

Quantitative Phytochemical Characterization and Evaluation of the Anti-Inflammatory Activity of the Aqueous Extract of the Stem Bark of *Zanthoxylum zanthoxyloides* (Lam.) Zepernick (Rutaceae)

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Abstract

Original Research Article

Zanthoxylum zanthoxyloides is a medicinal plant used in traditional African pharmacopoeias. The present study aimed to quantitatively characterize the main groups of phytochemical compounds in the aqueous extract of its stem bark and to evaluate its anti-inflammatory activity in vivo. The plant material was collected in the town of Dikodougou, in the Poro region, in northern Côte d'Ivoire. The aqueous extract was obtained by macerating the plant powder in distilled water, followed by successive filtrations and oven drying. Alkaloids, flavonoids, terpenoids, polyphenols, and saponosides were quantified using spectrophotometric methods. Anti-inflammatory activity was evaluated in Wistar rats using the carrageenan-induced paw edema model, comparing the extract to a negative control and to diclofenac, which was used as a reference. The extraction yield was 13.06%. Phytochemical analyses revealed the highest reported values for terpenoids (173.80 mg/mL), followed by saponosides (3.07), polyphenols (1.91), alkaloids (0.48), and flavonoids (0.10), according to the units presented in the original results. At a dose of 100 mg/kg, the extract was associated with edema inhibition of $50.36 \pm 11.41\%$ at the fifth hour, compared with $78.23 \pm 10.02\%$ for diclofenac. These findings suggest that the aqueous extract of *Z. zanthoxyloides* stem bark may have anti-inflammatory potential. However, further statistical and phytochemical analyses are needed to confirm this interpretation.

Keywords: *Zanthoxylum zanthoxyloides*; aqueous extract; quantitative phytochemistry; terpenoids; anti-inflammatory activity; carrageenan.

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INTRODUCTION

Inflammation is the body's biological response to an infectious, chemical, or physical insult. Although it plays a role in defense mechanisms and tissue repair, an excessive or persistent inflammatory response can contribute to the development of various diseases. The management of inflammation relies in particular on the use of nonsteroidal anti-inflammatory drugs, whose action is associated, among other things, with the modulation of prostaglandin synthesis. However, the search for new bioactive substances of natural origin remains relevant for identifying molecules with promising pharmacological properties. Medicinal plants are an important source of secondary metabolites capable of exerting various biological activities. These compounds include alkaloids, flavonoids, polyphenols,

terpenoids, and saponosides. Their presence and abundance vary depending on the plant species, the plant part being studied, environmental conditions, and extraction methods. Phytochemical characterization is therefore an important step in the study of plant extracts and in the exploration of their pharmacological properties. The genus *Zanthoxylum*, belonging to the Rutaceae family, includes several species used in traditional medicine. In particular, the study by Diatta *et al.*, (2014) evaluated the anti-inflammatory and analgesic activities of *Zanthoxylum zanthoxyloides* leaf extracts using experimental animal models. Furthermore, Ogunrinade *et al.*, (2021) demonstrated that the root extract of this species could modulate several mediators associated with neuroinflammation in a cellular model. These results provide scientific evidence supporting the species' pharmacological potential; however, they do not

allow for direct conclusions regarding the activity of all its plant parts or all types of extracts. The evaluation of the anti-inflammatory activity of plant extracts can, in particular, be based on the carrageenan-induced rat paw edema model. Described by Winter *et al.*, (1962), this model is commonly used to study the acute inflammatory response and to assess the effect of candidate substances with anti-inflammatory activity. Its application to a plant extract allows for a comparison of edema progression between a control group, a group receiving a reference substance, and a group treated with the extract under study. Despite the available data on the biological properties of *Z. zanthoxyloides*, the quantitative characterization of the aqueous extract of stem bark harvested in northern Côte d'Ivoire is of particular interest. Indeed, the results obtained with leaves or roots or with extracts prepared using other solvents cannot be automatically applied to stem bark extracted with water. The objective of this study is therefore to quantitatively characterize the main groups of phytochemical compounds in the aqueous extract of the stem bark of

Zanthoxylum zanthoxyloides harvested in Dikodougou, in the Poro region, and then to evaluate its anti-inflammatory activity in rats using the carrageenan-induced edema model. More specifically, the study aims to determine the extraction yield, quantify the targeted metabolite groups, and monitor the progression of edema following administration of the extract, in comparison with diclofenac, which was used as a pharmacological reference.

