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An Evaluation of Antioxidant and Anti-inflammatory Properties of Tribal Medicinal Plants Used in Bastar.

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ABSTRACT

Traditional medicinal plants have long been utilized by tribal communities of Bastar region in Chhattisgarh for the treatment of inflammatory disorders, wounds, infections, fever, and other ailments. The present study was undertaken to evaluate the antioxidant and anti-inflammatory properties of selected tribal medicinal plants commonly used in Bastar. Ethanolic extracts of Azadirachta indica (Neem), Ocimum sanctum (Tulsi), Aloe vera, and Tinospora cordifolia (Giloy) were prepared and investigated for their phytochemical constituents, total phenolic content, total flavonoid content, antioxidant activity, and anti-inflammatory activity. Preliminary phytochemical screening confirmed the presence of alkaloids, flavonoids, tannins, glycosides, phenolic compounds, and terpenoids in all extracts. The total phenolic content was estimated using the Folin–Ciocalteu method, while total flavonoid content was evaluated by aluminium chloride colorimetric assay. Antioxidant activity was assessed using DPPH radical scavenging assay, whereas anti-inflammatory activity was evaluated through protein denaturation inhibition assay. The results demonstrated concentration-dependent antioxidant and anti-inflammatory activities in all plant extracts. Among the tested samples, Tinospora cordifolia exhibited the highest antioxidant activity with significant free radical scavenging effect, while Azadirachta indica showed remarkable anti-inflammatory potential. The study validates the traditional therapeutic use of Bastar tribal medicinal plants and highlights their potential as natural sources of antioxidant and anti-inflammatory agents. The findings suggest that these medicinal plants can be explored further for the development of herbal formulations and pharmaceutical products.

Keywords: Antioxidant activity; Anti-inflammatory activity; Tribal medicinal plants; Bastar region; Phytochemical screening; DPPH assay; Herbal medicine.

1. INTRODUCTION

Medicinal plants have been an integral component of traditional healthcare systems since ancient times. The tribal communities residing in forest-rich regions depend extensively on herbal remedies for the treatment and prevention of various diseases. Bastar region of Chhattisgarh is recognized for its rich biodiversity and traditional ethnomedicinal knowledge preserved by tribal populations such as Gond, Maria, Muria, Halba, and Bhatra tribes. These indigenous communities use numerous medicinal plants for treating inflammatory conditions, wounds, fever, skin diseases, digestive disorders, respiratory problems, and infectious diseases.

Reactive oxygen species (ROS) generated during normal metabolic processes are known to cause oxidative stress when produced in excess. Oxidative stress damages cellular structures including lipids, proteins, and nucleic acids, leading to several chronic disorders such as cancer, diabetes, cardiovascular diseases, arthritis, and neurodegenerative disorders. Antioxidants are substances capable of scavenging free radicals and protecting biological systems from oxidative damage.

Inflammation is a physiological response of the body against harmful stimuli including pathogens, damaged cells, toxins, and irritants. Although inflammation acts as a protective mechanism, prolonged or uncontrolled inflammation contributes to chronic diseases such as rheumatoid arthritis, diabetes, asthma, inflammatory bowel disease, and cardiovascular complications. Synthetic anti-inflammatory drugs are effective but often associated with adverse side effects including gastric irritation, ulceration, liver toxicity, and renal damage. Therefore, natural plant-derived compounds with antioxidant and anti-inflammatory properties have gained considerable attention.

Many medicinal plants contain bioactive compounds such as flavonoids, tannins, phenols, alkaloids, saponins, and terpenoids that possess antioxidant and anti-inflammatory activities. Traditional healers in Bastar use plants like Neem (Azadirachta indica), Tulsi (Ocimum sanctum), Aloe vera, and Giloy (Tinospora cordifolia) for managing inflammation, fever, wounds, infections, and general health disorders.

Azadirachta indica is widely known for its antimicrobial, anti-inflammatory, antioxidant, antidiabetic, and wound-healing activities. Ocimum sanctum possesses adaptogenic, immunomodulatory, antimicrobial, and antioxidant properties. Aloe vera is rich in polysaccharides, vitamins, enzymes, and phenolic compounds and is traditionally used for skin diseases, burns, and inflammation. Tinospora cordifolia is considered an important medicinal plant in Ayurveda due to its immunomodulatory, antioxidant, hepatoprotective, and anti-inflammatory effects.

Despite their widespread traditional use, scientific validation of the antioxidant and anti-inflammatory potential of these tribal medicinal plants remains essential. Therefore, the present study was designed to evaluate the phytochemical constituents, antioxidant activity, and anti-inflammatory properties of selected medicinal plants used by tribal communities in Bastar region.

