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# Chemical composition, anti-inflammatory and anticholinesterase activities of the essential oils of *Elionurus platypus* (Trin.) Hack. from Congo

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**ABSTRACT**

This study reports the chemical composition, anti-inflammatory and anticholinesterase activities of the essential oils of *Elionurus platypus* (Trin.) Hack. The plant organs studied were the flowers (EOF), leaves (EOL), rhizomes (EORh) and roots (EOR). The essential oils were obtained by steam distillation. The chemical composition was determined using GC-MS and GC-FID. The anti-inflammatory activity was evaluated by lipoxygenase inhibition method and bovine serum albumin degradation inhibition method. The anticholinesterase activity was determined by Ellman's method. Twenty nine compounds were identified in the essential oils of different organs, with the main one being antsorenone. The content of this compound varied from one organ to another: leaves (58.51%), rhizomes (54.98%), roots (39.90%) and flowers (32.62%). Other compounds were also identified such as myrcene (28.97%) and prezizaene (5.35%) in the EOF; camphene (4.11%) and β-acorenone (4.31%) in the EOR; prezizaene (5.10%) and β-acorenone (4.24%) in the EORh; epiprezizaene (4.03%) and acorenone B (2.95%) in the EOL. The anti-inflammatory activity of the essential oils of the flowers ($IC_{50}$ =15.46 ± 0.54 -16.40 ± 0.47 µg/mL) and leaves ($IC_{50}$ = 15.78 ± 0.57- 16.41 ± 0.46µg/mL) was high. The essential oil anticholinesterase activity of the root with an $IC_{50}$ = 18.06 ± 1.85µg/mL exhibited the best inhibition.

**Keywords:** *Elionurus platypus* (Trin.) Hack, essential oil, antsorenone, antiinflammatory and anticholinesterase activities.

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## INTRODUCTION

The genus *Elionurus* has about twenty species growing in tropical and subtropical climates around the world (Bikindou, 2017). *Elionurus platypus* (Trin.) Hack. is an aromatic plant distributed in tropical Africa in countries

such as Congo, Gabon, Guinea, Sierra Leone, Liberia, Ivory Coast, Democratic Republic of Congo to Zambia (Sosef et al., 2019). This plant species is a perennial grass that is found in forest glades and savannahs (Royal Botanic Gardens, 1885). It provides some fodder, and in Sierra Leone, it has been promoted as a pasture grass (Burkill, 1994). In Congo-Brazzaville, the species is abundantly present on the Atlantic coast around the city of Pointe Noire. The flowers, leaves and roots of *Elionurus platypus* (Trin.) Hack. show a strong morphological resemblance to those of *Elionurus hensii* K. Schum. (an aromatic plant), which is used as an infusion by peasant populations to treat pain. Its essential oil has been the subject of recent studies concerning its chemical composition, antalgic, antioxidant and antiproliferative activities. The results of this study showed that the essential oil is rich in *cis* and *trans-p*-mentha-2,8-dien-1-ol, *cis* and *trans-p-mentha-1* (7), 8-dien-2-ol, aristolone and limonene (Loumouamou et al., 2016; 2017a). The antalgic activity of the oil is interesting, thus confirming its traditional use by the populations (Loumouamou et al., 2017b).

Other species of the genus *Elionurus* have also been studied, *E. viridulus* Hack. (Hefendehl and Fonseca, 1978), *E. elegans* Kunth (Mevy et al., 2002), *E. muticus* (Spreng.) Kuntze (Scramin et al., 2000; Chagonda et al., 2000; Chagonda et al., 2012 ; Füller et al., 2014 ; Celaya et al., 2023), *E. sp* (Radünza et al., 2022), *E. tristis* Hack. (Yedomona et al., 2017). A recent study on *Elionurus tristis* Hack. collected in madagascar described several sesquiterpenes including 7-epi-khusian-2-ol, 4,8-di-epi-acorone, 2-epi-ziza-5-en-2-ol and antsorenone (Garcia et al., 2019).

Moreover, the essential oils of *Elionurus platypus* (Trin.) Hack. has not yet been the subject of scientific studies.

