

*Short Research Article*

**Phytochemical composition and antioxidant activity of aqueous, methanolic and ethanolic extracts from the leaves of *Alchornea cordifolia* (Euphorbiaceae) from Côte d'Ivoire.**

UNDER PEER REVIEW

## Abstract

*Alchornea cordifolia* (Euphorbiaceae) is a medicinal plant widely used in West Africa for its many therapeutic properties. The present study aims to characterise the phytochemical composition and evaluate the antioxidant activity of aqueous, methanolic and ethanolic extracts from *Alchornea cordifolia* leaves harvested in Yamoussoukro (Côte d'Ivoire). The extracts were obtained by maceration in different solvents and then subjected to qualitative phytochemical sorting. The total polyphenol, total flavonoid and tannin contents were determined by spectrophotometric methods. Antioxidant activity was evaluated by DPPH and ABTS<sup>+</sup> radical scavenging assays. Phytochemical sorting revealed the presence of sterols and polyterpenes, polyphenols, flavonoids, alkaloids, tannins and quinone compounds, with variations depending on the extraction solvent. The aqueous extract had the highest total polyphenol content ( $126.25 \pm 2.01$  mg AG Eq/g), while the methanolic and ethanolic extracts showed high total flavonoid contents ( $342.51 \pm 3.62$  and  $307.83 \pm 1.07$  mg Eq Q/kg, respectively). Tannins were more abundant in the aqueous extract. Antioxidant tests showed dose-dependent antiradical activity, with organic extracts being more effective, particularly the ethanolic extract, which had the lowest IC<sub>50</sub> values for both the DPPH and ABTS tests. These results indicate that *Alchornea cordifolia* leaves are an important source of bioactive compounds with high antioxidant potential. The use of hydroalcoholic solvents appears to be particularly effective for extracting the compounds responsible for this activity, suggesting the potential interest of this plant in the development of nutraceutical and phytotherapeutic products.

Keywords: *Alchornea cordifolia*; plant extracts; phytochemical compounds

## I. INTRODUCTION

Secondary metabolites are sought after because they are known for their numerous biological activities that promote positive health effects. These activities include antibacterial, anticancer, antifungal and antioxidant activities used in the agricultural, food and pharmaceutical industries (Mambe, 2021). Plants are an essential resource for the world's populations in several areas such as construction, nutrition and health (Effo, 2018).

Plants produce a wide variety of secondary metabolites for defence and survival in the ecosystem. Plant secondary metabolites, currently exceeding 100,000 identified substances, belong to three main classes of chemicals: terpenes (a group of lipids), phenolics (carbohydrate derivatives) and alkaloids (BEN AMOR 2008).

Alchornea cordifolia (Schumach. & Thonn.) Müll. Arg., a medicinal plant widely used in West Africa, is recognised for its many applications in traditional medicine, particularly in the treatment of infections, inflammatory conditions and gastrointestinal disorders (Kone et al., 2025). The leaves of this species contain a variety of bioactive compounds, including polyphenols, flavonoids and tannins, which are attributed with significant antioxidant, antimicrobial and immunomodulatory properties (Koffi et al., 2021). Several studies have shown that extracts from A. cordifolia leaves have a high capacity to trap free radicals and contribute to reducing oxidative stress (Effo et al., 2017).

In addition, extracts of Alchornea cordifolia have shown promising antimicrobial activity (F. S. Ouattara-Soro et al., 2023) against various pathogenic bacterial strains, as well as antiparasitic potential, particularly against the agents responsible for avian coccidiosis, thus opening up interesting prospects for the development of natural alternatives to conventional antimicrobials. In recent years, studies have intensified in the search for phytochemical compounds from African plants (Mambe, 2021).

The aim of this study is to determine the condensed tannin, total tannin and total polyphenol content of Alchornea cordifolia leaf extracts, as well as to evaluate their antioxidant activity, with a view to contributing to the promotion of this plant as a nutraceutical and phytotherapeutic resource.

## II. MATERIALS AND METHOD

### ➤ MATERIALS

#### Plant material

The plant material consisted of leaves from Alchornea cordifolia, harvested in the city of Yamoussoukro. The choice of this plant for the present study was motivated by its many traditional uses, its antimicrobial, antifungal, anti-inflammatory and healing properties, and also by the fact that it is very abundant locally (M'bra, 2017).

### ➤ METHOD

#### Preparation of extracts

One hundred (100) grams of *Alchornea cordifolia* leaf powder were separately subjected to aqueous, hydroethanolic (ethanol/water, 70/30: v/v) and hydromethanolic (methanol/water, 70/30: v/v) extraction. Maceration was carried out with stirring using a magnetic stirrer for 24 hours. The mixtures were successively filtered through poplin cloth, cotton wool and Whatman No. 2 paper. The filtrates obtained were dried in an oven at 40 °C to obtain the corresponding dry extracts. The extracts were then stored at 4°C until use, according to the methods described by Bagré et al. (2011), Bouharb et al. (2014) and Minaflinou Sacca Sidi et al. (2015).