2. OBJECTIVES OF THE STUDY

1. To collect and identify selected tribal medicinal plants used in Bastar region.
2. To prepare ethanolic extracts of selected medicinal plants.
3. To perform preliminary phytochemical screening of the extracts.
4. To estimate total phenolic content and total flavonoid content.
5. To evaluate antioxidant activity using DPPH radical scavenging assay.
6. To evaluate anti-inflammatory activity using protein denaturation assay.
7. To compare the biological activities of selected medicinal plant extracts.

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3. MATERIALS AND METHODS

Collection and Identification of Plant Materials

Fresh leaves of Azadirachta indica (Neem), Ocimum sanctum (Tulsi), Aloe vera, and stems of Tinospora cordifolia (Giloy) were collected from forest and tribal areas of Bastar district, Chhattisgarh. The collected plant materials were authenticated by a botanist from the Department of Botany. Voucher specimens were deposited in the herbarium for future reference.

Preparation of Plant Extracts

The collected plant materials were washed thoroughly with distilled water and shade dried at room temperature for 10–15 days. The dried samples were powdered using a mechanical grinder. Approximately 50 g of powdered plant material was extracted with 500 ml ethanol using Soxhlet apparatus for 6–8 hours. The extracts were filtered and concentrated using a rotary evaporator. The dried extracts were stored at 4°C until further use.

Chemicals and Reagents

All chemicals and reagents used in the study were of analytical grade. DPPH (2,2-diphenyl-1-picrylhydrazyl), Folin–Ciocalteu reagent, gallic acid, quercetin, bovine serum albumin, diclofenac sodium, sodium carbonate, aluminium chloride, sodium hydroxide, and methanol were procured from standard suppliers.

Preliminary Phytochemical Screening

Preliminary phytochemical screening of the ethanolic extracts was carried out using standard qualitative methods to identify the presence of alkaloids, flavonoids, tannins, phenols, glycosides, saponins, proteins, carbohydrates, and terpenoids.

Tests Performed

Test for Alkaloids

Mayer’s test, Wagner’s test, and Dragendorff’s test were performed.

Test for Flavonoids

Shinoda test and alkaline reagent test were conducted.

Test for Tannins and Phenolic Compounds

Ferric chloride test and lead acetate test were used.

Test for Saponins

Foam test was performed.

Test for Carbohydrates

Molisch’s test and Benedict’s test were carried out.

Test for Glycosides

Keller–Killiani test was performed.

Test for Terpenoids

Salkowski test was conducted.

Determination of Total Phenolic Content

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The total phenolic content of plant extracts was estimated using the Folin–Ciocalteu method. Gallic acid was used as standard. Different concentrations of gallic acid solutions were prepared for calibration. One milliliter of extract solution was mixed with Folin–Ciocalteu reagent followed by sodium carbonate solution. The mixture was incubated for 30 minutes and absorbance was measured at 760 nm using a UV-visible spectrophotometer. Results were expressed as mg gallic acid equivalents per gram of extract (mg GAE/g).

Determination of Total Flavonoid Content

Total flavonoid content was determined by aluminium chloride colorimetric method using quercetin as standard. The reaction mixture containing extract, aluminium chloride, sodium nitrite, sodium hydroxide, and distilled water was incubated and absorbance was measured at 510 nm. Results were expressed as mg quercetin equivalents per gram of extract (mg QE/g).

Antioxidant Activity by DPPH Radical Scavenging Assay

The antioxidant activity of plant extracts was evaluated by DPPH free radical scavenging assay. Different concentrations of plant extracts (25, 50, 100, 200, and 400 µg/ml) were prepared in methanol. One milliliter of extract solution was mixed with 3 ml DPPH solution and incubated in dark for 30 minutes. Absorbance was measured at 517 nm.

Quercetin was used as standard antioxidant.

Anti-inflammatory Activity by Protein Denaturation Assay

The anti-inflammatory activity was determined by inhibition of protein denaturation method using bovine serum albumin. Different concentrations of extracts were mixed with phosphate buffer and bovine serum albumin solution. The reaction mixture was incubated at 37°C followed by heating at 60°C for 15 minutes. After cooling, absorbance was measured at 660 nm.

Diclofenac sodium was used as standard anti-inflammatory drug.

Statistical Analysis

All experiments were performed in triplicate and results were expressed as Mean ± Standard Deviation (SD). Statistical analysis was performed using one-way analysis of variance (ANOVA) followed by Tukey's test. A p-value less than 0.05 was considered statistically significant.

4. RESULTS

Preliminary Phytochemical Screening

The preliminary phytochemical screening indicated the presence of several bioactive compounds in the ethanolic extracts.