This work reports for the first time a study of the chemical composition, anti-inflammatory and anticholinesterase activities of the essential oils of this plant. Several studies have shown the potential of essential oils as low-cost antalgic/anti-inflammatory in new pain treatments (Sarmento-Neto et al., 2016). Moreover, being a rich source of bioactive molecules, aromatic and medicinal plants offer hope for the development of new molecules capable of treating many pathologies after in vivo studies and clinical assay (De Sousa, 2011; De Sousa et al., 2017). Therefore, this work is part of the development of the aromatic and medicinal plants of the Congo Basin in general and the Congolese flora in particular.

## MATERIALS AND METHODS

### Plant material

The plant material consists of the flowers (EOF), stem leaves (EOL), rhizomes (EORh) and roots (EOR) of *Elionurus platypus* (Trin.) Hack. which were collected at Pointe Noire ( 4° 37′ 04,9″ south and 11° 51′ 11,91″ east) on the Atlantic coast in Congo-Brazzaville. After the harvest, the plant material was sorted to remove the weeds and was authenticated under the references HMB-N°02 by the botanists of the National Herbarium of the National Institute for Research in Exact and Natural Sciences (IRSEN). The plant material was dried in the shade for seven days and then subjected to distillation. The different organs are presented in Figure 1.


**Figure 1**. Different organs of *Elionurus platypus* (Trin.) Hack.

**Extraction of essential oil**

The essential oils were obtained using steam distillation of the dry plant material using a Clevenger-type apparatus for three hours (Clevenger, 1928). First, 300 g of vegetable material, consisting of either the roots, the rhizome, the leaves or the flowers was placed in the plant tank above a balloon containing 500 mL of water and subjected to distillation. Then, the organic phase from the distillation was separated from the aqueous phase using extraction with hexane. The organic phase was dried over anhydrous sodium sulfate to remove all traces of water, the essential oils were recovered after evaporation of the hexane and were then submitted to chromatographic analysis.

**General procedures**

***GC-FID analysis***

Quantitative analysis of the essential oils was carried out using an Agilent gas chromatograph model 6890 equipped with a DB5 column (20m x 0.18mm; 0.18µm). The oven temperature was programmed to 50 °C for 3.2 min, then it was heated to 300 °C at a rate of 10°C/min. The temperatures of the injector and the flame ionization detector (FID) were maintained at 280 °C. The essential oils were diluted to 3.5% (v/v) in hexane and injected in split mode (1/60); hydrogen was used as the carrier gas (1mL/min), and the injection volume was 1µL. At the same time, a solution of n-alkanes (C8-C30) was analyzed under the same conditions to calculate the retention indices (RI) using the Van den Dool and Kratz equation (Van Del Dool and Kratz, 1963). The relative concentrations of the compounds were calculated from the peak area obtained using gas chromatography without using correction factors.

***GC-MS analysis***

Qualitative analysis of the oils was performed using an Agilent gas chromatograph model 7890 coupled to an Agilent mass spectrometer model 5975 (Agilent Technologies Inc., CA, USA) equipped with a DB5 MS column (20 m × 0.18 mm; 0.18 µm). The oven temperature was 50°C and remained constant for 3.2 min; then, it was increased to 300°C at a rate of 8°C/min. The injector temperature was 280°C. Ionization was obtained using electron impact at 70 eV, and the electron multiplier was maintained at 2200 eV. The temperature of the ion source was 230°C. Mass spectral data were acquired in the scan mode in the range 33-450 m/z. The flow of the carrier gas (helium) was set at 0.9 mL/min. The compounds were identified by comparison of their mass spectra and RI with those of libraries (Adams, 2012; NIST, 2008; Konig, 2001) and those of the laboratory.