#### Phytochemical sorting of extracts from *Alchornea cordifolia* leaves

Phytochemical screening was carried out according to the methods described by Lazureski et al. (2007), Abo (2013) and Mea et al. (2017) at the Animal Physiology and Phytotherapy Laboratory of the Biosciences Department (UFHB). Tannins were detected in catechin form using the Stiasny reaction after heating in a water bath, and in gallic form by saturation with sodium acetate followed by the addition of ferric chloride. Quinone compounds were detected using the Borntraeger reaction after acid hydrolysis, chloroform extraction and alkalisation with ammonia. The presence of alkaloids was demonstrated using Dragendorff's and Bouchardat's reagents, while saponosides were detected by the foam test based on the formation of persistent foam after vigorous shaking of the aqueous solutions. Appropriate standard substances were used as positive controls for each test.

#### Spectrophotometric measurement of total polyphenols

The total polyphenol content was measured by spectrophotometry according to the method described by Wood et al. (2002), based on the quantification of the total concentration of hydroxyl groups present in the extracts. A volume of 30  $\mu\text{L}$  of extract solution was mixed with 2.5 mL of Folin–Ciocalteu reagent diluted to 1/10. After incubation in the dark for 2 minutes at room temperature, 2 mL of sodium carbonate solution (75 g/L) was added. The mixture was then incubated in a water bath at 50°C for 15 minutes and then rapidly cooled. The absorbance was measured at 760 nm using a spectrophotometer, with distilled water as the blank. A calibration curve was established from gallic acid solutions of increasing concentrations. The analyses were performed in triplicate and the results were expressed in milligram equivalents of gallic acid.

#### **Spectrophotometric determination of total flavonoids**

The total flavonoid content was measured by spectrophotometry using the method described by Marinova et al. (2005), based on the formation of a stable complex between aluminium chloride and the oxygen atoms carried by carbons 4 and 5 of the flavonoid nucleus. In a 25 mL volumetric flask, 2.5 mL of extract solution was mixed with 0.75 mL of sodium nitrite (5%  $\text{NaNO}_2$ , m/v). After adding 0.75 mL of aluminium chloride (10%  $\text{NaCl}_3$ , m/v) and incubating in the dark for 6 minutes, 5 mL of sodium hydroxide (1 N  $\text{NaOH}$ ) was added and the volume was adjusted to 25 mL with distilled water. The mixture was stirred vigorously, then the absorbance was measured at 510 nm using a UV-visible spectrophotometer (BIOLABO Kenza Max, France). The analyses were performed in triplicate and the results were expressed in milligrams of quercetin equivalent per kilogram of extract (mg Eq Q/kg).

#### **Spectrophotometric measurement of condensed tannins**

The condensed tannins were measured by spectrophotometry using the vanillin–HCl method described by Julkunen-Titto (1985). This method is based on the reaction of vanillin with the terminal flavonoid group of condensed tannins, resulting in the formation of red-coloured complexes through the conversion of tannins into anthocyanidols. A volume of 50  $\mu\text{L}$  of the extract solution was mixed with 200  $\mu\text{L}$  of vanillin solution in 4% methanol and shaken vigorously. Next, 50  $\mu\text{L}$  of concentrated hydrochloric acid (HCl) was added and the mixture was incubated at room temperature for 20 minutes. The absorbance was measured at 550 nm against a blank. A calibration curve was established from catechin solutions with concentrations ranging from 0 to 1000  $\mu\text{g/mL}$ . The results were expressed in milligram equivalents of catechin per gram of extract (mg Eq C/g).

➤ **Antioxidant activity of *Alchornea cordifolia* leaf extracts**

**Measurement of anti-radical activity using the DPPH test**

❖ **Principle**

DPPH (2,2-diphenyl-1-picrylhydrazyl) is an unstable free radical that stabilises by accepting a hydrogen atom. The antioxidant effect is measured by the ability of extracts to donate a hydrogen atom to DPPH, which results in a decrease in its absorbance (Samarth et al., 2008). The method used for this analysis is that described by Mansouri et al. (2005), based on the reduction of DPPH, observable by a colour change from purple to yellow.