Table 1: Phytochemical Screening of Selected Medicinal Plants

Phytochemicals	Neem	Tulsi	Aloe vera	Giloy
Alkaloids	++	++	+	++
Flavonoids	+++	+++	++	++
Tannins	++	++	+	++

Phenols	+++	++	++	+++
Saponins	+	++	++	+
Glycosides	++	+	+	++
Terpenoids	++	++	+	++
Carbohydrates	+	+	++	+

Note: + = Present, ++ = Moderately present, +++ = Highly present.

Table 1 presents the results of the preliminary phytochemical screening of selected tribal medicinal plant extracts namely Neem (Azadirachta indica), Tulsi (Ocimum sanctum), Aloe vera, and Giloy (Tinospora cordifolia). Phytochemical screening is an important step in herbal research because it helps identify the major bioactive constituents present in medicinal plants. These phytochemicals are responsible for various pharmacological and therapeutic properties such as antioxidant, anti-inflammatory, antimicrobial, antidiabetic, anticancer, and wound-healing activities.

The results of the study revealed the presence of several important phytochemicals including alkaloids, flavonoids, tannins, phenolic compounds, glycosides, terpenoids, saponins, and carbohydrates in varying concentrations. Among the tested plants, Neem and Giloy exhibited comparatively richer phytochemical profiles, indicating their high medicinal value.

Flavonoids and phenolic compounds were highly present in Neem, Tulsi, and Giloy. These compounds are considered major natural antioxidants because they possess the ability to neutralize free radicals and reduce oxidative stress. Oxidative stress is one of the major causes of chronic diseases such as diabetes, arthritis, cardiovascular disorders, cancer, and neurodegenerative diseases. Therefore, the high presence of flavonoids and phenols in these extracts suggests strong antioxidant potential.

Alkaloids were detected in all the extracts, though Aloe vera showed relatively lower concentration. Alkaloids are biologically active compounds known for analgesic, antimicrobial, and anti-inflammatory properties. The presence of alkaloids may contribute to the traditional use of these plants in treating infections, pain, and inflammatory conditions.

Tannins were also observed in most extracts. Tannins are polyphenolic compounds with astringent, antimicrobial, and wound-healing properties. They help in reducing inflammation and protecting tissues against oxidative damage. The presence of tannins supports the use of these medicinal plants for skin diseases, wounds, and gastrointestinal disorders.

Terpenoids and glycosides were found in moderate quantities in Neem, Tulsi, and Giloy. Terpenoids are known for their anti-inflammatory, antiviral, antibacterial, and anticancer activities. Glycosides contribute to cardioprotective and therapeutic effects. Their presence enhances the medicinal significance of these plant extracts.

Saponins were predominantly present in Tulsi and Aloe vera. Saponins are known for immune-boosting, antimicrobial, and cholesterol-lowering properties. They also exhibit anti-inflammatory activity by modulating immune responses.

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Among all the tested plants, Tulsi showed strong presence of flavonoids and terpenoids, while Giloy demonstrated high levels of phenolic compounds. Neem contained a balanced distribution of multiple phytochemicals, indicating its broad-spectrum therapeutic potential. Aloe vera contained comparatively moderate levels of phytochemicals but still possessed significant medicinal constituents supporting its traditional applications.

phytochemical screening confirms that the selected tribal medicinal plants are rich sources of bioactive compounds. These phytochemicals are likely responsible for the antioxidant and anti-inflammatory activities observed in the study. The findings scientifically validate the traditional medicinal practices of tribal communities in Bastar region and support the future development of herbal formulations and natural therapeutic agents from these medicinal plants.

