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# Anticonvulsant, Sedative and Antidepressant Effects of Aqueous Extract of *Costus afer* Stems in Mice

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## Abstract

Epilepsy is a disorder in the nervous system which often causes a loss of consciousness. Traditional treatments are quiet a component of health care system in various populations in spite of the fact that well-established options are available. Most plants are used to treat epilepsy or those which have been verified for anticonvulsant activity were reported. Then, *Costus afer* is a plant of the Congolese flora used in traditional medicine for its many virtues. Therefore, the anticonvulsant activity of *Costus afer* was assessed with the strychnine convulsion induction test. Two tests were used for sedative activity such as the barbiturate sleep induction test and motor activity and finally the forced swimming test was also used to assess antidepressant activity. The results showed that the aqueous extract of *Costus afer* stems had no effects on strychnine-induced seizures at doses of 250 mg/kg and 500 mg/kg compared to the control group. However, the extract of *Costus afer* stems caused a very significant decrease in motricity at a dose of 500 mg/kg, showing a decrease in the onset time and a very significant increase in sleep duration like the reference molecule such as Diazepam. The aqueous extract of *Costus afer* stems also caused a decrease in immobility time in mice at a dose of 500 mg/kg.

## Keywords

Epilepsy, Sedative, Traditional Medicine, Antidepressant, Anticonvulsant

## 1. Introduction

Epilepsy is a corporate neurological disorder accompanied by persistent motive-

less seizures [1] [2] [3]. About 5% of the world population improves epilepsy in their lifetime while the global occurrence rate of epilepsy in Congo is 4.67 per 500 habitats [4]. Presently, various synthetic drugs like carbamazepine, ethosuximide, gabapentin, oxcarbazepine, phenobarbital, phenytoin, valproic acid, felbamate are used as effective antiepileptic agents; however, they remain not free from noticeable side effects. Nearly 30% of the patients endure having seizures with existing antiepileptic medication treatment [5] [6] [7]. Therefore, there is a requirement to lecture a persuasive alternative as antiepileptic agent with insignificant side effects. Some plants have been conventionally used in the therapy of epilepsy. Various studies have been done about medicinal plants focused on products and discovered worthy results once screened for anticonvulsant activity and many such plants are however to be systematically studied [8] [9] [10] [11].

Syndromes of Epileptic seizures can be because of a varied diversity of causes, such as genetic or picked up ones. Seizures mostly happen unexpectedly deprived of warning, with a few duration and stop by themselves [12]. Epileptic seizures can be the most common neurologic indicators in different local populations and keep on the greatest collective neurological conditions concerning people at any age. When fifty million worldwide are projected to have an epilepsy diagnosis, epileptic seizures remain seizure events that happen because of extreme, unusually synchronized spread neuronal electrical discharges [13] [14]. An epileptic seizure is an incident of neurologic dysfunction because of uncharacteristic neuronal firing clearly happening clinically through variations in sensory perception, motor control, behavior, or autonomic function [15].

*Costus afer* (*C.f*), is a medicinal plant belonging to the Zingiberaceae family and commonly known as Costaceae [16] [17]. It is generally a tropical plant non-ramified often considered an herbal plant with crawling rhizome. It is a relatively little endogen shrub that someone met fluently in the jungles and it is monstrous at the river's edge [16] [18]. This perennial can reach four meters high and carries white and yellow flowers [16] [17] [18]. Traditionally, the flowers, leaves, barks, roots and stems of *Costus afer* have been in clinical use in the Congo Republic since earliest times. Many parts of *Costus afer* are used in traditional medicine as shown in **Table 1**. Leaves are traditionally used as purgative, tonic, antipyretic and emmenagogue whereas stems have folkloric use in convulsions, intermittent fevers [19]. Moreover, *Costus afer* is reported to have anticonvulsant activity [20]. Therefore, based on the reported uses of this plant in traditional medicine, *Costus afer* stem was selected to evaluate the anticonvulsant activity in the present research work.

## 2. Material and Methods

Experimental procedures and protocols used in the current study were agreed by the Animal Ethics Committee of Marien Ngouabi University, Brazzaville, Congo and adapted to the guidelines of "Committee for the Purpose of Control and Supervision on Experiments on Animals".