❖ **Protocol**

A range of concentrations of the extract (from 0 to 200 µg/mL) and quercetin (used as a reference antioxidant) was prepared in an ethanol/water mixture (70/30, v/v). A volume of 100 µL of each solution was added to 3.9 mL of DPPH solution (70 µM) prepared in methanol. After homogenisation, the mixtures were incubated in the dark at room temperature (25 °C) for 15 minutes. The absorbance was then measured at 517 nm against a blank consisting solely of methanol. The percentage inhibition of the DPPH radical was calculated using the following formula: % I =  $[(A_0 - Abs_{\text{extract}}) / A_0] \times 100$

- % I: percentage of DPPH inhibition
- $A_0$ : absorbance of the DPPH solution alone (blank)
- $Abs_{\text{extract}}$ : absorbance of the DPPH solution with the sample

The 50% inhibitory concentration ( $IC_{50}$ ), corresponding to the concentration of extract or quercetin required to inhibit 50% of DPPH radicals, was determined graphically by projection from 50% inhibition on the curve linking the percentage of inhibition to the concentration. Each result represents the average of three replicates (n = 3).

**Measurement of anti-radical activity using the ABTS+ test**

### ❖ Principle

The antiradical activity was measured using the method described by Choong et al. (2007). This method is based on the ability of compounds present in the extracts to reduce the ABTS<sup>+</sup> radical cation (2,2'-azinobis-3-ethylbenzothiazoline-6-sulfonic acid).

### ❖ Protocol

The ABTS<sup>+</sup> radical cation was generated by the reaction between an 8 mM ABTS solution (87.7 mg in 20 mL of distilled water) and a 3 mM potassium persulphate solution (0.0162 g in 20 mL of distilled water), in a 1:1 volume ratio (v/v). The mixture was incubated in the dark at room temperature for 16 hours. The ABTS<sup>+</sup> solution thus obtained was then diluted with methanol until it reached an absorbance of  $0.70 \pm 0.02$  at 734 nm. A test sample of 3.9 mL of this diluted solution was added to 100  $\mu$ L of extract. After stirring, the mixture was incubated in the dark for 6 minutes at  $30 \pm 2$  °C. The residual absorbance of the ABTS<sup>+</sup>• radical was then measured at 734 nm using a UV-visible spectrophotometer. It had to be between 20% and 80% of the absorbance of the blank. The tests were performed in triplicate. The results were expressed in micromoles of Trolox equivalents per litre of extract ( $\mu$ mol TE/L).

A calibration curve was established using different concentrations of Trolox: 0.375  $\mu$ M, 0.5  $\mu$ M, 0.625  $\mu$ M, 1  $\mu$ M, 1.125  $\mu$ M, 1.375  $\mu$ M and 1.5  $\mu$ M.

The percentage inhibition of the ABTS<sup>+</sup>• radical was calculated using the following formula: % I =  $[(A_0 - A_{\text{S}_{\text{extract}}}) / A_0] \times 100$

- $A_0$ : absorbance of the diluted ABTS<sup>+</sup>• solution (blank)
- $A_{\text{S}_{\text{extract}}}$ : absorbance of the diluted ABTS<sup>+</sup>• solution containing the extract

The calibration curve obtained was used to express the antioxidant activity of the extracts as follows: Concentration or antioxidant activity ( $\mu$ M Trolox Eq) =  $(\% I \times fd) / (4.99 \times 10)$

The initial concentration of the extract before dilution was 0.1 g/25 mL.

## RESULTS

### ➤ Phytochemical sorting of extracts from *Alchornea cordifolia* leaves

#### 1. Phytochemical fractionation of the aqueous extract of *Alchornea cordifolia* (AEAC)

Phytochemical sorting of the aqueous extract of *Alchornea cordifolia* revealed the presence of several groups of secondary metabolites. The compounds detected were sterols and polyterpenes,

polyphenols, flavonoids, saponins, quinone compounds, alkaloids and catechin tannins. However, gallic tannins were not detected in this extract (Table 1).

Table 1: Phytochemical sorting of the aqueous extract

Compounds sought	Tests or reagents	Result
Sterols and polyterpenes	<i>Liebermann</i>	+
Polyphenols	<i>Ferric chloride</i>	+
Flavonoids	<i>Cyanidin</i>	+
Saponins	<i>Vigorous shaking</i>	+
Quinone compounds	<i>Borntraeger</i>	+
Alkaloids	<i>Dragendorff</i>	+
	<i>Bouchardat</i>	+
	<i>Stiasny</i>	+
Tannins	catechin	+
	Gallic	-

## 2. Phytochemical fractionation of the methanolic extract of *Alchornea cordifolia* (MEAC).

Phytochemical analysis of the methanolic extract of *Alchornea cordifolia* revealed the presence of several groups of secondary metabolites. The compounds detected were sterols and polyterpenes, polyphenols, flavonoids, saponins, alkaloids and gallic tannins. However, catechin tannins and quinone compounds were not detected in this extract (Table 2).