Fig 1. Preliminary Phytochemical Screening of Selected Tribal Medicinal Plants

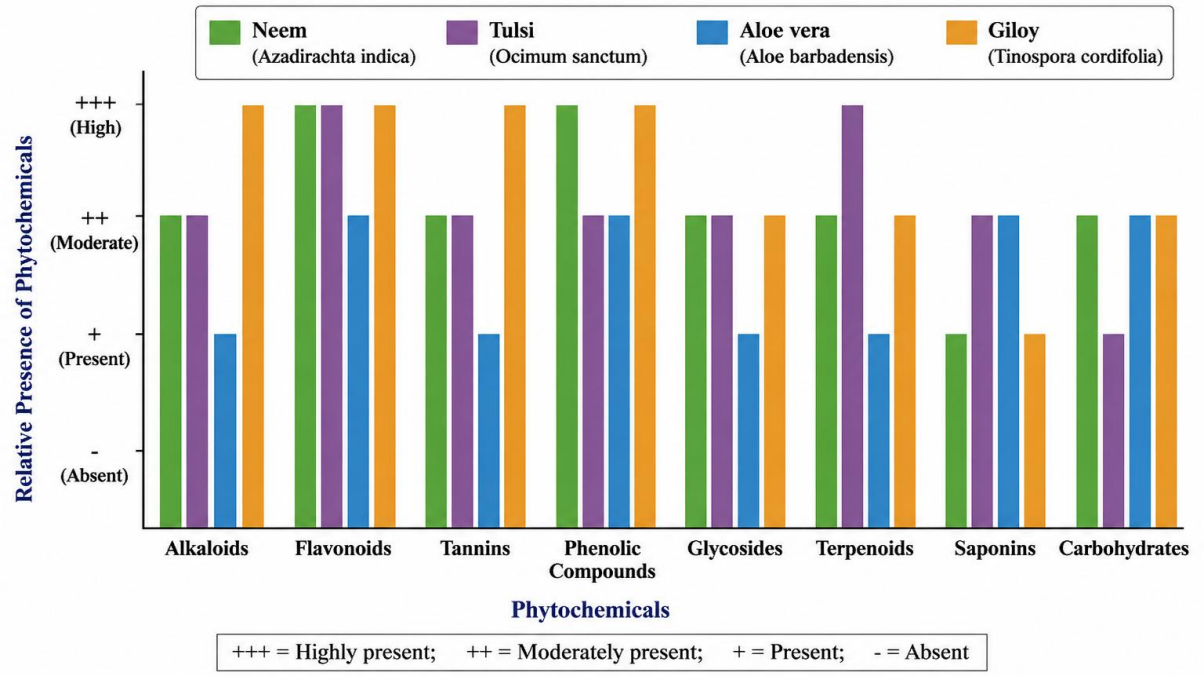

Table 2: Total Phenolic and Flavonoid Content

Plant Extract	Total Phenolic Content (mg GAE/g)	Total Flavonoid Content (mg QE/g)
Neem	95.42 ± 1.12	142.54 ± 0.88
Tulsi	82.16 ± 0.94	165.31 ± 1.04
Aloe vera	56.24 ± 0.75	98.42 ± 0.64
Giloy	108.75 ± 1.25	154.63 ± 0.91

Table 2 presents the quantitative estimation of total phenolic content and total flavonoid content of the ethanolic extracts of selected tribal medicinal plants. Phenolic compounds and flavonoids are among the most important secondary metabolites present in medicinal plants because they

contribute significantly to antioxidant, anti-inflammatory, antimicrobial, and therapeutic activities.

The results indicate considerable variation in phenolic and flavonoid contents among the plant extracts. Among all the investigated samples, Giloy exhibited the highest total phenolic content with a value of 108.75 ± 1.25 mg GAE/g. This indicates that Giloy is a rich source of phenolic compounds. Phenolics are capable of scavenging free radicals by donating hydrogen atoms or electrons, thereby reducing oxidative stress and cellular damage.

Neem also demonstrated high phenolic content with 95.42 ± 1.12 mg GAE/g. The substantial amount of phenolic compounds in Neem supports its traditional medicinal use in inflammatory disorders, skin diseases, wound healing, and infections. Tulsi exhibited moderate phenolic content, while Aloe vera showed comparatively lower phenolic concentration among the tested extracts.

The flavonoid content analysis revealed that Tulsi possessed the highest flavonoid concentration with 165.31 ± 1.04 mg QE/g. Flavonoids are powerful natural antioxidants that protect cells against oxidative damage and help reduce inflammation. The high flavonoid content in Tulsi may be due to the presence of eugenol, orientin, vicenin, and rosmarinic acid, which are known for strong pharmacological properties.

Giloy and Neem also exhibited appreciable flavonoid content, indicating their therapeutic significance. Aloe vera showed comparatively lower flavonoid levels, which may explain its moderate antioxidant and anti-inflammatory activity observed in subsequent analyses.

The findings suggest a direct relationship between phenolic and flavonoid contents and biological activities of the plant extracts. Medicinal plants rich in these phytochemicals are generally more effective in neutralizing free radicals and preventing oxidative stress-induced diseases. High phenolic and flavonoid content also contributes to anti-inflammatory activity by inhibiting inflammatory mediators and protecting tissues from damage.

Phenolic compounds and flavonoids have been reported to possess several pharmacological activities including antidiabetic, anticancer, cardioprotective, hepatoprotective, and neuroprotective effects. Therefore, the presence of these compounds in the selected medicinal plants enhances their therapeutic importance.

The study findings scientifically validate the traditional use of these plants by tribal communities in Bastar region. Tribal healers have long used Neem, Tulsi, Aloe vera, and Giloy for treating fever, wounds, inflammation, infections, and other disorders. The quantitative estimation of phenolics and flavonoids provides biochemical evidence supporting these ethnomedicinal applications.