MATERIAL AND METHODS

1-1-Material

1-1-1-Plant Material

The plant material consists of stem bark from *Zanthoxylum zanthoxyloides*, collected in the Poro region (Korhogo), specifically in the municipality of Dikodougou (Ivory Coast). The plant (Figure 1) was identified at the National Center for Floristics under herbarium number CSRS006424.



Figure 1: Photograph of *Zanthoxylum zanthoxyloides* (Dikodougou, 2024)

1-1-2-Animal Materials

The anti-inflammatory activity study was conducted on twenty (20) male and female Wistar rats, weighing between 100 and 250 g. These rats were obtained from the animal facility of the National Center for Floristics (CNF) at Félix HOUPOUËT BOGNY University (UFHB). These rats were housed at laboratory temperature (24°C) and fed a standard diet. Each rat was individually identified by a number marked on its tail using a permanent marker.

2-Methods

2-1-Preparation of the aqueous extract

The plant powder obtained by grinding the stem bark of *Zanthoxylum zanthoxyloides* was used to prepare the aqueous extract, according to the method described

by Zihiri *et al.*, (2003). Thus, one hundred grams (100 g) of plant powder were macerated in one liter of distilled water by homogenization in a blender for five (5) minutes. The resulting homogenate was filtered through a sieve. Next, the residues from the filtrate were returned to the blender and macerated again for five (5) minutes in 500 ml of distilled water. The resulting homogenate was filtered a second time through a sieve. The residues from this filtration were returned to the blender and macerated once more in 500 ml of distilled water under the same conditions. The homogenate obtained from these residues was also filtered through a sieve. Subsequently, the total filtrate obtained underwent a series of three (3) successive filtrations: first through clean cloth, then through cotton wool. The final filtrate obtained from these operations was dried in an oven at

50 °C for four (3) days. The dry evaporate was recovered in powder form to constitute the dry extract of the stem bark of *Zanthoxylum zanthoxyloides* (THOZA-ET).

2-2-Calculating Yield

Yield is the ratio of the amount of extract obtained to the amount of material. The result is expressed as a percentage of the dry plant powder and calculated using the formula above:

$$R (\%) = M1 \times 100/M0$$

R: Extract yield expressed as a percentage (%)

M1: Mass of dry extract (in g)

M0: Mass of plant powder (in g)

2-3-Quantitative Analysis of Phytochemicals

❖ Analysis of Alkaloids

Principle

100 mg of the extract were dissolved in 4 mL of ethanol to obtain a concentrated stock solution with a concentration of 25 mg/mL. Next, the pH of this solution was measured and maintained between 2 and 2.5 by adding a few drops of hydrochloric acid (HCl). Subsequently, 2 mL of Dragendorff's reagent was added to the extract, and the mixture was then centrifuged at 7,000 rpm for 3 minutes. A few drops of Dragendorff's reagent were added to the centrifugate to complete the precipitation; a second centrifugation was then performed, the supernatant was completely decanted, and the precipitate was recovered and washed with ethanol. The filtrate was discarded, and the residue was treated with 2 mL of disodium sulfate solution. The black-brown precipitate that forms is then centrifuged. Two drops of disodium sulfate are added to the solution to complete the precipitation, and a second centrifugation is performed. The residue is collected and dissolved in 2 mL of concentrated nitric acid, heating as needed. The resulting solution is then made up to 10 mL by adding distilled water. 1 mL of this diluted solution is then mixed with 5 mL of thiourea, and the absorbance is measured at 435 nm against a blank consisting of nitric acid, distilled water, and thiourea prepared using the same procedure (Sreevidya and Mehrotra, 2003).