Table 2: Phytochemical sorting of the methanolic extract

Compounds sought	Tests or reagents	Result
Sterols and polyterpenes	<i>Liebermann</i>	+
Polyphenols	<i>Ferric chloride</i>	+
Flavonoids	<i>Cyanidin</i>	+
Saponins	<i>Vigorous shaking</i>	+
Quinone compounds	<i>Borntraeger</i>	-
	<i>Dragendorff</i>	+

Alkaloids	<i>Bouchardat</i>	+	
catechin	<i>Stiasny</i>	-	
Tannins	Gallic	<i>Hydrochloric acid</i>	+

### 3. Phytochemical fractionation of the ethanolic extract of *Alchornea cordifolia* (EEAC)

Phytochemical sorting of the ethanolic extract of *Alchornea cordifolia* revealed the presence of several groups of secondary metabolites. The compounds detected were sterols and polyterpenes, polyphenols, flavonoids, quinone compounds, alkaloids and catechin tannins. However, gallic tannins and saponins were not detected in this extract (Table 3).

**Table 3: Phytochemical sorting of the methanolic extract**

Compounds sought	Tests or reagents	Result	
Sterols and polyterpenes	<i>Liebermann</i>	+	
Polyphenols	<i>Ferric chloride</i>	+	
Flavonoids	<i>Cyanidin</i>	+	
Saponins	<i>Vigorous shaking</i>	-	
Quinone compounds	<i>Borntraeger</i>	+	
Alkaloids	<i>Dragendorff</i>	+	
	<i>Bouchardat</i>	+	
catechin	<i>Stiasny</i>	+	
Tannins	Gallic	<i>Hydrochloric acid</i>	-

(+) : Presence of the compound

(-) : Absence of the compound

#### ➤ Spectrophotometric measurement of extracts from *Alchornea cordifolia* leaves

##### 1. Determination of phytochemical compounds in the aqueous extract (AEAC)

Quantitative analyses performed on the aqueous extract of *Alchornea cordifolia* leaves determined the total flavonoid, total polyphenol and total tannin content. The total flavonoid content was estimated at  $14.46 \pm 2.15$  mg quercetin equivalent per kilogram of extract (mg Eq Q/kg), indicating a moderate presence of these compounds. Total polyphenols were quantified at  $126.25 \pm 2.01$  mg gallic acid equivalent per gram of extract (mg Eq GA/g), indicating a high content of phenolic compounds in this extract. Finally, total tannins had a content of  $11.37 \pm 3.12$  mg catechin

equivalent per gram of extract (mg Eq C/g), indicating a significant presence of tannic compounds in the aqueous fraction.

## **2. Determination of phytochemical compounds in methanolic extract (EMAC)**

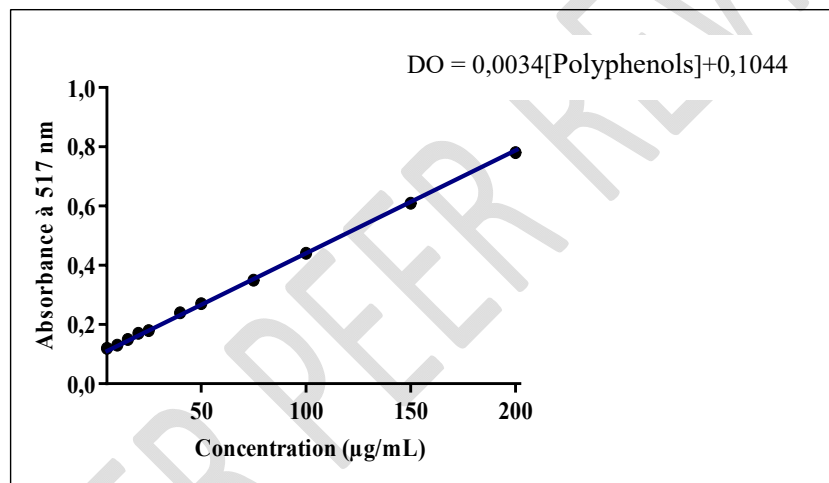
Analyses carried out on the methanolic extract of *Alchornea cordifolia* leaves revealed variable levels of phytochemical compounds. The concentration of total flavonoids was particularly high, with a value of  $342.51 \pm 3.62$  mg quercetin equivalent per kilogram of extract (mg Eq Q/kg), reflecting a high flavonoid content in this fraction. Total polyphenols were quantified at  $93.62 \pm 1.43$  mg gallic acid equivalent per gram of extract (mg Eq GA/g), representing a moderate content of overall phenolic compounds. In contrast, the total tannin content was lower, at  $2.06 \pm 0.91$  mg catechin equivalent per gram of extract (mg Eq C/g), suggesting a low contribution of these compounds to the antioxidant activity of this fraction.