Overall, the results confirm that the selected tribal medicinal plants are rich sources of natural antioxidants. Giloy emerged as the richest source of phenolic compounds, whereas Tulsi exhibited maximum flavonoid content. These findings suggest that the investigated plants possess significant therapeutic potential and can be further explored for the development of herbal medicines, nutraceutical products, and antioxidant-rich pharmaceutical formulations.

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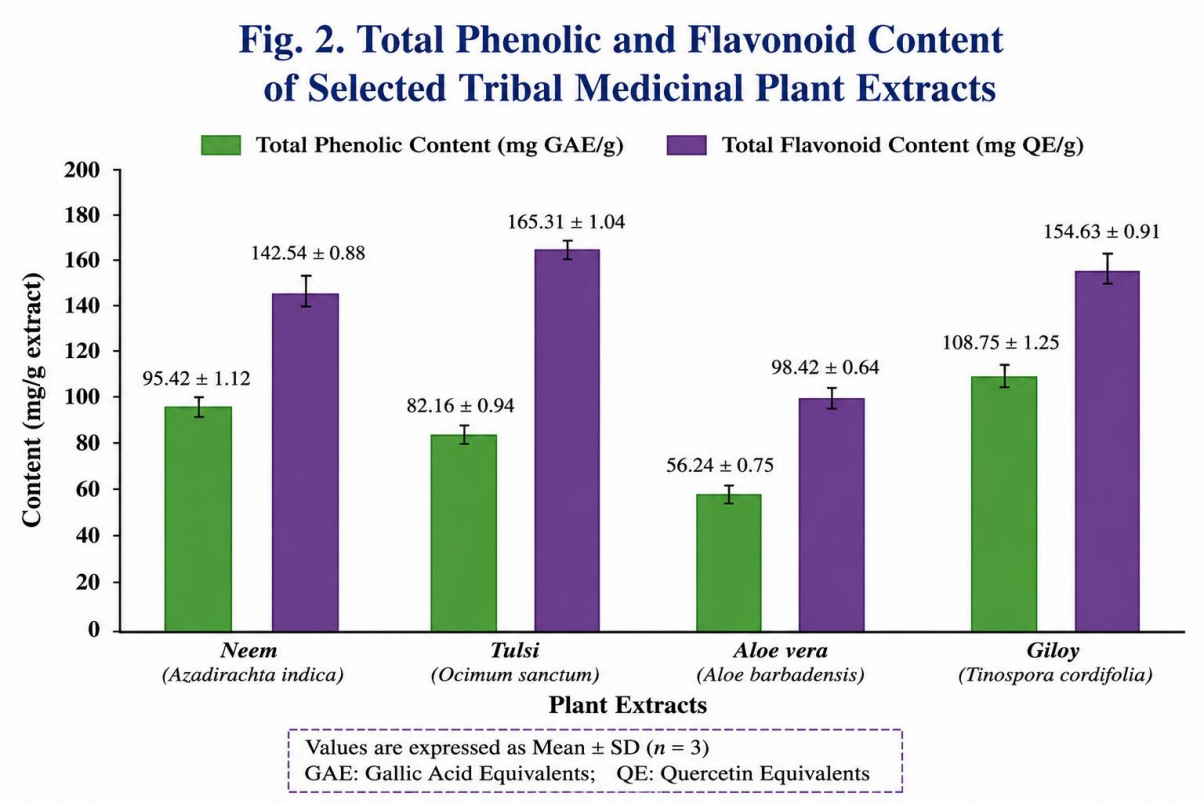

Table 3: DPPH Radical Scavenging Activity

Concentration (µg/ml)	Neem (%)	Tulsi (%)	Aloe vera (%)	Giloy (%)	Quercetin (%)
25	24.5	28.3	18.4	31.6	35.4
50	38.2	42.1	29.5	48.7	55.2
100	55.4	61.8	46.2	69.5	78.6
200	71.3	76.5	58.4	84.2	91.4
400	86.5	89.3	72.1	93.6	97.8

Table 3 illustrates the antioxidant activity of selected tribal medicinal plant extracts evaluated using the DPPH radical scavenging assay. The DPPH assay is one of the most commonly used methods for measuring antioxidant activity because it determines the ability of plant extracts to neutralize free radicals. Free radicals are unstable molecules that cause oxidative damage to cells and tissues, leading to several chronic diseases including cancer, diabetes, cardiovascular disorders, arthritis, and neurodegenerative diseases.

The results clearly demonstrate that all tested plant extracts showed concentration-dependent antioxidant activity. As the concentration of extracts increased from 25 µg/ml to 400 µg/ml, the percentage inhibition of DPPH radicals also increased significantly. This indicates that the antioxidant compounds present in the extracts effectively scavenged free radicals at higher concentrations.