Preparation of the Calibration Curve

17 g of atropine powder were dissolved in 17 mL of nitric acid to prepare a stock solution with a concentration of 1 mg/mL. Dilutions were made from this stock solution and made up to 10 mL with distilled water. Subsequently, 1 mL of each dilution was added to 5 mL of 3% thiourea. The absorbance (X) was measured at a wavelength of 435 nm.

❖ Polyphenol Assay

Preparation of Reagents

To prepare a 20% Na₂CO₃ solution, 10 grams of Na₂CO₃ were dissolved in 50 mL of distilled water and stirred until completely dissolved. The mixture was

allowed to stand for at least 1 hour, resulting in a 20% Na₂CO₃ solution. To prepare the Folin-Ciocalteu solution (1:10), 5 mL of Folin's reagent was taken and diluted in 50 mL of distilled water.

Procedure

10 g of extract were weighed and dissolved in 10 mL of methanol to obtain a concentrated stock solution with a concentration of 1 mg/mL. Next, 1 mL of this solution was withdrawn and added to 1 mL of FCR. The mixture was homogenized using a vortex mixer for 6 minutes. After mixing, 1 mL of sodium carbonate was added, and distilled water was added to bring the total volume to 10 mL. The mixture was kept in the dark for one hour. The absorbance was measured at 735 nm, using as a blank an identical preparation in which the extract was replaced with distilled water.

❖ Preparation of the Gallic Acid Calibration Series

5 mg of gallic acid was dissolved in 5 mL of distilled water; the mixture was then shaken to produce a stock solution with a concentration of 1 mg/mL. Subsequently, a series of dilutions of the gallic acid stock solution was prepared using distilled water. Specifically, 1 mL of each dilution was transferred to test tubes (labeled C0 through C10), where 1 mL of FCR (1:10) was added to each tube, and the mixture was allowed to stand for 6 minutes. After this time, 1 mL of 20% sodium carbonate was added to each tube. Finally, the entire mixture was incubated in the dark for 1 hour. Absorbance was measured at 735 nm.

❖ Terpenoid Assay

• Preparation of the 50 mg/mL stock extract solution

250 mg of dry extract was weighed out and dissolved in 5 mL of distilled water to obtain a concentrated stock solution (CSM = 50 mg/mL).

• Procedure

1 mL of the previously prepared stock solution was withdrawn and transferred to a test tube; then, 2 mL of chloroform was added. After mixing thoroughly, the mixture was allowed to stand undisturbed for 3 minutes. Next, 200 µL of concentrated sulfuric acid was added, and the solution was incubated in the dark for 2 hours. After incubation, the reddish-brown precipitate formed was carefully separated from the supernatant by decantation without agitation. Subsequently, 3 mL of absolute methanol was added, and the mixture was shaken thoroughly until the precipitate was completely dissolved. Absorbance was measured at 538 nm using a blank prepared in the same manner, substituting methanol for the plant extract.

❖ Flavonoid Assay

Preparation of the Stock Solution

100 mg of dry extract was weighed out and dissolved in 4 mL of distilled water to obtain a concentrated stock solution (CSM).

Principle

400 μ L of the stock solution were taken and transferred to a test tube, to which 120 μ L of 5% sodium nitrite (NaNO_2) were added. After 5 minutes, 120 μ L of 10% AlCl_3 was added, and the mixture was then shaken vigorously. Six minutes later, 800 μ L of 1 M NaOH was added. The absorbance was immediately measured at 510 nm against the blank. A stock solution of quercetin in methanol was prepared and then diluted to various concentrations between 0 and 1000 $\mu\text{g/mL}$ to plot the calibration curve (Kim *et al.*, 2003).