## **3. Determination of phytochemical compounds in the ethanolic extract (EEAC)**

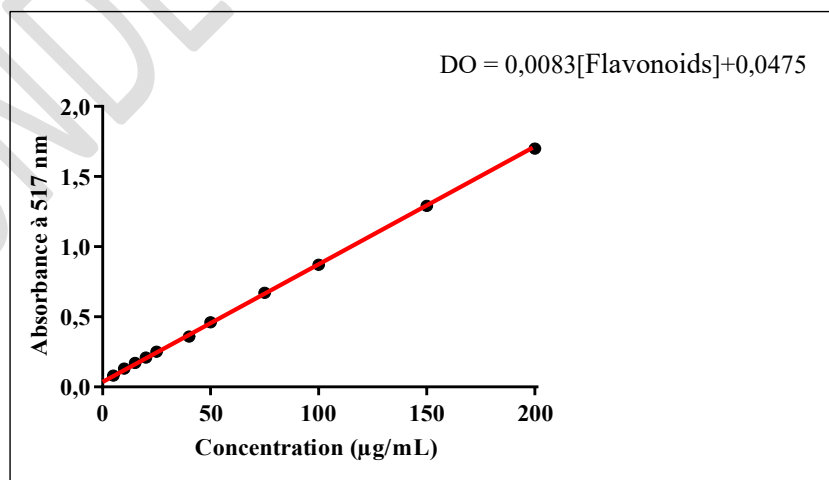
The ethanol extract of *Alchornea cordifolia* leaves was also analysed to measure phytochemical compounds. The results showed a high concentration of total flavonoids, with a value of  $307.83 \pm 1.07$  mg quercetin equivalent per kilogram of extract (mg Eq Q/kg), indicating a notable flavonoid content. The total polyphenol content was estimated at  $78.21 \pm 1.47$  mg gallic acid equivalent per gram of extract (mg Eq GA/g), reflecting a moderate presence of overall phenolic compounds. Finally, total tannins were quantified at  $2.58 \pm 1.67$  mg catechin equivalent per gram of extract (mg Eq C/g), suggesting a low proportion of tannic compounds in this fraction.

**Table 4: Quantification of total polyphenols, total flavonoids and total tannins.**

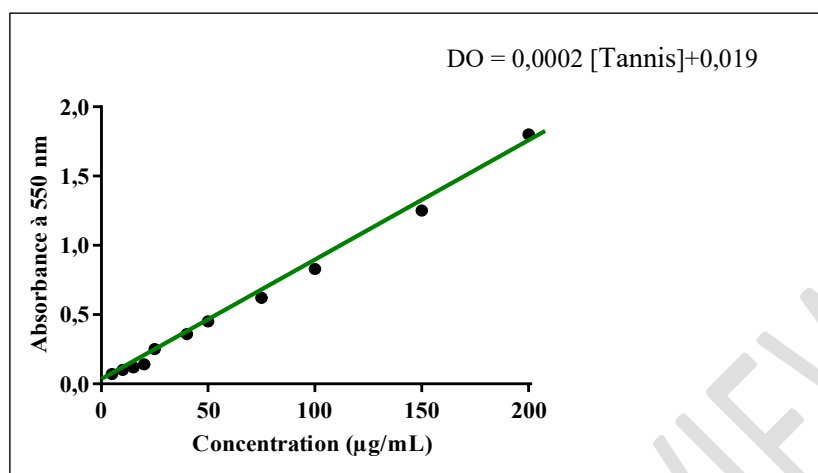
	<u>AEAC</u>	<u>MEAC</u>	<u>EEAC</u>
Total flavonoids (mg quercetin equivalent/kg)	14,46±2,15	342,51 ± 3,62	307,83 ± 1,07
Total polyphenols (mg Eq A.G/g)	126,25±2,01	93,62 ± 1,43	78,21 ± 1,47
Total tannins (mg Eq C/g)	11,37± 3,12	2,06 ± 0,91	2,58 ± 1,67



**Figure 1: Calibration curve for gallic acid**



**Figure 2 :** Calibration curve for quercetin



**Figure 3:** Calibration curve for catechin

➤ **Antioxidant activity of *Alchornea cordifolia* leaf extracts**

**1. Anti-radical activity as measured by the DPPH test**

The evaluation of the antioxidant activity of *Alchornea cordifolia* extracts using the DPPH test showed that all extracts have the ability to trap free radicals, with varying efficacy depending on the solvent used. The ethanolic extract (EEAC) proved to be the most active with an  $IC_{50}$  of 33.54 µg/ml, followed by the methanolic extract (EMAC) with an  $IC_{50}$  of 40.00 µg/ml, while the aqueous extract (EAAC) showed the lowest activity ( $IC_{50} = 55.90$  µg/ml). In comparison, quercetin, used as a reference antioxidant, showed much higher activity ( $IC_{50} = 3.40$  µg/ml). These results indicate that extracts obtained with organic solvents have better antioxidant capacity than the aqueous extract, probably due to their relative richness in fat-soluble phenolic and flavonoid compounds responsible for antioxidant activity.

en composés phénoliques et flavonoïdiques liposolubles responsables de l'activité antioxydante