**Table 1.** Use of *Costus afer* in traditional medicine [16].

| Diseases | Plant parts used |
|---|---|
| Inflammation | Stem |
| Arthritis | Stem |
| Stomach injuries | Leaves |
| Cough, throat injuries | Stem, Aerial part |
| Morbilli | Leaves |
| Malaria | Roots |
| Chickenpox | Stem |
| flu | Stem |
| Genital herpes | Stem |
| Fodder | Leaves, Stem |
| Purgative | Roots |
| Laxative | Roots |
| Diabetes | Stem, Leaves, Roots |
| Wounds healing | Leaves |
| Diuretic | Stem |
| Purgative | Stem |
| Jaundice | Leaves |
| Fever | Leaves |
| Leprosy | Roots |
| Gastric ulcer | Roots |
| Diarrhoea | Leaves |
| Hypertension | Leaves |
| Haemorrhoids | Stem |
| Tooth pain | Roots |

## 2.1. Plant Material and Preparation of Extracts

Fresh Stems of *costus afer* were collected from the forest of Mayombe in the village of Nemba (Department of Kouillou, Congo Republic) during the month of December 2021 and authentified by Dr. Emile Kami, Assistant Professor at Marien NGOUABI University. The coupon specimen (No. FST/LGP/IRSEN-47/2021) of the plant was preserved in the herbarium of the Institute for Research in Exact and Natural Sciences (IRSEN) of Brazzaville. The *costus afer* stems were dried at room temperature and then ground using a mortar. The Stems aqueous extract of *costus afer* was boiled in the glass recipient containing distilled water and the powder of this plant. The mixture was boiled for 15 minutes. After 15 minutes, the decoction was filtrated and the filtration was again boiled.

## 2.2. Animals

Swiss albino mice (20 and 25 g) of either sex were selected for the experimental study. They were obtained from the Institute for Research in Health Sciences (IRSA), Brazzaville, Congo Republic. These animals were raised in the laboratory of Pharmacodynamics and experimental physiopathology of the Faculty of Science and Techniques under standard conditions (±25˚C, 12 hours' light/dark cycle) and they were regularly fed.

## 2.3. Methods

### 2.3.1. Preparation of the Aqueous Extract from the Stems of *Costus afer*

50 g powder of *Costus afer* stems were boiled in 500 ml of distilled water for 15 minutes. After cooling and filtration, the decoction was dried and the dry extract obtained was used to prepare various solutions.

### 2.3.2. Pharmacological Tests

Various pharmacological tests were carried out in the Laboratory of Pharmacodynamics and Experimental Physiopathology (L2PE), Faculty of Science and Techniques of Marien Ngouabi University, Brazzaville, Congo. These laboratory tests allowed us to detect anticonvulsant, sedative and antidepressant effects of aqueous extract of *Costus afer* stems in mice.

### 2.3.3. Evaluation of the Effects of *Costus afer* Stems on Strychnine-Induced Seizures

Four groups of 4 mice each were made up and treated as follows: The negative control group received distilled water 0.5 ml/kg per os; the positive control group was treated intraperitoneally with diazepam 10 mg/kg of body weight; the test groups were treated with the aqueous extract of *Costus afer* stems at the respective doses of 250 and 500 mg/kg of body weight. Convulsions were induced by intraperitoneal injection of strychnine 2.5 mg/kg. Animals were then observed for 10 minutes, and the mice not showing convulsions or showing convulsions without dying were declared protected.

### 2.3.4. Evaluation of the Effects of the Aqueous Extract of *Costus afer* Stems on Motor Activity

Four groups (4) of 4 mice each are made up and treated orally as follows: The negative control group received distilled water 0.5 ml/100g; the positive control group was treated with diazepam 10 mg/kg; the test groups were treated with the aqueous extract of *Costus afer* stems at the respective doses of 250 and 500 mg/kg. One hour after all treatments, animals were placed in turn in a squared cage, and the number of squares crossed after five (5) minutes were reported.