**Antiinflammatory activity**

***Lipoxygenase inhibitory activity***

The anti-inflammatory activity of the essential oils was determined using the method of the inhibition of the enzyme lipoxygenase extracted from soybean (Tanoh et al., 2019; Nea et al., 2019). This method was used with some modifications. First, 700 µL of previously oxygenated sodium borate buffer (0.2 M, pH 9) was mixed with 35 µL of soy lipoxygenase (1000 U/mL, Sigma-Aldrich) and 100 µL of methanolic solutions of essential oils in different concentrations (25, 50, 75 and 100 µg/mL). Then, the mixtures were homogenized and then incubated for fifteen minutes at room temperature. After incubation, 35 µL of a linoleic acid solution (250 µM, Sigma-Aldrich) was added, and the kinetics of the reaction was immediately followed, by measuring the absorbance at 234 nm using an Ultrospec 7000 UV–Vis dual beam spectrophotometer (GE Healthcare, Chicago, IL, USA). The experiments were repeated three times. The quercetin supplied by the company Sigma-Aldrich used as a reference was prepared and analyzed under the same operating conditions as the samples of essential oils. The control consisted of the buffer mixture, lipoxygenase and linoleic acid. The percentage of inhibition was calculated by considering the absorbances of the linear part of the kinetic curves according to the following formula:

$$\mathrm{I}\% = \frac{Abs\ C - Abs\ E}{Abs\ C} x\ 100$$

I %: Inhibition percentage
Abs C: control absorbance
Abs E: sample absorbance

The $IC_{50}$ (µg/mL) were determined graphically and by calculation ($IC_{50}$ = Conc x 50/I%).

***Bovine serum albumin denaturation method***

Protein denaturation is among the causes of inflammation (Bagad et al., 2011; Sakat et al., 2010; Qamar et al., 2021). Indeed, the denaturation of a protein consists in the alteration of the bonds (electrostatic, hydrogen, hydrophobic and disulfide), which maintain the three-dimensional structure of proteins (Mizushima and Kobayashi, 1968). During the inflammatory process, there is a loss of the three-dimensional structure of

proteins due to the heat caused by the inflammation.

The bovine serum protein denaturation method was used to evaluate the anti-inflammatory activity of the essential oils with some modifications (Grace et al., 2017). The principle of the method is to prevent the denaturation of the bovine serum proteins in the presence of essential oils. The methanolic solutions of the essential oils at different concentrations (25, 50, 75, and 100 µg/mL) were mixed with BSA (1 %, Sigma-Aldrich) prepared in phosphate buffer (0.5 M, pH 6.3). After shaking, the mixture was incubated for twenty minutes at room temperature, and, then for three minutes at 57°C. After cooling for around ten minutes, 2.5 mL of phosphate buffer (0.5 M, pH 6.3) was added. The absorbances were measured at 255 nm using an Ultrospec 7000 UV–Vis dual beam spectrophotometer (GE Healthcare, Chicago, IL, USA) against a blank consisting solely of the phosphate buffer (0.5 M, pH 6.3). Diclofenac was used as a reference anti-inflammatory drug at the same concentrations as those of the essential oils and tested under the same conditions. The tests were carried out in triplicate. The percent inhibition was determined from the following formula:

$$\mathrm{I}\% = \frac{Abs\ E - Abs\ C}{Abs\ E} x\ 100$$

I%: Inhibition percentage
Abs E: sample absorbance
Abs C: control absorbance

The $IC_{50}$ (µg/mL) were determined graphically and by calculation ($IC_{50}$ = Conc x 50/I%).

### Anticholinesterase activity

The method used was that of Ellman (Ellman et al., 1961) taken up by Kulhankova (Kulhankova et al., 2013) with some modifications. The principle consists of the hydrolysis of acetylthiocholine by acetylcholinesterase to form thiocholine, which in the presence of DTNB (5,5'-dithiobis-[2-nitrobenzoate]) forms a yellow complex that absorbs at 412 nm. First, 1500 µL of phosphate buffer (0.1 M, pH 8) was mixed with 100 µL of the methanolic solution of the essential oils at different concentrations (25, 50, 75 and 100 µg/mL) and 200 µL of acetylcholinesterase (0.5 U/mL, Sigma-Aldrich). Then, the mixture was subjected to an initial incubation of fifteen minutes at room temperature. Then, DNTB (3 mM, Sigma-Aldrich) and acetylcholine (1.83 mM, Sigma-Aldrich) were added, and the mixture was subjected to a second incubation for fifteen minutes. The absorbances were measured at 412 nm using an Ultrospec 7000 UV–Vis dual beam spectrophotometer (GE Healthcare, Chicago, IL, USA) against a blank consisting of phosphate buffer. Galantamine was used as an acetylcholinesterase inhibitor at the same concentrations as the essential oil solutions. The control consisted of the mixture without the sample or the inhibitor. The experiments were repeated three times. The percentages of inhibition were calculated according to the formula:

