



## Section 2. Biology

DOI:10.29013/EJTNS-26-1-12-21



### PHYTOCHEMICAL STUDY AND EVALUATION OF THE ANTI-RADICAL, ANTI-INFLAMMATORY AND CYTOTOXIC ACTIVITIES OF THE LEAVES OF *TETRACERA ROSIFLORA GILG* (DILLENIACEAE)

**Christophe Muanyishay Lukanda**<sup>1,4</sup>, **Carlos Kabengele Nkongolo**<sup>2</sup>,  
**Fatuma Luhahi Lumba**<sup>1</sup>, **Sebastien Luyindula Ndiku**<sup>3</sup>,  
**Pius Mpiana Tshimankinda**<sup>2</sup>

<sup>1</sup> Department of Biology, Faculty of Sciences, University of Kinshasa, Kinshasa, Democratic Republic of the Congo.

<sup>2</sup> Department of Chemistry, Faculty of Sciences, University of Kinshasa, Kinshasa, Democratic Republic of the Congo.

<sup>3</sup> Laboratory of Plant Biotechnology and Molecular Biology, Kinshasa Regional Atomic Energy Center, Kinshasa, DR Congo

<sup>4</sup> Chemical, Biological, Radiological and Nuclear Centre of Excellence (CoE /CBRN), Kinshasa, Democratic Republic of Congo

---

**Cite:** Christophe Muanyishay Lukanda, Carlos Kabengele Nkongolo, Fatuma Luhahi Lumba, Sebastien Luyindula Ndiku, Pius Mpiana Tshimankinda. (2026). Phytochemical study and evaluation of the anti-radical, anti-inflammatory and cytotoxic activities of the leaves of *Tetracera rosiflora Gilg* (Dilleniaceae). *European Journal of Technical and Natural Sciences* 2025, No 1. <https://doi.org/10.29013/EJTNS-26-1-12-21>

---

#### Abstract

*Tetracera Tetracera rosiflora* is a medicinal plant used in traditional medicine to treat a number of ailments such as diabetes, arthritis, dysentery, hepatitis, etc. This study aimed to evaluate the microscopic, phytochemical, and biological characteristics of total aqueous and organic extracts of *Tetracera leaves. rosiflora* Gilg (*Dilleniaceae*), a plant used in traditional African medicine. Histological examination revealed several distinctive diagnostic features, including polycytic stomata, unicellular hairs, spiral vessels, and calcium oxalate crystals, which are reliable identification markers. Phytochemical screening demonstrated the presence of polyphenols, flavonoids, tannins, anthocyanins, leucoanthocyanins, and saponins. Quantitative assays showed a high total polyphenol content ( $42.12 \pm 1.14$  mg GAE/g), confirming the species' rich antioxidant content. Biological tests revealed marked antioxidant activity, greater in the low-concentration aqueous extract, and significant anti-inflammatory activity, especially

in the organic extract (maximum inhibition: 80.20%). Cytotoxicity assessment showed low to moderate toxicity (hemolysis rate < 50%), suggesting a satisfactory safety profile. Overall, *Tetracera rosiflora* is distinguished by a rich phytochemical composition and notable antioxidant and anti-inflammatory properties, justifying its traditional uses and supporting its potential for the development of plant-based therapeutic products.

**Keywords:** *Tetracera rosiflora*, polyphenols, antioxidant activity, anti-inflammatory activity, cytotoxicity, medicinal plant

## 1. Introduction

Medicinal plants constitute an inexhaustible source of bioactive molecules, playing a central role in the prevention and treatment of numerous diseases. For millennia, they have been used in traditional medicine for their diverse therapeutic properties. Currently, the growing interest in natural products is explained not only by their richness in secondary metabolites, but also by their potential to offer alternatives or complements to modern treatments, particularly in the face of chronic and degenerative diseases (Seudi. *et al.*, 2025, Muanyishay *et al.*, 2018).

Among the species of interest, *Tetracera rosiflora* Gilg, belonging to the *Dilleniaceae* family, is used in traditional Congolese medicine to treat various ailments, including diabetes, infections, and certain inflammations (Ogunlakin & Sonibare, 2022). The leaves of this plant are known to contain a variety of phenolic compounds, flavonoids, tannins, and other secondary metabolites, which may confer significant pharmacological properties (Kamisah). *et al.*, 2013).

Contemporary research is paying particular attention to biological activities related to oxidative stress and inflammation. Oxidative stress, resulting from an imbalance between the production of reactive oxygen species (ROS) and antioxidant defense systems, is implicated in the development of several chronic diseases such as cancer, diabetes, cardiovascular, and neurodegenerative diseases (Santos *et al.*, 2019). Inflammation, when it becomes chronic, also constitutes an aggravating factor in the progression of these conditions (Silva *et al.*, 2024). In this context, evaluating the free radical scavenging and anti-inflammatory activity of medicinal plants is of particular interest for identifying new molecules with therapeutic potential.