❖ Determination of Saponins

• Preparation of the Reagent

8 g of vanillin were dissolved in 100 mL of 96° ethanol, resulting in an 8% vanillin concentration.

• Principle

25 mg of extract were weighed and dissolved in 1 mL of distilled water to obtain a concentrated stock solution (CSM = 25 mg/mL of extract). Then, 100 μ L of this solution were withdrawn and transferred to a test tube. Next, 500 μ L of 8% vanillin was added to this mixture, which was placed in an ice bath; then, 5 mL of

72% sulfuric acid was added. The mixture was stirred and then held at room temperature ($21 \pm 2^\circ\text{C}$) for 3 min. After this time, the mixture was incubated for an additional 10 minutes at 60°C , and finally, the mixture was allowed to cool. Absorbance was measured at 544 nm against a reagent blank prepared as follows (ethanol + 8% vanillin + 72% sulfuric acid).

RESULTS

3-1-Extraction Yield

The average mass obtained from an initial mass of 100 g of plant powder for aqueous extraction was $m = 13.06$ g, corresponding to a yield of $R = 13.06\%$ for the stem bark of *Zanthoxylum zanthoxyloides*.

3-2-Assay of Phytochemicals in the Aqueous Extract

Phytochemical analysis of the aqueous extracts of *Zanthoxylum zanthoxyloides* stem bark revealed the presence of various chemical compounds, including alkaloids, polyphenols, terpenoids, flavonoids, and saponosides. However, in the aqueous extract, terpenoids are the most abundant, at 173.80 mg/mL (Figure 2).

