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PHYTOCHEMICAL CONTENT AND ANTICONVULSANT ACTIVITY OF *ZINGIBER OFFICINALE* ROSCOE IN MICE

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ABSTRACT

Recurrent seizures are the hallmark of epilepsy, a chronic neurological condition that continues to be a significant global public health concern. The search for safer and more potent substitutes from medicinal plants has been prompted by the drawbacks of the antiepileptic medications now on the market, such as side effects and treatment resistance. The phytochemical components and anticonvulsant properties of *Zingiber officinale* rhizome extract in mice were examined in this work. Fresh rhizomes were gathered, verified, dried and then extracted using ethanol. Flavonoids, tannins, saponins, alkaloids, phenols, terpenoids and glycosides were found using qualitative phytochemical screening. Pentylenetetrazol and strychnine-induced seizure models were used to assess the anticonvulsant activity of the extract in mice at 100, 200 and 400mg/kg. At 100, 20 and 400mg/kg, the extract significantly ($p < 0.05$) increased the seizure start time from 2.8 ± 0.3 min in the control group to 4.9 ± 0.4, 7.6 ± 0.5 and 10.8 ± 0.7 min, respectively. The control group's seizure duration dropped from 6.7 ± 0.5 minutes to 4.8 ± 0.4, 3.2 ± 0.3 and 1.9 ± 0.2 minutes, respectively. Additionally, at the same dosages, the extract protected 20%, 60% and 80% of rats from convulsions, while diazepam (5mg/kg) afforded 100% protection. These results confirm *Zingiber officinale's* potential as a source of new antiepileptic drugs and indicate that it has strong anticonvulsant efficacy, which may be related to its rich phytochemical content.

KEYWORDS

Zingiber officinale, Epilepsy, Anticonvulsant, Phytochemicals and Pentylenetetrazole.

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INTRODUCTION

Recurrent, spontaneous seizures brought on by aberrant brain electrical activity are the hallmark of epilepsy, a long-term neurological condition[1-3]. Due to treatment resistance, side effects and the limited effectiveness of currently available antiepileptic

drugs (AEDs), many patients still struggle to control their epilepsy despite tremendous advancements in medical and pharmaceutical sciences[3-5]. Finding alternative treatment agents with better safety profiles and better clinical outcomes is therefore becoming more and more important.

Medicinal plants continue to play a significant role in drug discovery and have long been valuable sources of medicinal compounds[6-8]. Bioactive chemicals derived from plants are the source of many synthetic medications currently used in clinical settings. Numerous phytochemicals, such as coumarins, flavonoids, terpenoids, and triterpenoids, have shown encouraging anticonvulsant actions[9-12]. Numerous medicinal plants have been studied for their anticonvulsant qualities. Ginger, or *Zingiber officinale* Roscoe (Plate I), is one of the most often used culinary and medicinal herbs in the world. It is a member of the Zingiberaceae family[13-17]. Traditional medicine has long used ginger to treat a variety of illnesses, including colds, coughs, gastrointestinal issues, and inflammation. Traditional herbalists in Northern Nigeria frequently treat respiratory and general health issues with powdered ginger combined with hot tea[13].

Numerous bioactive components, such as gingerols, shogaols, zingiberene, β-bisabolene, geranial, and neral, have been linked to the pharmacological actions of ginger. Ginger has been shown in earlier research to have antioxidant, anti-inflammatory, antibacterial, analgesic and neuroprotective qualities. Ginger may also have anticonvulsant properties based on these biological processes[15,18]. Because it gives information about the chemical components responsible for biological activity, phytochemical screening is a crucial first step in the study of therapeutic plants. To detect the main types of secondary metabolites, including alkaloids, flavonoids, tannins, saponins, glycosides, terpenoids and anthraquinones, basic qualitative chemical tests are used.

The current study was created to assess the phytochemical components and anticonvulsant activity of Zingiber officinale in mice in light of the extensive traditional usage of medicinal plants and the need for safer and more potent anticonvulsant drugs.

MATERIAL AND METHODS

Plant Collection and Identification

Fresh rhizomes of *Zingiber officinale* were obtained from a local market and authenticated by a qualified taxonomist Dr. C.A. Ukwubile, in the Department of Pharmacognosy. A voucher specimen number UMM/FPH/ZIB/001 was deposited in the departmental herbarium for future reference.

Preparation of Plant Extract

The rhizomes were cut into little pieces, properly cleaned with distilled water, and allowed to air dry at room temperature. A mechanical grinder was used to grind the dried material into a fine powder. Using a suitable solvent, the powdered material was extracted by macerating it for 72 hours while shaking it occasionally. A rotary evaporator was used to filter and concentrate the extract under low pressure. Before being used, the concentrated extract was kept at 4°C[12,19].

Experimental Animals

For the investigation, 20-30g of healthy adult mice were employed. Before being employed in experiments, the animals were given free access to food and water and kept in conventional laboratory settings. Every experiment was carried out in compliance with the institution's policies regarding the use and care of lab animals.