Furthermore, cytotoxic testing of plant extracts is a promising avenue for the search

for new anticancer agents, given the ongoing need for effective molecules that are less toxic than those already available (Naeem *et al.*, 2022). Therefore, an integrated study of the phytochemical profile and the antioxidant, anti-inflammatory, and cytotoxic activities of *T. rosiflora* extracts is relevant, as it could contribute to the pharmacological development of this species and the identification of new bioactive molecules.

The objective of this work is therefore to carry out a phytochemical study of the leaves of *T. rosiflora* Gilg and to evaluate their anti-radical, anti-inflammatory and cytotoxic activities in order to provide a scientific basis for the traditional use of this plant.

## 2. Materials and methods

### 2.1. Sample preparation

The biological material used in this study consists of *Tetracera leaves. rosiflora* Gilg leaves were collected in the commune of Mont-Ngafula (Kinwenzha), located in the city-province of Kinshasa in the Democratic Republic of Congo (4°27'25.179"S; 15°17'37.693"E).

Botanical identification of the plant was carried out at the Herbarium of the National Institute of Agronomic Studies and Research (INERA), housed at the Faculty of Sciences of the University of Kinshasa (UNIKIN). These leaves were air-dried ( $\pm 27$  °C) in the shade for two weeks. The dried samples were then ground using an electric mill to obtain a fine, homogeneous powder for various analyses. The blood sample used for quantitative cytotoxicity was collected from a healthy volunteer. Chicken eggs were purchased at the local market.

### 2.2. Micrograph

The histological elements were observed using a Primo Star 200® microscope according to the method described by Carlos *et al.* (2020). This analysis made it possible to

identify the characteristic anatomical structures of *T. rosiflora* leaves.

### 2.3. Qualitative phytochemical screening

The identification of the main classes of secondary metabolites (alkaloids, flavonoids, tannins, saponins, sterols, triterpenes, etc.) was carried out according to the classical methods described by Kasiama *et al.* (2023). These tests revealed the presence of various compounds with pharmacological potential.

### 2.4. Determination of phenolic compounds

The total polyphenol content was determined according to the Folin-Ciocalteu method (Kasiama *et al.*, 2022). Total flavonoids and anthocyanins were quantified according to the method of Lebreton *et al.* (1967). Condensed and hydrolyzable tannins were quantified, respectively, based on the condensation of polyphenolic compounds with vanillin in acidic medium and the reaction with ferric chloride (HCl) in acidic medium, according to the method described by Dohou. *et al.* (2003).

### 2.5. Evaluation of antioxidant activity

The antioxidant activity was evaluated using the FRAP method (ferric reducing antioxidant power) according to the protocol described by Ghaoui (2023).

### 2.6. Anti-inflammatory activity

The in vitro anti-inflammatory activity was evaluated according to the protein denaturation method (Albumin) following the approach described by Kumari (2015).

### 2.7. Qualitative cytotoxicity test

Qualitative cytotoxicity testing was performed to assess the potential effects of the extract on the integrity of human erythrocyte membranes. This test was evaluated according to the method described by Kaźmierczak. *et al.*, (2023), with some modifications.

### 2.8. Quantitative cytotoxicity test

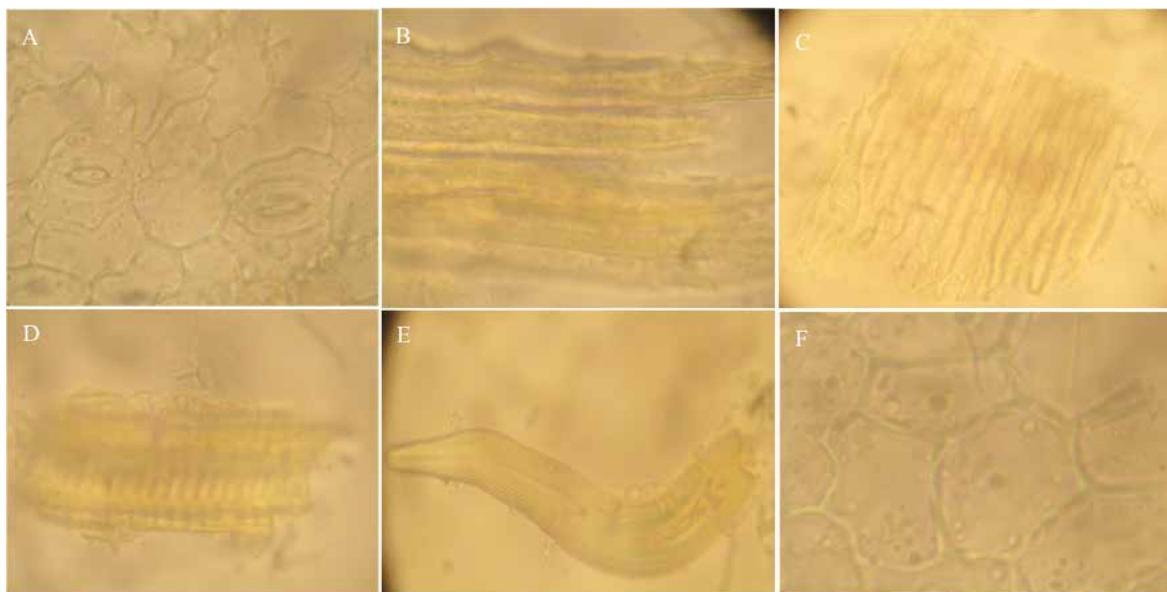
Badisa 's method *et al.* (2019), with some modifications, was used to evaluate the cytotoxicity of the extracts on human erythrocytes.