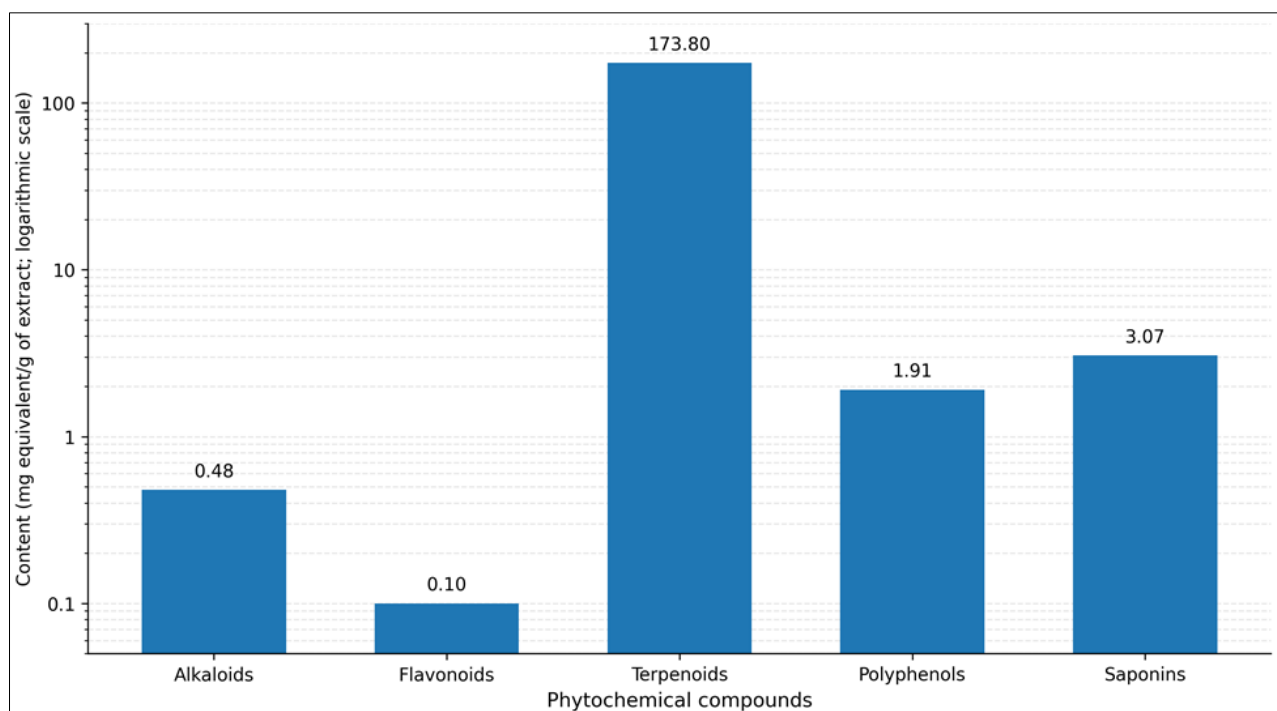


Figure 2: Concentrations of phytochemicals in the aqueous extract of *Zanthoxylum zanthoxyloides* stem bark

3-3-Effects of Different Products on Carrageenan-Induced Edema

Edematous changes were monitored over a 5-hour period following the induction of inflammation in rats using 1% carrageenan. The negative control group (NC) showed a gradual increase in the percentage of edema (PA), reaching a maximum value of $14.52 \pm 12.36\%$ at the 5th hour. In contrast, the group treated with

diclofenac sodium (Olfen, 1 mg/kg), a nonsteroidal anti-inflammatory drug used as a positive control, showed an inhibition (PI) ranging from 39.28% to 78.23% between the 1st and 5th hours. This trend confirms the well-established anti-inflammatory activity of diclofenac. The aqueous extract, THOZA-ET, administered at a dose of 100 mg/kg, also resulted in a reduction in edema (table 1).

Table I: Percentage Increase and Inhibition for the Various Products Used

	TN	Diclo (Olfen)		THOZA-ET (100 mg/kg)	
Tps	PA (%)	PA (%)	PI (%)	PA (%)	PI (%)
1 h	117,72±10,17 ^{ns}	69,92±23,91 ^{ns}	39,28±25,84 ^{ns}	87,69±8,57 ^{ns}	25,46±4,74 ^{ns}
2 h	128,99±13,46 ^{ns}	58,11±21,15 ^{ns}	54,55±17,43 ^{ns}	84,27±4,26 ^{ns}	34,02±9,73 ^{ns}
3 h	134,96±13,40 ^{ns}	51,53±20,35 ^{ns}	61,63±15,32 ^{ns}	75,50±5,11 ^{ns}	43,44±9,41 ^{ns}
4 h	141,72±8,90 ^{ns}	39,73±17,59 ^{ns}	72,10±11,74 ^{ns}	72,91±7,09 ^{ns}	48,20±8,50 ^{ns}
5 h	143,52±12,36 ^{ns}	31,63±16,04 ^{ns}	78,23±10,02 ^{ns}	70,30±9,50 ^{ns}	50,36±11,41 ^{ns}

A p-value of ≤ 0.05 was considered statistically significant. Comparisons were made between columns. PA: Percentage increase; PI: Percentage inhibition