**2. Antiradical activity by the radical cation ABTS<sup>+</sup>**

The evaluation of antioxidant activity using the ABTS test allowed for a comparison of the free radical scavenging efficacy of different extracts of *Alchornea cordifolia*. The results reveal dose-dependent activity, with notable variations between extracts. The ethanolic extract (EEAC) showed the best antioxidant capacity with an  $IC_{50}$  of 0.48 µM/mL, followed by the methanolic extract (EMAC) with an  $IC_{50}$  of 0.62 µM/mL. The aqueous extract (EAAC) showed lower antioxidant activity, with an  $IC_{50}$  of 0.72 µM/mL. Despite these performances, all extracts remain less active than Trolox, used as a reference standard, with an  $IC_{50}$  of 0.29 µM/mL. These results reveal that

hydroalcoholic extracts, particularly ethanolic extracts, are more effective at extracting the compounds responsible for antioxidant activity, probably due to their ability to solubilise a wide spectrum of phenolic compounds.

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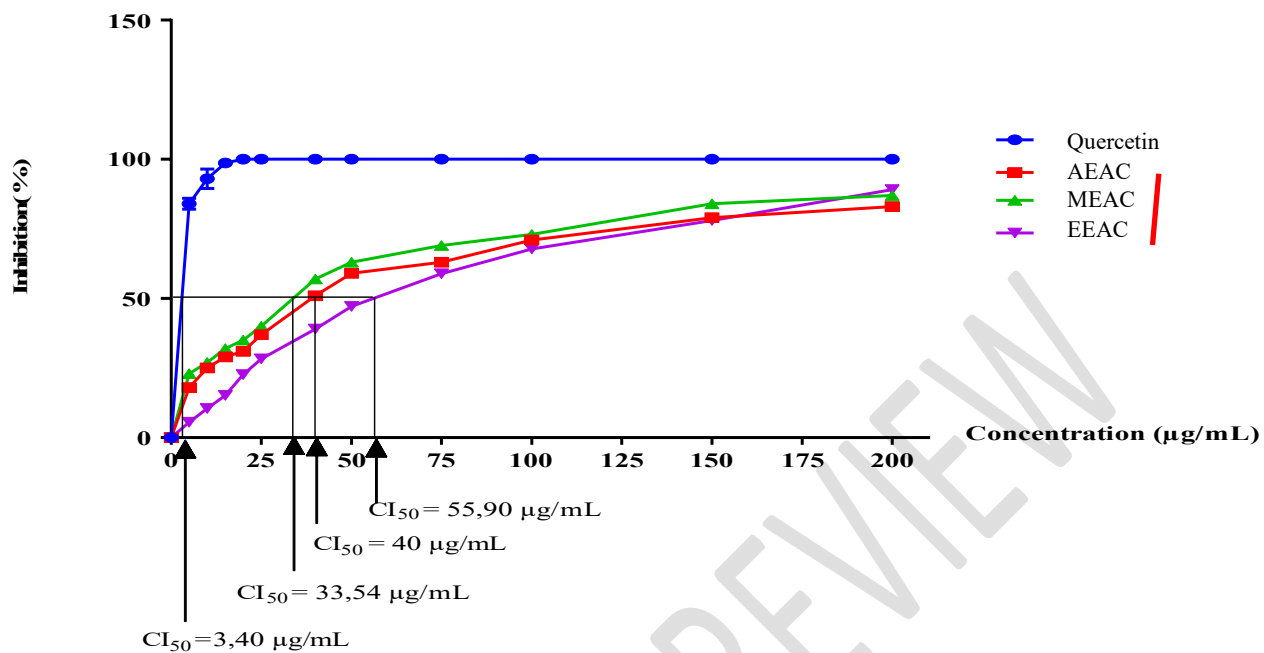