## 3. RESULTS AND DISCUSSION

### 3.1. Results of microscopic examination of *T. rosiflora* powders

The results of the micrograph performed on the *T. rosiflora* powder are presented in Figure 1 below:

**Figure 1.** Micrographic characteristics of *T. rosiflora*



Histological analysis of *T. rosiflora* leaves revealed several characteristic features (Figure 1), including: (A) polycytic stomata, (B) fragments of spiral vessels, (C) fiber fragments, (D) smooth, flattened unicellular hairs,

sometimes enlarged in their midsection, (E) parenchyma cells containing calcium oxalate crystals, and (F) epidermal cells containing oil droplets. These anatomical structures constitute distinctive histological markers of this

species and can serve as a baseline for its characterization and identification.

To our knowledge, no previous micrographic studies have been reported on *T. rosiflora*. However, similar work carried out on other plant species has revealed comparable histological features. Thus, Akoubet *et al.* (2022) observed in the fruit and extract of *Picralima nitida* (*Apocynaceae*) fragments of parenchyma, sclerenchyma, secretory hairs, and wood vessels. Similarly, recent studies on leaf powders of *Ficus exasperata* and *Uvariadendron molundense* (*Annonaceae*) revealed the presence of parenchyma fragments, calcium oxalate crystals, fibers, annular vessels, starch grains, and pitted vessels (Ukwubile, 2013; Alamgir, 2017). Furthermore, micrographic analysis of *Lippia multiflora* enabled the identification of epidermal cells, stomata, spiral vessels and non-glandular unicellular trichomes (Dalia, 2022).

These observations confirm that the histological elements identified in *T. rosiflora*. These variations are part of the anatomical variability commonly observed in medicinal plant species. Given the traditional use of this plant, knowledge of its microstructure is of

particular importance for the normalization and standardization of plant material. The precise identification of histological elements is indeed an essential step in the development of pharmacognosic monographs and the prevention of adulteration of herbal drugs.

### 3.2. Phytochemical screening in solution

On the one hand, chemical screening revealed the presence of polyphenolic compounds (flavonoids, anthocyanins, leucoanthocyanins, tannins, bound quinones), saponins, and terpenoids; and on the other hand, alkaloids, free quinones, and steroids were absent from the extract. The presence of polyphenols in the *T. rosiflora* extract. This justifies its use in traditional medicine against diabetes, back pain, arthritis, skin infections, ulcers, and gastrointestinal disorders (Ansari). *et al.*, 2025).

### 3.3. Determination of total phenolic compound content

Table 2 below shows the total polyphenol, total flavonoid, anthocyanin and condensed and hydrolyzable tannin content in *T. rosiflora* leaves.

*T. rosiflora* leaves.

Table 1.

Secondary metabolites	Total polyphenols	Total flavonoids	Anthocyanins
Concentrations	42.12 ± 114 mg GAE /g	0.090 ± 0.002 mg EQ/g	0.30 ± 0.07 mg EC/g

*Tetracera* leaves *rosiflora* revealed variable levels of secondary metabolites (Table 2). The concentration of total polyphenols is relatively high, estimated at 42.12 ± 1.14 mg gallic acid equivalent per gram of extract (mg GAE/g), while those of flavonoids and anthocyanins are respectively 0.090 ± 0.002 mg quercetin equivalent per gram (mg QE/g) and 0.30 ± 0.07 mg catechin equivalent per gram (mg EC/g).

The high polyphenol content suggests that *T. rosiflora* is an important source of phenolic compounds, known for their antioxidant, anti-inflammatory and antimicrobial properties (Imene, 2021; Trik, 2020).

In contrast, flavonoid and anthocyanin levels appear relatively low compared to total polyphenols. This difference can be explained by the fact that flavonoids and anthocyanins

represent specific subclasses of polyphenols. The low levels observed may also depend on ecophysiological factors (growing conditions, harvest season, light exposure) or extraction parameters (nature of the solvent, duration, temperature), which significantly influence the solubilization of these compounds.

Despite their low concentration, the presence of flavonoids and anthocyanins is nonetheless significant. Flavonoids often contribute to antioxidant and anti-inflammatory effects (Khamel & Baghiani, 2024), while anthocyanins contribute to free radical scavenging activity and can act synergistically with other phenols to enhance the overall antioxidant capacity of the extract (Chen *et al.*, 2022).