### 2.3.5. Evaluation of the Effect of the Aqueous Extract on Sleep Induced by Phenobarbital

Four (4) groups of 4 mice each were formed: The negative control group received distilled water 0.5 mL/100g, per os; the positive control group was treated with diazepam 10 mg/kg; the test groups received the aqueous extract of *costus*

*afer* stems at the respective doses of 250 and 500 mg/kg. One hour later, sleep was induced by an intraperitoneal injection of phenobarbital 5 mg/kg. The time to onset and the duration of sleep were reported for each mouse [21].

#### 2.3.6. Evaluation of the Effects of the Aqueous Extract of *C. afer* Stems on Forced Swimming

Four groups of 4 mice each were made up and treated as follows: Group 1 received distilled water 0.5 ml/kg of body weight orally; group 2 was treated with clomipramine 25 mg/kg of body weight; the test groups were treated orally with the aqueous extract of *Costus afer* stems at the respective doses of 250 and 500 mg/kg of body weight. One hour later, animals were placed in turn in a jar containing water for six minutes where the times of swimming, climbing and immobility were reported [22].

#### 2.3.7. Statistical Analysis

Experimental results and observations were expressed as mean ± standard deviation (SD). The significance of differences among groups was carried out by using one-way analysis of variance (ANOVA) surveyed by at any rate one of the following post hoc tests: Dunnett's multiple comparison tests ($p < 0.05$, $p < 0.01$, $p < 0.001$) where the level of significance was considered for each test. The statistical results were presented as mean ± S.D.

## 3. Results and Discussion

### 3.1. Results

#### 3.1.1. Effects of Aqueous Extract of *Costus afer* Stems against STR-Induced Seizures

Figure 1 and Figure 2 respectively show the effects of the aqueous extract of *C. afer* on the time to onset and the duration of seizures in mice. The results obtained show that the aqueous extract of *Costus afer* stems at doses of 250 and 500 mg/kg has no effects on the onset time and duration of convulsions in mice.

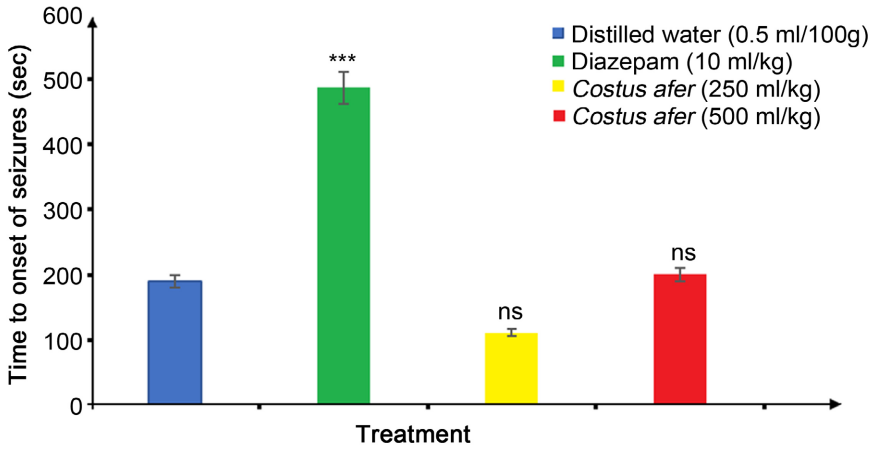


Figure 1. Effects of the aqueous extract of *C. afer* stems on the time to onset of seizures in mice. The results are expressed as mean ± standard error, n = 3; ***$p < 0.001$ compared to the control group.