Figure 4: Percentage inhibition of the DPPH radical by the extract or quercetin

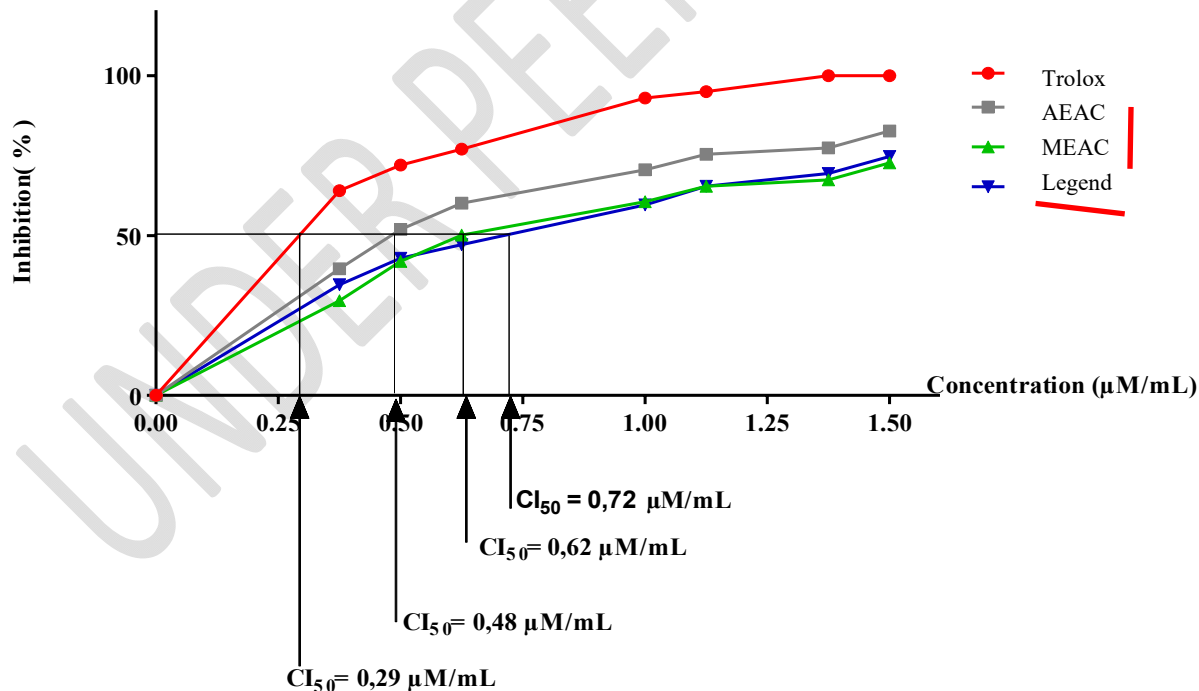


Figure 5: Percentage inhibition by the ABTS<sup>+</sup> radical cation

## DISCUSSION

Phytochemical sorting of aqueous, methanolic and ethanolic extracts from *Alchornea cordifolia* leaves revealed a remarkable richness and diversity of secondary metabolites. This chemical diversity is strongly influenced by the polarity of the extraction solvent, as has been widely reported in phytochemistry (Harborne, 1998).

The aqueous extract proved to be particularly rich, containing sterols and polyterpenes, polyphenols, flavonoids, saponins, quinone compounds, alkaloids and catechin tannins. This richness could be explained by the high polarity of water, which promotes the extraction of hydrophilic compounds such as polyphenols, flavonoids and saponins (Bruneton, 2009). The absence of gallic tannins in this extract can be attributed to their preferential solubility in polar organic solvents rather than in pure water, unlike catechin tannins, which are generally more soluble (Harborne, 1998).

The methanol extract also has a diverse composition, with the presence of sterols, polyphenols, flavonoids, saponins, alkaloids and gallic tannins. Methanol, as a protic polar solvent, is known for its ability to effectively extract hydrolysable tannins and certain alkaloids (Bruneton, 2009). The absence of catechin tannins and quinone compounds in this extract could be related to the selectivity of methanol towards certain phenolic structures or to their low affinity for this solvent. As for the ethanolic extract, it contains sterols and polyterpenes, polyphenols, flavonoids, quinone compounds, alkaloids and catechin tannins, but does not contain saponins or gallic tannins. This intermediate composition can be explained by the moderate polarity of ethanol, which allows the extraction of metabolites with medium polarity, while excluding certain highly hydrophilic compounds such as saponins (Sasidharan et al., 2011).

The differences observed between the phytochemical profiles of the extracts confirm the decisive role of the solvent in the targeted extraction of secondary metabolites. The concomitant presence of flavonoids, alkaloids, tannins, polyphenols and quinone compounds in most extracts is particularly interesting, as these families are widely recognised for their antimicrobial, antiparasitic, anti-inflammatory and antioxidant properties (Cowman, 1999; Cushnie & Lamb, 2005).

These results corroborate the traditional uses of A. cordifolia and suggest that its extracts could be a potential source of bioactive molecules. Thus, Alchornea cordifolia extracts show promising therapeutic potential as an alternative to synthetic antimicrobials in poultry production systems, particularly in the context of combating major diseases such as coccidiosis and salmonellosis, where the search for natural alternatives has become a priority (Abd El-Hack et al., 2022).