Phytochemical Screening

To find alkaloids, flavonoids, tannins, saponins, terpenoids, phenols, cardiac glycosides, anthraquinones, and other secondary metabolites, qualitative phytochemical investigations were carried out using conventional techniques[20].

Acute Toxicity Study

Standard laboratory techniques were used to establish the extract's acute toxicity profile. Within 24 hours and again for 14 days, animals were monitored for indicators of toxicity and mortality[21].

Evaluation of Anticonvulsant Activity

Standard seizure models in mice were used to assess the anticonvulsant efficacy of *Zingiber officinale* extract. Thirty mice were divided into six groups at random (n = 5 per group). Group I was given distilled water (10mL/kg) as the negative control. As the positive control, Group II was given the common anticonvulsant medication diazepam (5mg/kg, i.p.). *Zingiber officinale* extract was administered orally to groups III, IV, V and VI at doses of 100, 200, 400 and 800mg/kg body weight, respectively. The six groups were post-treated each after one hour with strychnine or **pentylenetetrazol** (1mg/kg) intraperitoneally separately. Observations were made of induction time, onset of myoclonic jerk, onset of action, number of convulsions, duration and protection using a stopwatch, respectively. The proper convulsant medication was used to cause seizures sixty minutes following therapy. The animals' mortality, percentage protection against convulsions, seizure duration and onset were all monitored. By contrasting the treated groups with the control and standard drug groups, the extract's anticonvulsant efficacy was ascertained[4,6,22].

Following treatment, seizures were induced using a convulsant agent. Parameters recorded included:

Onset of seizures (latency period)

Duration of seizures

Percentage protection against convulsions

Mortality rate

Statistical Analysis

Data were expressed as mean ± standard error of mean (SE). Statistical analysis was performed using one-way analysis of variance (ANOVA) followed by an appropriate post hoc test. Differences were considered statistically significant at $p < 0.05$.

RESULTS AND DISCUSSION

Phytochemical Screening

Flavonoids, tannins, saponins, phenolic compounds, terpenoids, alkaloids, and glycosides were among the secondary metabolites found in *Zingiber officinale* extract, according to a qualitative phytochemical study (Table No.1). Numerous pharmacological activities, including antioxidant and neuroprotective properties, have been linked to these phytochemical components. Neurotransmitter systems, such as γ-aminobutyric acid (GABA)-mediated neurotransmission, which is essential for controlling seizures, are known to be modulated by flavonoids. Terpenoids and phenolic compounds have also been discovered to display anticonvulsant and neuroprotective effects[10,23-25].

Oral Acute Toxicity Testing

The acute toxicity profile of *Zingiber officinale* rhizome extract in mice is shown in Table No.2. At any tested dose, no mortality was seen within 24 hours or over the course of the 14-day observation period. Higher doses were associated with mild and temporary behavioral effects, such as drowsiness and decreased locomotor activity. The extract has a large margin of safety because the estimated oral median lethal dose (LD_{50}) was higher than 5000mg/kg body weight. This is similar to results obtained by previous studies showing the safety of ginger rhizome in mice and rats[13-15.]

Anticonvulsant Activity

When compared to the control group, treatment with *Zingiber officinale* extract considerably shortened the duration of seizures and postponed the beginning of convulsions. A dosage-dependent response was shown by the anticonvulsant effect, increasing with dose (Figure No.1, Figure No.2).

The graph illustrates the effect of *Zingiber officinale* extract on seizure onset time and seizure duration in mice. Increasing doses of the extract progressively delayed the onset of convulsions and reduced seizure duration, indicating a dose-dependent anticonvulsant effect. Values are presented as mean observations for each treatment group.

Bar chart showing the effect of *Zingiber officinale* extract (100, 200 and 400mg/kg) on seizure onset time in PTZ-induced convulsions in mice. Data are expressed as mean ± SEM (n = 5). Treatment with the extract significantly increased seizure latency in a dose-dependent manner compared with the control group. Diazepam (5mg/kg) served as the standard anticonvulsant drug. Statistical

significance was determined using one-way ANOVA followed by an appropriate post hoc test. $p < 0.05$ (*), $p < 0.01$ (**) and $p < 0.001$(***) versus control.

The combined effects of bioactive components such as gingerols, shogaols, flavonoids, and terpenoids may be responsible for the observed anticonvulsant efficacy. These substances may work by increasing inhibitory neurotransmission, suppressing excitatory pathways, modulating ion channels that affect neuronal excitability, or by antioxidant processes[24,26]. The results show that ginger contains chemicals that can lessen seizure susceptibility and validate the plant's traditional use in ethnomedicine. The findings are in line with other studies that detailed the neuroprotective and central nervous system-modulating properties of ginger and its components[13,15]. To completely determine *Zingiber officinale's* medicinal potential as an anticonvulsant drug, more research incorporating the isolation of active components, mechanistic analyses and assessments of long-term toxicity is required.

Table No.1: Qualitative Phytochemical Constituents of *Zingiber officinale* Rhizome Extract

S.No	Phytochemical constituent	Inference
1	Alkaloids	+
2	Flavonoids	+
3	Tannins	+
4	Saponins	+
5	Phenolic compounds	+
6	Terpenoids	+
7	Glycosides	+
8	Anthraquinones	−
9	Cardiac glycosides	−
10	Steroids	+

Key: (+) Present; (−) Absent.