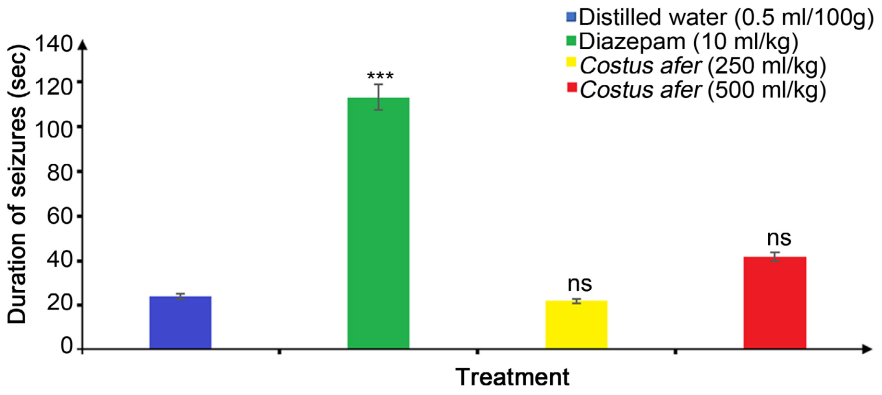


**Figure 2.** Effects of aqueous extract of *C. afer* stems on seizures duration in mice. The results are expressed as mean ± standard error, n = 3; ***p < 0.001 compared to the control group.

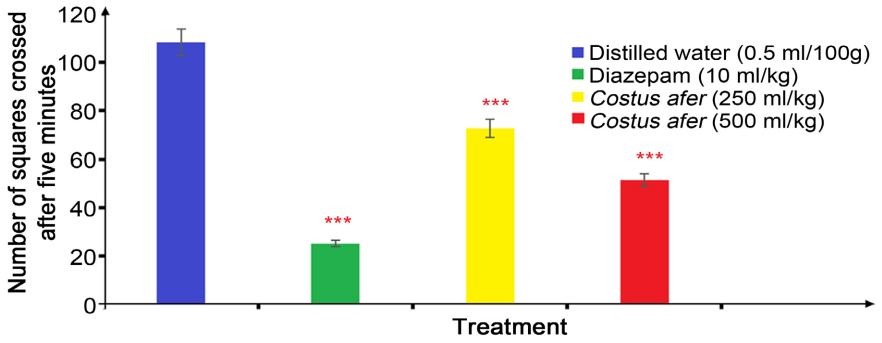


**Figure 3.** Effects of aqueous extract of *C. afer* stems on motor activity in mice. The results are expressed as mean ± standard error, n = 3; ***p < 0.001 compared to the control group.

### 3.1.2. Effects of Aqueous Extract of *Costus afer* Stems on Motor Activity

**Figure 3** shows the effects of *Costus afer* stems extract on motor activity in mice. It shows that, at doses of 250 and 500 mg/kg, the aqueous extract of *Costus afer* stems caused a very significant reduction in motor activity in mice compared to the control group.

### 3.1.3. Effects of Aqueous Extract of *Costus afer* Stems on Barbiturate Sleep

**Figure 4** and **Figure 5** respectively show the effects of the aqueous extract of *Costus afer* stemson on the time to onset and duration of sleep in mice. The results suggest that the extract at doses of 250 mg/kg and 500 mg/kg led to a decrease in onset time (**Figure 4**) and a significant increase in sleep duration (**Figure 5**).

### 3.1.4. Antidepressant Effect of Aqueous Extract of *C. afer* in Mice

**Table 2** shows the antidepressant effects of aqueous extract of *C. afer* stems in mice.

In **Table 2** values are expressed as mean ± mean standard error; n = 4; *p < 0.005 compared to the control group.

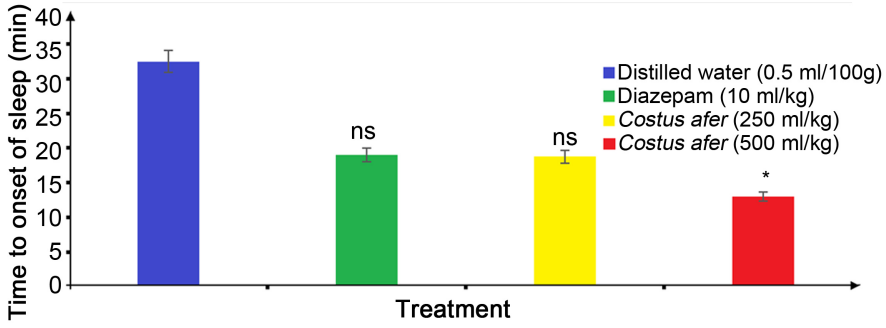


**Figure 4.** Effects of the aqueous extract of *C. afer* stems on the time to onset of sleep in mice. Results are expressed as mean ± standard error, n = 3; *p < 0.005; ***p < 0.001 compared to the control group.