$$\mathrm{I}\% = \frac{Abs\ C - Abs\ E}{Abs\ C} x\ 100$$

I%: Inhibition percentage
Abs E: sample absorbance
Abs C: control absorbance

The $IC_{50}$ (µg/mL) were determined graphically and by calculation ($IC_{50}$ = Conc x 50/I%).

### *Statistical analysis*

Each experiment was repeated three times. The data are expressed as the mean ± standard deviation. The analysis of the means was carried out using R software. Differences were considered significant at *p < 0.05 (Core Team, 2022).

## RESULTS AND DISCUSSION

The extractions allowed obtaining 2.7% of the flowers (EOF), 1.10% of the leaves (EOL), 2.16 % of the rhizomes (EORh), and 2.33% of the roots (EOR). These yields were comparable to those of *Elionurus hensii*, another species of the genus *Elionurus* (Trin.) Hack (Silou et al., 2006). With these high yields, *E. platypus* (Trin.) Hack. maybe of interest to the essential oil sector for the exploitation of its essential oil.

### Identification and quantification of the essential oil constituents

Table 1 presents the chemical composition of the essential oils obtained from the different organs of *Elionurus platypus* (Trin.) Hack. In total, twenty-nine compounds were identified in the essential oils of different organs, the main one being antsorenone. The content of this compound varied from one organ to another: flowers (32.62%), leaves (58.51%), rhizomes (54.98%), and roots (39.90%). Other compounds were also identified such as myrcene (28.97%), and prezizaene (5.35%) in the EOF; camphene (4.11%) and β-acorenone (4.31%) in the EOR; prezizaene (5.10%) and β-acorenone (4.24%) in the EORh; epiprezizaene (4.03%) and acorenone B (2.95%) in the EOL.

In general, the chemical profile of *Elionurus platypus*

**Table 1.** Chemical composition of essential oil from roots, rhizomes, leaves, and flowers of *E. platypus* (Trin.) Hack.