Table No.2: Acute Toxicity Profile of *Zingiber officinale* Rhizome Extract in Mice

S.No	Dose (mg/kg)	Number of Mice (n)	Mortality (24 h)	Mortality (14 days)	Observed Signs of Toxicity
1	10	5	0/5	0/5	None
2	100	5	0/5	0/5	None
3	1000	5	0/5	0/5	Mild reduction in locomotor activity
4	1600	5	0/5	0/5	Mild sedation observed
5	2900	5	0/5	0/5	Slight decrease in spontaneous movement
6	5000	5	0/5	0/5	Transient sedation; recovery within 24 h

Estimated LD_{50}: > 5000mg/kg body weight (oral administration).

Figure No.1: A Ginger Rhizome from Maiduguri Market, Nigeria

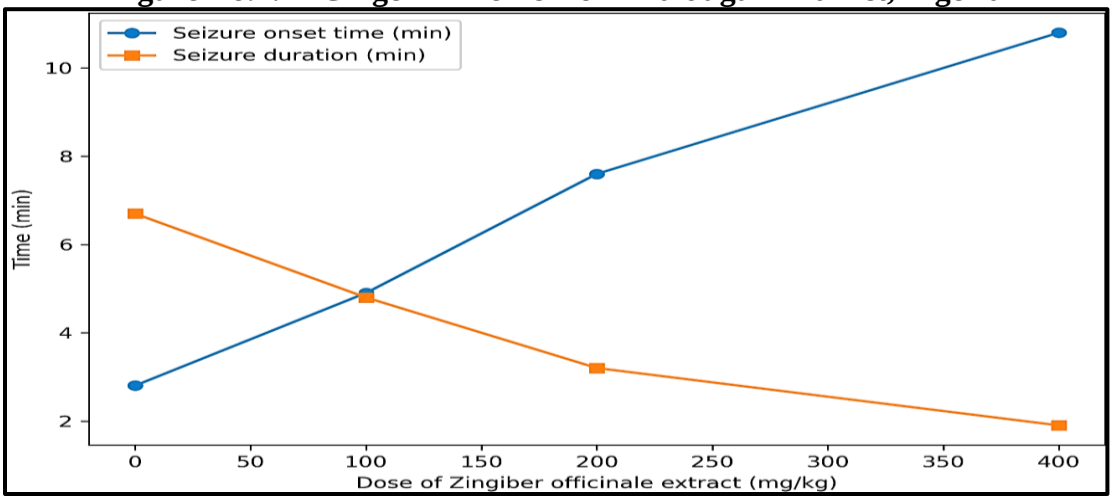

Figure No.2: Dose-dependent anticonvulsant activity of *Zingiber officinale* extract in mice

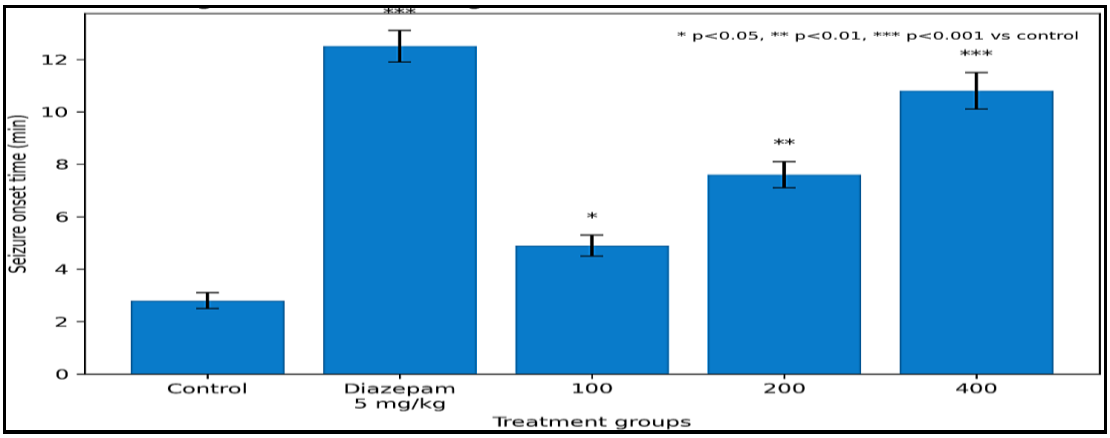

Figure No.3: Effect of *Zingiber officinale* extract on pentylenetetrazol (PTZ)-induced seizures in mice

CONCLUSION

Several physiologically active phytochemicals, such as flavonoids, tannins, saponins, terpenoids, phenols and alkaloids, were found in *Zingiber officinale*, according to the current study. By postponing the start of seizures and lessening their intensity, the extract demonstrated significant anticonvulsant effectiveness in mice. These results show that ginger may be a source of new anticonvulsant chemicals and offer scientific evidence in favor of its traditional therapeutic use. To determine the active principles and clarify their modes of action, more pharmacological and clinical research is advised.

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CONFLICT OF INTEREST

We have none to declare.

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