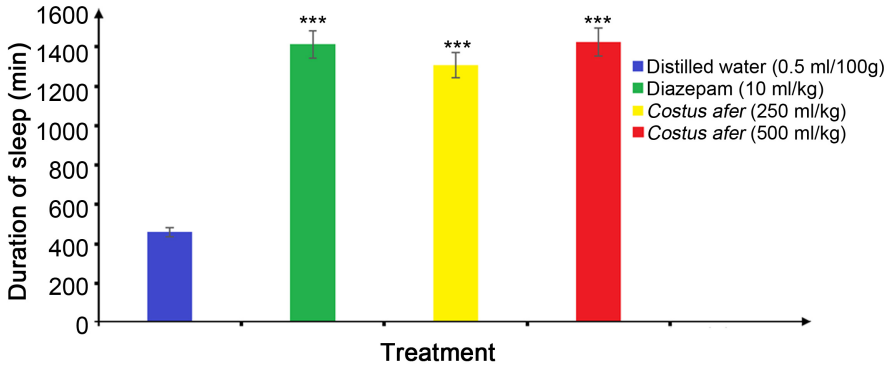


**Figure 5.** Effects of aqueous extract of *C. afer* stems on sleep duration in mice. The results are expressed as mean ± standard error, n = 3 mice per group; *p < 0.005; ***p < 0.001 compared to control group.

**Table 2.** Effects of aqueous extract of *C. afer* stems on forced swimming.

| Treatment | Climbing time (sec) | Swimming time (sec) | Immobility time (sec) |
|---|---|---|---|
| Distilled water (0.5 ml/100g) | 105 ± 17.17 | 104 ± 20.55 | 152.25 ± 10.69 |
| Clomipramine (25 mg/kg) | 190.5 ± 40.00 | 65 ± 20.21 | 86.5 ± 19.77* |
| *C. afer* (250 mg/kg) | 132.5 ± 14.67 | 22 ± 4.56 | 205.75 ± 18.06 |
| *C. afer* (500 mg/kg) | 231 ± 26.29* | 72.5 ± 24.54 | 56.6 ± 32.64* |

## 3.2. Discussion

The results obtained show that the aqueous extract of *costus afer* stems at doses of 250 and 500 mg/kg did not protect mice against strychnine-induced convulsions. In view of these results, we can deduce that the aqueous extract of *Costus afer* stems does not contain metabolites with an affinity for the glycine receptor located at the level of the Renshaw cell of the anterior horn of the spinal cord, since; strychnine is a competitive glycine antagonist [23]. Regarding the sedative activity, the results showed that *Costus afer* stems led to a decrease in the number of squares crossed by the mouse. This suggests that the aqueous extract of

*Costus afer* stems would have sedative properties, probably related to the presence of flavonoids in the extract. The aqueous extract at doses of 250 and 500 mg/kg caused a decrease in the time as well as a significant increase in sleep duration in mice like diazepam. These results suggest that the aqueous extract of *Costus afer* stems would have hypnotic properties. The existence of flavonoids in the aqueous extract of *Costus afer* stems is responsible for the effects observed [24] [25]. The results of antidepressant activity showed that the aqueous extract of *Costus afer* stems caused a decrease in immobility time and an increase in times of climbing and swimming in mice treated with a dose of 500 mg/kg. These results can be explained by the presence of alkaloids in the aqueous extract of *Costus afer* stems [26] [27] [28].

## 4. Conclusions

The objective of this study was to evaluate the anticonvulsant, sedative and antidepressant effects of *Costus afer* stems. It appears that the aqueous extract of *Costus afer* stems does not protect mice against seizures induced by strychnine. However, the extract caused a decrease in motor activity, sleep onset time and immobility time in mice. This suggests that *Costus afer* stems have sedative and antidepressant properties.

The results of this current research work proved that such pharmacological effects of *Costus afer* stems endorse and validate, at best in part, the current traditional usage of this plant to treat convulsions. However, other parts of this plant must be more studied profoundly for its anticonvulsant effects as well as its mechanism.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this research article.

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