Among all the tested plant extracts, Giloy exhibited the highest antioxidant activity. At a concentration of 400 µg/ml, Giloy showed 93.6% inhibition of DPPH radicals, which was very close to the standard antioxidant quercetin showing 97.8% inhibition. The remarkable antioxidant potential of Giloy may be attributed to its high phenolic and flavonoid contents. Polyphenolic compounds are known to donate electrons or hydrogen atoms to stabilize free radicals and prevent oxidative damage.

Tulsi also demonstrated strong antioxidant activity with 89.3% inhibition at the highest concentration. Tulsi contains bioactive compounds such as eugenol, rosmarinic acid, and flavonoids that possess excellent antioxidant properties. These compounds help protect cellular structures from oxidative stress and enhance the body's defense mechanisms.

Neem showed considerable antioxidant activity, reaching 86.5% inhibition at 400 µg/ml. The antioxidant effect of Neem may be associated with phytochemicals such as quercetin, azadirachtin, nimbin, and phenolic compounds. Neem has been traditionally used for managing infections, skin disorders, and inflammatory conditions, and the present findings support its medicinal importance.

Aloe vera demonstrated comparatively lower antioxidant activity than the other extracts, although its activity increased progressively with concentration. At 400 µg/ml, Aloe vera exhibited 72.1% inhibition, indicating moderate free radical scavenging ability. This moderate activity may be due to its comparatively lower phenolic and flavonoid content.

The findings suggest a positive correlation between antioxidant activity and the presence of phenolic and flavonoid compounds. Plant extracts with higher concentrations of these phytochemicals exhibited stronger free radical scavenging activity. The antioxidant activity observed in the study supports the traditional use of these medicinal plants in treating diseases associated with oxidative stress.

Natural antioxidants obtained from medicinal plants are considered safer alternatives to synthetic antioxidants, which may produce adverse side effects. The selected tribal medicinal plants may therefore serve as valuable sources of natural antioxidant agents for pharmaceutical and nutraceutical applications.

Overall, the results confirm that the selected medicinal plants possess significant antioxidant potential. Giloy emerged as the most potent antioxidant among the tested extracts, followed by Tulsi and Neem. The findings scientifically validate the ethnomedicinal use of these plants by tribal communities in Bastar region and suggest their potential role in preventing oxidative stress-related diseases.

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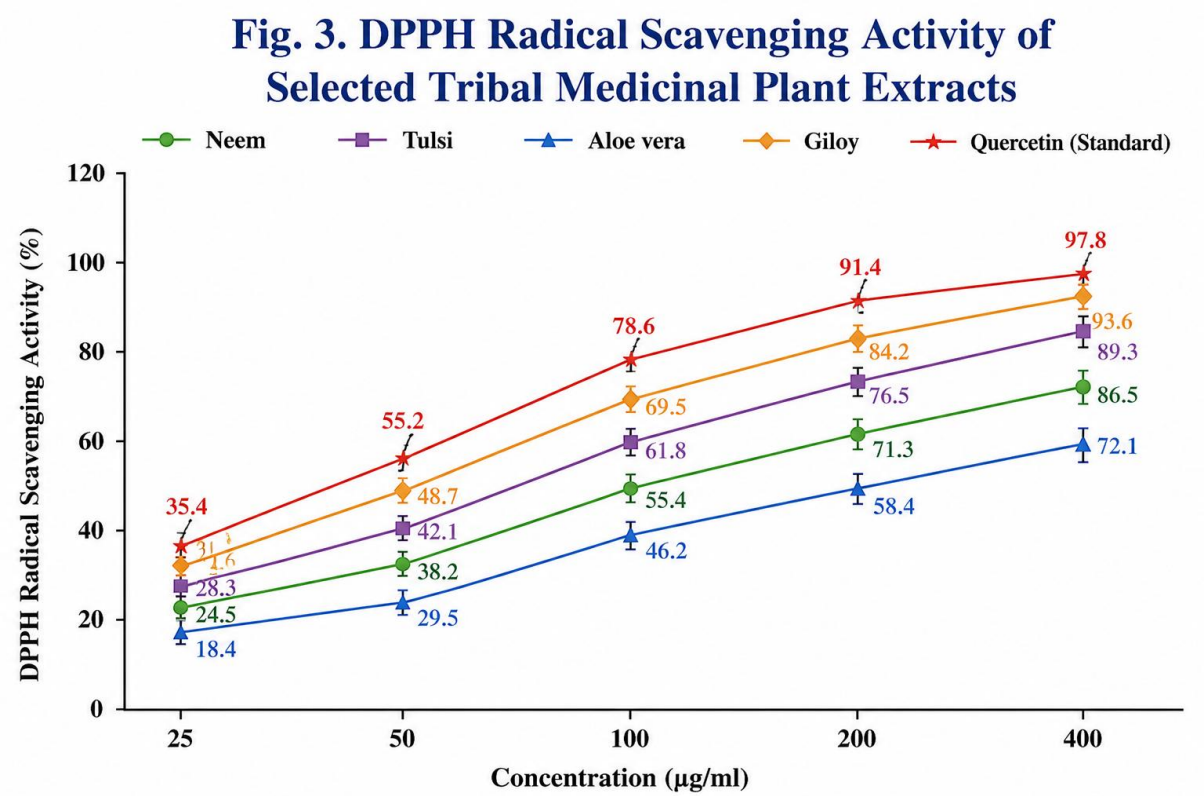