The aqueous extract has a moderate total flavonoid content ( $14.46 \pm 2.15$  mg Eq Q/kg), a notable richness in total polyphenols ( $126.25 \pm 2.01$  mg Eq AG/g) and a significant amount of total tannins ( $11.37 \pm 3.12$  mg Eq C/g). This composition reflects the high polarity of water, which promotes the extraction of hydrophilic compounds such as certain polyphenols and catechin tannins, but is less effective at solubilising fat-soluble flavonoids (Sasidharan et al., 2011). The dosage of phytochemicals in the methanolic extract reveals a particularly high concentration of total flavonoids ( $342.51 \pm 3.62$  mg Eq Q/kg), accompanied by a moderate content of total polyphenols ( $93.62 \pm 1.43$  mg Eq AG/g) and a low proportion of total tannins ( $2.06 \pm 0.91$  mg Eq C/g). This predominance of flavonoids can be explained by the intermediate polarity of methanol, which facilitates the extraction of slightly lipophilic phenolic compounds while limiting the extraction of highly polar tannins (Harborne, 1998; Bruneton, 2009). The ethanol extract shows a notable richness in total flavonoids ( $307.83 \pm 1.07$  mg Eq Q/kg), a moderate content of total polyphenols ( $78.21 \pm 1.47$  mg Eq AG/g) and a low proportion of total tannins ( $2.58 \pm 1.67$  mg Eq C/g). This composition is consistent with the intermediate polarity of ethanol, which is slightly less effective at extracting certain highly polar flavonoids. The low proportion of tannins also reflects the preference of catechin tannins for more polar solvents (Sasidharan et al., 2011).

The evaluation of the antioxidant activity of Alchornea cordifolia leaf extracts using DPPH and ABTS<sup>•+</sup> tests revealed a notable ability to scavenge free radicals, the intensity of which varies depending on the extraction solvent. The results obtained by the DPPH test show that the ethanolic extract has the best antiradical activity ( $CI_{50} = 33.54$   $\mu$ g/mL), followed by the methanolic extract ( $CI_{50} = 40.00$   $\mu$ g/mL), while the aqueous extract showed the lowest activity ( $CI_{50} = 55.90$   $\mu$ g/mL). This trend is consistent with the observations of Brand-Williams et al. (1995), according to which the antioxidant efficacy of plant extracts depends heavily on the nature of the extracted compounds and their ability to donate electrons or protons to neutralise free radicals. The superiority of organic extracts could be explained by their richness in phenolic and flavonoid compounds, whose antioxidant properties are widely documented (Rice-Evans et al., 1997; Pietta, 2000).

Several studies have also reported that Alchornea cordifolia leaves contain polyphenols, tannins and flavonoids responsible for their biological activity, particularly antioxidant activity (Okoye et al., 2014; Agyare et al., 2016). Quercetin, used as a reference antioxidant, showed significantly higher activity than the extracts, which is consistent with its highly reductive chemical structure and strong free radical scavenging capacity (Pietta, 2000). Furthermore, the results obtained with the ABTS<sup>+•</sup> test confirm those of the DPPH test, revealing dose-dependent antioxidant activity and greater efficacy of the ethanolic extract (CI<sub>50</sub> = 0.48 μM/mL), followed by the methanol extract (CI<sub>50</sub> = 0.62 μM/mL) and the aqueous extract (CI<sub>50</sub> = 0.72 μM/mL). This test, which evaluates both hydrophilic and lipophilic antioxidants, highlights the ability of hydroalcoholic solvents to extract a wide spectrum of bioactive compounds (Re et al., 1999). Although the extracts tested are less active than Trolox (CI<sub>50</sub> = 0.29 μM/mL), their performance remains significant and comparable to that reported for other polyphenol-rich medicinal plants (Adebayo et al., 2018). Taken together, these results suggest that the antioxidant activity of *Alchornea cordifolia* leaves is closely linked to their secondary metabolite composition and justifies their traditional use in the management of conditions associated with oxidative stress, although further in vivo studies and in-depth chemical characterisation would be necessary to confirm these effects and identify the compounds responsible.

## CONCLUSION

Medicinal plants are a major resource for human and animal health due to their richness in bioactive compounds and their therapeutic potential. Alchornea cordifolia (Euphorbiaceae) is a species widely used in traditional medicine in West Africa, but its scientific value remains limited. This study aims to contribute to the evaluation of this plant by characterising its phytochemical composition and assessing the antioxidant activity of aqueous, methanolic and ethanolic extracts from its leaves.

The extracts were obtained by maceration in different solvents and then subjected to qualitative phytochemical sorting. The total polyphenol, total flavonoid and tannin contents were determined by spectrophotometric methods. Antioxidant activity was evaluated by DPPH and ABTS<sup>+</sup>• free radical scavenging assays. Phytochemical sorting revealed the presence of several secondary metabolites of interest, including polyphenols, flavonoids, tannins, alkaloids, sterols and quinone compounds, with variations depending on the extraction solvent. The aqueous extract had the highest total polyphenol content, while the methanolic and ethanolic extracts were distinguished by their high flavonoid content. Antioxidant tests showed dose-dependent antiradical activity for all extracts, with hydroalcoholic extracts, particularly the ethanolic extract, being more effective.

These results highlight the potential of *Alchornea cordifolia* leaves as a natural source of antioxidant compounds and support their use in the development of phytotherapeutic and nutraceutical products, thereby contributing to the promotion and sustainable exploitation of local medicinal plants.

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