These results therefore confirm that *T. rosiflora* has a phytochemical profile rich

in phenolic compounds, which may justify some of its traditional uses in the treatment of infectious and inflammatory conditions.

### 3.4. Antioxidant activity

The results of the antioxidant activity of the aqueous and organic extracts are shown in Tables 2 and 4 below.

Table 2 shows that the curve exhibits a nearly linear increase in reducing power over the studied concentration range, without a marked plateau at low doses. This profile suggests the predominant presence of water-soluble compounds, particularly polyphenols, glycosylated flavonoids, and phenolic acids, whose antioxidant activity is evident even at low concentrations. The observed effect thus reflects a homogeneous distribution of active molecules and good solubility in the reaction medium.

**Table 2.** Evolution of optical density as a function of the concentration of the total aqueous extract of *Tetracera rosiflora*

Aqueous extract of <i>T. rosiflora</i>	
Concentration (mg/ mL)	Optical density
0.002	1.16
0.001	0.996
0.0006	0.946

**Table 4.** Evolution of optical density as a function of the concentration of the total organic extract of *Tetracera rosiflora*

Organic extract of <i>T. rosiflora</i>	
Concentration (mg/ mL)	Optical density
0.002	1,802
0.001	1.32
0.0006	1,304

In contrast, the curve corresponding to the organic extract (Table 4) shows a relatively shallow slope at low concentrations, followed by a marked increase at higher doses. This non-linear evolution likely reflects the lipophilic nature of the extracted compounds, whose limited solubility in the aqueous medium of the test reduces their initial activity. The rapid increase in reducing power at high concentrations could be attributed to the presence of less abundant but strongly

reducing molecules, such as certain flavonoid aglycones or terpene compounds.

Comparison of the two extracts reveals a notable difference in their antioxidant profiles. The aqueous extract is more active at low concentrations, exhibiting immediate and sustained antioxidant activity, while the organic extract displays its full potential at higher concentrations. These results underscore the crucial influence of solvent polarity on the nature and reactivity of bioactive compounds extracted from *Tetracera rosiflora*, suggesting a complementarity between hydrophilic and lipophilic fractions in the overall contribution to the plant's antioxidant activity.

Furthermore, the Ladeska study *et al.* (2024) on the pharmacognostic evaluation and antioxidant activities of *Tetracera indica* revealed an optical density of  $4296.67 \pm 0.024$ , higher than that obtained for the total aqueous and organic extracts in the present study. Similarly, the extracts tested here showed a notable antioxidant effect compared to those reported in Kittiwisut 's work *et al.* (2021) and Roheem *et al.* (2020), confirming the high antioxidant potential of the genus *Tetracera*.

### 3.5. Anti-inflammatory activity

The anti-inflammatory effect of aqueous and organic extracts of *T. rosiflora* was evaluated *in vitro* with respect to protein denaturation. Figure 3 below shows the degree of inhibition of thermal denaturation of ovalbumin (%I) by aqueous and organic extracts of *T. rosiflora*.

The results obtained in Table 3 demonstrate that the total extracts of *T. rosiflora* possesses notable anti-inflammatory activity, although less than that of diclofenac sodium, used as a reference anti-inflammatory. This observation is consistent with previous work on other species of the genus *Tetracera*, notably *Tetracera alnifolia*, *Tetracera scandens* and *Tetracera potatoria*, whose extracts have also shown significant anti-inflammatory properties *in vivo* and *in vitro* (Akinmoladun *et al.*, 2015; Agbor *et al.*, 2018; Ayele *et al.*, 2020).

The greater activity of the organic extract compared to the aqueous extract is consistent with the observations reported by Olayemi *et al.* (2019), who showed that fractions rich in lipophilic compounds (methoxy lated flavonoids, triterpenes, sterols, and phenolic ac-

ids) exhibit better inhibition of pro-inflammatory mediators such as cyclooxygenase (COX) and lipoxygenase (LOX). These secondary metabolites, mostly soluble in organ-

ic solvents, are known to modulate the production of inflammatory cytokines (TNF- $\alpha$ , IL-1 $\beta$ ) and the expression of inducible nitric oxide synthase (iNOS).

**Table 3.** Anti-inflammatory activity of total aqueous and organic extracts of *Tetracera rosiflora*

Concentration (mg/ mL)	Percentage of inhibition (%)		
	aqueous extract	Organic extract	Diclofenac sodium
12	68.20 $\pm$ 0.21	71.60 $\pm$ 0.12	80.20 $\pm$ 0.16
16	72.40 $\pm$ 0.15	80.20 $\pm$ 0.02	91.60 $\pm$ 0.02
25	50.0 $\pm$ 0.3	78.70 $\pm$ 0.50	99.7 $\pm$ 0.1

The increase in activity between 12 and 16 mg/ mL reflects a classic dose-dependent effect, already described for *Tetracera* extracts *alnifolia* (Akinmoladun *et al.*, 2015), where an increase in concentration leads to increased inhibition of inflammation up to a certain threshold. The drop in activity observed for the 25 mg/ mL aqueous extract could be related to precipitation of water-soluble compounds or to thermal or oxidative instability of the active ingredients at high concentrations, unp This phenomenon was also reported by Ibrahim *et al.* (2021) for aqueous extracts of plants rich in polyphenols.