Table 4: Anti-inflammatory Activity of Plant Extracts

Concentration (µg/ml)	Neem (%)	Tulsi (%)	Aloe vera (%)	Giloy (%)	Diclofenac Sodium (%)
25	29.4	24.6	18.5	26.3	38.5
50	42.8	38.2	30.1	41.7	56.4
100	61.5	54.3	45.7	58.6	74.2
200	82.4	75.5	63.4	79.3	92.6

Table 4 presents the anti-inflammatory activity of selected tribal medicinal plant extracts evaluated using the protein denaturation inhibition assay. Inflammation is a biological defense response against harmful stimuli such as pathogens, toxins, injuries, and infections. However, excessive or prolonged inflammation can contribute to chronic diseases including arthritis, cardiovascular disorders, diabetes, asthma, and autoimmune diseases.

Protein denaturation is considered one of the major causes of inflammation. During inflammatory conditions, proteins lose their structural integrity and function, leading to tissue damage and inflammatory responses. Therefore, substances capable of preventing protein denaturation are regarded as potential anti-inflammatory agents.

The results revealed that all the tested plant extracts exhibited concentration-dependent anti-inflammatory activity. As the concentration increased from 25 µg/ml to 200 µg/ml, the percentage inhibition of protein denaturation also increased significantly. This indicates that

the bioactive compounds present in the medicinal plants effectively protected proteins against heat-induced denaturation.

Among all the tested extracts, Neem demonstrated the highest anti-inflammatory activity. At a concentration of 200 µg/ml, Neem exhibited 82.4% inhibition of protein denaturation, which was close to the standard anti-inflammatory drug diclofenac sodium showing 92.6% inhibition. The strong anti-inflammatory activity of Neem may be attributed to the presence of flavonoids, phenolic compounds, terpenoids, alkaloids, and limonoids such as azadirachtin and nimbin.

Giloy also exhibited remarkable anti-inflammatory activity with 79.3% inhibition at the highest concentration. The anti-inflammatory effect of Giloy may be due to the presence of diterpenoid lactones, alkaloids, glycosides, and phenolic compounds. Giloy has traditionally been used in Ayurveda for treating fever, arthritis, and inflammatory conditions, and the present findings scientifically support these therapeutic applications.

Tulsi showed appreciable anti-inflammatory activity, reaching 75.5% inhibition at 200 µg/ml. The anti-inflammatory effect of Tulsi may be associated with eugenol, flavonoids, and terpenoids that inhibit inflammatory mediators and reduce tissue inflammation.

Aloe vera demonstrated moderate anti-inflammatory activity compared to the other extracts. At 200 µg/ml, Aloe vera showed 63.4% inhibition of protein denaturation. Although comparatively lower, the activity still validates the traditional use of Aloe vera for treating burns, wounds, skin irritation, and inflammatory disorders.

The findings suggest that the selected tribal medicinal plants possess significant anti-inflammatory potential due to their rich phytochemical composition. Flavonoids, phenolic compounds, terpenoids, and alkaloids are known to inhibit inflammatory pathways, stabilize cellular membranes, and reduce oxidative stress associated with inflammation.

The study also highlights the importance of medicinal plants as natural alternatives to synthetic anti-inflammatory drugs. Synthetic drugs such as non-steroidal anti-inflammatory drugs (NSAIDs) often cause adverse effects including gastric irritation, ulceration, liver toxicity, and kidney damage during long-term use. Plant-derived anti-inflammatory agents may therefore provide safer therapeutic options.

Overall, the results confirm that the selected tribal medicinal plants possess substantial anti-inflammatory activity. Neem emerged as the most effective anti-inflammatory extract among the tested plants. The findings scientifically validate the traditional medicinal practices of Bastar tribal communities and support the future development of herbal anti-inflammatory formulations from these medicinal plants.