| Constituents | Cas | RI[a] | RI[b] | EOR (%) | EORh (%) | EOL (%) | EOF (%) |
|---|---|---|---|---|---|---|---|
| Tricyclene | 508-32-7 | 926 | 925 | 1.08 | 0.09 | - | - |
| α-pinene | 80-56-8 | 939 | 935 | 1.26 | 0.10 | - | - |
| Camphene | 79-92-5 | 954 | 952 | 4.11 | 0.34 | - | - |
| Sabinene | 3387-41-5 | 975 | 974 | 0.05 | - | - | - |
| β-Pinene | 127-91-3 | 979 | 980 | 0.03 | - | - | - |
| β-Myrcene | 123-35-3 | 990 | 988 | 0.03 | - | - | 28.97 |
| *p*-Cymene | 99-87-6 | 1025 | 1026 | 0.40 | - | - | - |
| Limonene | 138-86-3 | 1029 | 1031 | 0.44 | - | 0.04 | 1.27 |
| 1,8-Cineole | 470-82-6 | 1031 | 1034 | 2.51 | 0.13 | - | - |
| α-Campholenal | 4501-58-0 | 1130 | 1130 | 0.20 | - | - | - |
| *trans*-Verbenol | 22339-08-8 | 1150 | 1151 | 0.19 | - | - | - |
| Camphor | 76-22-2 | 1148 | 1153 | 0.47 | - | - | - |
| Borneol | 507-70-0 | 1169 | 1180 | 0.47 | - | - | - |
| Verbenone | 80-57-9 | 1204 | 1204 | 0.15 | - | - | - |
| Bornyle acetate | 5655-61-8 | 1285 | 1290 | 1.80 | - | - | - |
| α-Ylangene | 14912-44-8 | 1375 | 1373 | 0.62 | - | 0.05 | - |
| α-Cedrene | 469-61-4 | 1409 | 1410 | 0.40 | 1.08 | - | 1.64 |
| β-Caryophyllene | 87-44-5 | 1419 | 1416 | - | - | - | 1.86 |
| β-Cedrene | 546-28-1 | 1418 | 1419 | 0.18 | 0.38 | - | 0.16 |
| Sesquisabinene | 58319-04-3 | 1437 | 1454 | - | - | - | 1.49 |
| Prezizaene | 31145-21-8 | 1389 | 1467 | 0.90 | 5.10 | 1.17 | 5.35 |
| Epiprezizaene | | 1389 | 1473 | 2.80 | - | 4.03 | - |
| ar-Curcumene | 4176-17-4 | 1480 | 1488 | 0.13 | 0.59 | 0.41 | 0.37 |
| δ-Cadinene | 483-76-1 | 1524 | 1522 | 0.25 | - | 0.45 | - |
| β-Sesquiphellandrene | 20307-83-9 | 1522 | 1529 | - | - | - | 3.59 |
| Caryophyllene oxide | 1139-30-6 | 1583 | 1598 | 0.40 | - | 0.33 | 0.24 |
| Acorenone | 5956-05-8 | 1698 | 1684 | 2.47 | - | 0.72 | 1.4 |
| Acorenone B | 21653-33-8 | 1698 | 1706 | 4.31 | 4.24 | 2.95 | 3.37 |
| Antsorenone | 2418624-37-8 | 1749 | 1735 | 39.90 | 54.98 | 58.51 | 32.62 |
| Hydrocarbon monoterpenes | | | | 7.4 | 0.53 | 0.04 | 30.24 |
| Oxygenated monoterpenes | | | | 5.79 | 0.13 | - | - |
| Hydrocarbon sesquiterpenes | | | | 5.28 | 7.15 | 6.11 | 14.46 |
| Oxygenated sesquiterpenes | | | | 47.08 | 59.22 | 62.51 | 37.63 |
| Total (%) | | | | 65.55 | 67.03 | 68.66 | 82.33 |

RI[a] Literature retention index; RI[b] Retention index determined on DB-5 column, using the homologous series of n-alkanes (C8–C30).

(Trin.) Hack. essential oils were very different from those of the essential oils of the other species of *Elionurus* already studied as shown in Table 2. *p*-menthadienol isomers (40-49%), limonene (15-30%), and aristolone (42-55%) were identified as the majority compounds in the essential oil of *Elionurus hensii* (Loumouamou et al., 2017a, 2017b; Bikindou, 2017); geranial (44.8%), neral (35.4%), and aristolone (72.1%) were identified in the essential oil of *Elionurus muticus* (Scramin et al., 2000; Chagonda et al., 2012; Chagonda et al., 2000; Füller et al., 2014; Celaya et al., 2023); campherenone (43%) was identified in the essential oil of *Elionurus elegans* (Mevy et al., 2002); acorenone B (19%) was identified in the essential oil of *Elionurus viridulus* ( Hefendehl et Fonseca, 1978); camphene (13%), calarene (12,7%), antsorenone (15,4%), and acorenone B (17,6%) were identified in the essential oil of *Elionurus tristis* (Garcia et al., 2019). The essential oil from a sample of *Elionurus tristis* collected in Madagascar was rich in β-gurjunene (18,4%), neoclovene (15,8%), nootkatone (10,4%) (Yedomona et al., 2017); α-citral (33.23%), ß-citral (28.88%), 4,8-dimethyl-nona-3,8-dien-2-one (15.47%) and trans-1-Isopropyl-4-methyl-1,4-cyclohexanediol (8.16%) was identified in the essential oil of *Elionurus sp* (Radünza et al., 2022).

Antsorenone, which is the main component of the essential oil of *E. platypus* (Trin.) Hack, was identified also in the essential oil of *E. tristis* (Chazan, 1969; Garcia et al., 2019), an aromatic species endemic to the Malagasy flora. Moreover, the content of this compound is higher in the essential oil of *E. platypus (Trin.) Hack* than in that of *E. tristis*.