Compared to diclofenac (99.7% inhibition at 25 mg/ mL), *T. rosiflora* extracts exhibit inhibition percentages exceeding 70% for the organic extract, which remains remarkable for an unpurified crude extract. These values are close to those reported for *Tetracera. alnifolia* (78% at 100  $\mu$ g/ mL; Akinmoladun *et al.*, 2015) and for *Tetracera scandens* (75% at 200  $\mu$ g/ mL; Ayele *et al.*, 2020), confirming that the genus *Tetracera* contains bioactive compounds of pharmacological interest.

Thus, these observations suggest that *T. rosiflora*, like other species of the same genus, represents a potential source of natural anti-inflammatory molecules. The results justify further investigations into the chromatographic fractionation and structural characterization of the active constituents in order to better understand the mechanisms of action and to explore the potential of this species in the development of phytomedicines.

### 3.6. Cytotoxicity of aqueous and organic extracts of *T. rosiflora* leaves

#### 3.6.1. Qualitative test

Figure 4 illustrates the qualitative cytotoxicity of aqueous and organic extracts of *Tetracera rosiflora*.

Qualitative evaluation of the cytotoxicity of extracts of *Tetracera rosiflora* was achieved by comparative microscopic observation between the positive control, the negative control and the total aqueous and organic extracts (Figure A–D).

The positive control (A) shows marked alteration of cellular structures characterized by disintegration and loss of membrane integrity, indicating high cytotoxicity. This observation confirms the sensitivity of the biological system used and the validity of the experimental protocol. Conversely, the negative control (B) presents intact cells with clear and homogeneous outlines, showing no signs of lysis or degradation, indicating a complete absence of toxicity from the culture medium or solvent used.

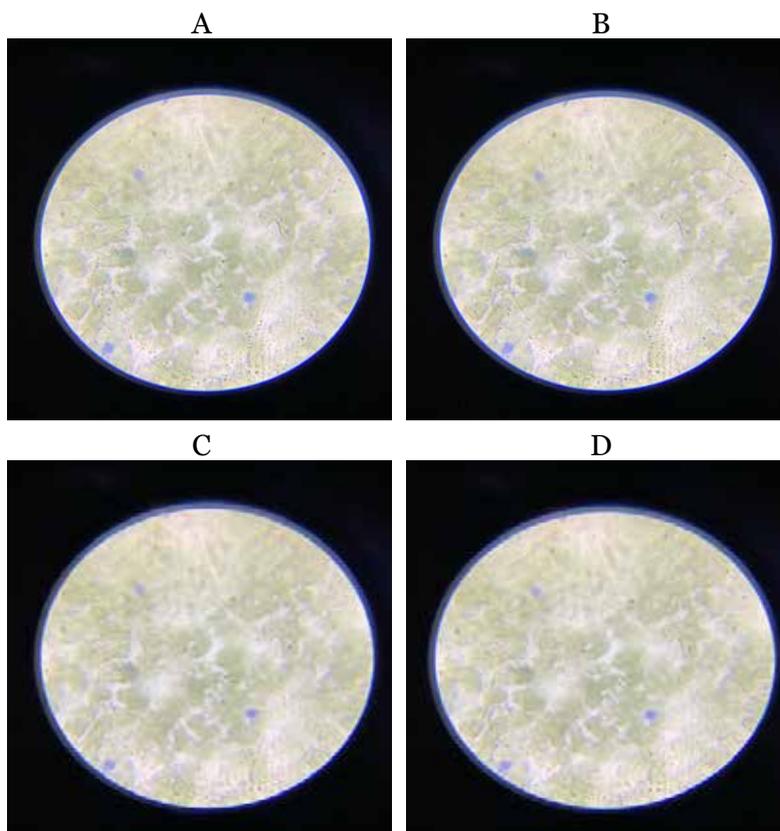
Observation of the aqueous extract treatment (C) reveals low to moderate cytotoxicity, resulting in slight turbidity and some areas of cellular alteration. This limited activity could be attributed to the presence of polar compounds such as polyphenols, glycosylated flavonoids, and tannins, whose biological effects are often associated with reduced toxicity and protective antioxidant properties.

In contrast, the organic extract (D) exhibits more pronounced cytotoxicity, evidenced by cell fragmentation and visible areas of

necrosis. This behavior could result from the presence of lipophilic molecules such as flavonoid aglycones, triterpenes, and free quinones, known for their affinity with cell membranes and their potential to alter cell permeability.