DISCUSSION

Aqueous extraction was used to evaluate the yield of the plant's aqueous extract. The aqueous extract of the stem bark of *Zanthoxylum zanthoxyloides* yielded an average yield (13.06%) when extracted by aqueous maceration. This value is close to that reported by Zihiri *et al.*, (2003), who used a similar method. Phytochemical analysis identified several categories of biologically active secondary metabolites: alkaloids, polyphenols, flavonoids, saponosides, and terpenoids. These results are consistent with those of other researchers, who confirm that powder from the stems of *Zanthoxylum zanthoxyloides* harvested in Mali contains alkaloids, phenolic compounds (flavonoids, tannins, coumarins), saponins, sterols, and triterpenes (Togola *et al.*, 2023). Terpenoids were found to be the most abundant compounds in the stem extract (173.80 mg/mL). This result is consistent with the findings of (Chaaib *et al.*, 2003; Adesina, 2006; and Zahoui *et al.*, 2010), who reported high levels of terpenoids and alkaloids in extracts of *Zanthoxylum zanthoxyloides*. These compounds are known for their anti-inflammatory effects (Bourkhiss *et al.*, 2010; Kherbache, 2018). Assessment of anti-inflammatory activity, based on the carrageenan-induced edema model in rats (Sy *et al.*, 2009; Elion *et al.*, 2014), demonstrated that the administered extract resulted in a significant reduction in inflammation compared to the control group. Other studies indicate that the aqueous extract of *Zanthoxylum zanthoxyloides* roots possesses anti-inflammatory activity, notably by reducing prostaglandins (PGE₂) through non-selective inhibition of COX-1 and COX-2 (ABA and Mensah-Attipoe, 2008). Isolated compounds, such as fagaramide, have also been shown to inhibit prostaglandin synthesis and exhibit anti-inflammatory activity (Oriowo, 1982). The maximum inhibition of edema observed in the plant at the 5th hour of the experiment is attributed to the synergistic action of secondary metabolites at the time of prostaglandin release at the site of inflammation and could be explained by the presence in this plant of COX inhibitors, the inhibition of which leads to a reduction in prostaglandin synthesis. This result indicates that the plant exerts an anti-inflammatory effect similar to that of NSAIDs, linked to its bioactive compounds such as phenols and saponins (Santangelo, 2007). This inhibition is similar to that of diclofenac, which was used as a reference substance. Several studies have shown that polyphenols and their metabolites block enzymes involved in

arachidonic acid metabolism, thereby reducing the production of inflammatory mediators such as nitric oxide, prostaglandins, and leukotrienes (Kim *et al.*, 2004; Guo *et al.*, 2009). These compounds therefore possess anti-inflammatory properties and are considered potential chemopreventive agents (Sahu and Saxena, 2013).

CONCLUSION

This study quantitatively characterized several groups of phytochemical compounds in the aqueous extract of *Zanthoxylum zanthoxyloides* stem bark, harvested in the municipality of Dikodougou, in the Poro region of Côte d'Ivoire. The extraction yield was 13.06%. The analyses revealed the presence of alkaloids, flavonoids, terpenoids, polyphenols, and saponosides, with terpenoids accounting for the highest proportion among the compounds studied. Pharmacological evaluation conducted in rats using the carrageenan-induced edema model showed a reduction in edema in the group treated with the extract at a dose of 100 mg/kg. At the fifth hour, the reported inhibition percentage was $50.36 \pm 11.41\%$, compared to $78.23 \pm 10.02\%$ for diclofenac. These results constitute preliminary observations consistent with the anti-inflammatory potential of the extract under study.

REFERENCES

- ABA Prempeh, A., Mensah-Attipoe, J. (2008). In vivo inhibition of prostaglandin E₂ production by crude aqueous extract of the root bark of *Zanthoxylum xanthoxyloides*. Ghana Medical Journal, 42(2), 85–88.
- Adesina, S. K. (2006). The Nigerian *Zanthoxylum*; chemical and biological values. African Journal of Traditional, Complementary and Alternative Medicines, 2(3), 282–301.
- Bourkhiss M'barek, Hnach M, Paolini J., Jean C., Abdallah F., Badr S (2010). Propriétés antioxydante et anti-inflammatoire des huiles essentielles des différentes parties de *Tetraclinis articulata* (Vahl) Masters du Maroc. Bull Soc Roy Sci Liège (79) : 141–54.
- Chaaib, F., Queiroz, E. F., Ndjoko, K., Diallo, D., Hostettmann, K. (2003). Antifungal and antioxidant compounds from the root bark of *Fagara zanthoxyloides*. Planta Medica, 69(4), 316–320.

