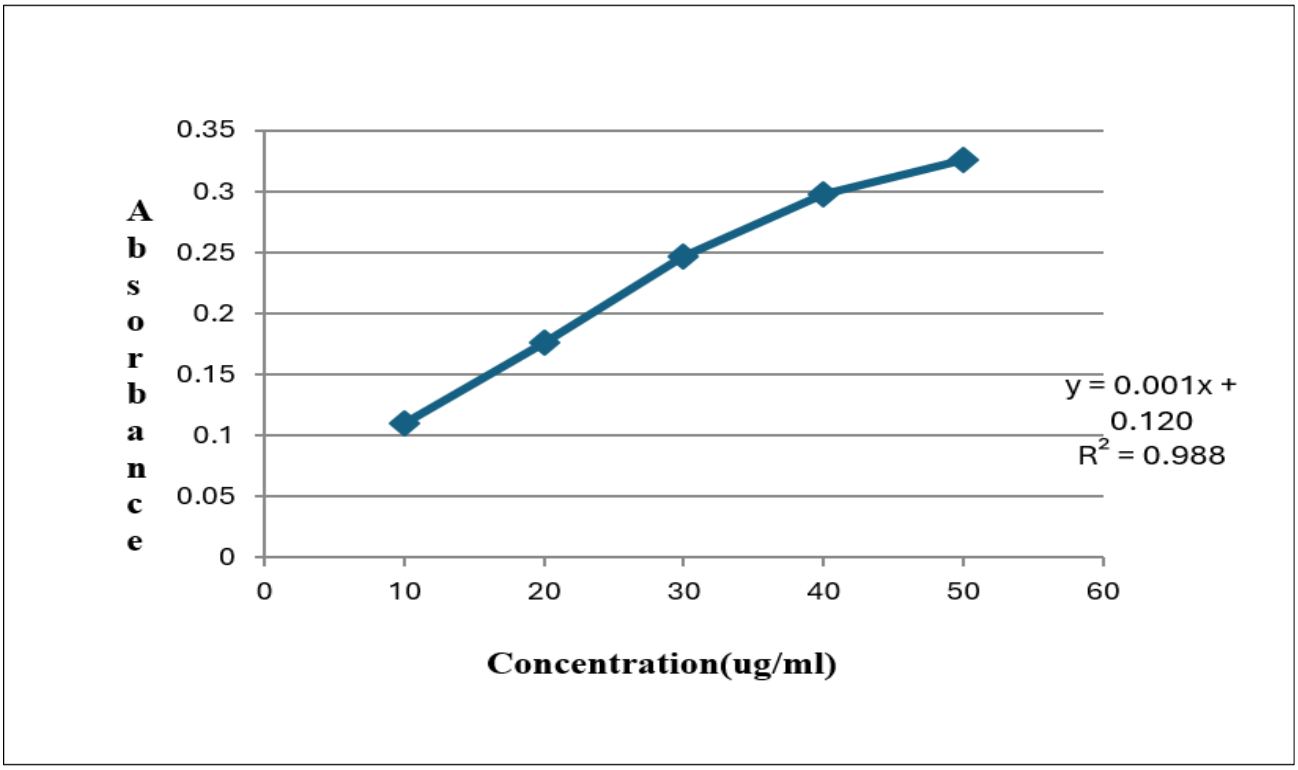


Fig 5 Calibration Curve of Rutin Used for Estimation of Total Flavonoid Content in *C. aromatica* Extracts

## V. CONCLUSION

The present study provides a comprehensive qualitative and quantitative phytochemical evaluation of *Curcuma aromatica* rhizomes using a multi-solvent extraction approach. The findings confirmed the presence of important bioactive constituents such as alkaloids, flavonoids, phenolics, tannins, and glycosides, with higher concentrations observed in polar extracts. Quantitative estimation revealed that the 70% methanolic extract possessed significantly higher total phenolic and flavonoid contents, indicating its superior antioxidant potential.

The presence of these phytochemicals suggests that *Curcuma aromatica* may serve as an effective natural source of antioxidants capable of combating oxidative stress-related disorders. The antioxidant activity of phenolic and flavonoid compounds plays a crucial role in neutralizing free radicals, thereby contributing to the prevention of chronic diseases (Kim et al., 1997).

From a societal and healthcare perspective, *Curcuma aromatica* holds considerable importance. Traditionally, it has been widely used for skin care, wound healing, and treatment of inflammatory conditions (Kumar et al., 2009). The results of the present study further support its potential application in the development of herbal formulations for skin protection and rejuvenation. In particular, the rich antioxidant profile of the plant indicates its possible role in protecting skin cells from oxidative damage, which is often associated with premature aging and various skin disorders (Panich et al., 2010).

Moreover, the bioactive constituents present in *Curcuma aromatica* suggest its potential use in the management of certain skin-related conditions, including abnormal cell growth. Although preliminary evidence indicates that compounds such as curcuminoids may exhibit anticancer properties, including activity against skin-related cancers, further detailed pharmacological and clinical studies are required to validate these effects (Wu et al., 2000; Ha et al., 2011).

In addition to medicinal applications, the plant also shows promising potential in pharmaceutical, nutraceutical, and cosmetic industries due to its natural origin and bioactive

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richness. The increasing demand for plant-based and safer therapeutic agents further highlights the relevance of such studies (Lesgards et al., 2014).

Overall, the findings of this study not only validate the traditional uses of *Curcuma aromatica* but also emphasize its potential as a valuable natural resource for the development of novel therapeutic and skincare products. Furthermore, it may be considered a promising natural source of antioxidant compounds with potential anticancer properties (Gupta et al., 2013). Future research focusing on the isolation, characterization, and mechanism of action of individual bioactive compounds will further strengthen its applicability in modern medicine.

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