## Antiinflammatory activity

The anti-inflammatory activity of the EOR, the EOF, and the EOL was evaluated using two methods, namely the

**Table 2.** Main compounds of other *Elionurus* species.

| Species | Main major compounds | References |
|---|---|---|
| *Elionurus platypus* | antsorenone (32.62% - 58.51%), myrcene (28.97%), prezizaene (5.35%), camphene (4.11%), β-acorenone (4.31%), epiprezizaene (4.03%) | [Present study] |
| *Elionurus hensii* | *p*-menthadienol isomers (40-49%), limonene (15-30%), aristolone (42-55%) | Loumouamou et al., 2017a; Loumouamou et al., 2017b; Bikindou, 2017 |
| *Elionurus muticus* | geranial (44.8%), neral (35,4%), aristolone (72.1%), acorénone, bisabolone | Scramin et al., 2000; Chagonda et al., 2012; Chagonda et al., 2000; Thanise et al., 2014; Liliana et al., 2023 |
| *Elionurus elegans* | campherenone (43%), *epi*-β santalene (12%) | Mevy et al., 2002 |
| *Elionurus viridulus* | ß-acorenone (19%) | Hefendehl and Fonseca, 1978 |
| *Elionurus tristis* | camphene (13%), calarene (12.7%), antsorenone (15.4%), acorenone B (17.6%), β-gurjunene (18,4%), neoclovene (15,8%), nootkatone (10,4%) | Gabriel et al., 2019<br>Yedomona et al., 2017 |
| *Elionurus sp* | α-citral (33.23%), ß-citral (28.88%), 4,8-dimethyl-nona-3,8-dien-2-one (15.47%), *trans*-1-Isopropyl-4-methyl-1,4-cyclohexanediol (8.16%) | Radünza et al., 2022 |

inhibition of lipoxygenase (LOX) extracted from soybean and the inhibition of the denaturation of bovine serum albumin (BSA). The EORh was not tested because the quantity was insufficient. Regarding the first method (LOX), all the tested samples inhibited lipoxygenase (Figure 2a). However, the EOF and the EOL samples with an $IC_{50}$ of 15.46 ± 0.54 µg/mL and 15.78 ± 0.57 µg/mL respectively were the most active. Statistical analysis of the results showed that there was no significant difference between the EOF and EOL samples and the quercetin used as the reference inhibitor ($IC_{50}$ =14.21 ± 0.1 µg/mL). Since the EOF and the EOL samples are rich in sesquiterpene compounds of which antsorenone, the high activity observed can be attributed to the presence of these compounds.

Moreover, the literature reports that monoterpene and sesquiterpene compounds of essential oils can exhibit various biological effects (Benali et al., 2023). Similarly, molecules with chemical functional groups such as sesquiterpene ketones have shown interesting anti-inflammatory effects (Fernandes et al., 2007). The observed biological activity can also be attributed to synergistic-like interactions between the sesquiterpene and monoterpene compounds (Gbenou et al., 2012). Myrcene, which is a monoterpene, has been mentioned in the literature as a bioactive compound that has shown interesting pharmacological activity in various models of pain and inflammation (Lorenzetti et al., 1991). The moderate activity of the EOR ($IC_{50}$ = 21.83 ± 1.27 µg/mL) can be explained by antagonistic type interactions between the compounds contained in this sample.

Figure 2b presents the results obtained with the second method (BSA denaturation). The $IC_{50}$ values obtained were 16.40 ± 0.47 µg/mL, 16.41 ± 0.46 µg/mL, and 20.44 ± 0.73 µg/mL, respectively for the EOF, the EOL, and the EOR. The EOF and the EOL samples were the most active. Statistical analysis using R software concluded that there was no significant difference between the EOF and the EOL samples. Diclofenac was used as a reference anti-inflammatory drug with an $IC_{50}$ =15.53 ± 0.67 µg/mL. As for the first method, the anti-inflammatory activity observed with these samples can be attributed on the one hand to the sesquiterpene compounds because they are the majority compounds in the essential oils, and on the other hand to the interactions between the sesquiterpene and the monoterpene. These results highlight the anti-inflammatory potential of the essential oils of *E. platypus* (Trin.) Hack which can be exploited as a source of active compounds for the formulation of improved traditional medicines necessary in the management of inflammatory diseases such as osteoarthritis, rheumatism, etc.