- Diatta, W., Sy, G. Y., Manga, C. I., Diatta, K., Fall, A. D., Bassene, E. (2014). Recherche des activités anti-inflammatoire et analgésique des extraits de feuilles de *Zanthoxylum zanthoxyloides* (Lam.) Zepernick et Timler (Rutaceae). International Journal of Biological and Chemical Sciences, 8(1), 128–133.
- Elion J., Laurence S. Lapoumériou C. (2010). Physiopathologie de la drépanocytose. Médecine. Tropical, 70: 454-458.
- Guo, W., Kong, E., Meydani, M. (2009). Dietary polyphenols, inflammation, and cancer. Nutrition and Cancer, 61(6), 807–810.
- Kherbache (2014). Propriétés anti-inflammatoire et antioxydant des extraits d'*anacyclus Clavatus*, Mémoire de Magister en Biologie, Algérie, 87p
- Kim, D. O., Chun, O. K., Kim, Y. J., Moon, H. Y., Lee, C. Y. (2003). Quantification of polyphenolics and their antioxidant capacity in fresh plums. Food Chemistry, 81(3), 321-328.
- Kim, H.P., Son K.H. & Chan H.W., 2004. Anti-inflammatory plant flavonoids and cellular action mechanisms. *J Pharm Sci*, (96): 229-245.
- Ogunrinade, F. A., Guetchueng, S. T., Katola, F. O., Aderogba, M. A., Akande, I. S., Sarker, S. D., Olajide, O. A. (2021). *Zanthoxylum zanthoxyloides* inhibits lipopolysaccharide- and synthetic hemozoin-induced neuroinflammation in BV-2 microglia: roles of NF- κ B transcription factor and NLRP3 inflammasome activation. Journal of Pharmacy and Pharmacology, 73(1), 118–134.
- Oriowo MA. (1982). Anti-inflammatory activity of piperonyl-4-acrylic isobutyl amide, an extractive from *Zanthoxylum zanthoxyloides*. *Planta Med.*, 44(1): 54-56.
- Sahu, R., Saxena, J. (2013). Screening of Total Phenolic and Flavonoid Content in Conventional and Non-Conventional Species of Curcuma. *J.of Pharm and Phyto*, 2(1): 176-179.
- Santangelo, C., Vari, R., Scazzocchio, B., Di Benedetto, R., Filesi, C., Masella, R. (2007). Polyphenols, intracellular signalling and inflammation. *Annali dell'Istituto Superiore di Sanità*, 43(4), 394–405.
- Sreevidya, N., Mehrotra, S. (2003). Spectrophotometric method for estimation of alkaloids precipitable with Dragendorff's reagent in plant materials. *Journal of AOAC International*, 86(6), 1124–1127.
- Sy GY, Fall AD, Diatta W, Gueye M, Badji, Bassène E, Faye B. (2009). Analgesic and anti-inflammatory activity of aqueous root extract of *Cassia sieberiana* D. C. (Caesalpiniaceae) *Afr.J. Phar.*, 3(12): 651-653.
- Togola, I., N'Diaye, M., Traoré, N., Konaré, M. A., Diarra, N. (2023). Ethnobotanical and comparative study of the antioxidant and anti-inflammatory potential of three organs of *Zanthoxylum zanthoxyloides*, a plant used in the traditional treatment of sickle-cell disease in Bamako. *GSC Biological and Pharmaceutical Sciences*, 25(1), 019–030.
- Winter, C. A., Risley, E. A., Nuss, G. W. (1962). Carrageenin-induced edema in hind paw of the rat as an assay for antiinflammatory drugs. *Proceedings of the Society for Experimental Biology and Medicine*, 111(3), 544–547.
- Zahoui, O. S., Coulibaly, A., Yapo, A. P. A., N'Guessan, J. D. (2010). Étude de la toxicité aiguë de l'extrait aqueux des racines de *Zanthoxylum zanthoxyloides* chez la souris. *Rev Ivoir de Sci et Tech*, (16) : 92–101.
- Zihiri, G. N., Kra, A. K., Guédé-Guina, F. (2003). Évaluation de l'activité anti-inflammatoire de l'extrait aqueux de *Microglossa pyrifolia* (Lam.) O. Ktze (Asteraceae). *Phyt*, 1(1) : 21–28.