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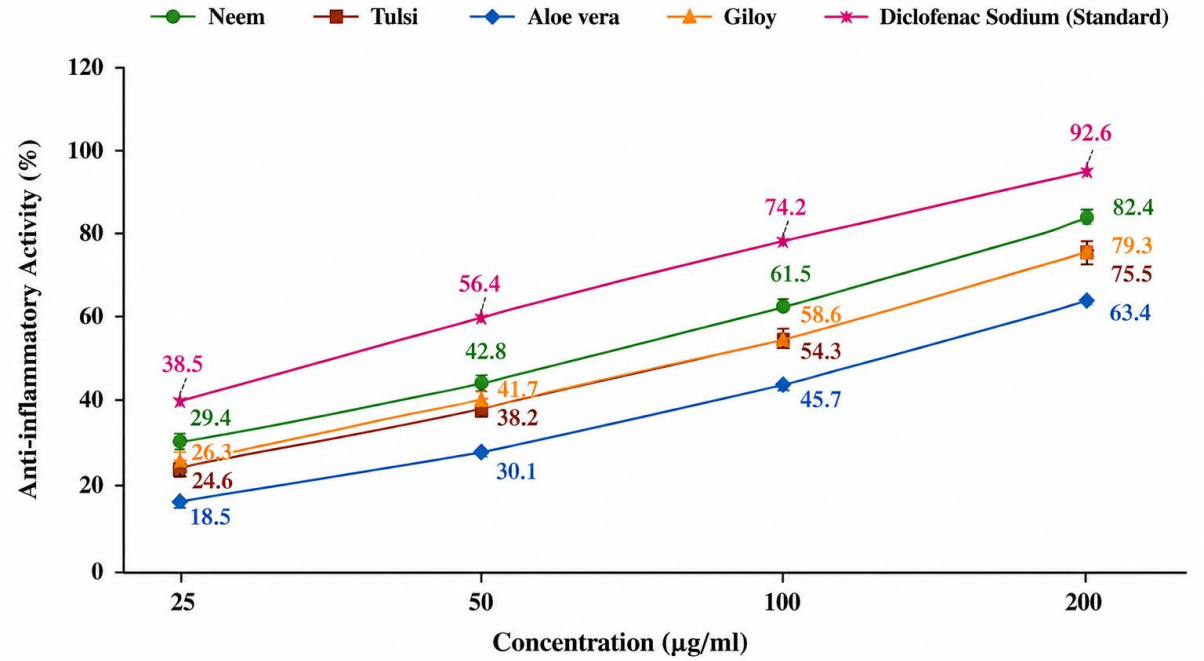
Fig. 4. Anti-inflammatory Activity of Selected Tribal Medicinal Plant Extracts



5. DISCUSSION

The present investigation demonstrated significant antioxidant and anti-inflammatory activities in selected medicinal plants used by tribal communities of Bastar region. Phytochemical screening confirmed the presence of bioactive compounds such as flavonoids, tannins, alkaloids, phenolic compounds, glycosides, and terpenoids that are known to contribute to therapeutic activities.

Phenolic compounds and flavonoids are important secondary metabolites possessing strong antioxidant activity due to their ability to donate hydrogen atoms or electrons and neutralize free radicals. Giloy exhibited the highest phenolic content and demonstrated excellent antioxidant activity in DPPH assay. The antioxidant property may be attributed to the presence of polyphenols, flavonoids, and alkaloids.

Tulsi also exhibited strong antioxidant activity due to the presence of eugenol, flavonoids, and rosmarinic acid. Neem showed remarkable anti-inflammatory activity, which may be related to the presence of azadirachtin, nimbin, quercetin, and other bioactive compounds capable of inhibiting inflammatory mediators.

Aloe vera exhibited moderate antioxidant and anti-inflammatory activities. The therapeutic potential of Aloe vera may be associated with anthraquinones, polysaccharides, vitamins, and phenolic compounds.

The results support the traditional medicinal use of these plants by tribal healers in Bastar. Natural antioxidants and anti-inflammatory agents derived from medicinal plants can provide safer alternatives to synthetic drugs with fewer side effects.

6. CONCLUSION

The present study scientifically validates the traditional use of selected medicinal plants employed by tribal communities in Bastar region for the treatment of inflammatory and oxidative stress-related disorders. Ethanolic extracts of Azadirachta indica, Ocimum sanctum, Aloe vera, and Tinospora cordifolia exhibited significant antioxidant and anti-inflammatory activities.

Among the tested extracts, Tinospora cordifolia showed maximum antioxidant activity, whereas Azadirachta indica demonstrated superior anti-inflammatory activity. The observed biological activities may be attributed to the presence of phenolic compounds, flavonoids, alkaloids, tannins, and terpenoids.

The findings indicate that these medicinal plants possess promising therapeutic potential and can be further explored for the development of herbal formulations, nutraceuticals, and pharmaceutical products. Further studies involving isolation of active compounds, toxicity evaluation, and in vivo pharmacological investigations are recommended.

7. ACKNOWLEDGEMENT

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8. CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this research work.

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