## Anticholinesterase activity

The decrease in the level of acetylcholine in neurons is among the causes of the occurrence of Alzheimer's disease. Inhibition of acetylcholinesterase is one of the strategies used in the management of this pathology (Grutzendler and Morris, 2001). The anticholinergic activity of the essential oils of *E. platypus* (Trin.) Hack. from the EOL, the EOR and the EOF were evaluated. All the tested samples inhibited acetylcholinesterase (Figure 3). The $IC_{50}$ obtained were 24.29 ± 1.54 µg/mL and 18.06 ± 1.85 µg/mL respectively for the flowers and for the roots. The inhibition of leaves essential oil is very low (< 50%), so it was not possible to determine the $IC_{50}$. The most significant inhibition was observed with the EOR sample ($IC_{50}$ = 18.06 ± 1.85 µg/mL). This interesting activity can be explained by the chemical composition of this sample (EOR). Indeed, the EOR sample is a mixture

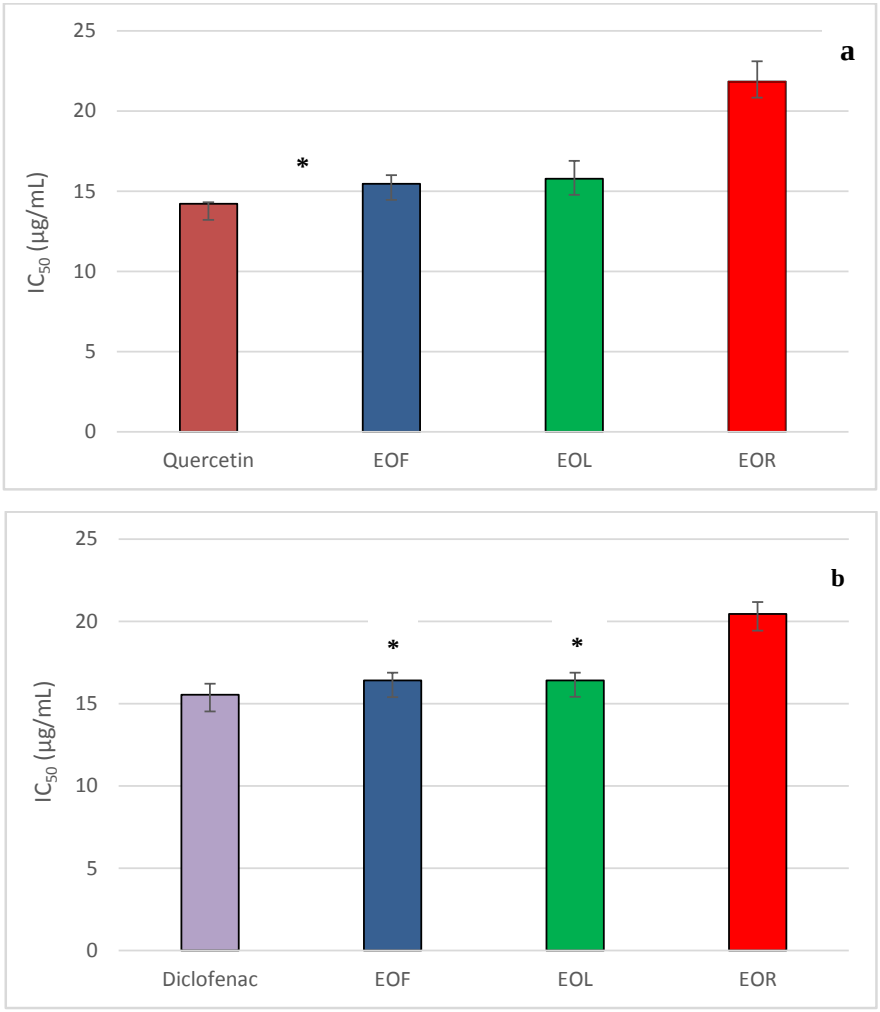


**Figure 2.** (a) Anti-inflammatory activity of the essential oil of *E. platypus* (Trin.) Hack by LOX, (b) by denaturation of bovine serum albumin (BSA), *p <0.05.