These results suggest that the organic extract of *Tetracera rosiflora* contains biologically active secondary metabolites that may exert cytotoxic effects at certain concentrations, while the aqueous extract appears less aggressive and may have a more favorable safety profile for therapeutic use.

**Figure 4.** Qualitative evaluation of the cytotoxicity of aqueous and organic extracts of *Tetracera rosiflora* (A: Positive control; B: Negative control; C: Aqueous total extracts; D: Organic total extracts)



**3.6.2. Quantitative test**  
*in vitro* cytotoxicity test of *Tetracera rosiflora* showed an average percentage of  $3.81 \pm 0.06\%$ , significantly lower than the generally accepted threshold of 50% for indicating significant cytotoxicity. This result reflects low cytotoxic activity, suggesting good cellular tolerance of the extract studied.

These observations are consistent with previous work reported for other species of the genus *Tetracera*. Indeed, Adesina *et al.* (2013) demonstrated moderate cytotoxicity of methanolic extracts of *T. potatoria* and *T. alnifolia* only at high concentrations, while Abubakar *et al.* (2016) observed an absence of significant toxicity of aqueous extracts of *T. alnifolia* on rat hepatocytes. Similarly, Eze

*et al.* (2020) reported low cytotoxicity of ethanolic extracts of *T. scandens*.

Thus, the results obtained for *T. rosiflora* follow the same trend, confirming the non-cytotoxicity of the species under the experimental conditions of the test. This relative safety could be attributed to the presence of secondary metabolites such as flavonoids, tannins, and saponins, whose antioxidant properties contribute to cell protection. These data support the safe traditional use of *T. rosiflora* and justify further *in vivo* investigations to confirm its overall toxicological profile.

#### 4. Conclusion

The overall results obtained in this study highlight the remarkable pharmacological

and bioactive potential of *Tetracera rosiflora* Gilg (*Dilleniaceae*). Microscopic examination of the powders has made it possible to identify several characteristic histological elements: polycytic stomata, spiral vessels, unicellular hairs, calcium oxalate crystals and oleiferous epidermal cells constituting reliable anatomical markers for the authentication of the species and the prevention of possible falsifications of plant drugs.

Phytochemical screening revealed the presence of a broad spectrum of secondary metabolites, including polyphenols, flavonoids, tannins, anthocyanins, leucoanthocyanins, and saponins, confirming the chemical richness of this species and justifying its use in traditional medicine for various inflammatory and metabolic conditions. Quantitative analyses showed a high total polyphenol content ( $42.12 \pm 1.14$  mg GAE/g), indicating strong potential antioxidant capacity.

Antioxidant activity tests revealed a difference in behavior between the aqueous and organic extracts: the aqueous extract was more active at low concentrations, indicating the rapid action of water-soluble compounds, while the organic extract showed increasing efficacy at higher doses, suggesting the contribution of lipophilic compounds with strong reducing power. These observa-

tions suggest a functional complementarity between the hydrophilic and lipophilic fractions in modulating oxidative stress.

Anti-inflammatory tests confirmed the plant's biological potential, with the organic extract exhibiting greater inhibition of protein denaturation than the aqueous extract, although less than that of diclofenac sodium. This result highlights the likely presence of triterpenes and flavonoids responsible for this effect.

Finally, both qualitative and quantitative cytotoxicity tests showed low to moderate toxicity, with a hemolysis rate of less than 50%, indicating a satisfactory safety profile for therapeutic use. The aqueous extract, in particular, appears to be the safest, while the organic extract exhibits slightly more pronounced cytotoxicity, related to the lipophilic nature of some of the active compounds.

Overall, *Tetracera rosiflora* is distinguished by its balanced phytochemical composition and significant biological activities, combining antioxidant and anti-inflammatory effects with low toxicity. These results confirm the pharmacological value of this species and pave the way for further investigations aimed at isolating, characterizing, and evaluating *in vivo* the active principles responsible for its therapeutic effects.

## References

- Seudi, A.K., Muanyishay, C.L., Muabu, A.K., Bulubulu, F.O., Kazadi, T.K., Amogu, J.D., Tshiongo, C.M., Taba, K.M., & Ntumba, J.K. (2025). Extraction of secondary metabolites responsible for biological activities from the leaf callus of *Tetracera rosiflora*. *Orapuh Journal*, – 6(5). – e1243. URL: <https://www.orapuh.org/ojs/index.php/orapj/article/view/e1243>
- Muanyishay, C.L., Mutwale, P.K., Diamuini, A.N., Luhahi, F.L., Ngombe, N.K., Luyindula, S.N., & Mpiana, P.T. (2018). Microscopic features, chromatographic fingerprints and antioxidant property of *Tetracera rosiflora* Gilg. *Scholars Bulletin*, – 4(5). – 451–459. URL: <https://saudijournals.com/articles/9582>
- Ogunlakin, A., & Sonibare, M. (2022). Phytochemistry and biology activities of *Tetracera* species. *Trends in Phytochemicals Research*, – 6(1). – P. 1–20. URL: <https://oiccpres.com/tpr/article/view/11836>
- Kamisah, Y., Othman, F., & Jaarin, K. (2013). Anti-cancer properties of *Dillenia suffruticosa* root extract by induction of apoptosis and G2/M cell cycle arrest. *Journal of Ethnopharmacology*, – 146(2). – P. 525–535. URL: <https://pubmed.ncbi.nlm.nih.gov/23353897>
- Santos, A.T., Ragasa, C.Y., De Roxas, M.B., Mandia, E.H., Brkljača, R., & Urban, S. (2019). Cytotoxic triterpenes from the leaves of *Dillenia philippinensis*. *Natural Product Research*, – 34(23). – P. 3421–3425. URL: <https://pubmed.ncbi.nlm.nih.gov/31759350>
- Silva, L.F., Silva, R.B., Souza, C.R., et al. (2024). Phyto-cytogenotoxic potential assessment of *Davilla nitida* and *Davilla elliptica* (*Dilleniaceae*). *Journal of Toxicology and Environmen-*

- tal Health, Part A, – 87(11). – P. 635–648. URL: <https://doi.org/10.1080/15287394.2024.2397649>
- Naeem, A., Hu, P., Yang, M., Zhang, J., Liu, Y., Zhu, W. and Zheng, Q. (2022). Natural products as anticancer agents: current state and future prospects. *Molecules*, – 27(23). – 8367 p.
- Carlos N., Kabengele, Etienne M., Ngoyi, Giresse N., Kasiama, Jason T., Kilembe, Aristote Matondo, Clement L. Inkoto, Emmanuel M. Lengbiye, Clement M. Mbadiko, Jean Jacques D. Amogu, Gedeon N. Bongo Pius T. Mpiana: Antihelminthic Activity, Phytochemical Profile and Microscopic Characteristics of *Ocimum basilicum* Collected in DR Congo. *AJOB*, – 10(3): 42–50, 2020.
- Kasiama G. N., Kabengele C. N., Kilembe J. T., Kitadi J. M., Mifundu M., Ngbolua J. P., ... & Tshimankinda P. T. (2023). Green Synthesis, Characterization and Evaluation of Biological Activities of Ag-Mno Nanocomposites from *Cyttaranthus Congolensis*. *Diyala Journal of Engineering Sciences*, – P. 24–36.
- Kasiama, G.N., Ikey, A., Kabengele, C.N., Kilembe, J.T., Matshimba, E.N., Bete, J.M., ... and Mpiana, P.T. (2022). Activities anthelmintic and antioxidant profile phytochemicals and characteristics microscopic samples of *Senna alata* collected in the Democratic Republic of Congo. *Biol*, – 37. – P. 28–36.
- Lebreton P., Jay M., Voirin B. On the qualitative and quantitative analysis of flavonoids. *Chem. Anal. (Paris)*. 1967; 49(7): 375–383.
- Dohou N., Yamni K., Tahrouch S., Hassani L. M., Badoc A. Gmiran. Phytochemical screening of an Ibero-Moroccan endemic, *thymelaea lythroids*. *Bull. Soc. Pharma. Bordeaux*; 2003.
- Ghaoui Abir. NHHR (2023). Activity Evaluation antioxidant from two medicinal plants (*Calendula suffruticosa* and *Drimia anthericoides*).
- Kumari C. Sree, N. Yasmin, R. M. Hussain and M. Babuselvam. Invitro anti-inflammatory and anti-arthritic property of *rhizopora mucronata* leaves. *International Journal of Pharma Sciences and Research (IJPSR)*. Flight.; – 6 (2015) 3. ISSN: 0975 9492.
- Kaźmierczak, T., Bonarska-Kujawa, D., Męczarska, K., Cyboran-Mikołajczyk, S., Oszmiański, J., & Kapusta, I. (2023). Analysis of the polyphenolic composition of *vaccinium L.* extracts and their effect protective on the membranes of red blood cells. *Membranes*, – 13(6). – 589 p.
- Akoubet, et al. (2022). Histological and pharmacognostic study of *Picalima nitida* (Apocynaceae). *Journal of Ethnopharmacology*, – 275. – P. 114–128.
- Ukwubile, C.A. (2013). Comparative pharmacognostic study of *Ficus abutilifolia* miq. (Moraceae) plant leaf, stem bark, and root. *Int. J. Adv. Pharm. Organic. Chem*, – 2(1). – P. 90–98.
- Alamgir, A.N.M. (2017). Pharmacognostical Botany: Classification of medicinal and aromatic plants (MAPs), botanical taxonomy, morphology, and anatomy of drug plants. In *Therapeutic use of medicinal plants and their extracts: Volume 1: Pharmacognosy* (P. 177–293). Cham: Springer International Publishing.
- Dalia, F., & Bentchouala, C. (2022). Study of the main medicinal plants aromatics used traditionally in infectious diseases respiratory in Northeast Algeria (Doctoral dissertation, University Constantine 3 Salah Boubnider, Faculty of Medicine).
- Ansari, P., Reberio, A.D., Ansari, N.J., Kumar, S., Khan, J.T., Chowdhury, S., ... and Seidel, V. (2025). Potential therapeutics of medicinal plants and their Phytoconstituents in diabetes, cancer, infections, cardiovascular diseases, inflammation and gastrointestinal disorders. *Biopharmaceuticals*, – 13(2). – 454 p.
- Imene, Bakhouch. (2021). Phytochemical study and evaluation of properties biological of a plant spontaneous Algerian: *Limonium delicatulum* (Doctoral dissertation).
- Trik, S. (2020). Synthesis on activities biological d'Arbutus unedo L (Doctoral dissertation, Mouloud Mammeri University).
- Khamel, A., Salhi, S., & Baghiani, A.E. (2024). Potential assessment antioxidant and anti-inflammatory of five compounds flavonoids isolated from *Varthemia iphionoides* (Boiss&Blanche).
- Antioxidant Interactions synergistic and antagonistic combinations phytochemicals food science. *Critical reviews in food science and nutrition*, – 62(20). – P. 5658–5677.