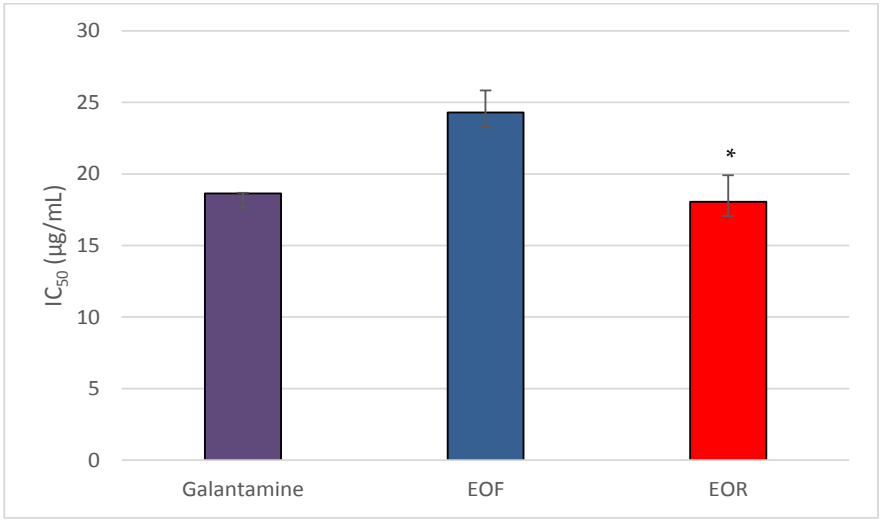


**Figure 3.** Anticholinesterase activity of essential oil of *E. platypus* (Trin.) Hack, *p<0.05.

of several monoterpene and sesquiterpene type compounds which seem to interact in synergy to produce a greater effect. Several studies report these observations (Miyazawa et al., 1988; Savelev et al., 2004; Loizzo et al., 2010; Patel and Amin, 2012; Owokotomo et al., 2015). Galantamine with an $IC_{50}$ = 18.64 ± 0.04 µg/mL was used as a reference inhibitor.

## CONCLUSION AND PERSPECTIVES

This study constitutes the first description of the chemical composition and anti-inflammatory and anticholinesterase activities of the essential oils of *Elionurus platypus* (Trin.) Hack, a species endemic to Congo. The yields obtained after extraction were 2.7% at the flower, 2.33% at the root, 2.16% at the rhizome and 1.10% at the leaf. Given the yields obtained, *E. platypus* can constitute an interesting species for the essential oil sector. Twenty-nine compounds were identified in the essential oils of the different organs (flowers, leaves, rhizomes and roots), including a major sesquiterpene ketone 1,4,5,5-tetramethyl-4,5,6,7-tetrahydro-3a,6-ethanoindene-2(3H)-one (Antsorenone). Essential oils from the flowers ($IC_{50}$ = 15.46 ± 0.54 µg/mL - 16.40 ± 0.47 µg/mL) and leaves ($IC_{50}$ = 15.78 ± 0.57 µg/mL - 16.41 ± 0.46 µg/mL) showed potent anti-inflammatory activity by comparison with quercetin ($IC_{50}$ =14.21 ± 0.1 µg/mL) and diclofenac ($IC_{50}$ = 15.53 ± 0.67 µg/mL) used as reference. The essential oil from the roots significantly inhibited acetylcholinesterase with an $IC_{50}$ = 18.06 ± 1.85 µg/mL. The presence of myrcenes and sesquiterpenes, including the new ketone, at high levels suggests that the activity is due to these compounds or their synergistic interactions. Additional studies are therefore necessary, in particular a study of the seasonal variation of the chemical composition, and an evaluation of the biological activities using other methods such as the inhibition of COX-2, of the THP1 line and also of laboratory animals. Finally, carry out a bioguided study to highlight the molecule(s) responsible for the biological activities.

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