- Ladeska, V., Elya, B., Hanafi, M. and Rohmat, S.S. (2024). Assessment pharmacognostics and activities antioxidants from *Tetracera indica* (Christm. et Panz.) Merr. *HAYATI Journal of Biosciences*, – 31(5). – P. 836–853.
- Kittiwisut, S., Amnuoypol, S., Pathompak, P. and Setharaksa, S. (2021).  $\alpha$ -glucosidase and  $\alpha$ -amylase inhibitory effects with antioxidant activity of *Tetracera loureiri* (Finet & Gagnep.) Extracts of leaves of Pierre ex Craib. *Pharmaceutical Sciences in Asia*, – 48 (2).
- Roheem, F.O., Ahmed, Q.U., So'ad, S.M., Shah, S.A.A., Latip, J., Alhassan, A.M., and Mohammad, S.S. (2020). Evaluation of the free radical scavenging and digestive enzyme inhibitory activities of extract, fractions, and compounds isolated from *Tetracera* leaves macrophylla. *Journal of phytotherapy*, – 22. – 100351 p.
- Akinmoladun, A.C., Ibukun, E.O., Aiyegoro, O.A., & Akinrinlola, B.L. (2015). Anti-inflammatory and antioxidant activities of *Tetracera alnifolia* Willd. leaf extract. *Journal of Ethnopharmacology*, – 162. – P. 137–146.
- Agbor, G.A., Kuate, D., & Oben, J.E. (2018). Medicinal plants of the genus *Tetracera* and their pharmacological potentials. *Pharmacognosy Reviews*, – 12(24). – P. 112–119.
- Olayemi, S.O., Adetutu, A., & Adesanya, S.A. (2019). Bioactive triterpenes and flavonoids with anti-inflammatory potential from *Tetracera* species. *Natural Product Research*, – 33(4). – P. 543–550.
- Ayele, T.T., Mekonnen, Y.T., & Tadesse, E.G. (2020). Anti-inflammatory and antioxidant activities of *Tetracera scandens* extract. *BMC Complementary Medicine and Therapies*, – 20. – 102 p.
- Ibrahim, M.A., Lawal, A.M., & Bello, A.M. (2021). Effect of extraction solvents on the anti-inflammatory activity of polyphenol-rich plant extracts. *Journal of Applied Pharmaceutical Science*, – 11(3). – P. 95–101.
- Adesina, S. K., Idowu, O., Ogundaini, A.O., Oladimeji, H., Olugbade, T.A., Onawunmi, G.O., & Pais, M. (2013). Antimicrobial and cytotoxic activities of *Tetracera potatoria* and *Tetracera alnifolia* (Dilleniaceae). *Phytotherapy Research*, – 27(8). – P. 1218–1223. URL: <https://doi.org/10.1002/ptr.4841>
- Abubakar, M. S., Musa, A. M., Ahmed, A., & Hussaini, I. M. (2016). The perception and practice of traditional medicine in the treatment of diseases in Northern Nigeria. *Journal of Ethnopharmacology*, – 194. – P. 387–394. URL: <https://doi.org/10.1016/j.jep.2016.09.018>
- Eze, P.M., Eze, C.N., Abba, C.C., Nnadi, C.O., & Esimone, C.O. (2020). Evaluation of the cytotoxic and antioxidant potentials of *Tetracera scandens* Linn. *BMC Complementary Medicine and Therapies*, – 20(1). – 198 p. URL: <https://doi.org/10.1186/s12906-020-02994-2>

submitted 12.12.2025;

accepted for publication 27.12.2025;

published 30.01.2026

© Christophe Muanyishay Lukanda, Carlos Kabengele Nkongolo, Fatuma Luhahi Lumba, Sebastien Luyindula Ndiku, Pius Mpiana Tshimankinda

Contact: arlokabengele1@gmail.com